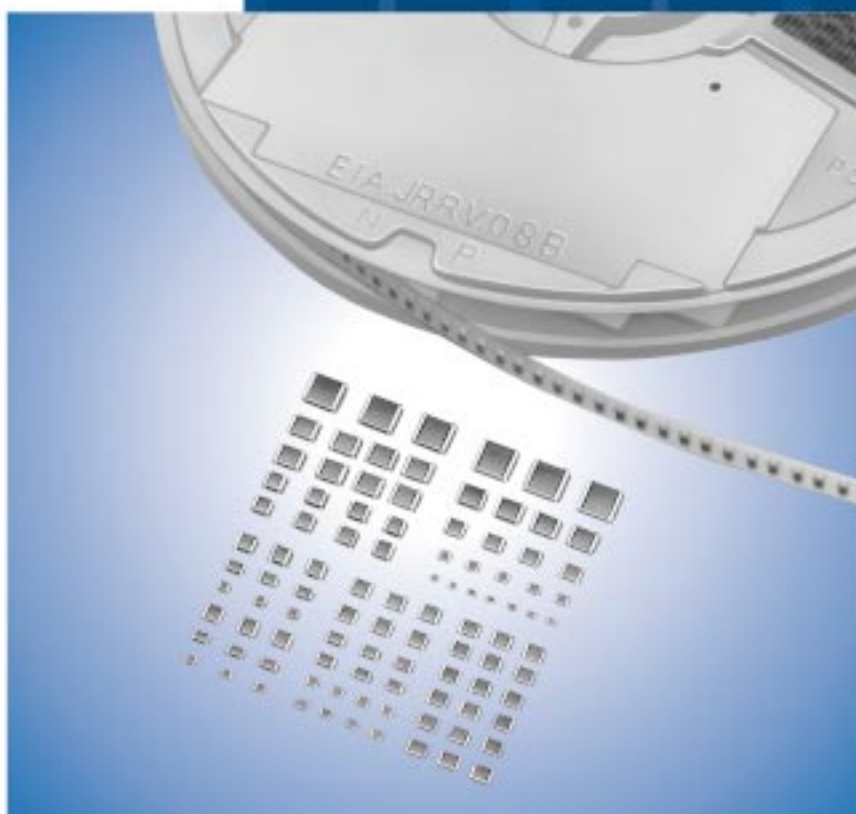


# Chip Monolithic Ceramic Capacitors



**muRata**

*Innovator  
in Electronics*

Murata  
Manufacturing Co., Ltd.

Cat.No.C02E-10

# CONTENTS

|                                                                            |     |
|----------------------------------------------------------------------------|-----|
| <b>Part Numbering</b>                                                      | 2   |
| <b>Selection Guide</b>                                                     | 6   |
| <b>1 for Flow/Reflow Soldering GRM15/18/21/31 Series</b>                   | 7   |
| <b>2 for Reflow Soldering GRM32/43/55 Series</b>                           | 15  |
| <b>3 Ultra-small GRM03 Series</b>                                          | 18  |
| <b>4 Thin Type (Flow/Reflow)</b>                                           | 20  |
| <b>GRM Series Specifications and Test Methods</b>                          | 22  |
| <b>5 Thin Layer Large-capacitance Type</b>                                 | 27  |
| <b>6 Low-dissipation Type</b>                                              | 32  |
| <b>GRM Series Data</b>                                                     | 37  |
| <b>7 Microchips</b>                                                        | 39  |
| <b>8 Capacitor Arrays</b>                                                  | 42  |
| <b>9 for Ultrasonic Sensors</b>                                            | 48  |
| <b>10 Low ESL</b>                                                          | 51  |
| <b>11 High Frequency for Flow/Reflow Soldering</b>                         | 56  |
| <b>12 High-Q &amp; High Power Type</b>                                     | 61  |
| <b>13 High Frequency Type</b>                                              | 69  |
| <b>ERF/ERH/ERA/ERD Series Data</b>                                         | 79  |
| <b>Package</b>                                                             | 81  |
| <b>⚠ Caution</b>                                                           | 85  |
| <b>Notice</b>                                                              | 91  |
| <b>Reference Data</b>                                                      | 97  |
| <b>14 Medium-voltage Low Dissipation Factor</b>                            | 104 |
| <b>15 Medium-voltage High-Capacitance for General-Use</b>                  | 109 |
| <b>16 Only for Information Devices/Tip &amp; Ring</b>                      | 113 |
| <b>17 AC250V(r.m.s.) Type</b>                                              | 117 |
| <b>18 Safety Standard Recognized Type GC (UL, IEC60384-14 Class X1/Y2)</b> | 121 |
| <b>19 Safety Standard Recognized Type GD (IEC60384-14 Class Y3)</b>        | 122 |
| <b>20 Safety Standard Recognized Type GF (IEC60384-14 Class Y2)</b>        | 123 |

|           |                                                                  |     |
|-----------|------------------------------------------------------------------|-----|
| <b>21</b> | <b>Safety Standard Recognized Type GB (IEC60384-14 Class X2)</b> | 124 |
|           | <b>GA3 Series Specifications and Test Methods</b>                | 125 |
|           | <b>GRM/GR4/GA2/GA3 Series Data</b>                               | 129 |
|           | <b>Package</b>                                                   | 132 |
|           | <b>⚠ Caution</b>                                                 | 135 |
|           | <b>Notice</b>                                                    | 141 |
|           | <b>ISO 9000 Certifications</b>                                   | 145 |

- Please refer to "Specifications and Test Methods" at the end of each chapter of **5** – **17** .

## ● Part Numbering

### Chip Monolithic Ceramic Capacitors

(Part Number)

|    |   |    |   |    |    |     |   |     |   |
|----|---|----|---|----|----|-----|---|-----|---|
| GR | M | 18 | 8 | B1 | 1H | 102 | K | A01 | K |
| ①  | ② | ③  | ④ | ⑤  | ⑥  | ⑦   | ⑧ | ⑨   | ⑩ |

#### ① Product ID

#### ② Series

| Product ID | Code | Series                                               |
|------------|------|------------------------------------------------------|
| GR         | M    | Tin Plated Layer                                     |
|            | 4    | Only for Information Devices / Tip & Ring            |
| ER         | F    | High Frequency and high Power Type                   |
|            | H    | High Frequency and High Power Type (Ribbon Terminal) |
|            | A    | High Frequency Type                                  |
|            | D    | High Frequency Type (Ribbon Terminal)                |
| GQ         | M    | High Frequency for Flow/Reflow Soldering             |
| GM         | A    | Monolithic Microchip                                 |
| GN         | M    | Capacitor Array                                      |
| LL         | L    | Low ESL Wide Width Type                              |
| GJ         | M    | High Frequency Low Loss Type Tin Plated Type         |
|            | 6    | High Frequency Low Loss Type                         |
| GA         | 2    | for AC250V (r.m.s.)                                  |
|            | 3    | Safety Standard Recognized Type                      |
| GC         | P    | Automotive Soldering Electrode                       |
|            | M    | Automotive Tin Plated Layer                          |

#### ③ Dimension (L×W)

| Code | Dimension (L×W)                  | EIA  |
|------|----------------------------------|------|
| 03   | 0.6×0.3 mm                       | 0201 |
| 05   | 0.5×0.5 mm                       | 0202 |
| 08   | 0.8×0.8 mm                       | 0303 |
| 11   | 1.25×1.0 mm                      | 0504 |
| 15   | 1.0×0.5 mm                       | 0402 |
| 18   | 1.6×0.8 mm                       | 0603 |
| 1D   | 1.4×1.4 mm                       |      |
| 1X   | Depends on individual standards. |      |
| 21   | 2.0×1.25 mm                      | 0805 |
| 22   | 2.8×2.8 mm                       | 1111 |
| 31   | 3.2×1.6 mm                       | 1206 |
| 32   | 3.2×2.5 mm                       | 1210 |
| 3X   | Depends on individual standards. |      |
| 42   | 4.5×2.0 mm                       | 1808 |
| 43   | 4.5×3.2 mm                       | 1812 |
| 52   | 5.7×2.8 mm                       | 2211 |
| 55   | 5.7×5.0 mm                       | 2220 |

#### ④ Dimension (T)

| Code | Dimension (T)                    |
|------|----------------------------------|
| 2    | 2-elements (Array Type)          |
| 3    | 0.3 mm                           |
| 4    | 4-elements (Array Type)          |
| 5    | 0.5 mm                           |
| 6    | 0.6 mm                           |
| 7    | 0.7 mm                           |
| 8    | 0.8 mm                           |
| 9    | 0.85 mm                          |
| A    | 1.0 mm                           |
| B    | 1.25 mm                          |
| C    | 1.6 mm                           |
| D    | 2.0 mm                           |
| E    | 2.5 mm                           |
| F    | 3.2 mm                           |
| M    | 1.15 mm                          |
| N    | 1.35 mm                          |
| R    | 1.8 mm                           |
| S    | 2.8 mm                           |
| Q    | 1.5 mm                           |
| X    | Depends on individual standards. |

With the array type GNM series, "Dimension(T)" indicates the number of elements.

Continued on the following page. 

 Continued from the preceding page.

**⑤ Temperature Characteristics**

| Code | Temperature Characteristics | Temperature Range | Capacitance Change or Temperature Coefficient | Operating Temperature Range |
|------|-----------------------------|-------------------|-----------------------------------------------|-----------------------------|
| 1X   | SL                          | 20 to 85°C        | +350 to -1000ppm/°C                           | -55 to 125°C                |
| 2C   | CH                          | -55 to 125°C      | 0±60ppm/°C                                    | -55 to 125°C                |
| 2P   | PH                          | -25 to 85°C       | -150±60ppm/°C                                 | -25 to 85°C                 |
| 2R   | RH                          | -25 to 85°C       | -220±60ppm/°C                                 | -25 to 85°C                 |
| 2S   | SH                          | -25 to 85°C       | -330±60ppm/°C                                 | -25 to 85°C                 |
| 2T   | TH                          | -25 to 85°C       | -470±60ppm/°C                                 | -25 to 85°C                 |
| 3C   | CJ                          | -55 to 125°C      | 0±120ppm/°C                                   | -55 to 125°C                |
| 3P   | PJ                          | -25 to 85°C       | -150±120ppm/°C                                | -25 to 85°C                 |
| 3R   | RJ                          | -25 to 85°C       | -220±120ppm/°C                                | -25 to 85°C                 |
| 3S   | SJ                          | -25 to 85°C       | -330±120ppm/°C                                | -25 to 85°C                 |
| 3T   | TJ                          | -25 to 85°C       | -470±120ppm/°C                                | -25 to 85°C                 |
| 3U   | UJ                          | -25 to 85°C       | -750±120ppm/°C                                | -25 to 85°C                 |
| 4C   | CK                          | -55 to 125°C      | 0±250ppm/°C                                   | -55 to 125°C                |
| 5C   | C0G                         | -55 to 125°C      | 0±30ppm/°C                                    | -55 to 125°C                |
| 6C   | C0H/CH *1                   | -55 to 125°C      | 0±60ppm/°C                                    | -55 to 125°C                |
| 6P   | P2H                         | -55 to 85°C       | -150±60ppm/°C                                 | -55 to 125°C                |
| 6R   | R2H                         | -55 to 85°C       | -220±60ppm/°C                                 | -55 to 125°C                |
| 6S   | S2H                         | -55 to 85°C       | -330±60ppm/°C                                 | -55 to 125°C                |
| 6T   | T2H                         | -55 to 85°C       | -470±60ppm/°C                                 | -55 to 125°C                |
| 7C   | CJ *1                       | -55 to 125°C      | 0±120ppm/°C                                   | -55 to 125°C                |
| 7U   | U2J                         | -55 to 85°C       | -750±120ppm/°C                                | -55 to 125°C                |
| 8C   | CK *1                       | -55 to 125°C      | 0±250ppm/°C                                   | -55 to 125°C                |
| B1   | B *2                        | -25 to 85°C       | ±10%                                          | -25 to 85°C                 |
| B3   | B                           | -25 to 85°C       | ±10%                                          | -25 to 85°C                 |
| E4   | Z5U                         | 10 to 85°C        | +22, -56%                                     | 10 to 85°C                  |
| F1   | F *2                        | -25 to 85°C       | +30, -80%                                     | -25 to 85°C                 |
| F5   | Y5V                         | -30 to 85°C       | +22, -82%                                     | -30 to 85°C                 |
| R1   | R *2                        | -55 to 125°C      | ±15%                                          | -55 to 125°C                |
| R3   | R                           | -55 to 125°C      | ±15%                                          | -55 to 125°C                |
| R6   | X5R                         | -55 to 85°C       | ±15%                                          | -55 to 85°C                 |
| R7   | X7R                         | -55 to 125°C      | ±15%                                          | -55 to 125°C                |
| C8   | X6S                         | -55 to 105°C      | ±22%                                          | -55 to 105°C                |
| 9E   | ZLM                         | -25 to 20°C       | -4700+100/-2500ppm/°C                         | -25 to 85°C                 |
|      |                             | 20 to 85°C        | -4700+500/-1000ppm/°C                         |                             |

\*1 ER series only.

\*2 Add 50% of the rated voltage.

Continued on the following page. 

Continued from the preceding page.

#### ⑥ Rated Voltage

| Code | Rated Voltage                                       |
|------|-----------------------------------------------------|
| 0G   | DC4V                                                |
| 0J   | DC6.3V                                              |
| 1A   | DC10V                                               |
| 1C   | DC16V                                               |
| 1E   | DC25V                                               |
| 1H   | DC50V                                               |
| 2A   | DC100V                                              |
| 2D   | DC200V                                              |
| 2E   | DC250V                                              |
| YD   | DC300V                                              |
| 2H   | DC500V                                              |
| 2J   | DC630V                                              |
| 3A   | DC1kV                                               |
| 3D   | DC2kV                                               |
| 3F   | DC3.15kV                                            |
| E2   | AC250V                                              |
| GB   | X2; AC250V (Safety Standard Recognized Type GB)     |
| GC   | X1, Y2; AC250V (Safety Standard Recognized Type GC) |
| GD   | Y3; AC250V (Safety Standard Recognized Type GD)     |
| GF   | Y2; AC250V (Safety Standard Recognized Type GF)     |

#### ⑦ Capacitance

Expressed by three figures. The unit is pico-farad (pF). The first and second figures are significant digits, and the third figure expresses the number of zeros which follow the two numbers. If there is a decimal point, it is expressed by the capital letter "R". In this case, all figures are significant digits.

Ex.)

| Code | Capacitance |
|------|-------------|
| R50  | 0.5pF       |
| 1R0  | 1.0pF       |
| 100  | 10pF        |
| 103  | 10000pF     |

#### ⑧ Capacitance Tolerance

| Code | Capacitance Tolerance            | TC              | Series                  | Capacitance Step |                |
|------|----------------------------------|-----------------|-------------------------|------------------|----------------|
| B    | ±0.1pF                           | CΔ              | GJM                     | ≤5pF             | E24 Series,1pF |
| C    | ±0.25pF                          | CΔ-SL           | GRM/ERF/ERH/ERA/ERD/GQM | ≤5pF             | * 1pF          |
|      |                                  | CΔ              | GJM                     | <10pF            | E24 Series,1pF |
| D    | ±0.5pF                           | CΔ-SL           | GRM                     | 6.0 to 9.0pF     | * 1pF          |
|      |                                  | CΔ              | ERF/ERH/ERA/ERD/GQM/GJM | 5.1 to 9.1pF     | E24 Series     |
| G    | ±2%                              | CΔ              | GJM                     | ≥10pF            | E12 Series     |
|      |                                  | CΔ              | GQM                     | ≥10pF            | E24 Series     |
| J    | ±5%                              | CΔ-SL           | GRM/GA3                 | ≥10pF            | E12 Series     |
|      |                                  | CΔ              | ERF/ERH/ERA/ERD/GQM/GJM | ≥10pF            | E24 Series     |
| K    | ±10%                             | B,R,X7R,X5R,ZLM | GRM/GA3                 | E6 Series        |                |
|      |                                  |                 | GR4                     | E12 Series       |                |
| M    | ±20%                             | Z5U             | GRM                     | E3 Series        |                |
|      |                                  | B,R,X7R         | GMA/LLL                 | E6 Series        |                |
|      |                                  | X7R             | GA2                     | E3 Series        |                |
| Z    | +80%, -20%                       | F,Y5V           | GRM                     | E3 Series        |                |
| R    | Depends on individual standards. |                 |                         |                  |                |

\* E24 series is also available.

#### ⑨ Individual Specification Code

| Code    | Series         | Individual Specification                                                                             | Temperature Characteristics Type *4 | Inner Electrode | Undercoat Metal of Outer Electrode |
|---------|----------------|------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------|------------------------------------|
| A01     | GRM *1         | Standard Type                                                                                        | TC                                  | Base Metal      | Base Metal                         |
|         | GRM *1/LLL/GNM |                                                                                                      | HiK                                 |                 |                                    |
| A11     | GRM *1         | Special Dimension Type<br>(Tolerances of L×W×T are ±0.15mm)                                          | HiK                                 | Base Metal      | Base Metal                         |
| A12     | GRM *1         | Special Characteristics<br>(Applied Voltage is X1.25 of Rated Voltage at High Temperature Load Test) | HiK                                 | Base Metal      | Base Metal                         |
| A35/A39 | GRM *1         | Special Dimension Type                                                                               | HiK                                 | Base Metal      | Base Metal                         |

Continued on the following page. ↗

Continued from the preceding page.

| Code                   | Series                    | Individual Specification                                                                   | Temperature Characteristics Type *4 | Inner Electrode | Undercoat Metal of Outer Electrode |
|------------------------|---------------------------|--------------------------------------------------------------------------------------------|-------------------------------------|-----------------|------------------------------------|
| <b>A61/A88/A92/A93</b> | <b>GRM *1</b>             | Special Characteristics (Under special control)                                            | HiK                                 | Base Metal      | Base Metal                         |
| <b>B01</b>             | <b>GJM/GQM</b>            | Standard Type                                                                              | TC                                  | Base Metal (Cu) | Base Metal                         |
| <b>C01</b>             | <b>GRM *1</b>             | Standard Type                                                                              | HiK                                 | Base Metal      | Precious Metal                     |
| <b>C11</b>             | <b>GRM *1</b>             | Special Dimension Type<br>(Tolerances of L×W are ±0.2mm, others)                           | HiK                                 | Base Metal      | Precious Metal                     |
| <b>C12</b>             | <b>GRM *1</b>             | Special Dimension Type (Length is 3.2±0.2,<br>Width is 1.6±0.2mm, Thickness is 1.2 ±0.1mm) | HiK                                 | Base Metal      | Precious Metal                     |
| <b>D01</b>             | <b>ERA/ERD/ERF/ERH</b>    | Standard Type<br>(Non-coated type for ERH series)                                          | TC                                  | Precious Metal  | Precious Metal                     |
|                        | <b>GRM *1/GNM</b>         |                                                                                            | TC                                  |                 |                                    |
|                        | <b>GRM *1/GMA/LLL/GNM</b> |                                                                                            | HiK                                 |                 |                                    |
| <b>D02</b>             | <b>ERH</b>                | Standard Type (Coated with Resin)                                                          | TC                                  | Precious Metal  | Precious Metal                     |
| <b>DB4</b>             | <b>GJM</b>                | Special Dimension Type (Thickness is 0.25±0.05mm)                                          | TC                                  | Precious Metal  | Precious Metal                     |
| <b>E01</b>             | <b>GRM *1</b>             | Standard Type (Thin Layer Large Capacitance Type)                                          | HiK                                 | Base Metal      | Base Metal                         |
| <b>E19/E34</b>         | <b>GRM *1</b>             | Special Characteristics (Under Special Control)                                            | HiK                                 | Base Metal      | Base Metal                         |
| <b>E20</b>             | <b>GRM *1</b>             | Special Dimension Type                                                                     | HiK                                 | Base Metal      | Base Metal                         |
| <b>E39</b>             | <b>GRM *1</b>             | Special Dimension Type                                                                     | HiK                                 | Base Metal      | Base Metal                         |
| <b>V01</b>             | <b>GRM *2</b>             | Standard Type (New Ceramic Material)                                                       | TC                                  | Precious Metal  | Precious Metal                     |
| <b>W01</b>             | <b>GRM *3/GR4/GA2/GA3</b> | Tolerance of Thickness is +0/-0.3mm                                                        | HiK                                 | Base Metal      | Base Metal                         |
|                        | <b>GRM *3</b>             |                                                                                            | TC                                  |                 |                                    |
| <b>W02</b>             | <b>GA3</b>                | Tolerance of Thickness is ±0.2mm                                                           | HiK                                 | Base Metal      | Base Metal                         |
| <b>W03</b>             | <b>GRM *3</b>             | Tolerance of Thickness is ±0.2mm                                                           | HiK                                 | Base Metal      | Base Metal                         |
| <b>W07</b>             | <b>GRM *3</b>             | Tolerance of Thickness is ±0.1mm                                                           | HiK                                 | Base Metal      | Base Metal                         |
| <b>Y01</b>             | <b>GRM *3</b>             | Tolerance of Thickness is +0/-0.3mm                                                        | TC                                  | Precious Metal  | Precious Metal                     |
|                        | <b>GRM *3</b>             |                                                                                            | HiK                                 |                 |                                    |
| <b>Y02</b>             | <b>GA3</b>                | Tolerance of Thickness is ±0.3mm                                                           | HiK                                 | Precious Metal  | Precious Metal                     |
|                        | <b>GRM *3/GA3</b>         |                                                                                            | TC                                  |                 |                                    |
| <b>Y06</b>             | <b>GA3</b>                | Thickness is 2.7±0.3mm                                                                     | HiK                                 | Precious Metal  | Precious Metal                     |
| <b>Y21</b>             | <b>GRM *2</b>             | Standard Type                                                                              | TC                                  | Precious Metal  | Precious Metal                     |
| <b>Z01</b>             | <b>GRM *1</b>             | Standard Type (New Ceramic Material)                                                       | TC                                  | Precious Metal  | Precious Metal                     |

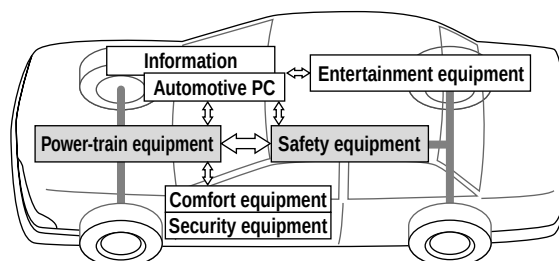
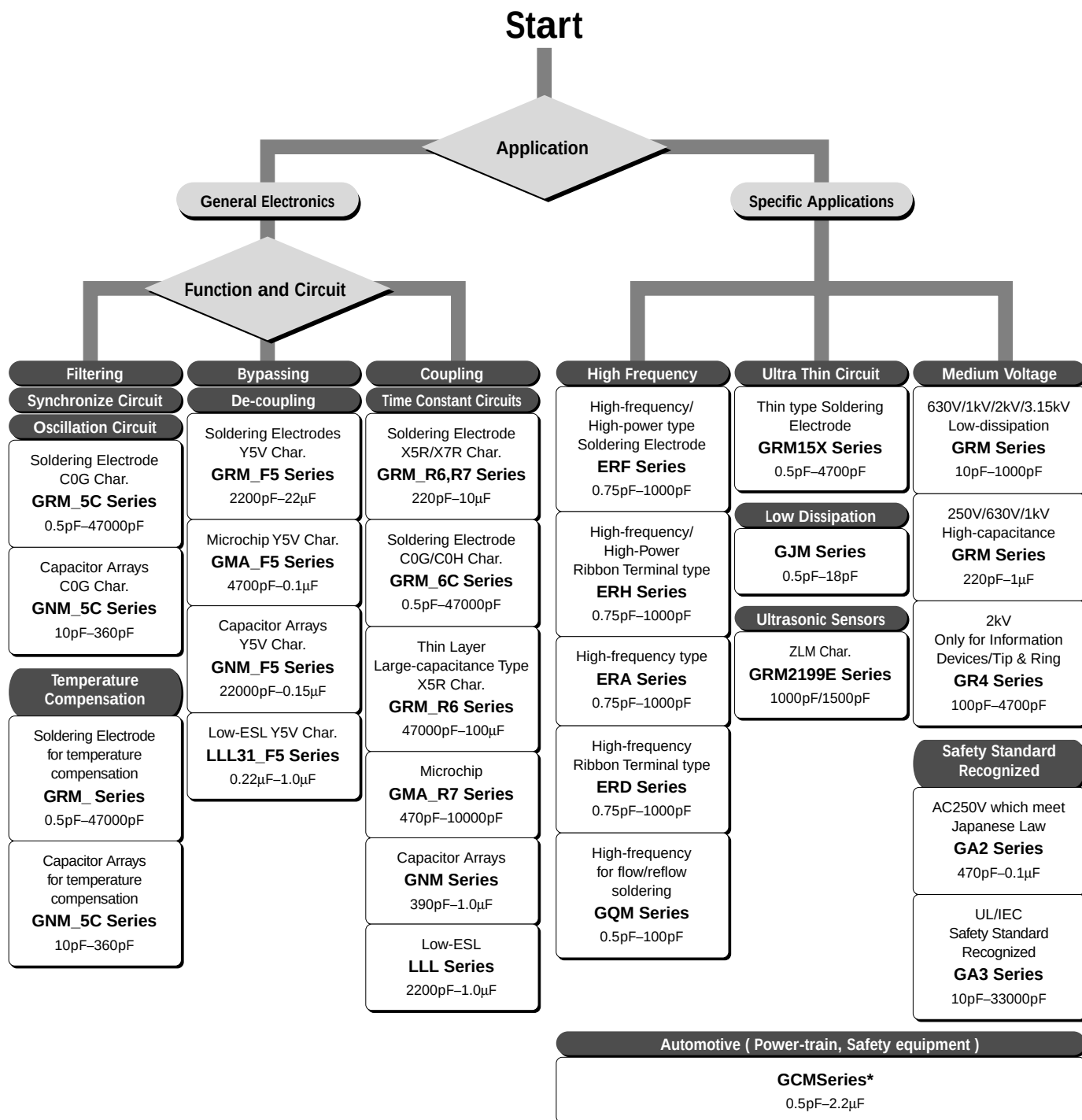
\*1 Apply to rated voltage 100V and under. \*2 Apply to rated voltage 200/500V. \*3 Apply to rated voltage 250V, 630V to 3.15kV.

\*4 "TC" means Temperature Compensating Type and "HiK" means High Dielectric Type.

#### ⑩Packaging

| Code     | Packaging                |
|----------|--------------------------|
| <b>L</b> | ø178mm Plastic Taping    |
| <b>D</b> | ø178mm Paper Taping      |
| <b>K</b> | ø330mm Plastic Taping    |
| <b>J</b> | ø330mm Paper Taping      |
| <b>E</b> | ø178mm Special Packaging |
| <b>F</b> | ø330mm Special Packaging |
| <b>B</b> | Bulk                     |
| <b>C</b> | Bulk Case                |
| <b>T</b> | Bulk Tray                |

# Selection Guide of Chip Monolithic Ceramic Capacitors



★For other automotive equipment such as comfort, security, information, entertainment, GRM series (for general electronics) are available.

# Chip Monolithic Ceramic Capacitors

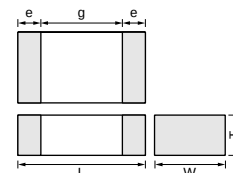
**muRata**

1

## for Flow/Reflow Soldering GRM15/18/21/31 Series

### ■ Features

1. Terminations are made of metal highly resistant to migration.
2. The GRM series is a complete line of chip ceramic capacitors in 6.3V, 10V, 16V, 25V, 50V, 100V, 200V and 500V ratings. These capacitors have temperature characteristics ranging from C0G to Y5V.
3. A wide selection of sizes is available, from the miniature LxWxT: 1.0x0.5x0.5mm to LxWxT: 3.2x1.6x1.15mm.  
GRM18, 21 and GRM31 types are suited to flow and reflow soldering.  
GRM15 type is applied to only reflow soldering.
4. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placement on PCBs.
5. The GRM series is available in paper or plastic embossed tape and reel packaging for automatic placement. Bulk case packaging is also available for GRM15, GRM18 and GRM21.



| Part Number | Dimensions (mm) |           |             |             |        |
|-------------|-----------------|-----------|-------------|-------------|--------|
|             | L               | W         | T           | e           | g min. |
| GRM155      | 1.0 ±0.05       | 0.5 ±0.05 | 0.5 ±0.05   | 0.15 to 0.3 | 0.4    |
| GRM188*     | 1.6 ±0.1        | 0.8 ±0.1  | 0.8 ±0.1    | 0.2 to 0.5  | 0.5    |
| GRM216      | 2.0 ±0.1        | 1.25 ±0.1 | 0.6 ±0.1    | 0.2 to 0.7  | 0.7    |
| GRM219      |                 |           | 0.85 ±0.1   |             |        |
| GRM21A      |                 |           | 1.0 +0/-0.2 |             |        |
| GRM21B      |                 |           | 1.25 ±0.1   |             |        |
| GRM316      | 3.2 ±0.15       | 1.6 ±0.15 | 0.6 ±0.1    | 0.3 to 0.8  | 1.5    |
| GRM319      |                 |           | 0.85 ±0.1   |             |        |
| GRM31M      |                 |           | 1.15 ±0.1   |             |        |
| GRM31C      |                 |           | 1.6 ±0.2    |             |        |

\* Bulk Case : 1.6 ±0.07(L) × 0.8 ±0.07(W) × 0.8 ±0.07(T)

### ■ Applications

General electronic equipment

### Temperature Compensating Type GRM15 Series (1.0x0.5 mm) 50V/25V

| Part Number                                                                                          | GRM15            |             |             |             |            |            |             |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|-------------|-------------|------------|------------|-------------|-------------|
| L x W [EIA]                                                                                          | 1.00x0.50 [0402] |             |             |             |            |            |             |             |
| TC                                                                                                   | C0G<br>(5C)      | P2H<br>(6P) | R2H<br>(6R) | S2H<br>(6S) | SL<br>(1X) |            | T2H<br>(6T) | U2J<br>(7U) |
| Rated Volt.                                                                                          | 50<br>(1H)       | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H) | 25<br>(1E) | 50<br>(1H)  | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |             |             |            |            |             |             |
| 0.50pF(R50)                                                                                          | 0.50(5)          |             |             |             |            |            |             |             |
| 0.75pF(R75)                                                                                          | 0.50(5)          |             |             |             |            |            |             |             |
| 1.0pF(1R0)                                                                                           | 0.50(5)          |             |             |             |            |            |             |             |
| 2.0pF(2R0)                                                                                           | 0.50(5)          |             |             |             |            |            |             |             |
| 3.0pF(3R0)                                                                                           | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 4.0pF(4R0)                                                                                           | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 5.0pF(5R0)                                                                                           | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 6.0pF(6R0)                                                                                           | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 7.0pF(7R0)                                                                                           | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 8.0pF(8R0)                                                                                           | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 9.0pF(9R0)                                                                                           | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 10pF(100)                                                                                            | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 12pF(120)                                                                                            | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 15pF(150)                                                                                            | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 18pF(180)                                                                                            | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 22pF(220)                                                                                            | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 27pF(270)                                                                                            | 0.50(5)          | 0.50(5)     | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 33pF(330)                                                                                            | 0.50(5)          |             | 0.50(5)     | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |

Continued on the following page.

**muRata**

Continued from the preceding page.

1

| Part Number                                                                                          | GRM15            |             |             |             |            |            |             |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|-------------|-------------|------------|------------|-------------|-------------|
| L x W [EIA]                                                                                          | 1.00x0.50 [0402] |             |             |             |            |            |             |             |
| TC                                                                                                   | COG<br>(5C)      | P2H<br>(6P) | R2H<br>(6R) | S2H<br>(6S) | SL<br>(1X) |            | T2H<br>(6T) | U2J<br>(7U) |
| Rated Volt.                                                                                          | 50<br>(1H)       | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H) | 25<br>(1E) | 50<br>(1H)  | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |             |             |            |            |             |             |
| 39pF(390)                                                                                            | 0.50(5)          |             |             | 0.50(5)     |            |            | 0.50(5)     | 0.50(5)     |
| 47pF(470)                                                                                            | 0.50(5)          |             |             |             | 0.50(5)    |            | 0.50(5)     | 0.50(5)     |
| 56pF(560)                                                                                            | 0.50(5)          |             |             |             | 0.50(5)    |            | 0.50(5)     | 0.50(5)     |
| 68pF(680)                                                                                            | 0.50(5)          |             |             |             | 0.50(5)    |            | 0.50(5)     | 0.50(5)     |
| 82pF(820)                                                                                            | 0.50(5)          |             |             |             | 0.50(5)    |            | 0.50(5)     | 0.50(5)     |
| 100pF(101)                                                                                           | 0.50(5)          |             |             |             | 0.50(5)    |            | 0.50(5)     | 0.50(5)     |
| 120pF(121)                                                                                           | 0.50(5)          |             |             |             | 0.50(5)    |            |             | 0.50(5)     |
| 150pF(151)                                                                                           | 0.50(5)          |             |             |             | 0.50(5)    |            |             | 0.50(5)     |
| 180pF(181)                                                                                           | 0.50(5)          |             |             |             | 0.50(5)    |            |             | 0.50(5)     |
| 220pF(221)                                                                                           | 0.50(5)          |             |             |             |            | 0.50(5)    |             |             |
| 270pF(271)                                                                                           | 0.50(5)          |             |             |             |            | 0.50(5)    |             |             |
| 330pF(331)                                                                                           | 0.50(5)          |             |             |             |            | 0.50(5)    |             |             |
| 390pF(391)                                                                                           | 0.50(5)          |             |             |             |            | 0.50(5)    |             |             |
| 470pF(471)                                                                                           | 0.50(5)          |             |             |             |            |            |             |             |
| 560pF(561)                                                                                           | 0.50(5)          |             |             |             |            |            |             |             |
| 680pF(681)                                                                                           | 0.50(5)          |             |             |             |            |            |             |             |
| 820pF(821)                                                                                           | 0.50(5)          |             |             |             |            |            |             |             |
| 1000pF(102)                                                                                          | 0.50(5)          |             |             |             |            |            |             |             |

The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

## Temperature Compensating Type GRM18 Series (1.60x0.80 mm) 200V/100V/50V/25V

| Part Number                                                                                          | GRM18            |             |            |             |             |             |             |             |            |            |             |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|------------|------------|-------------|-------------|
| L x W [EIA]                                                                                          | 1.60x0.80 [0603] |             |            |             |             |             |             |             |            |            |             |             |
| TC                                                                                                   | COG<br>(5C)      |             |            | P2H<br>(6P) | R2H<br>(6R) | S2H<br>(6S) | SL<br>(1X)  |             |            |            | T2H<br>(6T) | U2J<br>(7U) |
| Rated Volt.                                                                                          | 200<br>(2D)      | 100<br>(2A) | 50<br>(1H) | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H)  | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 25<br>(1E) | 50<br>(1H)  | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |            |             |             |             |             |             |            |            |             |             |
| 0.50pF(R50)                                                                                          | 0.80(8)          | 0.80(8)     | 0.80(8)    |             |             |             |             |             |            |            |             |             |
| 0.75pF(R75)                                                                                          | 0.80(8)          | 0.80(8)     | 0.80(8)    |             |             |             |             |             |            |            |             |             |
| 1.0pF(1R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    |             |             |             |             |             |            |            |             |             |
| 2.0pF(2R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    |             |             |             |             |             |            |            |             |             |
| 3.0pF(3R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |             |            |            | 0.80(8)     | 0.80(8)     |
| 4.0pF(4R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |             |            |            | 0.80(8)     | 0.80(8)     |
| 5.0pF(5R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |             |            |            | 0.80(8)     | 0.80(8)     |
| 6.0pF(6R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |             |            |            | 0.80(8)     | 0.80(8)     |
| 7.0pF(7R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |             |            |            | 0.80(8)     | 0.80(8)     |
| 8.0pF(8R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |             |            |            | 0.80(8)     | 0.80(8)     |
| 9.0pF(9R0)                                                                                           | 0.80(8)          | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |             |            |            | 0.80(8)     | 0.80(8)     |
| 10pF(100)                                                                                            | 0.80(8)          | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |             |            |            | 0.80(8)     | 0.80(8)     |
| 12pF(120)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |
| 15pF(150)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |
| 18pF(180)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |
| 22pF(220)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |
| 27pF(270)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |
| 33pF(330)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |
| 39pF(390)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |
| 47pF(470)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |
| 56pF(560)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             |            |            | 0.80(8)     | 0.80(8)     |

Continued on the following page. ➤

Continued from the preceding page.

| Part Number                                                                                          | GRM18            |             |            |             |             |             |             |             |            |            |             |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|------------|------------|-------------|-------------|
| L x W [EIA]                                                                                          | 1.60x0.80 [0603] |             |            |             |             |             |             |             |            |            |             |             |
| TC                                                                                                   | COG<br>(5C)      |             |            | P2H<br>(6P) | R2H<br>(6R) | S2H<br>(6S) | SL<br>(1X)  |             |            |            | T2H<br>(6T) | U2J<br>(7U) |
| Rated Volt.                                                                                          | 200<br>(2D)      | 100<br>(2A) | 50<br>(1H) | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H)  | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 25<br>(1E) | 50<br>(1H)  | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |            |             |             |             |             |             |            |            |             |             |
| 68pF(680)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 82pF(820)                                                                                            |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 100pF(101)                                                                                           |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     | 0.80(8)     |             | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 120pF(121)                                                                                           |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             | 0.80(8)     | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 150pF(151)                                                                                           |                  | 0.80(8)     | 0.80(8)    | 0.80(8)     | 0.80(8)     | 0.80(8)     |             | 0.80(8)     | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 180pF(181)                                                                                           |                  | 0.80(8)     | 0.80(8)    |             | 0.80(8)     | 0.80(8)     |             | 0.80(8)     | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 220pF(221)                                                                                           |                  | 0.80(8)     | 0.80(8)    |             |             | 0.80(8)     |             | 0.80(8)     | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 270pF(271)                                                                                           |                  | 0.80(8)     | 0.80(8)    |             |             |             |             | 0.80(8)     | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 330pF(331)                                                                                           |                  | 0.80(8)     | 0.80(8)    |             |             |             |             | 0.80(8)     | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 390pF(391)                                                                                           |                  | 0.80(8)     | 0.80(8)    |             |             |             |             | 0.80(8)     | 0.80(8)    |            | 0.80(8)     | 0.80(8)     |
| 470pF(471)                                                                                           |                  | 0.80(8)     | 0.80(8)    |             |             |             |             |             | 0.80(8)    |            |             | 0.80(8)     |
| 560pF(561)                                                                                           |                  | 0.80(8)     | 0.80(8)    |             |             |             |             |             | 0.80(8)    |            |             | 0.80(8)     |
| 680pF(681)                                                                                           |                  |             | 0.80(8)    |             |             |             |             |             | 0.80(8)    |            |             | 0.80(8)     |
| 820pF(821)                                                                                           |                  |             | 0.80(8)    |             |             |             |             |             |            | 0.80(8)    |             |             |
| 1000pF(102)                                                                                          |                  |             | 0.80(8)    |             |             |             |             |             |            | 0.80(8)    |             |             |
| 1200pF(122)                                                                                          |                  |             | 0.80(8)    |             |             |             |             |             |            | 0.80(8)    |             |             |
| 1500pF(152)                                                                                          |                  |             | 0.80(8)    |             |             |             |             |             |            | 0.80(8)    |             |             |
| 1800pF(182)                                                                                          |                  |             | 0.80(8)    |             |             |             |             |             |            |            |             |             |
| 2200pF(222)                                                                                          |                  |             | 0.80(8)    |             |             |             |             |             |            |            |             |             |
| 2700pF(272)                                                                                          |                  |             | 0.80(8)    |             |             |             |             |             |            |            |             |             |

The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

## Temperature Compensating Type GRM21 Series (2.00x1.25 mm) 200V/100V/50V/25V

| Part Number                                                                                          | GRM21            |             |            |             |             |             |             |             |             |            |            |             |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|------------|-------------|-------------|
| L x W [EIA]                                                                                          | 2.00x1.25 [0805] |             |            |             |             |             |             |             |             |            |            |             |             |
| TC                                                                                                   | COG<br>(5C)      |             |            | COH<br>(6C) | P2H<br>(6P) | R2H<br>(6R) | S2H<br>(6S) | SL<br>(1X)  |             |            |            | T2H<br>(6T) | U2J<br>(7U) |
| Rated Volt.                                                                                          | 200<br>(2D)      | 100<br>(2A) | 50<br>(1H) | 25<br>(1E)  | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H)  | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 25<br>(1E) | 50<br>(1H)  | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |            |             |             |             |             |             |             |            |            |             |             |
| 12pF(120)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 15pF(150)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 18pF(180)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 22pF(220)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 27pF(270)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 33pF(330)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 39pF(390)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 47pF(470)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 56pF(560)                                                                                            | 0.85(9)          |             |            |             |             |             |             |             |             |            |            |             |             |
| 68pF(680)                                                                                            | 1.25(B)          | 0.85(9)     |            |             |             |             |             |             |             |            |            |             |             |
| 82pF(820)                                                                                            | 1.25(B)          | 0.85(9)     |            |             |             |             |             |             |             |            |            |             |             |
| 100pF(101)                                                                                           | 1.25(B)          | 0.60(6)     |            |             |             |             |             |             |             |            |            |             |             |
| 120pF(121)                                                                                           | 1.25(B)          | 0.60(6)     |            |             |             |             |             | 0.85(9)     |             |            |            |             |             |
| 150pF(151)                                                                                           | 1.25(B)          | 0.60(6)     |            |             |             |             |             | 1.25(B)     |             |            |            |             |             |
| 180pF(181)                                                                                           | 1.25(B)          | 0.60(6)     |            |             | 0.85(9)     |             |             | 1.25(B)     |             |            |            |             |             |
| 220pF(221)                                                                                           | 1.25(B)          | 0.60(6)     |            |             | 0.85(9)     | 0.85(9)     |             | 1.25(B)     |             |            |            |             |             |
| 270pF(271)                                                                                           |                  | 0.60(6)     |            |             | 0.85(9)     | 0.85(9)     | 0.85(9)     | 1.25(B)     |             |            |            |             |             |
| 330pF(331)                                                                                           |                  | 0.60(6)     |            |             | 0.85(9)     | 0.85(9)     | 0.85(9)     | 1.25(B)     |             |            |            |             |             |
| 390pF(391)                                                                                           |                  | 0.60(6)     |            |             | 1.25(B)     | 0.85(9)     | 0.85(9)     | 1.25(B)     |             |            |            |             |             |

Continued on the following page. ➤

Continued from the preceding page.

| Part Number                                                                                          | GRM21            |             |            |             |             |             |             |             |             |            |            |             |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|------------|-------------|-------------|
| L x W [EIA]                                                                                          | 2.00x1.25 [0805] |             |            |             |             |             |             |             |             |            |            |             |             |
| TC                                                                                                   | C0G<br>(5C)      |             |            | C0H<br>(6C) | P2H<br>(6P) | R2H<br>(6R) | S2H<br>(6S) | SL<br>(1X)  |             |            |            | T2H<br>(6T) | U2J<br>(7U) |
| Rated Volt.                                                                                          | 200<br>(2D)      | 100<br>(2A) | 50<br>(1H) | 25<br>(1E)  | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H)  | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 25<br>(1E) | 50<br>(1H)  | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |            |             |             |             |             |             |             |            |            |             |             |
| 470pF(471)                                                                                           |                  | 0.60(6)     |            |             | 1.25(B)     | 0.85(9)     | 0.85(9)     | 1.25(B)     | 0.85(9)     |            |            |             |             |
| 560pF(561)                                                                                           |                  | 0.60(6)     |            |             | 1.25(B)     | 1.25(B)     | 1.25(B)     |             | 0.85(9)     |            |            | 1.25(B)     |             |
| 680pF(681)                                                                                           |                  | 0.85(9)     |            |             |             | 1.25(B)     | 1.25(B)     |             | 0.85(9)     |            |            | 1.25(B)     |             |
| 820pF(821)                                                                                           |                  | 0.85(9)     |            |             |             |             | 1.25(B)     |             | 1.25(B)     | 0.60(6)    |            | 1.25(B)     | 0.60(6)     |
| 1000pF(102)                                                                                          |                  | 0.85(9)     |            |             |             |             |             |             | 1.25(B)     | 0.60(6)    |            | 1.25(B)     | 0.60(6)     |
| 1200pF(122)                                                                                          |                  |             |            |             |             |             |             |             | 1.25(B)     | 0.60(6)    |            | 1.25(B)     | 0.60(6)     |
| 1500pF(152)                                                                                          |                  |             |            |             |             |             |             |             | 1.25(B)     | 0.85(9)    |            | 1.25(B)     | 0.85(9)     |
| 1800pF(182)                                                                                          |                  |             | 0.60(6)    |             |             |             |             |             | 1.25(B)     | 0.85(9)    |            | 1.25(B)     | 0.85(9)     |
| 2200pF(222)                                                                                          |                  |             | 0.60(6)    |             |             |             |             |             |             | 0.85(9)    |            |             | 0.85(9)     |
| 2700pF(272)                                                                                          |                  |             | 0.60(6)    | 1.25(B)     |             |             |             |             |             | 1.25(B)    |            |             | 1.25(B)     |
| 3300pF(332)                                                                                          |                  |             | 0.60(6)    | 1.25(B)     |             |             |             |             |             | 1.25(B)    |            |             | 1.25(B)     |
| 3900pF(392)                                                                                          |                  |             | 0.60(6)    | 1.25(B)     |             |             |             |             |             |            | 0.85(9)    |             |             |
| 4700pF(472)                                                                                          |                  |             | 0.60(6)    |             |             |             |             |             |             |            | 0.85(9)    |             |             |
| 5600pF(562)                                                                                          |                  |             | 0.85(9)    |             |             |             |             |             |             |            | 1.25(B)    |             |             |
| 6800pF(682)                                                                                          |                  |             | 0.85(9)    |             |             |             |             |             |             |            | 1.25(B)    |             |             |
| 8200pF(822)                                                                                          |                  |             | 0.85(9)    |             |             |             |             |             |             |            |            |             |             |
| 10000pF(103)                                                                                         |                  |             | 0.85(9)    |             |             |             |             |             |             | 0.60(6)    |            |             | 0.60(6)     |
| 12000pF(123)                                                                                         |                  |             |            |             |             |             |             |             |             | 0.60(6)    |            |             | 0.60(6)     |
| 15000pF(153)                                                                                         |                  |             |            |             |             |             |             |             |             | 0.60(6)    |            |             | 0.60(6)     |
| 18000pF(183)                                                                                         |                  |             |            |             |             |             |             |             |             | 0.60(6)    |            |             | 0.60(6)     |
| 22000pF(223)                                                                                         |                  |             |            |             |             |             |             |             |             | 0.85(9)    |            |             | 0.85(9)     |
| 27000pF(273)                                                                                         |                  |             |            |             |             |             |             |             |             | 0.85(9)    |            |             | 0.85(9)     |
| 33000pF(333)                                                                                         |                  |             |            |             |             |             |             |             |             | 1.00(A)    |            |             | 1.00(A)     |
| 39000pF(393)                                                                                         |                  |             |            |             |             |             |             |             |             | 1.25(B)    |            |             | 1.25(B)     |
| 47000pF(473)                                                                                         |                  |             |            |             |             |             |             |             |             | 1.25(B)    |            |             | 1.25(B)     |

The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

## Temperature Compensating Type GRM31 Series (3.20x1.60 mm) 500V/200V/100V/50V/25V

| Part Number                                                                                          | GRM31            |             |            |            |             |             |             |             |             |             |            |            |             |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|------------|-------------|-------------|
| L x W [EIA]                                                                                          | 3.20x1.60 [1206] |             |            |            |             |             |             |             |             |             |            |            |             |             |
| TC                                                                                                   | C0G<br>(5C)      |             |            |            | C0H<br>(6C) | P2H<br>(6P) | R2H<br>(6R) | S2H<br>(6S) | SL<br>(1X)  |             |            |            | T2H<br>(6T) | U2J<br>(7U) |
| Rated Volt.                                                                                          | 500<br>(2H)      | 200<br>(2D) | 50<br>(1H) | 25<br>(1E) | 25<br>(1E)  | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H)  | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 25<br>(1E) | 50<br>(1H)  | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 1.0pF(1R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 2.0pF(2R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 3.0pF(3R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 4.0pF(4R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 5.0pF(5R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 6.0pF(6R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 7.0pF(7R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 8.0pF(8R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 9.0pF(9R0)                                                                                           | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 10pF(100)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 12pF(120)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 15pF(150)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 18pF(180)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 22pF(220)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |

Continued on the following page. ➤

Continued from the preceding page.

| Part Number                                                                                          | GRM31            |             |            |            |             |             |             |             |             |             |            |            |             |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|------------|-------------|-------------|
| L x W [EIA]                                                                                          | 3.20x1.60 [1206] |             |            |            |             |             |             |             |             |             |            |            |             |             |
| TC                                                                                                   | C0G<br>(5C)      |             |            |            | C0H<br>(6C) | P2H<br>(6P) | R2H<br>(6R) | S2H<br>(6S) | SL<br>(1X)  |             |            |            | T2H<br>(6T) | U2J<br>(7U) |
| Rated Volt.                                                                                          | 500<br>(2H)      | 200<br>(2D) | 50<br>(1H) | 25<br>(1E) | 25<br>(1E)  | 50<br>(1H)  | 50<br>(1H)  | 50<br>(1H)  | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 25<br>(1E) | 50<br>(1H)  | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 27pF(270)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 33pF(330)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 39pF(390)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 47pF(470)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 56pF(560)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 68pF(680)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 82pF(820)                                                                                            | 1.15(M)          |             |            |            |             |             |             |             |             |             |            |            |             |             |
| 270pF(271)                                                                                           |                  | 1.15(M)     |            |            |             |             |             |             |             |             |            |            |             |             |
| 330pF(331)                                                                                           |                  | 1.15(M)     |            |            |             |             |             |             |             |             |            |            |             |             |
| 390pF(391)                                                                                           |                  | 1.15(M)     |            |            |             |             |             |             |             |             |            |            |             |             |
| 470pF(471)                                                                                           |                  | 1.15(M)     |            |            |             |             |             |             |             |             |            |            |             |             |
| 560pF(561)                                                                                           |                  |             |            |            |             |             |             |             | 1.15(M)     |             |            |            |             |             |
| 680pF(681)                                                                                           |                  |             |            |            |             | 0.85(9)     |             |             | 1.15(M)     |             |            |            |             |             |
| 820pF(821)                                                                                           |                  |             |            |            |             | 0.85(9)     | 0.85(9)     |             | 1.15(M)     |             |            |            |             |             |
| 1000pF(102)                                                                                          |                  |             |            |            |             | 1.15(M)     | 1.15(M)     | 0.85(9)     | 1.15(M)     |             |            |            |             |             |
| 1200pF(122)                                                                                          |                  |             |            |            |             | 1.15(M)     | 1.15(M)     | 1.15(M)     | 1.15(M)     |             |            |            |             |             |
| 1500pF(152)                                                                                          |                  |             |            |            |             | 1.15(M)     | 1.15(M)     | 1.15(M)     |             |             |            |            |             |             |
| 1800pF(182)                                                                                          |                  |             |            |            |             |             |             | 1.15(M)     |             |             |            |            |             |             |
| 2200pF(222)                                                                                          |                  |             |            |            |             |             |             |             |             | 1.15(M)     |            |            | 1.15(M)     |             |
| 2700pF(272)                                                                                          |                  |             |            |            |             |             |             |             |             | 1.15(M)     |            |            | 1.15(M)     |             |
| 3300pF(332)                                                                                          |                  |             |            |            |             |             |             |             |             | 1.15(M)     |            |            | 1.15(M)     |             |
| 3900pF(392)                                                                                          |                  |             |            |            |             |             |             |             |             | 1.15(M)     | 0.85(9)    |            | 1.15(M)     | 0.85(9)     |
| 4700pF(472)                                                                                          |                  |             |            |            |             |             |             |             |             | 1.15(M)     | 0.85(9)    |            |             | 0.85(9)     |
| 5600pF(562)                                                                                          |                  |             | 0.85(9)    |            |             |             |             |             |             |             | 0.85(9)    |            |             | 0.85(9)     |
| 6800pF(682)                                                                                          |                  |             | 0.85(9)    |            | 0.85(9)     |             |             |             |             |             | 1.15(M)    |            |             | 1.15(M)     |
| 8200pF(822)                                                                                          |                  |             | 0.85(9)    |            | 1.15(M)     |             |             |             |             |             | 1.15(M)    |            |             | 1.15(M)     |
| 10000pF(103)                                                                                         |                  |             | 0.85(9)    |            |             |             |             |             |             |             |            | 1.15(M)    |             |             |
| 12000pF(123)                                                                                         |                  |             |            |            |             |             |             |             |             |             |            | 1.15(M)    |             |             |
| 15000pF(153)                                                                                         |                  |             |            |            |             |             |             |             |             |             |            | 1.15(M)    |             |             |
| 27000pF(273)                                                                                         |                  |             | 0.85(9)    |            |             |             |             |             |             |             |            |            |             |             |
| 33000pF(333)                                                                                         |                  |             | 0.85(9)    |            |             |             |             |             |             |             |            |            |             |             |
| 47000pF(473)                                                                                         |                  |             | 1.15(M)    |            |             |             |             |             |             |             |            |            |             |             |
| 56000pF(563)                                                                                         |                  |             |            |            |             |             |             |             |             |             | 0.85(9)    |            |             | 0.85(9)     |
| 68000pF(683)                                                                                         |                  |             |            |            |             |             |             |             |             |             | 1.15(M)    |            |             | 1.15(M)     |
| 82000pF(823)                                                                                         |                  |             |            |            |             |             |             |             |             |             | 1.15(M)    |            |             | 1.15(M)     |
| 0.10μF(104)                                                                                          |                  |             |            | 1.60(C)    |             |             |             |             |             |             | 1.15(M)    |            |             | 1.15(M)     |

The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

## High Dielectric Constant Type X5R (R6) Characteristics

| TC                                                                                                   | X5R<br>(R6)      |            |                  |             |                  |             |                  |             |
|------------------------------------------------------------------------------------------------------|------------------|------------|------------------|-------------|------------------|-------------|------------------|-------------|
| Part Number                                                                                          | GRM15            |            | GRM18            |             | GRM21            |             | GRM31            |             |
| L x W [EIA]                                                                                          | 1.00x0.50 [0402] |            | 1.60x0.80 [0603] |             | 2.00x1.25 [0805] |             | 3.20x1.60 [1206] |             |
| Rated Volt.                                                                                          | 16<br>(1C)       | 10<br>(1A) | 10<br>(1A)       | 6.3<br>(0J) | 10<br>(1A)       | 6.3<br>(0J) | 10<br>(1A)       | 6.3<br>(0J) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |            |                  |             |                  |             |                  |             |
| 68000pF(683)                                                                                         |                  | 0.50(5)    |                  |             |                  |             |                  |             |
| 0.10μF(104)                                                                                          | 0.50(5)          | 0.50(5)    |                  |             |                  |             |                  |             |
| 0.33μF(334)                                                                                          |                  |            | 0.80(8)          |             |                  |             |                  |             |

Continued on the following page. ➤

Continued from the preceding page.

1

| TC                                                                                                   | X5R<br>(R6)      |            |                  |             |                  |             |                  |             |
|------------------------------------------------------------------------------------------------------|------------------|------------|------------------|-------------|------------------|-------------|------------------|-------------|
| Part Number                                                                                          | GRM15            |            | GRM18            |             | GRM21            |             | GRM31            |             |
| L x W [EIA]                                                                                          | 1.00x0.50 [0402] |            | 1.60x0.80 [0603] |             | 2.00x1.25 [0805] |             | 3.20x1.60 [1206] |             |
| Rated Volt.                                                                                          | 16<br>(1C)       | 10<br>(1A) | 10<br>(1A)       | 6.3<br>(0J) | 10<br>(1A)       | 6.3<br>(0J) | 10<br>(1A)       | 6.3<br>(0J) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |            |                  |             |                  |             |                  |             |
| 0.47μF(474)                                                                                          |                  |            | 0.80(8)          |             |                  |             |                  |             |
| 0.68μF(684)                                                                                          |                  |            | 0.80(8)          |             |                  |             |                  |             |
| 1.0μF(105)                                                                                           |                  |            | 0.80(8)          | 0.80(8)     | 0.85(9)          |             |                  |             |
| 1.5μF(155)                                                                                           |                  |            |                  |             |                  | 0.85(9)     |                  |             |
| 2.2μF(225)                                                                                           |                  |            |                  |             | 1.25(B)          | 1.25(B)     | 0.85(9)          |             |
| 3.3μF(335)                                                                                           |                  |            |                  |             |                  | 1.25(B)     | 1.30(X)          |             |
| 4.7μF(475)                                                                                           |                  |            |                  |             |                  | 1.25(B)     | 1.60(C)          | 1.15(M)     |
| 10μF(106)                                                                                            |                  |            |                  |             |                  |             | 1.60(C)          | 1.60(C)     |

The part numbering code is shown in each ( ).

3.3μF and 4.7μF, 6.3V rated are GRM21 series of L: 2±0.15, W: 1.25±0.15, T: 1.25±0.15.

T: 1.15±0.1mm is also available for GRM31 1.0μF for 16V.

L: 3.2±0.2, W: 1.6±0.2 for GRM31 16V 1.0μF type. Also L: 3.2±0.2, W: 1.6±0.2, T: 1.15±0.15 for GRM31 16V 1.5μF and 2.2μF type.

Dimensions are shown in mm and Rated Voltage in Vdc.

## High Dielectric Constant Type X7R (R7) Characteristics

| TC                                                                                                   | X7R<br>(R7)      |             |             |             |                  |             |             |            |            |                  |             |            |            |                  |            |            |            |            |
|------------------------------------------------------------------------------------------------------|------------------|-------------|-------------|-------------|------------------|-------------|-------------|------------|------------|------------------|-------------|------------|------------|------------------|------------|------------|------------|------------|
| Part Number                                                                                          | GRM15            |             |             |             | GRM18            |             |             |            |            | GRM21            |             |            |            | GRM31            |            |            |            |            |
| L x W [EIA]                                                                                          | 1.00x0.50 [0402] |             |             |             | 1.60x0.80 [0603] |             |             |            |            | 2.00x1.25 [0805] |             |            |            | 3.20x1.60 [1206] |            |            |            |            |
| Rated Volt.                                                                                          | 50<br>(1H)       | 25<br>(1E)  | 16<br>(1C)  | 10<br>(1A)  | 100<br>(2A)      | 50<br>(1H)  | 25<br>(1E)  | 16<br>(1C) | 10<br>(1A) | 100<br>(2A)      | 50<br>(1H)  | 25<br>(1E) | 16<br>(1C) | 100<br>(2A)      | 50<br>(1H) | 25<br>(1E) | 16<br>(1C) | 10<br>(1A) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |             |             |                  |             |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 220pF<br>(221)                                                                                       | 0.50<br>(5)      |             |             |             |                  | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 330pF<br>(331)                                                                                       | 0.50<br>(5)      |             |             |             |                  | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 470pF<br>(471)                                                                                       | 0.50<br>(5)      |             |             |             |                  | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 680pF<br>(681)                                                                                       | 0.50<br>(5)      |             |             |             |                  | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 1000pF<br>(102)                                                                                      | 0.50<br>(5)      |             |             |             |                  | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 1500pF<br>(152)                                                                                      | 0.50<br>(5)      |             |             |             |                  | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 2200pF<br>(222)                                                                                      | 0.50<br>(5)      |             |             |             | 0.80<br>(8)      | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 3300pF<br>(332)                                                                                      | 0.50<br>(5)      |             |             |             | 0.80<br>(8)      | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 4700pF<br>(472)                                                                                      | 0.50<br>(5)      |             |             |             |                  | 0.80<br>(8) |             |            |            | 0.85<br>(9)      |             |            |            |                  |            |            |            |            |
| 6800pF<br>(682)                                                                                      |                  | 0.50<br>(5) |             |             |                  | 0.80<br>(8) |             |            |            | 0.85<br>(9)      |             |            |            |                  |            |            |            |            |
| 10000pF<br>(103)                                                                                     |                  | 0.50<br>(5) |             |             |                  | 0.80<br>(8) |             |            |            | 1.25<br>(B)      |             |            |            |                  |            |            |            |            |
| 15000pF<br>(153)                                                                                     |                  |             | 0.50<br>(5) |             |                  | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 22000pF<br>(223)                                                                                     |                  |             | 0.50<br>(5) |             |                  | 0.80<br>(8) |             |            |            |                  |             |            |            |                  |            |            |            |            |
| 33000pF<br>(333)                                                                                     |                  |             |             | 0.50<br>(5) |                  | 0.80<br>(8) | 0.80<br>(8) |            |            |                  | 0.85<br>(9) |            |            | 1.15<br>(M)      |            |            |            |            |

Continued on the following page. ↗

Continued from the preceding page.

| TC                                                                                                   | X7R<br>(R7)      |            |             |             |                  |             |             |             |             |                  |             |             |             |                  |             |             |             |             |
|------------------------------------------------------------------------------------------------------|------------------|------------|-------------|-------------|------------------|-------------|-------------|-------------|-------------|------------------|-------------|-------------|-------------|------------------|-------------|-------------|-------------|-------------|
| Part Number                                                                                          | GRM15            |            |             |             | GRM18            |             |             |             |             | GRM21            |             |             |             | GRM31            |             |             |             |             |
| L x W [EIA]                                                                                          | 1.00x0.50 [0402] |            |             |             | 1.60x0.80 [0603] |             |             |             |             | 2.00x1.25 [0805] |             |             |             | 3.20x1.60 [1206] |             |             |             |             |
| Rated Volt.                                                                                          | 50<br>(1H)       | 25<br>(1E) | 16<br>(1C)  | 10<br>(1A)  | 100<br>(2A)      | 50<br>(1H)  | 25<br>(1E)  | 16<br>(1C)  | 10<br>(1A)  | 100<br>(2A)      | 50<br>(1H)  | 25<br>(1E)  | 16<br>(1C)  | 100<br>(2A)      | 50<br>(1H)  | 25<br>(1E)  | 16<br>(1C)  | 10<br>(1A)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |            |             |             |                  |             |             |             |             |                  |             |             |             |                  |             |             |             |             |
| 47000pF<br>(473)                                                                                     |                  |            |             | 0.50<br>(5) |                  | 0.80<br>(8) | 0.80<br>(8) |             |             |                  | 1.25<br>(B) |             |             | 1.15<br>(M)      |             |             |             |             |
| 68000pF<br>(683)                                                                                     |                  |            |             |             |                  | 0.80<br>(8) | 0.80<br>(8) |             |             |                  | 1.25<br>(B) |             |             |                  |             |             |             |             |
| 0.10μF<br>(104)                                                                                      |                  |            | 0.50<br>(5) | 0.50<br>(5) |                  | 0.80<br>(8) | 0.80<br>(8) | 0.80<br>(8) |             |                  | 1.25<br>(B) | 1.25<br>(B) |             |                  |             |             |             |             |
| 0.15μF<br>(154)                                                                                      |                  |            |             |             |                  |             | 0.80<br>(8) |             | 0.80<br>(8) |                  | 1.25<br>(B) | 1.25<br>(B) |             |                  |             |             |             |             |
| 0.22μF<br>(224)                                                                                      |                  |            |             |             |                  |             |             | 0.80<br>(8) | 0.80<br>(8) |                  | 1.25<br>(B) | 0.85<br>(9) |             |                  |             |             |             |             |
| 0.33μF<br>(334)                                                                                      |                  |            |             |             |                  |             |             |             |             |                  | 0.85<br>(9) | 1.25<br>(B) |             |                  | 0.85<br>(9) |             |             |             |
| 0.47μF<br>(474)                                                                                      |                  |            |             |             |                  |             |             |             |             |                  | 1.25<br>(B) | 1.25<br>(B) | 0.85<br>(9) |                  | 1.15<br>(M) |             |             |             |
| 0.68μF<br>(684)                                                                                      |                  |            |             |             |                  |             |             |             |             |                  |             |             | 0.85<br>(9) |                  |             | 0.85<br>(9) |             |             |
| 1.0μF<br>(105)                                                                                       |                  |            |             |             |                  |             |             |             |             |                  |             |             | 1.25<br>(B) |                  | 1.15<br>(M) | 1.15<br>(M) | 0.85<br>(9) | 0.85<br>(9) |
| 1.5μF<br>(155)                                                                                       |                  |            |             |             |                  |             |             |             |             |                  |             |             |             |                  | 1.60<br>(C) |             | 1.15<br>(M) |             |
| 2.2μF<br>(225)                                                                                       |                  |            |             |             |                  |             |             |             |             |                  |             |             |             |                  | 1.60<br>(C) |             | 1.15<br>(M) | 0.85<br>(9) |
| 3.3μF<br>(335)                                                                                       |                  |            |             |             |                  |             |             |             |             |                  |             |             |             |                  |             | 1.60<br>(C) |             |             |
| 4.7μF<br>(475)                                                                                       |                  |            |             |             |                  |             |             |             |             |                  |             |             |             |                  |             | 1.60<br>(C) |             |             |

The part numbering code is shown in each ( ).

The tolerance will be changed to L: 3.2±0.2, W: 1.6±0.2 for GRM31 16V 1.0μF type. Also L: 3.2±0.2, W: 1.6±0.2, T: 1.15±0.15 for GRM31 16V 1.5μF and 2.2μF type.

Dimensions are shown in mm and Rated Voltage in Vdc.

## High Dielectric Constant Type Y5V (F5) Characteristics

| TC                                                                                                   | Y5V<br>(F5)      |             |             |                  |             |             |            |            |                  |            |            |            |                  |            |            |            |             |
|------------------------------------------------------------------------------------------------------|------------------|-------------|-------------|------------------|-------------|-------------|------------|------------|------------------|------------|------------|------------|------------------|------------|------------|------------|-------------|
| Part Number                                                                                          | GRM15            |             |             | GRM18            |             |             |            |            | GRM21            |            |            |            | GRM31            |            |            |            |             |
| L x W [EIA]                                                                                          | 1.00x0.50 [0402] |             |             | 1.60x0.80 [0603] |             |             |            |            | 2.00x1.25 [0805] |            |            |            | 3.20x1.60 [1206] |            |            |            |             |
| Rated Volt.                                                                                          | 50<br>(1H)       | 25<br>(1E)  | 16<br>(1C)  | 100<br>(2A)      | 50<br>(1H)  | 25<br>(1E)  | 16<br>(1C) | 10<br>(1A) | 50<br>(1H)       | 25<br>(1E) | 16<br>(1C) | 10<br>(1A) | 50<br>(1H)       | 25<br>(1E) | 16<br>(1C) | 10<br>(1A) | 6.3<br>(0J) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |             |                  |             |             |            |            |                  |            |            |            |                  |            |            |            |             |
| 2200pF<br>(222)                                                                                      | 0.50<br>(5)      |             |             |                  |             |             |            |            |                  |            |            |            |                  |            |            |            |             |
| 4700pF<br>(472)                                                                                      | 0.50<br>(5)      |             |             | 0.80<br>(8)      |             |             |            |            |                  |            |            |            |                  |            |            |            |             |
| 10000pF<br>(103)                                                                                     | 0.50<br>(5)      |             |             |                  | 0.80<br>(8) |             |            |            |                  |            |            |            |                  |            |            |            |             |
| 22000pF<br>(223)                                                                                     |                  | 0.50<br>(5) |             |                  | 0.80<br>(8) |             |            |            |                  |            |            |            |                  |            |            |            |             |
| 47000pF<br>(473)                                                                                     |                  |             | 0.50<br>(5) |                  | 0.80<br>(8) |             |            |            |                  |            |            |            |                  |            |            |            |             |
| 0.10μF<br>(104)                                                                                      |                  | 0.50<br>(5) | 0.50<br>(5) |                  | 0.80<br>(8) | 0.80<br>(8) |            |            | 0.85<br>(9)      |            |            |            |                  |            |            |            |             |

Continued on the following page. ➤

Continued from the preceding page.

1

| TC                                                                                                   | Y5V<br>(F5)      |            |            |                  |            |            |             |             |                  |             |             |             |                  |             |             |             |             |
|------------------------------------------------------------------------------------------------------|------------------|------------|------------|------------------|------------|------------|-------------|-------------|------------------|-------------|-------------|-------------|------------------|-------------|-------------|-------------|-------------|
| Part Number                                                                                          | GRM15            |            |            | GRM18            |            |            |             |             | GRM21            |             |             |             | GRM31            |             |             |             |             |
| L x W [EIA]                                                                                          | 1.00x0.50 [0402] |            |            | 1.60x0.80 [0603] |            |            |             |             | 2.00x1.25 [0805] |             |             |             | 3.20x1.60 [1206] |             |             |             |             |
| Rated Volt.                                                                                          | 50<br>(1H)       | 25<br>(1E) | 16<br>(1C) | 100<br>(2A)      | 50<br>(1H) | 25<br>(1E) | 16<br>(1C)  | 10<br>(1A)  | 50<br>(1H)       | 25<br>(1E)  | 16<br>(1C)  | 10<br>(1A)  | 50<br>(1H)       | 25<br>(1E)  | 16<br>(1C)  | 10<br>(1A)  | 6.3<br>(0J) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |            |            |                  |            |            |             |             |                  |             |             |             |                  |             |             |             |             |
| 0.22μF<br>(224)                                                                                      |                  |            |            |                  |            |            | 0.80<br>(8) |             | 1.25<br>(B)      | 0.85<br>(9) |             |             |                  |             |             |             |             |
| 0.47μF<br>(474)                                                                                      |                  |            |            |                  |            |            | 0.80<br>(8) | 0.80<br>(8) |                  | 1.25<br>(B) |             |             | 1.15<br>(M)      |             |             |             |             |
| 1.0μF<br>(105)                                                                                       |                  |            |            |                  |            |            | 0.80<br>(8) | 0.80<br>(8) |                  | 0.85<br>(9) | 0.85<br>(9) | 0.85<br>(9) |                  | 1.15<br>(M) | 0.85<br>(9) |             |             |
| 2.2μF<br>(225)                                                                                       |                  |            |            |                  |            |            |             |             |                  | 1.25<br>(B) | 1.25<br>(B) | 1.25<br>(B) |                  |             | 1.15<br>(M) | 0.85<br>(9) |             |
| 4.7μF<br>(475)                                                                                       |                  |            |            |                  |            |            |             |             |                  |             |             | 1.25<br>(B) |                  | 1.15<br>(M) | 1.15<br>(M) | 1.15<br>(M) |             |
| 10μF<br>(106)                                                                                        |                  |            |            |                  |            |            |             |             |                  |             |             |             |                  | 1.60<br>(C) |             | 1.15<br>(M) | 1.15<br>(M) |

The part numbering code is shown in each ( ).

T: 1.25±0.1mm is also available for GRM21 25V or 16V 1.0μF type.

Dimensions are shown in mm and Rated Voltage in Vdc.

## High Dielectric Constant Type Z5U (E4) Characteristics

| TC                                                                                                   | Z5U<br>(E4)      |                  |                  |
|------------------------------------------------------------------------------------------------------|------------------|------------------|------------------|
| Part Number                                                                                          | GRM18            | GRM21            | GRM31            |
| L x W [EIA]                                                                                          | 1.60x0.80 [0603] | 2.00x1.25 [0805] | 3.20x1.60 [1206] |
| Rated Volt.                                                                                          | 50<br>(1H)       | 50<br>(1H)       | 50<br>(1H)       |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |                  |                  |
| 10000pF(103)                                                                                         | 0.80(8)          |                  |                  |
| 22000pF(223)                                                                                         | 0.80(8)          |                  |                  |
| 47000pF(473)                                                                                         |                  | 0.60(6)          |                  |
| 0.10μF(104)                                                                                          |                  | 0.85(9)          |                  |
| 0.22μF(224)                                                                                          |                  |                  | 0.85(9)          |

The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

# Chip Monolithic Ceramic Capacitors



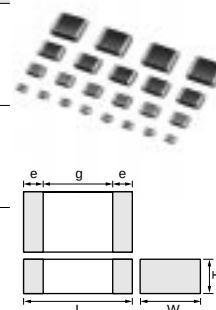
## for Reflow Soldering GRM32/43/55 Series

2

### ■ Features

1. Terminations are made of metal highly resistant to migration.
2. The GRM series is a complete line of chip ceramic capacitors in 10V, 16V, 25V, 50V, 100V and 200V ratings.  
These capacitors have temperature characteristics ranging from C0G to Y5V.
3. This series consists of type LxWxT: 3.2x2.5x0.85mm to LxWxT: 5.7x5.0x2.5mm. These are suited to only reflow soldering.
4. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placement on PCBs.
5. The GRM series is available in paper or plastic embossed tape and reel packaging for automatic placement.

| Part Number | Dimensions (mm) |          |            | e min. | g min. |
|-------------|-----------------|----------|------------|--------|--------|
|             | L               | W        | T          |        |        |
| GRM329      | 3.2 ±0.3        | 2.5 ±0.2 | 0.85 ±0.1  | 0.3    | 1.0    |
| GRM32M      |                 |          | 1.15 ±0.1  |        |        |
| GRM32N      |                 |          | 1.35 ±0.15 |        |        |
| GRM32R      |                 |          | 1.8 ±0.2   |        |        |
| GRM32E      |                 |          | 2.5 ±0.2   |        |        |
| GRM43M      | 4.5 ±0.4        | 3.2 ±0.3 | 1.15 ±0.1  | 0.3    | 2.0    |
| GRM43N      |                 |          | 1.35 ±0.15 |        |        |
| GRM43R      |                 |          | 1.8 ±0.2   |        |        |
| GRM43D      |                 |          | 2.0 ±0.2   |        |        |
| GRM43E      |                 |          | 2.5 ±0.2   |        |        |
| GRM55M      | 5.7 ±0.4        | 5.0 ±0.4 | 1.15 ±0.1  | 0.3    | 2.0    |
| GRM55N      |                 |          | 1.35 ±0.15 |        |        |
| GRM55C      |                 |          | 1.6 ±0.2   |        |        |
| GRM55R      |                 |          | 1.8 ±0.2   |        |        |
| GRM55D      |                 |          | 2.0 ±0.2   |        |        |
| GRM55E      |                 |          | 2.5 ±0.2   |        |        |



### ■ Applications

General electronic equipment

## Temperature Compensating Type GRM32/43/55 Series

| Part Number       | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------------|---------------------|------------------|---------------|--------------|------------------|
| GRM32N5C2D561JV01 | C0G (EIA)          | 200                 | 560 ±5%          | 3.20          | 2.50         | 1.35             |
| GRM32N5C2D681JY21 | C0G (EIA)          | 200                 | 680 ±5%          | 3.20          | 2.50         | 1.35             |
| GRM32N5C2D821JY21 | C0G (EIA)          | 200                 | 820 ±5%          | 3.20          | 2.50         | 1.35             |
| GRM32N5C2D102JY21 | C0G (EIA)          | 200                 | 1000 ±5%         | 3.20          | 2.50         | 1.35             |
| GRM43R5C2D122JV01 | C0G (EIA)          | 200                 | 1200 ±5%         | 4.50          | 3.20         | 1.80             |
| GRM43R5C2D152JV01 | C0G (EIA)          | 200                 | 1500 ±5%         | 4.50          | 3.20         | 1.80             |
| GRM43R5C2D182JY21 | C0G (EIA)          | 200                 | 1800 ±5%         | 4.50          | 3.20         | 1.80             |
| GRM43R5C2D222JY21 | C0G (EIA)          | 200                 | 2200 ±5%         | 4.50          | 3.20         | 1.80             |
| GRM43R5C2D272JY21 | C0G (EIA)          | 200                 | 2700 ±5%         | 4.50          | 3.20         | 1.80             |
| GRM55N5C2D332JY21 | C0G (EIA)          | 200                 | 3300 ±5%         | 5.70          | 5.00         | 1.35             |
| GRM55R5C2D392JY21 | C0G (EIA)          | 200                 | 3900 ±5%         | 5.70          | 5.00         | 1.80             |
| GRM55R5C2D472JY21 | C0G (EIA)          | 200                 | 4700 ±5%         | 5.70          | 5.00         | 1.80             |
| GRM55R5C2D562JY21 | C0G (EIA)          | 200                 | 5600 ±5%         | 5.70          | 5.00         | 1.80             |
| GRM32N1X2D152JV01 | SL (JIS)           | 200                 | 1500 ±5%         | 3.20          | 2.50         | 1.35             |
| GRM43N1X2D182JV01 | SL (JIS)           | 200                 | 1800 ±5%         | 4.50          | 3.20         | 1.35             |
| GRM43N1X2D222JV01 | SL (JIS)           | 200                 | 2200 ±5%         | 4.50          | 3.20         | 1.35             |
| GRM43R1X2D272JV01 | SL (JIS)           | 200                 | 2700 ±5%         | 4.50          | 3.20         | 1.80             |
| GRM43R1X2D332JV01 | SL (JIS)           | 200                 | 3300 ±5%         | 4.50          | 3.20         | 1.80             |
| GRM43R1X2D392JV01 | SL (JIS)           | 200                 | 3900 ±5%         | 4.50          | 3.20         | 1.80             |
| GRM55N1X2D472JV01 | SL (JIS)           | 200                 | 4700 ±5%         | 5.70          | 5.00         | 1.35             |
| GRM55R1X2D562JV01 | SL (JIS)           | 200                 | 5600 ±5%         | 5.70          | 5.00         | 1.80             |
| GRM55R1X2D682JV01 | SL (JIS)           | 200                 | 6800 ±5%         | 5.70          | 5.00         | 1.80             |
| GRM55R1X2D822JV01 | SL (JIS)           | 200                 | 8200 ±5%         | 5.70          | 5.00         | 1.80             |
| GRM32N1X2A562JZ01 | SL (JIS)           | 100                 | 5600 ±5%         | 3.20          | 2.50         | 1.35             |
| GRM32N1X2A682JZ01 | SL (JIS)           | 100                 | 6800 ±5%         | 3.20          | 2.50         | 1.35             |
| GRM43N1X2A822JZ01 | SL (JIS)           | 100                 | 8200 ±5%         | 4.50          | 3.20         | 1.35             |
| GRM43R1X2A103JZ01 | SL (JIS)           | 100                 | 10000 ±5%        | 4.50          | 3.20         | 1.80             |

Continued on the following page.

Continued from the preceding page.

| Part Number       | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------------|---------------------|------------------|---------------|--------------|------------------|
| GRM43R1X2A123JZ01 | SL (JIS)           | 100                 | 12000 ±5%        | 4.50          | 3.20         | 1.80             |
| GRM43R1X2A153JZ01 | SL (JIS)           | 100                 | 15000 ±5%        | 4.50          | 3.20         | 1.80             |
| GRM55M1X2A183JZ01 | SL (JIS)           | 100                 | 18000 ±5%        | 5.70          | 5.00         | 1.15             |
| GRM55N1X2A223JZ01 | SL (JIS)           | 100                 | 22000 ±5%        | 5.70          | 5.00         | 1.35             |
| GRM55R1X2A273JZ01 | SL (JIS)           | 100                 | 27000 ±5%        | 5.70          | 5.00         | 1.80             |
| GRM55R1X2A333JZ01 | SL (JIS)           | 100                 | 33000 ±5%        | 5.70          | 5.00         | 1.80             |
| GRM55R1X2A393JZ01 | SL (JIS)           | 100                 | 39000 ±5%        | 5.70          | 5.00         | 1.80             |
| GRM32N1X1H103JZ01 | SL (JIS)           | 50                  | 10000 ±5%        | 3.20          | 2.50         | 1.35             |
| GRM32N1X1H123JZ01 | SL (JIS)           | 50                  | 12000 ±5%        | 3.20          | 2.50         | 1.35             |
| GRM43R1X1H153JZ01 | SL (JIS)           | 50                  | 15000 ±5%        | 4.50          | 3.20         | 1.80             |
| GRM55M1X1H183JZ01 | SL (JIS)           | 50                  | 18000 ±5%        | 5.70          | 5.00         | 1.15             |
| GRM55N1X1H223JZ01 | SL (JIS)           | 50                  | 22000 ±5%        | 5.70          | 5.00         | 1.35             |
| GRM55R1X1H273JZ01 | SL (JIS)           | 50                  | 27000 ±5%        | 5.70          | 5.00         | 1.80             |
| GRM55R1X1H333JZ01 | SL (JIS)           | 50                  | 33000 ±5%        | 5.70          | 5.00         | 1.80             |
| GRM55R1X1H393JZ01 | SL (JIS)           | 50                  | 39000 ±5%        | 5.70          | 5.00         | 1.80             |

### High Dielectric Constant Type Type GRM32 Series (3.20x2.50mm)

| Part Number       | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance     | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------------|---------------------|-----------------|---------------|--------------|------------------|
| GRM32ER61A106KC01 | X5R (EIA)          | 10                  | 10μF ±10%       | 3.20          | 2.50         | 2.50             |
| GRM32NR72A683KA01 | X7R (EIA)          | 100                 | 68000pF ±10%    | 3.20          | 2.50         | 1.35             |
| GRM32NR72A104KA01 | X7R (EIA)          | 100                 | 0.10μF ±10%     | 3.20          | 2.50         | 1.35             |
| GRM32ER72A105KA01 | X7R (EIA)          | 100                 | 1.0μF ±10%      | 3.20          | 2.50         | 2.50             |
| GRM32NR71H684KA01 | X7R (EIA)          | 50                  | 0.68μF ±10%     | 3.20          | 2.50         | 1.35             |
| GRM32RR71H105KA01 | X7R (EIA)          | 50                  | 1.0μF ±10%      | 3.20          | 2.50         | 1.80             |
| GRM32RR71E225KC01 | X7R (EIA)          | 25                  | 2.2μF ±10%      | 3.20          | 2.50         | 1.80             |
| GRM32MR71C225KC01 | X7R (EIA)          | 16                  | 2.2μF ±10%      | 3.20          | 2.50         | 1.15             |
| GRM32NR71C335KC01 | X7R (EIA)          | 16                  | 3.3μF ±10%      | 3.20          | 2.50         | 1.35             |
| GRM32RR71C475KC01 | X7R (EIA)          | 16                  | 4.7μF ±10%      | 3.20          | 2.50         | 1.80             |
| GRM32ER71H475KA88 | X7R (EIA)          | 16                  | 4.7μF ±10%      | 3.20          | 2.50         | 2.50             |
| GRM32NF52A104ZA01 | Y5V (EIA)          | 100                 | 0.10μF +80/-20% | 3.20          | 2.50         | 1.35             |
| GRM32RF51H105ZA01 | Y5V (EIA)          | 50                  | 1.0μF +80/-20%  | 3.20          | 2.50         | 1.8              |
| GRM32DF51H106ZA01 | Y5V (EIA)          | 50                  | 10μF +80/-20%   | 3.20          | 2.50         | 2.00             |
| GRM329F51E475ZA01 | Y5V (EIA)          | 25                  | 4.7μF +80/-20%  | 3.20          | 2.50         | 0.85             |
| GRM32NF51E106ZA01 | Y5V (EIA)          | 25                  | 10μF +80/-20%   | 3.20          | 2.50         | 1.35             |
| GRM32NF51C106ZA01 | Y5V (EIA)          | 16                  | 10μF +80/-20%   | 3.20          | 2.50         | 1.35             |

### High Dielectric Constant Type Type GRM43 Series (4.50x3.20mm)

| Part Number       | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance (μF) | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------------|---------------------|------------------|---------------|--------------|------------------|
| GRM43RR72A154KA01 | X7R (EIA)          | 100                 | 0.15 ±10%        | 4.50          | 3.20         | 1.80             |
| GRM43RR72A224KA01 | X7R (EIA)          | 100                 | 0.22 ±10%        | 4.50          | 3.20         | 1.80             |
| GRM43DR72A474KA01 | X7R (EIA)          | 100                 | 0.47 ±10%        | 4.50          | 3.20         | 2.00             |
| GRM43ER72A225KA01 | X7R (EIA)          | 100                 | 2.2 ±10%         | 4.50          | 3.20         | 2.50             |
| GRM43ER71H225KA01 | X7R (EIA)          | 50                  | 2.2 ±10%         | 4.50          | 3.20         | 2.50             |

## High Dielectric Constant Type Type GRM55 Series (5.70x5.00mm)

| Part Number              | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance (μF) | Length L (mm) | Width W (mm) | Thickness T (mm) |
|--------------------------|--------------------|---------------------|------------------|---------------|--------------|------------------|
| <b>GRM55DR61H106KA01</b> | X5R (EIA)          | 50                  | 10.0 ±10%        | 5.70          | 5.00         | 2.00             |
| <b>GRM55DR72A105KA01</b> | X7R (EIA)          | 100                 | 1.0 ±10%         | 5.70          | 5.00         | 2.00             |
| <b>GRM55ER72A475KA01</b> | X7R (EIA)          | 100                 | 4.7 ±10%         | 5.70          | 5.00         | 2.50             |
| <b>GRM55RR71H105KA01</b> | X7R (EIA)          | 50                  | 1.0 ±10%         | 5.70          | 5.00         | 1.80             |
| <b>GRM55RR71H155KA01</b> | X7R (EIA)          | 50                  | 1.5 ±10%         | 5.70          | 5.00         | 1.80             |
| <b>GRM55ER71H475KA01</b> | X7R (EIA)          | 50                  | 4.7 ±10%         | 5.70          | 5.00         | 2.50             |
| <b>GRM55RF52A474ZA01</b> | Y5V (EIA)          | 100                 | 0.47 +80/-20%    | 5.70          | 5.00         | 1.80             |

# Chip Monolithic Ceramic Capacitors

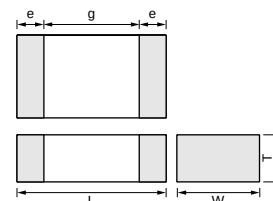


## Ultra-small GRM03 Series

3

### ■ Features

1. Small chip size (LxWxT: 0.6x0.3x0.3mm).
2. Terminations are made of metal highly resistant to migration.
3. GRM03 type is suited to only reflow soldering.
4. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placement on PCBs.
5. GRM03 series are suited to miniature micro wave module, portable equipment and high frequency circuits.



| Part Number   | Dimensions (mm) |           |           |            |        |
|---------------|-----------------|-----------|-----------|------------|--------|
|               | L               | W         | T         | e          | g min. |
| <b>GRM033</b> | 0.6 ±0.03       | 0.3 ±0.03 | 0.3 ±0.03 | 0.1 to 0.2 | 0.2    |

### ■ Applications

1. Miniature micro wave module
2. Portable equipment
3. High frequency circuit

| Part Number                                                                                          | GRM03       |             |             |             |             |
|------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|
| L x W                                                                                                | 0.6x0.3     |             |             |             |             |
| TC                                                                                                   | C0G<br>(5C) | X5R<br>(R6) | X7R<br>(R7) |             | Y5V<br>(F5) |
| Rated Volt.                                                                                          | 25<br>(1E)  | 10<br>(1A)  | 16<br>(1C)  | 6.3<br>(0J) | 10<br>(1A)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |             |             |             |             |
| 0.50pF(R50)                                                                                          | 0.3(3)      |             |             |             |             |
| 1.0pF(1R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 2.0pF(2R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 3.0pF(3R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 4.0pF(4R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 5.0pF(5R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 6.0pF(6R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 7.0pF(7R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 8.0pF(8R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 9.0pF(9R0)                                                                                           | 0.3(3)      |             |             |             |             |
| 10pF(100)                                                                                            | 0.3(3)      |             |             |             |             |
| 12pF(120)                                                                                            | 0.3(3)      |             |             |             |             |
| 15pF(150)                                                                                            | 0.3(3)      |             |             |             |             |
| 18pF(180)                                                                                            | 0.3(3)      |             |             |             |             |
| 22pF(220)                                                                                            | 0.3(3)      |             |             |             |             |
| 27pF(270)                                                                                            | 0.3(3)      |             |             |             |             |
| 33pF(330)                                                                                            | 0.3(3)      |             |             |             |             |
| 39pF(390)                                                                                            | 0.3(3)      |             |             |             |             |
| 47pF(470)                                                                                            | 0.3(3)      |             |             |             |             |
| 56pF(560)                                                                                            | 0.3(3)      |             |             |             |             |
| 68pF(680)                                                                                            | 0.3(3)      |             |             |             |             |
| 82pF(820)                                                                                            | 0.3(3)      |             |             |             |             |
| 100pF(101)                                                                                           | 0.3(3)      |             | 0.3(3)      |             |             |
| 150pF(151)                                                                                           |             |             | 0.3(3)      |             |             |
| 220pF(221)                                                                                           |             |             | 0.3(3)      |             |             |
| 330pF(331)                                                                                           |             |             | 0.3(3)      |             |             |
| 470pF(471)                                                                                           |             |             | 0.3(3)      |             |             |
| 680pF(681)                                                                                           |             |             | 0.3(3)      |             |             |

Continued on the following page.

Continued from the preceding page.

| Part Number                                                                                          | GRM03       |             |             |             |             |
|------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|
| L x W                                                                                                | 0.6x0.3     |             |             |             |             |
| TC                                                                                                   | C0G<br>(5C) | X5R<br>(R6) | X7R<br>(R7) |             | Y5V<br>(F5) |
| Rated Volt.                                                                                          | 25<br>(1E)  | 10<br>(1A)  | 16<br>(1C)  | 6.3<br>(0J) | 10<br>(1A)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |             |             |             |             |
| 1000pF(102)                                                                                          |             |             | 0.3(3)      |             |             |
| 1500pF(152)                                                                                          |             | 0.3(3)      |             | 0.3(3)      |             |
| 2200pF(222)                                                                                          |             | 0.3(3)      |             | 0.3(3)      | 0.3(3)      |
| 3300pF(332)                                                                                          |             | 0.3(3)      |             | 0.3(3)      |             |
| 4700pF(472)                                                                                          |             | 0.3(3)      |             | 0.3(3)      | 0.3(3)      |
| 6800pF(682)                                                                                          |             | 0.3(3)      |             | 0.3(3)      |             |
| 10000pF(103)                                                                                         |             | 0.3(3)      |             | 0.3(3)      | 0.3(3)      |

The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

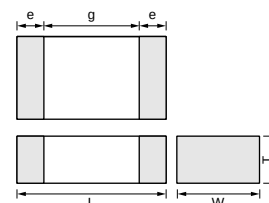
# Chip Monolithic Ceramic Capacitors

**muRata**

## Thin Type (Flow/Reflow)

### ■ Features

1. This series is suited to flow and reflow soldering.  
Capacitor terminations are made of metal highly resistant to migration.
2. Large capacitance values enable excellent bypass effects to be realized.
3. Its thin package makes this series ideally suited for the production of small electronic products and for mounting underneath ICs.



| Part Number | Dimensions (mm) |           |            |            |        |
|-------------|-----------------|-----------|------------|------------|--------|
|             | L               | W         | T          | e          | g min. |
| GRM15X      | 1.0 ±0.05       | 0.5 ±0.05 | 0.25 ±0.05 | 0.1 to 0.3 | 0.4    |

### ■ Applications

Thin equipment such as IC cards

## Temperature Compensating Type

| Part Number       | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------------|---------------------|------------------|---------------|--------------|------------------|
| GRM15X5C1H1R0CDB4 | C0G (EIA)          | 50                  | 1.0 ±0.25pF      | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H2R0CDB4 | C0G (EIA)          | 50                  | 2.0 ±0.25pF      | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H3R0CDB4 | C0G (EIA)          | 50                  | 3.0 ±0.25pF      | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H4R0CDB4 | C0G (EIA)          | 50                  | 4.0 ±0.25pF      | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H5R0CDB4 | C0G (EIA)          | 50                  | 5.0 ±0.25pF      | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H6R0CDB4 | C0G (EIA)          | 50                  | 6.0 ±0.5pF       | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H7R0CDB4 | C0G (EIA)          | 50                  | 7.0 ±0.5pF       | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H8R0CDB4 | C0G (EIA)          | 50                  | 8.0 ±0.5pF       | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H9R0CDB4 | C0G (EIA)          | 50                  | 9.0 ±0.5pF       | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H100JDB4 | C0G (EIA)          | 50                  | 10 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H120JDB4 | C0G (EIA)          | 50                  | 12 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H150JDB4 | C0G (EIA)          | 50                  | 15 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H180JDB4 | C0G (EIA)          | 50                  | 18 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H220JDB4 | C0G (EIA)          | 50                  | 22 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H270JDB4 | C0G (EIA)          | 50                  | 27 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H330JDB4 | C0G (EIA)          | 50                  | 33 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H390JDB4 | C0G (EIA)          | 50                  | 39 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H470JDB4 | C0G (EIA)          | 50                  | 47 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H560JDB4 | C0G (EIA)          | 50                  | 56 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H680JDB4 | C0G (EIA)          | 50                  | 68 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H820JDB4 | C0G (EIA)          | 50                  | 82 ±5%           | 1.00          | 0.50         | 0.25             |
| GRM15X5C1H101JDB4 | C0G (EIA)          | 50                  | 100 ±5%          | 1.00          | 0.50         | 0.25             |
| GRM15X5C1E121JDB4 | C0G (EIA)          | 25                  | 120 ±5%          | 1.00          | 0.50         | 0.25             |
| GRM15X5C1E151JDB4 | C0G (EIA)          | 25                  | 150 ±5%          | 1.00          | 0.50         | 0.25             |
| GRM15X5C1E181JDB4 | C0G (EIA)          | 25                  | 180 ±5%          | 1.00          | 0.50         | 0.25             |
| GRM15X5C1E221JDB4 | C0G (EIA)          | 25                  | 220 ±5%          | 1.00          | 0.50         | 0.25             |

## High Dielectric Constant Type

| Part Number       | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------------|---------------------|------------------|---------------|--------------|------------------|
| GRM15XR71H221KA86 | X7R (EIA)          | 50                  | 220 ±10%         | 1.00          | 0.50         | 0.25             |
| GRM15XR71H331KA86 | X7R (EIA)          | 50                  | 330 ±10%         | 1.00          | 0.50         | 0.25             |
| GRM15XR71H471KA86 | X7R (EIA)          | 50                  | 470 ±10%         | 1.00          | 0.50         | 0.25             |

Continued on the following page.

Continued from the preceding page.

| Part Number              | TC Code<br>(Standard) | Rated Voltage<br>(Vdc) | Capacitance<br>(pF) | Length L<br>(mm) | Width W<br>(mm) | Thickness T<br>(mm) |
|--------------------------|-----------------------|------------------------|---------------------|------------------|-----------------|---------------------|
| <b>GRM15XR71H681KA86</b> | X7R (EIA)             | 50                     | 680 ±10%            | 1.00             | 0.50            | 0.25                |
| <b>GRM15XR71H102KA86</b> | X7R (EIA)             | 50                     | 1000 ±10%           | 1.00             | 0.50            | 0.25                |
| <b>GRM15XR71H152KA86</b> | X7R (EIA)             | 50                     | 1500 ±10%           | 1.00             | 0.50            | 0.25                |
| <b>GRM15XR71E182KA86</b> | X7R (EIA)             | 25                     | 1800 ±10%           | 1.00             | 0.50            | 0.25                |
| <b>GRM15XR71E222KA86</b> | X7R (EIA)             | 25                     | 2200 ±10%           | 1.00             | 0.50            | 0.25                |
| <b>GRM15XR71C332KA86</b> | X7R (EIA)             | 16                     | 3300 ±10%           | 1.00             | 0.50            | 0.25                |
| <b>GRM15XR71C472KA86</b> | X7R (EIA)             | 16                     | 4700 ±10%           | 1.00             | 0.50            | 0.25                |
| <b>GRM15XR71C682KA86</b> | X7R (EIA)             | 16                     | 6800 ±10%           | 1.00             | 0.50            | 0.25                |

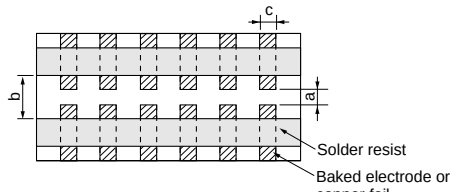
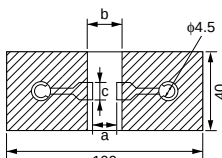
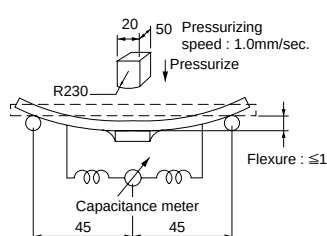
## GRM Series Specifications and Test Methods

| No.                             | Item                                                                        | Specifications                                                            |                                                                                                                                                                                                                                                                                                     | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
|---------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------------|-----------|---------|---------------------------------|------------------------------------------------------------------|----------|--------------|---------------------------------|------------------------------------------|----------|-----------|-----------------------------|--|----------|-----------|-----------------------------|--|----------|-------------|----|--|----------|--------------|
|                                 |                                                                             | Temperature Compensating Type                                             | High Dielectric Type                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 1                               | Operating Temperature                                                       | −55 to +125℃                                                              | R6 : −55 to +85℃<br>R7 : −55 to +125℃<br>E4 : +10 to +85℃<br>F5 : −30 to +85℃                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 2                               | Rated Voltage                                                               | See the previous page.                                                    |                                                                                                                                                                                                                                                                                                     | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, V <sup>P-P</sup> or V <sup>O-P</sup> , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 3                               | Appearance                                                                  | No defects or abnormalities                                               |                                                                                                                                                                                                                                                                                                     | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 4                               | Dimensions                                                                  | Within the specified dimensions                                           |                                                                                                                                                                                                                                                                                                     | Using calipers on micrometer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 5                               | Dielectric Strength                                                         | No defects or abnormalities                                               |                                                                                                                                                                                                                                                                                                     | No failure should be observed when *300% of the rated voltage (C0Δ to U2J and SL) or *250% of the rated voltage (X5R, X7R, Z5U and Y5V) is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA. *200% for 500V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 6                               | Insulation Resistance                                                       | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                     |                                                                                                                                                                                                                                                                                                     | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 2 minutes of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 7                               | Capacitance                                                                 | Within the specified tolerance                                            |                                                                                                                                                                                                                                                                                                     | The capacitance/Q/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 8                               | Q/<br>Dissipation Factor (D.F.)                                             | 30pFmin. : Q≥1000<br>30pFmax. : Q≥400+20C<br>C : Nominal Capacitance (pF) | [R6, R7]<br>W.V. : 25Vmin. : 0.025max.<br>W.V. : 16/10V : 0.035max.<br>W.V. : 6.3V<br>0.05max.(C<3.3μF)<br>0.1max.(C≥3.3μF)<br>[E4]<br>W.V. : 25Vmin. : 0.025max.<br>[F5]<br>W.V. : 25Vmin.<br>0.05max.(C<0.10μF)<br>0.09max.(C≥0.10μF)<br>W.V. : 16V/10V : 0.125max.<br>W.V. : 6.3Vmax. : 0.15max. | <table><tr><th>Item</th><th>Char.</th><th>Frequency</th><th>Voltage</th></tr><tr><td>ΔC to 7U, 1X (1000pF and below)</td><td></td><td>1±0.1MHz</td><td>0.5 to 5Vrms</td></tr><tr><td>ΔC to 7U, 1X (more than 1000pF)</td><td></td><td>1±0.1kHz</td><td>1±0.2Vrms</td></tr><tr><td>R6, R7, F5 (10μF and below)</td><td></td><td>1±0.1kHz</td><td>1±0.2Vrms</td></tr><tr><td>R6, R7, F5 (more than 10μF)</td><td></td><td>120±24Hz</td><td>0.5±0.1Vrms</td></tr><tr><td>E4</td><td></td><td>1±0.1kHz</td><td>0.5±0.05Vrms</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Item      | Char.          | Frequency | Voltage | ΔC to 7U, 1X (1000pF and below) |                                                                  | 1±0.1MHz | 0.5 to 5Vrms | ΔC to 7U, 1X (more than 1000pF) |                                          | 1±0.1kHz | 1±0.2Vrms | R6, R7, F5 (10μF and below) |  | 1±0.1kHz | 1±0.2Vrms | R6, R7, F5 (more than 10μF) |  | 120±24Hz | 0.5±0.1Vrms | E4 |  | 1±0.1kHz | 0.5±0.05Vrms |
|                                 |                                                                             |                                                                           | Item                                                                                                                                                                                                                                                                                                | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Frequency | Voltage        |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| ΔC to 7U, 1X (1000pF and below) |                                                                             | 1±0.1MHz                                                                  | 0.5 to 5Vrms                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| ΔC to 7U, 1X (more than 1000pF) |                                                                             | 1±0.1kHz                                                                  | 1±0.2Vrms                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| R6, R7, F5 (10μF and below)     |                                                                             | 1±0.1kHz                                                                  | 1±0.2Vrms                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| R6, R7, F5 (more than 10μF)     |                                                                             | 120±24Hz                                                                  | 0.5±0.1Vrms                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| E4                              |                                                                             | 1±0.1kHz                                                                  | 0.5±0.05Vrms                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 9                               | Capacitance Temperature Characteristics                                     | Capacitance Change                                                        | Within the specified tolerance (Table A)<br><br>R6 : Within±15% (−55 to +85℃)<br>R7 : Within±15% (−55 to +125℃)<br>E4 : Within +22/−56% (+10 to +85℃)<br>F5 : Within +22/−82% (−30 to +85℃)                                                                                                         | The capacitance change should be measured after 5 min. at each specified temperature stage.<br>(1) Temperature Compensating Type<br>The temperature coefficient is determined using the Capacitance measured in step 3 as a reference.<br>When cycling the temperature sequentially from step 1 through 5 (C0Δ : +25℃ to +125℃ : other temp. coeffs. : +25℃ to +85℃) the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A.<br>The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.<br><table><tr><th>Step</th><th>Temperature(℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>−55±3 (for ΔC to 7U/1X/R6/R7)<br/>−30±3 (for F5)<br/>10±3 (for E4)</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3 (for ΔC/R7)<br/>85±3 (for other TC)</td></tr><tr><td>5</td><td>25±2</td></tr></table> | Step      | Temperature(℃) | 1         | 25±2    | 2                               | −55±3 (for ΔC to 7U/1X/R6/R7)<br>−30±3 (for F5)<br>10±3 (for E4) | 3        | 25±2         | 4                               | 125±3 (for ΔC/R7)<br>85±3 (for other TC) | 5        | 25±2      |                             |  |          |           |                             |  |          |             |    |  |          |              |
|                                 |                                                                             | Step                                                                      | Temperature(℃)                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
|                                 |                                                                             | 1                                                                         | 25±2                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 2                               | −55±3 (for ΔC to 7U/1X/R6/R7)<br>−30±3 (for F5)<br>10±3 (for E4)            |                                                                           |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 3                               | 25±2                                                                        |                                                                           |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 4                               | 125±3 (for ΔC/R7)<br>85±3 (for other TC)                                    |                                                                           |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| 5                               | 25±2                                                                        |                                                                           |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| Temperature Coefficient         | Within the specified tolerance (Table A)                                    | —                                                                         |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
| Capacitance Drift               | Within ±0.2% or ±0.05pF (Whichever is larger.)<br>*Does not apply to 1X/25V | —                                                                         |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |
|                                 |                                                                             |                                                                           |                                                                                                                                                                                                                                                                                                     | (2) High Dielectric Constant Type<br>The ranges of capacitance change compared with the above 25℃ value over the temperature ranges shown in the table should be within the specified ranges.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |                |           |         |                                 |                                                                  |          |              |                                 |                                          |          |           |                             |  |          |           |                             |  |          |             |    |  |          |              |

Continued on the following page. 

## GRM Series Specifications and Test Methods

Continued from the preceding page.

| No.   | Item                             | Specifications                                                            |                                                                                                                                                                                                                                                                                                                                     | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
|-------|----------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---|---|---|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|------|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|
|       |                                  | Temperature Compensating Type                                             | High Dielectric Type                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 10    | Adhesive Strength of Termination | No removal of the terminations or other defect should occur.              |                                                                                                                                                                                                                                                                                                                                     | <p>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1sec. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock. *2N (GR□03) 5N (GR□15, GRM18)</p> <div><table><thead><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr></thead><tbody><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></tbody></table><p>(in mm)</p><p>Fig. 1</p></div>                                                                      | Type | a | b | c | GR□03 | 0.3 | 0.9 | 0.3 | GR□15 | 0.4 | 1.5 | 0.5 | GRM18 | 1.0 | 3.0 | 1.2 | GRM21 | 1.2 | 4.0 | 1.65 | GRM31 | 2.2 | 5.0 | 2.0 | GRM32 | 2.2 | 5.0 | 2.9 | GRM43 | 3.5 | 7.0 | 3.7 | GRM55 | 4.5 | 8.0 | 5.6 |
|       |                                  | Type                                                                      | a                                                                                                                                                                                                                                                                                                                                   | b                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | c    |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GR□03 | 0.3                              | 0.9                                                                       | 0.3                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GR□15 | 0.4                              | 1.5                                                                       | 0.5                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM18 | 1.0                              | 3.0                                                                       | 1.2                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM21 | 1.2                              | 4.0                                                                       | 1.65                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM31 | 2.2                              | 5.0                                                                       | 2.0                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM32 | 2.2                              | 5.0                                                                       | 2.9                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM43 | 3.5                              | 7.0                                                                       | 3.7                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM55 | 4.5                              | 8.0                                                                       | 5.6                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 11    | Vibration Resistance             | Appearance                                                                | No defects or abnormalities                                                                                                                                                                                                                                                                                                         | <p>Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10). The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
|       |                                  | Capacitance                                                               | Within the specified tolerance                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 11    | Q/D.F.                           | 30pFmin. : Q≥1000<br>30pFmax. : Q≥400+20C<br>C : Nominal Capacitance (pF) | <p>[R6, R7]<br/>W.V. : 25Vmin. : 0.025max.<br/>W.V. : 16/10V : 0.035max.<br/>W.V. : 6.3V : 0.05max. (C&lt;3.3μF)<br/>0.1max. (C≥3.3μF)</p> <p>[E4]<br/>W.V. : 25Vmin. : 0.025max.</p> <p>[F5]<br/>W.V. : 25Vmin. : 0.05max. (C&lt;0.10μF)<br/>0.09max. (C≥0.10μF)<br/>W.V. : 16V/10V : 0.125max.<br/>W.V. : 6.3Vmax. : 0.15max.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
|       |                                  | No crack or marked defect should occur.                                   |                                                                                                                                                                                                                                                                                                                                     | <p>Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p> <div><table><thead><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr></thead><tbody><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></tbody></table><p>(in mm)</p><p>Fig. 2</p></div> <div><p>Fig. 3</p></div> | Type | a | b | c | GR□03 | 0.3 | 0.9 | 0.3 | GR□15 | 0.4 | 1.5 | 0.5 | GRM18 | 1.0 | 3.0 | 1.2 | GRM21 | 1.2 | 4.0 | 1.65 | GRM31 | 2.2 | 5.0 | 2.0 | GRM32 | 2.2 | 5.0 | 2.9 | GRM43 | 3.5 | 7.0 | 3.7 | GRM55 | 4.5 | 8.0 | 5.6 |
| Type  | a                                | b                                                                         | c                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GR□03 | 0.3                              | 0.9                                                                       | 0.3                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GR□15 | 0.4                              | 1.5                                                                       | 0.5                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM18 | 1.0                              | 3.0                                                                       | 1.2                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM21 | 1.2                              | 4.0                                                                       | 1.65                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM31 | 2.2                              | 5.0                                                                       | 2.0                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM32 | 2.2                              | 5.0                                                                       | 2.9                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM43 | 3.5                              | 7.0                                                                       | 3.7                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM55 | 4.5                              | 8.0                                                                       | 5.6                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |

Continued on the following page.

## GRM Series Specifications and Test Methods

Continued from the preceding page.

| No.         | Item                         | Specifications                                                      |                                                                                                     | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|-------------|------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|------|---|----------------|------------|---------------------------|----------------|---------------------------|------------|-------------|------|--------|------|--------|
|             |                              | Temperature Compensating Type                                       | High Dielectric Type                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
| 13          | Solderability of Termination | 75% of the terminations are to be soldered evenly and continuously. |                                                                                                     | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C.                                                                                                                                                                                                                                                                              |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
| 14          | Resistance to Soldering Heat |                                                                     | The measured and observed characteristics should satisfy the specifications in the following table. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | Appearance                                                          | No marking defects                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | Capacitance Change                                                  | Within ±2.5% or ±0.25pF (Whichever is larger)                                                       | R6, R7 : Within ±7.5%<br>E4, F5 : Within ±20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | Q/D.F.                                                              | 30pFmin. : Q≥1000<br>30pFmax. : Q≥400+20C<br>C : Nominal Capacitance (pF)                           | [R6, R7]<br>W.V. : 25Vmin. : 0.025max.<br>W.V. : 16/10V : 0.035max.<br>W.V. : 6.3V : 0.05max. (C<3.3μF)<br>0.1max. (C≥3.3μF)<br>[E4]<br>W.V. : 25Vmin. : 0.025max.<br>[F5]<br>W.V. : 25Vmin. : 0.05max. (C<0.10μF)<br>0.09max. (C≥0.10μF)<br>W.V. : 16V/10V : 0.125max.<br>W.V. : 6.3Vmax. : 0.15max.                                                                                                                                                                                                                              |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | I.R.                                                                | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | Dielectric Strength                                                 | No failure                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
| 15          | Temperature Cycle            |                                                                     | The measured and observed characteristics should satisfy the specifications in the following table. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | Appearance                                                          | No marking defects                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | Capacitance Change                                                  | Within ±2.5% or ±0.25pF (Whichever is larger)                                                       | R6, R7 : Within ±7.5%<br>E4, F5 : Within ±20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | Q/D.F.                                                              | 30pFmin. : Q≥1000<br>30pFmax. : Q≥400+20C<br>C : Nominal Capacitance (pF)                           | [R6, R7]<br>W.V. : 25Vmin. : 0.025max.<br>W.V. : 16/10V : 0.035max.<br>W.V. : 6.3V : 0.05max. (C<3.3μF)<br>0.1max. (C≥3.3μF)<br>[E4]<br>W.V. : 25Vmin. : 0.025max.<br>[F5]<br>W.V. : 25Vmin. : 0.05max. (C<0.10μF)<br>0.09max. (C≥0.10μF)<br>W.V. : 16V/10V : 0.125max.<br>W.V. : 6.3Vmax. : 0.15max.                                                                                                                                                                                                                              |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | I.R.                                                                | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              | Dielectric Strength                                                 | No failure                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              |                                                                     |                                                                                                     | Preheat the capacitor at 120 to 150°C for 1 minute.<br>Immerse the capacitor in a eutectic solder solution at 270±5°C for 10±0.5 seconds. Let sit at room temperature for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type), then measure.<br><br>•Initial measurement for high dielectric constant type<br>Perform a heat treatment at 150 ±1.8°C for one hour and then let sit for 48±4 hours at room temperature.<br>Perform the initial measurement.<br><br>*Preheating for GRM32/43/55 |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              |                                                                     |                                                                                                     | <table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100°C to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170°C to 200°C</td><td>1 min.</td></tr></table>                                                                                                                                                                                                                                                                                                                                           | Step | Temperature | Time | 1 | 100°C to 120°C | 1 min.     | 2                         | 170°C to 200°C | 1 min.                    |            |             |      |        |      |        |
| Step        | Temperature                  | Time                                                                |                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
| 1           | 100°C to 120°C               | 1 min.                                                              |                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
| 2           | 170°C to 200°C               | 1 min.                                                              |                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              |                                                                     |                                                                                                     | Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours (temperature compensating type) or 48±4 hour (high dielectric constant type) at room temperature, then measure.                                                                                                                                                                                              |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              |                                                                     |                                                                                                     | <table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (°C)</td><td>Min. Operating Temp.+0/−3</td><td>Room Temp.</td><td>Max. Operating Temp.+3/−0</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>                                                                                                                                                                                                                           | Step | 1           | 2    | 3 | 4              | Temp. (°C) | Min. Operating Temp.+0/−3 | Room Temp.     | Max. Operating Temp.+3/−0 | Room Temp. | Time (min.) | 30±3 | 2 to 3 | 30±3 | 2 to 3 |
| Step        | 1                            | 2                                                                   | 3                                                                                                   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
| Temp. (°C)  | Min. Operating Temp.+0/−3    | Room Temp.                                                          | Max. Operating Temp.+3/−0                                                                           | Room Temp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
| Time (min.) | 30±3                         | 2 to 3                                                              | 30±3                                                                                                | 2 to 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |
|             |                              |                                                                     |                                                                                                     | •Initial measurement for high dielectric constant type<br>Perform a heat treatment at 150 ±1.8°C for one hour and then let sit for 48±4 hours at room temperature.<br>Perform the initial measurement.                                                                                                                                                                                                                                                                                                                             |      |             |      |   |                |            |                           |                |                           |            |             |      |        |      |        |

Continued on the following page. ➤

## GRM Series Specifications and Test Methods

Continued from the preceding page.

| No. | Item                  | Specifications                                                                                      |                                                                                                                                            | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----|-----------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     |                       | Temperature Compensating Type                                                                       | High Dielectric Type                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 16  | Humidity Steady State | The measured and observed characteristics should satisfy the specifications in the following table. |                                                                                                                                            | Let the capacitor sit at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.                                                                                                                                                                                                                                       |
|     |                       | Appearance                                                                                          | No marking defects                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|     |                       | Capacitance Change                                                                                  | Within ±5% or ±0.5pF (Whichever is larger)                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|     |                       | Q/D.F.                                                                                              | 30pF and over : $Q \geq 350$<br>10pF and over : $Q \geq 275 + 5C/2$<br>30pF and below : $Q \geq 200 + 10C$<br>C : Nominal Capacitance (pF) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|     |                       | I.R.                                                                                                | More than 1,000MΩ or 50Ω • F (Whichever is smaller)                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|     |                       | Dielectric Strength                                                                                 | No failure                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 17  | Humidity Load         | The measured and observed characteristics should satisfy the specifications in the following table. |                                                                                                                                            | Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.<br><br>•Initial measurement for F5/10V max.<br>Apply the rated DC voltage for 1 hour at 40±2°C. Remove and let sit for 48±4 hours at room temperature. Perform initial measurement. |
|     |                       | Appearance                                                                                          | No marking defects                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|     |                       | Capacitance Change                                                                                  | Within ±7.5% or ±0.75pF (Whichever is larger)                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|     |                       | Q/D.F.                                                                                              | 30pF and over : $Q \geq 200$<br>30pF and below : $Q \geq 100 + 10C/3$<br>C : Nominal Capacitance (pF)                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|     |                       | I.R.                                                                                                | More than 500MΩ or 25Ω • F (Whichever is smaller)                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|     |                       | Dielectric Strength                                                                                 | No failure                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

Continued on the following page. ➤

## GRM Series Specifications and Test Methods

Continued from the preceding page.

| No. | Item                  | Specifications                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----|-----------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     |                       | Temperature Compensating Type                                                                       | High Dielectric Type                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 18  | High Temperature Load | The measured and observed characteristics should satisfy the specifications in the following table. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.</p> <p>•Initial measurement for high dielectric constant type. Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3°C. Remove and let sit for 48±4 hours at room temperature. Perform initial measurement.</p> <p>*150% for 500V and C≥10μF</p> |
|     |                       | Appearance                                                                                          | No marking defects                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|     |                       | Capacitance Change                                                                                  | <p>Within ±3% or ±0.3pF (Whichever is larger)</p> <p>R6, R7 : Within ±12.5%<br/>E4 : Within ±30%<br/>F5 : Within ±30% (Cap&lt;1.0μF)<br/>F5 : Within +30/-40% (Cap≥1.0μF)</p>                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|     |                       | Q/D.F.                                                                                              | <p>30pF and over : Q≥350<br/>10pF and over<br/>30pF and below : Q≥275+5C/2<br/>10pF and below : Q≥200+10C<br/>C : Nominal Capacitance (pF)</p> <p>[R6, R7]<br/>W.V. : 25Vmin. : 0.05max.<br/>W.V. : 16/10V : 0.05max.<br/>W.V. : 6.3V : 0.075max. (C&lt;3.3μF)<br/>0.125max. (C≥3.3μF)<br/>[E4]<br/>W.V. : 25Vmin. : 0.05max<br/>[F5]<br/>W.V. : 25Vmin. : 0.075max. (C&lt;0.10μF)<br/>0.125max. (C≥0.10μF)<br/>W.V. : 16V/10V : 0.15max.<br/>W.V. : 6.3Vmax. : 0.2max.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|     |                       | I.R.                                                                                                | More than 1,000MΩ or 50Ω•F (Whichever is smaller)                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|     |                       | Dielectric Strength                                                                                 | No failure                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

Table A

| Char. Code | Nominal Values (ppm/°C)* | Capacitance Change from 25°C (%) |       |      |       |      |       |
|------------|--------------------------|----------------------------------|-------|------|-------|------|-------|
|            |                          | -55                              |       | -30  |       | -10  |       |
|            |                          | Max.                             | Min.  | Max. | Min.  | Max. | Min.  |
| 5C         | 0 ± 30                   | 0.58                             | -0.24 | 0.40 | -0.17 | 0.25 | -0.11 |
| 6C         | 0 ± 60                   | 0.87                             | -0.48 | 0.59 | -0.33 | 0.38 | -0.21 |
| 6P         | -150 ± 60                | 2.33                             | 0.72  | 1.61 | 0.50  | 1.02 | 0.32  |
| 6R         | -220 ± 60                | 3.02                             | 1.28  | 2.08 | 0.88  | 1.32 | 0.56  |
| 6S         | -330 ± 60                | 4.09                             | 2.16  | 2.81 | 1.49  | 1.79 | 0.95  |
| 6T         | -470 ± 60                | 5.46                             | 3.28  | 3.75 | 2.26  | 2.39 | 1.44  |
| 7U         | -750 ±120                | 8.78                             | 5.04  | 6.04 | 3.47  | 3.84 | 2.21  |
| 1X         | +350 to -1000            | —                                | —     | —    | —     | —    | —     |

\*Nominal values denote the temperature coefficient within a range of 25°C to 125°C (for ΔC)/85°C (for other TC).

# Chip Monolithic Ceramic Capacitors



## Thin Layer Large-capacitance Type

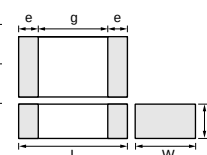
### ■ Features

1. Smaller size and higher capacitance value.
2. High reliability and no polarity.
3. Excellent pulse responsibility and noise reduction due to the low impedance at high frequency.

### ■ Applications

General electronic equipment

| Part Number | Dimensions (mm) |           |           |             |        |
|-------------|-----------------|-----------|-----------|-------------|--------|
|             | L               | W         | T         | e min.      | g min. |
| GRM033      | 0.6 ±0.03       | 0.3 ±0.03 | 0.3 ±0.03 | 0.1 to 0.2  | 0.2    |
| GRM155      | 1.0 ±0.05       | 0.5 ±0.05 | 0.5 ±0.05 | 0.15 to 0.3 | 0.4    |
| GRM185      | 1.6 ±0.1        | 0.8 ±0.1  | 0.5 ±0.05 | 0.2 to 0.5  | 0.5    |
| GRM188      | 1.6 ±0.1        | 0.8 ±0.1  | 0.8 ±0.1  | 0.2 to 0.5  | 0.5    |
| GRM216      |                 |           | 0.6 ±0.1  |             |        |
| GRM219      | 2.0 ±0.1        | 1.25 ±0.1 | 0.85 ±0.1 | 0.2 to 0.7  | 0.7    |
| GRM21B      |                 |           | 1.25 ±0.1 |             |        |
| GRM316      |                 |           | 0.6 ±0.1  |             |        |
| GRM319      | 3.2 ±0.15       | 1.6 ±0.15 | 0.85 ±0.1 | 0.3 to 0.8  | 1.5    |
| GRM31M      |                 |           | 1.6 ±0.2  |             |        |
| GRM31C      | 3.2 ±0.2        | 1.6 ±0.2  | 1.15 ±0.1 | 0.3 to 0.8  | 1.5    |
| GRM32D      |                 |           | 2.0 ±0.2  |             |        |
| GRM32E      | 3.2 ±0.3        | 2.5 ±0.2  | 2.5 ±0.2  | 0.3         | 1.0    |
| GRM43D      |                 |           | 2.0 ±0.2  |             |        |
| GRM43E      | 4.5 ±0.4        | 3.2 ±0.3  | 2.5 ±0.2  | 0.3         | 2.0    |
| GRM43S      |                 |           | 2.8 ±0.2  |             |        |
| GRM55F      | 5.7 ±0.4        | 5.0 ±0.4  | 3.2 ±0.2  | 0.3         | 2.0    |



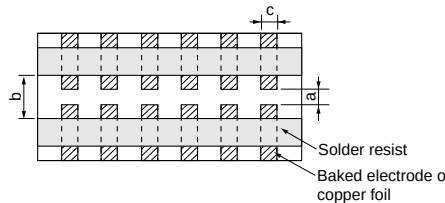
| Part Number       | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance  | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------------|---------------------|--------------|---------------|--------------|------------------|
| GRM188R61C105KE93 | X5R (EIA)          | 16                  | 1.0μF ±10%   | 1.60          | 0.80         | 0.80             |
| GRM219R61C225KA88 | X5R (EIA)          | 16                  | 2.2μF ±10%   | 2.00          | 1.25         | 0.85             |
| GRM319R61C475KA88 | X5R (EIA)          | 16                  | 4.7μF ±10%   | 3.20          | 1.60         | 0.85             |
| GRM32ER61C226KE20 | X5R (EIA)          | 16                  | 22μF ±10%    | 3.20          | 2.50         | 2.50             |
| GRM185R61A105KE36 | X5R (EIA)          | 10                  | 1.0μF ±10%   | 1.60          | 0.80         | 0.50             |
| GRM155R61A154KE19 | X5R (EIA)          | 10                  | 1.5μF ±10%   | 1.00          | 0.50         | 0.50             |
| GRM155R61A224KE19 | X5R (EIA)          | 10                  | 2.2μF ±10%   | 1.00          | 0.50         | 0.50             |
| GRM188R61A225KE34 | X5R (EIA)          | 10                  | 2.2μF ±10%   | 1.60          | 0.80         | 0.80             |
| GRM188R61A225ME34 | X5R (EIA)          | 10                  | 2.2μF ±10%   | 1.60          | 0.80         | 0.80             |
| GRM216R61A225KE24 | X5R (EIA)          | 10                  | 2.2μF ±10%   | 2.00          | 1.25         | 0.60             |
| GRM219R61A225KA01 | X5R (EIA)          | 10                  | 2.2μF ±10%   | 2.00          | 1.25         | 0.85             |
| GRM219R61A335KE19 | X5R (EIA)          | 10                  | 3.3μF ±10%   | 2.00          | 1.25         | 0.85             |
| GRM316R61A335KE19 | X5R (EIA)          | 10                  | 3.3μF ±10%   | 3.20          | 1.60         | 0.60             |
| GRM219R61A475KE19 | X5R (EIA)          | 10                  | 4.7μF ±10%   | 2.00          | 1.25         | 0.85             |
| GRM219R61A475KE34 | X5R (EIA)          | 10                  | 4.7μF ±10%   | 2.00          | 1.25         | 0.85             |
| GRM316R61A475KE19 | X5R (EIA)          | 10                  | 4.7μF ±10%   | 3.20          | 1.60         | 0.60             |
| GRM319R61A475KA01 | X5R (EIA)          | 10                  | 4.7μF ±10%   | 3.20          | 1.60         | 0.85             |
| GRM31MR61A106KE19 | X5R (EIA)          | 10                  | 10μF ±10%    | 3.20          | 1.60         | 1.15             |
| GRM033R60J153KE01 | X5R (EIA)          | 6.3                 | 15000pF ±10% | 0.6           | 0.3          | 0.3              |
| GRM033R60J223KE01 | X5R (EIA)          | 6.3                 | 22000pF ±10% | 0.6           | 0.3          | 0.3              |
| GRM033R60J333KE01 | X5R (EIA)          | 6.3                 | 33000pF ±10% | 0.6           | 0.3          | 0.3              |
| GRM033R60J393KE19 | X5R (EIA)          | 6.3                 | 39000pF ±10% | 0.6           | 0.3          | 0.3              |
| GRM033R60J473KE19 | X5R (EIA)          | 6.3                 | 47000pF ±10% | 0.6           | 0.3          | 0.3              |
| GRM033R60J104KE19 | X5R (EIA)          | 6.3                 | 0.10μF ±10%  | 0.6           | 0.3          | 0.3              |
| GRM155R60J154KE01 | X5R (EIA)          | 6.3                 | 0.15μF ±10%  | 1.00          | 0.50         | 0.50             |
| GRM155R60J224KE01 | X5R (EIA)          | 6.3                 | 0.22μF ±10%  | 1.00          | 0.50         | 0.50             |
| GRM155R60J334KE01 | X5R (EIA)          | 6.3                 | 0.33μF ±10%  | 1.00          | 0.50         | 0.50             |
| GRM155R60J474KE19 | X5R (EIA)          | 6.3                 | 0.47μF ±10%  | 1.00          | 0.50         | 0.50             |
| GRM155R60J105KE19 | X5R (EIA)          | 6.3                 | 1.0μF ±10%   | 1.00          | 0.50         | 0.50             |
| GRM185R60J105KE21 | X5R (EIA)          | 6.3                 | 1.0μF ±10%   | 1.60          | 0.80         | 0.50             |
| GRM185R60J105KE26 | X5R (EIA)          | 6.3                 | 1.0μF ±10%   | 1.60          | 0.80         | 0.50             |
| GRM185R60J225KE26 | X5R (EIA)          | 6.3                 | 2.2μF ±10%   | 1.60          | 0.80         | 0.50             |
| GRM188R60J225KE01 | X5R (EIA)          | 6.3                 | 2.2μF ±10%   | 1.60          | 0.80         | 0.80             |
| GRM188R60J225KE19 | X5R (EIA)          | 6.3                 | 2.2μF ±10%   | 1.60          | 0.80         | 0.80             |
| GRM188R60J475KE19 | X5R (EIA)          | 6.3                 | 4.7μF ±10%   | 1.60          | 0.80         | 0.80             |
| GRM219R60J475KE01 | X5R (EIA)          | 6.3                 | 4.7μF ±10%   | 2.00          | 1.25         | 0.85             |
| GRM219R60J106KE19 | X5R (EIA)          | 6.3                 | 10μF ±10%    | 2.00          | 1.25         | 0.85             |
| GRM219R60J106ME19 | X5R (EIA)          | 6.3                 | 10μF ±20%    | 2.00          | 1.25         | 0.85             |

Continued on the following page.

Continued from the preceding page.

| Part Number       | TC Code<br>(Standard) | Rated Voltage<br>(Vdc) | Capacitance    | Length L<br>(mm) | Width W<br>(mm) | Thickness T<br>(mm) |
|-------------------|-----------------------|------------------------|----------------|------------------|-----------------|---------------------|
| GRM21BR60J106KE01 | X5R (EIA)             | 6.3                    | 10μF ±10%      | 2.00             | 1.25            | 1.25                |
| GRM21BR60J106KE19 | X5R (EIA)             | 6.3                    | 10μF ±10%      | 2.00             | 1.25            | 1.25                |
| GRM21BR60J106ME01 | X5R (EIA)             | 6.3                    | 10μF ±20%      | 2.00             | 1.25            | 1.25                |
| GRM21BR60J106ME19 | X5R (EIA)             | 6.3                    | 10μF +10/-20%  | 2.00             | 1.25            | 1.25                |
| GRM21BR60J226ME39 | X5R (EIA)             | 6.3                    | 22μF ±20%      | 2.00             | 1.25            | 1.25                |
| GRM31CR60J226ME19 | X5R (EIA)             | 6.3                    | 22μF ±20%      | 3.20             | 1.60            | 1.60                |
| GRM32DR60J226KA01 | X5R (EIA)             | 6.3                    | 22μF ±10%      | 3.20             | 2.50            | 2.00                |
| GRM32DR60J336ME19 | X5R (EIA)             | 6.3                    | 33μF ±10%      | 3.20             | 2.50            | 2.00                |
| GRM32ER60J476ME20 | X5R (EIA)             | 6.3                    | 47μF ±20%      | 3.20             | 2.50            | 2.50                |
| GRM32ER60J107ME20 | X5R (EIA)             | 6.3                    | 100μF ±20%     | 3.20             | 2.50            | 2.50                |
| GRM43SR60J107ME20 | X5R (EIA)             | 6.3                    | 100μF ±20%     | 4.50             | 3.20            | 2.80                |
| GRM32ER71A226KE20 | X7R (EIA)             | 10                     | 22μF ±10%      | 3.20             | 2.50            | 2.50                |
| GRM32ER71A226ME20 | X7R (EIA)             | 10                     | 22μF ±20%      | 3.20             | 2.50            | 2.50                |
| GRM188F51A225ZE01 | Y5V (EIA)             | 10                     | 2.2μF +80/-20% | 1.60             | 0.80            | 0.80                |
| GRM188F50J225ZE01 | Y5V (EIA)             | 6.3                    | 2.2μF +80/-20% | 1.60             | 0.80            | 0.80                |
| GRM21BF50J106ZE01 | Y5V (EIA)             | 6.3                    | 10μF +80/-20%  | 2.00             | 1.25            | 1.25                |

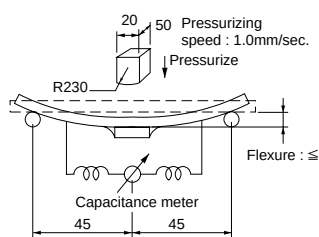
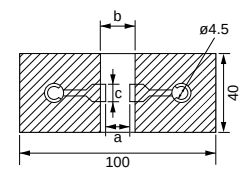
## Specifications and Test Methods

| No.                             | Item                                    | Specifications                                                                                                                                                                                                                                                                                                                                                                                           | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
|---------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------|-------------|---------------------------------|-------------|---------------------------|--------------------|----------|--------------|--------|------------|-------------|--------------------|----------------|----------------|----------------|--------------|-----|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|
| 1                               | Operating Temperature Range             | R6 : -55℃ to +85℃<br>R7 : -55℃ to +125℃<br>F5 : -30℃ to +85℃<br>C8 : -55℃ to +105℃                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 2                               | Rated Voltage                           | See the previous pages.                                                                                                                                                                                                                                                                                                                                                                                  | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, V <sup>p-p</sup> or V <sup>o-p</sup> , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 3                               | Appearance                              | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                              | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 4                               | Dimensions                              | Within the specified dimension                                                                                                                                                                                                                                                                                                                                                                           | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 5                               | Dielectric Strength                     | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                              | No failure should be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 6                               | Insulation Resistance                   | 50Ω • F min.                                                                                                                                                                                                                                                                                                                                                                                             | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 1 minute of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 7                               | Capacitance                             | Within the specified tolerance                                                                                                                                                                                                                                                                                                                                                                           | The capacitance/D.F. should be measured at 25℃ at the frequency and voltage shown in the table. <table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>C≤10μF (10V min.)*<sup>1</sup></td><td>1±0.1kHz</td><td>1.0±0.2Vrms*<sup>1</sup></td></tr><tr><td>C≤10μF (6.3V max.)</td><td>1±0.1kHz</td><td>0.5±0.1Vrms</td></tr><tr><td>C&gt;10μF</td><td>120±24Hz</td><td>0.5±0.1Vrms</td></tr></table> <p>*<sup>1</sup> Table 1 items are applied to 0.5+/-0.1Vrms.</p> <p>Table 1</p> <table><tr><td>GRM155R61A124~224K</td></tr><tr><td>GRM185R61A105K</td></tr><tr><td>GRM188R61A225K</td></tr><tr><td>GRM219R61A475K</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Capacitance | Frequency       | Voltage     | C≤10μF (10V min.)* <sup>1</sup> | 1±0.1kHz    | 1.0±0.2Vrms* <sup>1</sup> | C≤10μF (6.3V max.) | 1±0.1kHz | 0.5±0.1Vrms  | C>10μF | 120±24Hz   | 0.5±0.1Vrms | GRM155R61A124~224K | GRM185R61A105K | GRM188R61A225K | GRM219R61A475K |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| Capacitance                     | Frequency                               | Voltage                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| C≤10μF (10V min.)* <sup>1</sup> | 1±0.1kHz                                | 1.0±0.2Vrms* <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| C≤10μF (6.3V max.)              | 1±0.1kHz                                | 0.5±0.1Vrms                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| C>10μF                          | 120±24Hz                                | 0.5±0.1Vrms                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM155R61A124~224K              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM185R61A105K                  |                                         |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM188R61A225K                  |                                         |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM219R61A475K                  |                                         |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 8                               | Dissipation Factor (D.F.)               | R6 / R7 / C8 : 0.1 max.<br>F5 : 0.2 max.                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 9                               | Capacitance Temperature Characteristics | <table><tr><th>Char.</th><th>Temp. Range</th><th>Reference Temp.</th><th>Cap. Change</th></tr><tr><td>R6</td><td>-55 to +85℃</td><td>25℃</td><td>Within±15%</td></tr><tr><td>R7</td><td>-55 to +125℃</td><td>25℃</td><td>Within±15%</td></tr><tr><td>F5</td><td>-30 to +85℃</td><td>25℃</td><td>Within+22/-82%</td></tr><tr><td>C8</td><td>-55 to +105℃</td><td>25℃</td><td>Within±22%</td></tr></table> | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Temp. Range | Reference Temp. | Cap. Change | R6                              | -55 to +85℃ | 25℃                       | Within±15%         | R7       | -55 to +125℃ | 25℃    | Within±15% | F5          | -30 to +85℃        | 25℃            | Within+22/-82% | C8             | -55 to +105℃ | 25℃ | Within±22% | The capacitance change should be measured after 5 min. at each specified temperature stage.<br>The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table should be within the specified ranges.<br>Measuring Voltage : GRM43 R6 0J/1A 336/476 : 1.0+/-0.2Vrms |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| Char.                           | Temp. Range                             | Reference Temp.                                                                                                                                                                                                                                                                                                                                                                                          | Cap. Change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| R6                              | -55 to +85℃                             | 25℃                                                                                                                                                                                                                                                                                                                                                                                                      | Within±15%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| R7                              | -55 to +125℃                            | 25℃                                                                                                                                                                                                                                                                                                                                                                                                      | Within±15%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| F5                              | -30 to +85℃                             | 25℃                                                                                                                                                                                                                                                                                                                                                                                                      | Within+22/-82%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| C8                              | -55 to +105℃                            | 25℃                                                                                                                                                                                                                                                                                                                                                                                                      | Within±22%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| 10                              | Adhesive Strength of Termination        | No removal of the terminations or other defects should occur.                                                                                                                                                                                                                                                                                                                                            | Solder the capacitor to the test jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply * <sup>2</sup> 10N force in parallel with the test jig for 10±1 sec. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br><br>* <sup>2</sup> 5N (GR□15, GRM18) / 2N (GR□03)<br><br> <table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table> <p>(in mm)</p> <p>Fig.1</p> | Type        | a               | b           | c                               | GR□03       | 0.3                       | 0.9                | 0.3      | GR□15        | 0.4    | 1.5        | 0.5         | GRM18              | 1.0            | 3.0            | 1.2            | GRM21        | 1.2 | 4.0        | 1.65                                                                                                                                                                                                                                                                                                            | GRM31 | 2.2 | 5.0 | 2.0 | GRM32 | 2.2 | 5.0 | 2.9 | GRM43 | 3.5 | 7.0 | 3.7 | GRM55 | 4.5 | 8.0 | 5.6 |
| Type                            | a                                       | b                                                                                                                                                                                                                                                                                                                                                                                                        | c                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GR□03                           | 0.3                                     | 0.9                                                                                                                                                                                                                                                                                                                                                                                                      | 0.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GR□15                           | 0.4                                     | 1.5                                                                                                                                                                                                                                                                                                                                                                                                      | 0.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM18                           | 1.0                                     | 3.0                                                                                                                                                                                                                                                                                                                                                                                                      | 1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM21                           | 1.2                                     | 4.0                                                                                                                                                                                                                                                                                                                                                                                                      | 1.65                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM31                           | 2.2                                     | 5.0                                                                                                                                                                                                                                                                                                                                                                                                      | 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM32                           | 2.2                                     | 5.0                                                                                                                                                                                                                                                                                                                                                                                                      | 2.9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM43                           | 3.5                                     | 7.0                                                                                                                                                                                                                                                                                                                                                                                                      | 3.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |
| GRM55                           | 4.5                                     | 8.0                                                                                                                                                                                                                                                                                                                                                                                                      | 5.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                 |             |                                 |             |                           |                    |          |              |        |            |             |                    |                |                |                |              |     |            |                                                                                                                                                                                                                                                                                                                 |       |     |     |     |       |     |     |     |       |     |     |     |       |     |     |     |

Continued on the following page. 

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                     |                                                                                                           | Specifications                                                     | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|---------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------|---|---|----------|---------------------------|------------|---------------------------|------------|------------|------|--------|-------|--------|-----|-----|-------|-----|-----|------|-------|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|-----|-------|
| 11                  | Vibration                                | Appearance                                                                                                | No defects or abnormalities                                        | Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10).The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | Capacitance                                                                                               | Within the specified tolerance                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | D.F.                                                                                                      | R6 / R7 / C8 : 0.1 max.<br>F5 : 0.2 max.                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| 12                  | Deflection                               | No cracking or marking defects should occur.                                                              |                                                                    | Solder the capacitor to the test jig (glass epoxy board) shown in Fig.2 using a eutectic solder. Then apply a force in the direction shown in Fig.3. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | <div></div> <p>Fig.3</p> |                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <div></div> <p>t : 1.6mm<br/>(GR□03, GR□15 : t : 0.8mm)</p> <table><thead><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr></thead><tbody><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></tbody></table> <p>(in mm)</p> <p>Fig.2</p> | Type                      | a          | b | c | GR□03    | 0.3                       | 0.9        | 0.3                       | GR□15      | 0.4        | 1.5  | 0.5    | GRM18 | 1.0    | 3.0 | 1.2 | GRM21 | 1.2 | 4.0 | 1.65 | GRM31 | 2.2 | 5.0 | 2.0 | GRM32 | 2.2 | 5.0 | 2.9 | GRM43 | 3.5 | 7.0 | 3.7 | GRM55 |
| Type                | a                                        | b                                                                                                         | c                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| GR□03               | 0.3                                      | 0.9                                                                                                       | 0.3                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| GR□15               | 0.4                                      | 1.5                                                                                                       | 0.5                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| GRM18               | 1.0                                      | 3.0                                                                                                       | 1.2                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| GRM21               | 1.2                                      | 4.0                                                                                                       | 1.65                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| GRM31               | 2.2                                      | 5.0                                                                                                       | 2.0                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| GRM32               | 2.2                                      | 5.0                                                                                                       | 2.9                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| GRM43               | 3.5                                      | 7.0                                                                                                       | 3.7                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| GRM55               | 4.5                                      | 8.0                                                                                                       | 5.6                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| 13                  | Solderability of Termination             |                                                                                                           | 75% of the terminations is to be soldered evenly and continuously. | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120℃ for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5℃.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| 14                  | Resistance to Soldering Heat             | Appearance                                                                                                | No marking defects                                                 | Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 48±4 hours, then measure.<br><br>•Initial measurement<br>Perform a heat treatment at 150 ± <sub>1</sub> 8℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | Capacitance Change                                                                                        | R6 / R7 / C8 : Within ±7.5%<br>F5 : Within ±20%                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | D.F.                                                                                                      | R6 / R7 / C8 : 0.1 max.<br>F5 : 0.2 max.                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | I.R.                                                                                                      | 50Ω • F min.                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | Dielectric Strength                                                                                       | No failure                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| 15                  | Temperature Sudden Change                | Appearance                                                                                                | No marking defects                                                 | Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 48±4 hours at room temperature, then measure.<br><br><table><thead><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr></thead><tbody><tr><td>Temp.(℃)</td><td>Min. Operating Temp.+0/—3</td><td>Room Temp.</td><td>Max. Operating Temp.+3/—0</td><td>Room Temp.</td></tr><tr><td>Time(min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></tbody></table><br>•Initial measurement<br>Perform a heat treatment at 150± <sub>1</sub> 8℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement. | Step                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1                         | 2          | 3 | 4 | Temp.(℃) | Min. Operating Temp.+0/—3 | Room Temp. | Max. Operating Temp.+3/—0 | Room Temp. | Time(min.) | 30±3 | 2 to 3 | 30±3  | 2 to 3 |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | Step                                                                                                      | 1                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3                         | 4          |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | Temp.(℃)                                                                                                  | Min. Operating Temp.+0/—3                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Room Temp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Max. Operating Temp.+3/—0 | Room Temp. |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | Time(min.)                                                                                                | 30±3                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2 to 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 30±3                      | 2 to 3     |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
|                     |                                          | Capacitance Change                                                                                        | R6 / R7 / C8 : Within ±7.5%<br>F5 : Within ±20%                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| D.F.                | R6 / R7 / C8 : 0.1 max.<br>F5 : 0.2 max. |                                                                                                           |                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| I.R.                | 50Ω • F min.                             |                                                                                                           |                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |
| Dielectric Strength | No failure                               |                                                                                                           |                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |            |   |   |          |                           |            |                           |            |            |      |        |       |        |     |     |       |     |     |      |       |     |     |     |       |     |     |     |       |     |     |     |       |

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No. | Item                                          |                    | Specifications                                               | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|-----------------------------------------------|--------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16  | High Temperature<br>High Humidity<br>(Steady) | Appearance         | No marking defects                                           | <p>Apply the rated voltage at <math>40\pm 2^{\circ}\text{C}</math> and 90 to 95% humidity for <math>500\pm 12</math> hours. The charge/discharge current is less than 50mA.</p> <p>•Initial measurement<br/>Perform a heat treatment at <math>150\pm 1.8^{\circ}\text{C}</math> for one hour and then let sit for <math>48\pm 4</math> hours at room temperature.<br/>Perform the initial measurement.</p> <p>•Measurement after test<br/>Perform a heat treatment at <math>150\pm 1.8^{\circ}\text{C}</math> for one hour and then let sit for <math>48\pm 4</math> hours at room temperature, then measure</p>                        |
|     |                                               | Capacitance Change | R6 / R7 / C8 : Within $\pm 12.5\%$<br>F5 : Within $\pm 30\%$ |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|     |                                               | D.F.               | R6 / R7 / C8 : 0.2 max.<br>F5 : 0.4 max.                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|     |                                               | I.R.               | $12.5\Omega \cdot \text{F min.}$                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 17  | Durability                                    | Appearance         | No marking defects                                           | <p>Apply 150% of the rated voltage for <math>1000\pm 12</math> hours at the maximum operating temperature <math>\pm 3^{\circ}\text{C}</math>.<br/>The charge/discharge current is less than 50mA.</p> <p>•Initial measurement<br/>Perform a heat treatment at <math>150\pm 1.8^{\circ}\text{C}</math> for one hour and then let sit for <math>48\pm 4</math> hours at room temperature.<br/>Perform the initial measurement.</p> <p>•Measurement after test<br/>Perform a heat treatment at <math>150\pm 1.8^{\circ}\text{C}</math> for one hour and then let sit for <math>48\pm 4</math> hours at room temperature, then measure.</p> |
|     |                                               | Capacitance Change | R6 / R7 / C8 : Within $\pm 12.5\%$<br>F5 : Within $\pm 30\%$ |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|     |                                               | D.F.               | R6 / R7 / C8 : 0.2 max.<br>F5 : 0.4 max.                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|     |                                               | I.R.               | $25\Omega \cdot \text{F min.}$                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

# Chip Monolithic Ceramic Capacitors

**muRata**

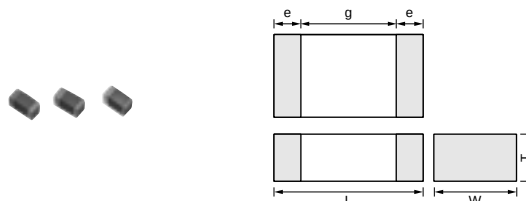
## Low-dissipation Type

### ■ Features

1. Mobile telecommunication and RF module, mainly
2. Quality improvement of telephone calls, Low power consumption, yield ratio improvement

### ■ Applications

VCO, PA, Mobile Telecommunications



| Part Number  | Dimensions (mm) |           |           |             |        |
|--------------|-----------------|-----------|-----------|-------------|--------|
|              | L               | W         | T         | e           | g min. |
| <b>GJM15</b> | 1.0 ±0.05       | 0.5 ±0.05 | 0.5 ±0.05 | 0.15 to 0.3 | 0.4    |
| <b>GJM03</b> | 0.6 ±0.03       | 0.3 ±0.03 | 0.3 ±0.03 | 0.1 to 0.2  | 0.2    |

| Part Number       | TC Code (Standard) | Rated Voltage (Vdc) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------------|---------------------|------------------|---------------|--------------|------------------|
| GJM1555C1HR50CB01 | C0G (EIA)          | 50                  | 0.50 ±0.25pF     | 1.00          | 0.50         | 0.50             |
| GJM1555C1HR75CB01 | C0G (EIA)          | 50                  | 0.75 ±0.25pF     | 1.00          | 0.50         | 0.50             |
| GJM1555C1H1R0CB01 | C0G (EIA)          | 50                  | 1.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H1R1CB01 | C0G (EIA)          | 50                  | 1.1 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H1R2CB01 | C0G (EIA)          | 50                  | 1.2 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H1R3CB01 | C0G (EIA)          | 50                  | 1.3 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H1R5CB01 | C0G (EIA)          | 50                  | 1.5 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H1R6CB01 | C0G (EIA)          | 50                  | 1.6 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H1R8CB01 | C0G (EIA)          | 50                  | 1.8 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H2R0CB01 | C0G (EIA)          | 50                  | 2.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H2R2CB01 | C0G (EIA)          | 50                  | 2.2 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H2R4CB01 | C0G (EIA)          | 50                  | 2.4 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H2R7CB01 | C0G (EIA)          | 50                  | 2.7 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H3R0CB01 | C0G (EIA)          | 50                  | 3.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H3R3CB01 | C0G (EIA)          | 50                  | 3.3 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H3R6CB01 | C0G (EIA)          | 50                  | 3.6 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H3R9CB01 | C0G (EIA)          | 50                  | 3.9 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H4R0CB01 | C0G (EIA)          | 50                  | 4.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H4R3CB01 | C0G (EIA)          | 50                  | 4.3 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H4R7CB01 | C0G (EIA)          | 50                  | 4.7 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H5R0CB01 | C0G (EIA)          | 50                  | 5.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H5R1CB01 | C0G (EIA)          | 50                  | 5.1 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H5R6CB01 | C0G (EIA)          | 50                  | 5.6 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H6R0CB01 | C0G (EIA)          | 50                  | 6.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H6R0DB01 | C0G (EIA)          | 50                  | 6.0 ±0.5pF       | 1.00          | 0.50         | 0.50             |
| GJM1555C1H6R2CB01 | C0G (EIA)          | 50                  | 6.2 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H6R8CB01 | C0G (EIA)          | 50                  | 6.8 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H7R0CB01 | C0G (EIA)          | 50                  | 7.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H7R0DB01 | C0G (EIA)          | 50                  | 7.0 ±0.5pF       | 1.00          | 0.50         | 0.50             |
| GJM1555C1H7R5CB01 | C0G (EIA)          | 50                  | 7.5 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H8R0CB01 | C0G (EIA)          | 50                  | 8.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H8R0DB01 | C0G (EIA)          | 50                  | 8.0 ±0.5pF       | 1.00          | 0.50         | 0.50             |
| GJM1555C1H8R2CB01 | C0G (EIA)          | 50                  | 8.2 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H9R0CB01 | C0G (EIA)          | 50                  | 9.0 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H9R0DB01 | C0G (EIA)          | 50                  | 9.0 ±0.5pF       | 1.00          | 0.50         | 0.50             |
| GJM1555C1H9R1CB01 | C0G (EIA)          | 50                  | 9.1 ±0.25pF      | 1.00          | 0.50         | 0.50             |
| GJM1555C1H100JB01 | C0G (EIA)          | 50                  | 10 ±5%           | 1.00          | 0.50         | 0.50             |
| GJM1555C1H100RB01 | C0G (EIA)          | 50                  | 10 ±2.5%         | 1.00          | 0.50         | 0.50             |

Continued on the following page.

Continued from the preceding page.

| Part Number              | TC Code<br>(Standard) | Rated Voltage<br>(Vdc) | Capacitance<br>(pF) | Length L<br>(mm) | Width W<br>(mm) | Thickness T<br>(mm) |
|--------------------------|-----------------------|------------------------|---------------------|------------------|-----------------|---------------------|
| <b>GJM1555C1H120JB01</b> | C0G (EIA)             | 50                     | 12 ±5%              | 1.00             | 0.50            | 0.50                |
| <b>GJM1555C1H150JB01</b> | C0G (EIA)             | 50                     | 15 ±5%              | 1.00             | 0.50            | 0.50                |
| <b>GJM1555C1H180JB01</b> | C0G (EIA)             | 50                     | 18 ±5%              | 1.00             | 0.50            | 0.50                |

## Specifications and Test Methods

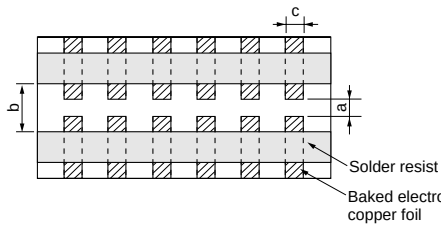
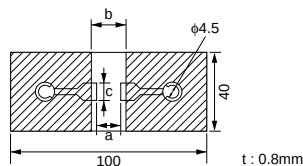
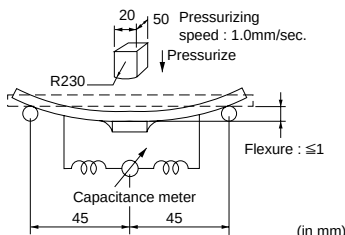
| No.                     | Item                                     |                                                | Specifications                                                 | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |       |                       |                       |           |       |          |         |      |                 |       |     |      |
|-------------------------|------------------------------------------|------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------|-----------------------|-----------|-------|----------|---------|------|-----------------|-------|-----|------|
|                         |                                          |                                                | Temperature Compensating Type                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 1                       | Operating Temperature Range              |                                                | −55 to +125℃                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 2                       | Rated Voltage                            |                                                | See the previous pages                                         | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, $V^{p-p}$ or $V^{o-p}$ , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 3                       | Appearance                               |                                                | No defects or abnormalities                                    | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 4                       | Dimensions                               |                                                | Within the specified dimensions                                | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 5                       | Dielectric Strength                      |                                                | No defects or abnormalities                                    | No failure should be observed when 300% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 6                       | Insulation Resistance (I.R.)             |                                                | 10,000MΩ min. or 500Ω • F min. (Whichever is smaller)          | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 2 minutes of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 7                       | Capacitance                              |                                                | Within the specified tolerance                                 | The capacitance/Q should be measured at 25℃ at the frequency and voltage shown in the table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 8                       | Q                                        |                                                | 30pF max. : $Q \geq 400 + 20C$<br>C : Nominal Capacitance (pF) | <table><tr><th>Item</th><th>Char.</th><th>ΔC (1000pF and below)</th></tr><tr><td>Frequency</td><td></td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td></td><td>0.5 to 5Vr.m.s.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Item  | Char.                 | ΔC (1000pF and below) | Frequency |       | 1±0.1MHz | Voltage |      | 0.5 to 5Vr.m.s. |       |     |      |
|                         |                                          |                                                |                                                                | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Char. | ΔC (1000pF and below) |                       |           |       |          |         |      |                 |       |     |      |
| Frequency               |                                          | 1±0.1MHz                                       |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| Voltage                 |                                          | 0.5 to 5Vr.m.s.                                |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 9                       | Capacitance Temperature Characteristics  | Capacitance Change                             | Within the specified tolerance (Table A)                       | The capacitance change should be measured after 5 min. at each specified temperature stage.<br>Temperature Compensating Type<br>The temperature coefficient is determined using the capacitance measured in step 3 as a reference.<br>When cycling the temperature sequentially from step 1 through 5, (ΔC : +25℃ to +125℃ : other temp. coeffs. : +25℃ to 85℃) the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A.<br>The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.<br><table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>−55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table> | Step  | Temperature (℃)       | 1                     | 25±2      | 2     | −55±3    | 3       | 25±2 | 4               | 125±3 | 5   | 25±2 |
|                         |                                          | Step                                           | Temperature (℃)                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
|                         |                                          | 1                                              | 25±2                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 2                       | −55±3                                    |                                                |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 3                       | 25±2                                     |                                                |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 4                       | 125±3                                    |                                                |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 5                       | 25±2                                     |                                                |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| Temperature Coefficient | Within the specified tolerance (Table A) |                                                |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
|                         | Capacitance Drift                        | Within ±0.2% or ±0.05pF (Whichever is larger.) |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| 10                      | Adhesive Strength of Termination         |                                                | No removal of the terminations or other defect should occur.   | Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply a 5N* force in parallel with the test jig for 10±1sec. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br>*2N (GJM03)<br> <table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GJM03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GJM15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr></table> <p>(in mm)</p>                                                                                                                                                                                                                                | Type  | a                     | b                     | c         | GJM03 | 0.3      | 0.9     | 0.3  | GJM15           | 0.4   | 1.5 | 0.5  |
| Type                    | a                                        | b                                              | c                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| GJM03                   | 0.3                                      | 0.9                                            | 0.3                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |
| GJM15                   | 0.4                                      | 1.5                                            | 0.5                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |                       |                       |           |       |          |         |      |                 |       |     |      |

Fig. 1

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No.   | Item                         |                                                                                                                                                                                                                                                                                                                                                                               | Specifications                                                                                                                    | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |   |   |   |       |     |     |     |       |
|-------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---|---|---|-------|-----|-----|-----|-------|
|       |                              |                                                                                                                                                                                                                                                                                                                                                                               | Temperature Compensating Type                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
| 11    | Vibration Resistance         | Appearance                                                                                                                                                                                                                                                                                                                                                                    | No defects or abnormalities                                                                                                       | Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10).<br>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours). |      |   |   |   |       |     |     |     |       |
|       |                              | Capacitance                                                                                                                                                                                                                                                                                                                                                                   | Within the specified tolerance                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | Q                                                                                                                                                                                                                                                                                                                                                                             | 30pF max. : $Q \geq 400 + 20C$<br>C : Nominal Capacitance (pF)                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
| 12    | Deflection                   | No cracking or marking defects should occur                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                   | Solder the capacitor to the test jig (glass epoxy boards) shown in Fig. 2 using a eutectic solder.<br>Then apply a force in the direction shown in Fig. 3.<br>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.                                                                                                                                                                                        |      |   |   |   |       |     |     |     |       |
|       |                              |  <table border="1" data-bbox="367 857 879 931"><thead><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr></thead><tbody><tr><td>GJM03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GJM15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr></tbody></table> <p>(in mm)</p> <p>Fig. 2</p> |                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Type | a | b | c | GJM03 | 0.3 | 0.9 | 0.3 | GJM15 |
| Type  | a                            | b                                                                                                                                                                                                                                                                                                                                                                             | c                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
| GJM03 | 0.3                          | 0.9                                                                                                                                                                                                                                                                                                                                                                           | 0.3                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
| GJM15 | 0.4                          | 1.5                                                                                                                                                                                                                                                                                                                                                                           | 0.5                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              |  <p>(in mm)</p> <p>Fig. 3</p>                                                                                                                                                                                                                                                              |                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
| 13    | Solderability of Termination |                                                                                                                                                                                                                                                                                                                                                                               | 75% of the terminations are to be soldered evenly and continuously.                                                               | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C.                                                                                                                                                                                                                                                                                       |      |   |   |   |       |     |     |     |       |
| 14    | Resistance to Soldering Heat | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                           |                                                                                                                                   | Preheat the capacitor at 120 to 150°C for 1 minute.<br>Immerse the capacitor in a eutectic solder solution at 270±5°C for 10±0.5 seconds.<br>Let sit at room temperature for 24±2 hours.                                                                                                                                                                                                                                                                                                                                                    |      |   |   |   |       |     |     |     |       |
|       |                              | Appearance                                                                                                                                                                                                                                                                                                                                                                    | No marking defects                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | Capacitance Change                                                                                                                                                                                                                                                                                                                                                            | Within ±2.5% or ±0.25pF (Whichever is larger)                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | Q                                                                                                                                                                                                                                                                                                                                                                             | 30pF and below : $Q \geq 400 + 20C$<br>C : Nominal Capacitance (pF)                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | I.R.                                                                                                                                                                                                                                                                                                                                                                          | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
| 15    | Temperature Cycle            | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                           |                                                                                                                                   | Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure.                                                                                                                                                                                                                                                                                    |      |   |   |   |       |     |     |     |       |
|       |                              | Appearance                                                                                                                                                                                                                                                                                                                                                                    | No marking defects                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | Capacitance Change                                                                                                                                                                                                                                                                                                                                                            | Within ±2.5% or ±0.25pF (Whichever is larger)                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | Q                                                                                                                                                                                                                                                                                                                                                                             | 30pF and below : $Q \geq 400 + 20C$<br>C : Nominal Capacitance (pF)                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | I.R.                                                                                                                                                                                                                                                                                                                                                                          | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
| 16    | Humidity, Steady State       | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                           |                                                                                                                                   | Let the capacitor sit at 40±2°C and 90 to 95% humidity for 500±12 hours.<br>Remove and let sit for 24±2 hours (temperature compensating type) at room temperature, then measure.                                                                                                                                                                                                                                                                                                                                                            |      |   |   |   |       |     |     |     |       |
|       |                              | Appearance                                                                                                                                                                                                                                                                                                                                                                    | No marking defects                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | Capacitance Change                                                                                                                                                                                                                                                                                                                                                            | Within ±5% or ±0.5pF (Whichever is larger)                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | Q                                                                                                                                                                                                                                                                                                                                                                             | 10pF and over, 30pF and below : $Q \geq 275 + \frac{C}{2}$<br>10pF and below : $Q \geq 200 + 10C$<br>C : Nominal Capacitance (pF) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |
|       |                              | I.R.                                                                                                                                                                                                                                                                                                                                                                          | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |       |     |     |     |       |

Continued on the following page.

## Specifications and Test Methods

Continued from the preceding page.

| No. | Item                  | Specifications                                                                        |                                                                                                                                    | Test Method                                                                                                                                                                                                                              |
|-----|-----------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     |                       | Temperature Compensating Type                                                         |                                                                                                                                    |                                                                                                                                                                                                                                          |
| 17  | Humidity Load         |                                                                                       | The measured and observed characteristics should satisfy the specifications in the following table.                                | Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours.<br>Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.                                        |
|     |                       | Appearance                                                                            | No marking defects                                                                                                                 |                                                                                                                                                                                                                                          |
|     |                       | Capacitance Change                                                                    | Within ±7.5% or ±0.75pF (Whichever is larger)                                                                                      |                                                                                                                                                                                                                                          |
|     |                       | Q                                                                                     | 30pF and below : $Q \geq 100 + \frac{1}{3}C$<br>C : Nominal Capacitance (pF)                                                       |                                                                                                                                                                                                                                          |
|     |                       | I.R.                                                                                  | More than 500MΩ or 25Ω • F (Whichever is smaller)                                                                                  |                                                                                                                                                                                                                                          |
|     |                       | Dielectric Strength                                                                   | No failure                                                                                                                         |                                                                                                                                                                                                                                          |
| 18  | High Temperature Load |                                                                                       | The measured and observed characteristics should satisfy the specifications in the following table.                                | Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3℃. Let sit for 24±2 hours (temperature compensating type) at room temperature, then measure.<br>The charge/discharge current is less than 50mA. |
|     |                       | Appearance                                                                            | No marking defects                                                                                                                 |                                                                                                                                                                                                                                          |
|     |                       | Capacitance Change                                                                    | Within ±3% or ±0.3pF (Whichever is larger)                                                                                         |                                                                                                                                                                                                                                          |
|     |                       | Q                                                                                     | 10pF and over, 30pF and below : $Q \geq 275 + \frac{5}{2}C$<br>10pF and below : $Q \geq 200 + 10C$<br>C : Nominal Capacitance (pF) |                                                                                                                                                                                                                                          |
|     |                       | I.R.                                                                                  | More than 1,000MΩ or 50Ω • F (Whichever is smaller)                                                                                |                                                                                                                                                                                                                                          |
|     |                       | Dielectric Strength                                                                   | No failure                                                                                                                         |                                                                                                                                                                                                                                          |
| 19  | ESR                   | 0.5pF≤C≤1pF : 350mΩ • pF below<br>1pF<C≤5pF : 300mΩ below<br>5pF<C≤10pF : 250mΩ below |                                                                                                                                    | The ESR should be measured at room Temperature. and frequency 1±0.2GHz with the equivalent of BOONTON Model 34A.                                                                                                                         |
|     |                       | 10pF<C≤20pF : 400mΩ below                                                             |                                                                                                                                    | The ESR should be measured at room Temperature. and frequency 500±50MHz with the equivalent of HP8753B.                                                                                                                                  |

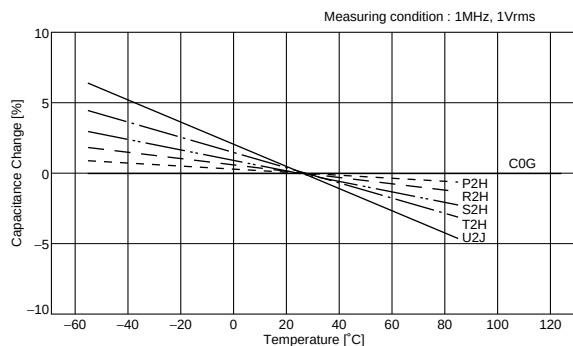
Table A

| Char. Code | Temp. Coeff.<br>(ppm/℃) Note 1 | Capacitance Change from 25℃ Value (%) |       |      |       |      |       |
|------------|--------------------------------|---------------------------------------|-------|------|-------|------|-------|
|            |                                | -55℃                                  |       | -30℃ |       | -10℃ |       |
|            |                                | Max.                                  | Min.  | Max. | Min.  | Max. | Min.  |
| 5C         | 0±30                           | 0.58                                  | -0.24 | 0.40 | -0.17 | 0.25 | -0.11 |

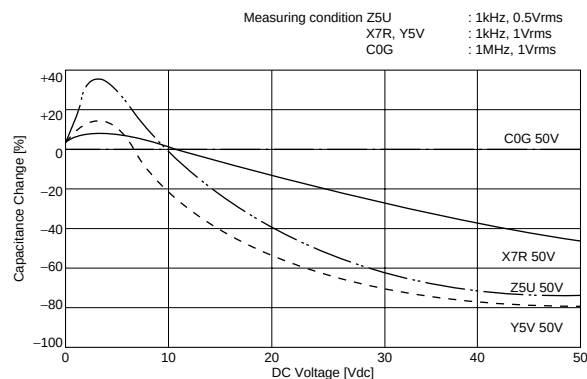
Note 1 : Nominal values denote the temperature coefficient within a range of 25 to 125℃.(for ΔC)

## GRM Series Data

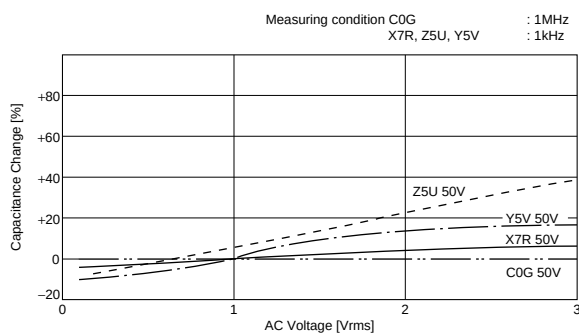
### ■ Capacitance-Temperature Characteristics



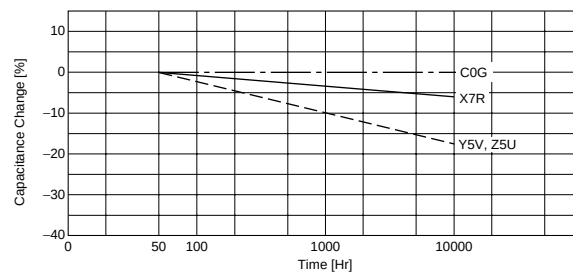
### ■ Capacitance-DC Voltage Characteristics



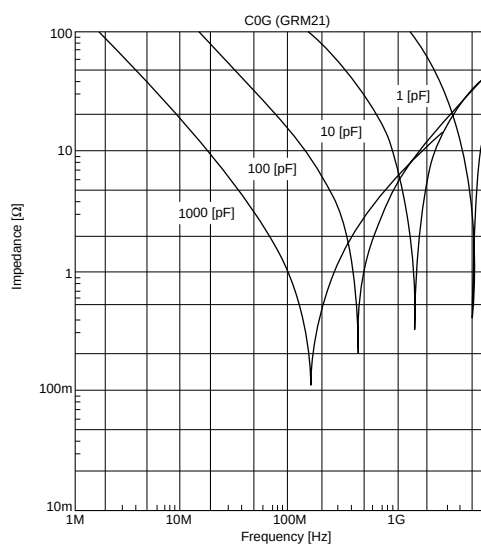
### ■ Capacitance-AC Voltage Characteristics



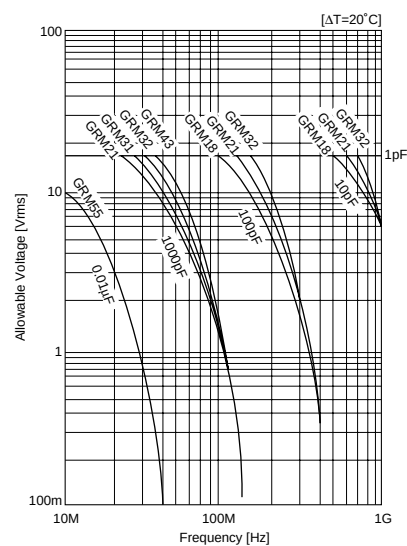
### ■ Capacitance Change-Aging



### ■ Impedance-Frequency Characteristics



### ■ Allowable Voltage-Frequency



Continued on the following page. ➤

### ■ Allowable Current-Frequency

# Chip Monolithic Ceramic Capacitors



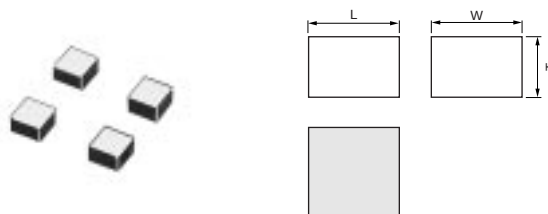
## Microchips

### ■ Features

1. Better microwave characteristics
2. Suitable for by-passing
3. High density mounting

### ■ Applications

1. Optical device for telecommunication
2. IC, IC packaging built-in
3. Measuring equipment



| Part Number   | Dimensions (mm) |           |            |
|---------------|-----------------|-----------|------------|
|               | L               | W         | T          |
| <b>GMA05X</b> | 0.5 ±0.05       | 0.5 ±0.05 | 0.35 ±0.05 |
| <b>GMA085</b> | 0.8 ±0.05       | 0.8 ±0.05 | 0.5 ±0.1   |

| Part Number              | TC Cod (Standard) | Rated Voltage (Vdc) | Capacitance      | Length L (mm) | Width W (mm) | Thickness T (mm) |
|--------------------------|-------------------|---------------------|------------------|---------------|--------------|------------------|
| <b>GMA05XR71H471MD01</b> | X7R (EIA)         | 50                  | 470pF ±20%       | 0.5           | 0.5          | 0.35             |
| <b>GMA05XR71C102MD01</b> | X7R (EIA)         | 16                  | 1000pF ±20%      | 0.5           | 0.5          | 0.35             |
| <b>GMA05XR71C152MD01</b> | X7R (EIA)         | 16                  | 1500pF ±20%      | 0.5           | 0.5          | 0.35             |
| <b>GMA05XR71C222MD01</b> | X7R (EIA)         | 16                  | 2200pF ±20%      | 0.5           | 0.5          | 0.35             |
| <b>GMA085R71C103MD01</b> | X7R (EIA)         | 16                  | 10000pF ±20%     | 0.8           | 0.8          | 0.5              |
| <b>GMA05XF51C472ZD01</b> | Y5V (EIA)         | 16                  | 4700pF +80/-20%  | 0.5           | 0.5          | 0.35             |
| <b>GMA05XF51C682ZD01</b> | Y5V (EIA)         | 16                  | 6800pF +80/-20%  | 0.5           | 0.5          | 0.35             |
| <b>GMA085F51C473ZD01</b> | Y5V (EIA)         | 16                  | 47000pF +80/-20% | 0.8           | 0.8          | 0.5              |
| <b>GMA05XF51A153ZD01</b> | Y5V (EIA)         | 10                  | 15000pF +80/-20% | 0.5           | 0.5          | 0.35             |
| <b>GMA085F51A104ZD01</b> | Y5V (EIA)         | 10                  | 0.10μF +80/-20%  | 0.8           | 0.8          | 0.5              |

## Specifications and Test Methods

| No.                 | Item                                                                      |                    | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Test Method                                                                                                                                                                                                                                                  |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
|---------------------|---------------------------------------------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|------------------|--------------------|----------------------------------------------|------|--------------------|------|---------------------------------------------------------------------------|---------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---|---|---|---|----------|-------------------------|------------|-------------------------|------------|------------|------|--------|------|--------|
| 1                   | Operating Temperature                                                     |                    | R7 : -55℃ to +125℃<br>F5 : -30℃ to +85℃                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 2                   | Rated Voltage                                                             |                    | See the previous pages.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, $V^{P-P}$ or $V^{O-P}$ , whichever is larger, should be maintained within the rated voltage range. |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 3                   | Appearance                                                                |                    | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Visual inspection                                                                                                                                                                                                                                            |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 4                   | Dimensions                                                                |                    | See the previous pages.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Visual inspection                                                                                                                                                                                                                                            |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 5                   | Dielectric Strength                                                       |                    | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | No failure should be observed when a voltage of 250% of the rated voltage is applied between the both terminations for 1 to 5 seconds provided the charge/discharge current is less than 50mA.                                                               |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 6                   | Insulation Resistance (I.R.)                                              |                    | 10,000MΩ min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at normal temperature and humidity and within 2 minutes of charging.                                                                                          |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 7                   | Capacitance                                                               |                    | Within the specified tolerance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | The capacitance should be measured at 25℃ with 1±0.1kHz in frequency and 1±0.2Vr.m.s. in voltage.                                                                                                                                                            |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 8                   | Dissipation Factor (D.F.)                                                 |                    | R7 : 0.035 max.<br>F5 : 0.09 max. (for 16V)<br>: 0.125 max. (for 10V)                                                                                                                                                                                                                                                                                                                                                                                                                                                | D.F. should be measured under the same conditions at the capacitance.                                                                                                                                                                                        |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 9                   | Capacitance Temperature Characteristics                                   |                    | <table><tr><th>Char.</th><th>Temp. Range</th><th>Reference Temp.</th><th>Cap. Change Rate</th></tr><tr><td>R7</td><td>-55 to +125℃</td><td>25℃</td><td>Within±15%</td></tr><tr><td>F5</td><td>-30 to +85℃</td><td>25℃</td><td>Within±22%</td></tr></table>                                                                                                                                                                                                                                                           | Char.                                                                                                                                                                                                                                                        | Temp. Range    | Reference Temp. | Cap. Change Rate | R7                 | -55 to +125℃                                 | 25℃  | Within±15%         | F5   | -30 to +85℃                                                               | 25℃                 | Within±22% | The range of capacitance change in reference to 25℃ within the temperature range shown in the table should be within the specified ranges.<br>The capacitance change should be measured after 5 min. at each specified temperature stage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Char.               | Temp. Range                                                               | Reference Temp.    | Cap. Change Rate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| R7                  | -55 to +125℃                                                              | 25℃                | Within±15%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| F5                  | -30 to +85℃                                                               | 25℃                | Within±22%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 10                  | Mechanical Strength                                                       | Bond Strength      | Pull force : 3.0g min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | MIL-STD-883 Method 2011 Condition D<br>Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20) and bond a 20μm (0.0008 inch) gold wire to the capacitor terminal using an ultrasonic wedge bond. Then, pull wire.                      |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
|                     |                                                                           | Die Shear Strength | Die Shear force : 200g min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | MIL-STD-883 Method 2019<br>Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20). Apply the force parallel to the substrate.                                                                                                         |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 11                  | Vibration Resistance                                                      | Appearance         | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Ramp frequency from 10 to 55Hz then return to 10Hz all within 1 minute. Amplitude : 1.5 mm (0.06 inch) max. total excursion. Apply this motion for a period of 2 hours in each of 3 mutually perpendicular directions (total 6 hours).                       |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
|                     |                                                                           | Capacitance        | Within the specified tolerance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
|                     |                                                                           | D.F.               | R7 : 0.035 max.<br>F5 : 0.09 max. (for 16V)<br>: 0.125 max. (for 10V)                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 12                  | Temperature Cycle                                                         |                    | <p>The measured values should satisfy the values in the following table.</p> <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>R7 ..... Within±7.5%<br/>F5 ..... Within±20%</td></tr><tr><td>I.R.</td><td>More than 10,000MΩ</td></tr><tr><td>D.F.</td><td>R7 ..... 0.035 max.<br/>F5 ..... 0.09 max.(for 16V)<br/>          0.125 max.(for 10V)</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table> | Item                                                                                                                                                                                                                                                         | Specifications | Appearance      | No marked defect | Capacitance Change | R7 ..... Within±7.5%<br>F5 ..... Within±20%  | I.R. | More than 10,000MΩ | D.F. | R7 ..... 0.035 max.<br>F5 ..... 0.09 max.(for 16V)<br>0.125 max.(for 10V) | Dielectric Strength | No failure | <p>The capacitor should be set for 48±4 hours at room temperature after one hour heat of treatment at 150±5℃, then measure for the initial measurement. Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11) and conduct the five cycles according to the temperatures and time shown in the following table. Set it for 48±4 hours at room temperature, then measure.</p> <table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp.(℃)</td><td>Min. Operating Temp. ±9</td><td>Room Temp.</td><td>Max. Operating Temp. ±9</td><td>Room Temp.</td></tr><tr><td>Time(min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table> | Step | 1 | 2 | 3 | 4 | Temp.(℃) | Min. Operating Temp. ±9 | Room Temp. | Max. Operating Temp. ±9 | Room Temp. | Time(min.) | 30±3 | 2 to 3 | 30±3 | 2 to 3 |
| Item                | Specifications                                                            |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Appearance          | No marked defect                                                          |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Capacitance Change  | R7 ..... Within±7.5%<br>F5 ..... Within±20%                               |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| I.R.                | More than 10,000MΩ                                                        |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| D.F.                | R7 ..... 0.035 max.<br>F5 ..... 0.09 max.(for 16V)<br>0.125 max.(for 10V) |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Dielectric Strength | No failure                                                                |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Step                | 1                                                                         | 2                  | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 4                                                                                                                                                                                                                                                            |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Temp.(℃)            | Min. Operating Temp. ±9                                                   | Room Temp.         | Max. Operating Temp. ±9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Room Temp.                                                                                                                                                                                                                                                   |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Time(min.)          | 30±3                                                                      | 2 to 3             | 30±3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2 to 3                                                                                                                                                                                                                                                       |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| 13                  | Humidity (Steady State)                                                   |                    | <p>The measured values should satisfy the values in the following table.</p> <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>R7 ..... Within±12.5%<br/>F5 ..... Within±30%</td></tr><tr><td>I.R.</td><td>More than 1,000MΩ</td></tr><tr><td>D.F.</td><td>R7 ..... 0.05 max.<br/>F5 ..... 0.125 max.(for 16V)<br/>          0.15 max.(for 10V)</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table>  | Item                                                                                                                                                                                                                                                         | Specifications | Appearance      | No marked defect | Capacitance Change | R7 ..... Within±12.5%<br>F5 ..... Within±30% | I.R. | More than 1,000MΩ  | D.F. | R7 ..... 0.05 max.<br>F5 ..... 0.125 max.(for 16V)<br>0.15 max.(for 10V)  | Dielectric Strength | No failure | <p>Set the capacitor for 500±12 hours at 40±20℃, in 90 to 95% humidity.<br/>Take it out and set it for 48±4 hours at room temperature, then measure.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Item                | Specifications                                                            |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Appearance          | No marked defect                                                          |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Capacitance Change  | R7 ..... Within±12.5%<br>F5 ..... Within±30%                              |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| I.R.                | More than 1,000MΩ                                                         |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| D.F.                | R7 ..... 0.05 max.<br>F5 ..... 0.125 max.(for 16V)<br>0.15 max.(for 10V)  |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |
| Dielectric Strength | No failure                                                                |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                              |                |                 |                  |                    |                                              |      |                    |      |                                                                           |                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |   |   |   |   |          |                         |            |                         |            |            |      |        |      |        |

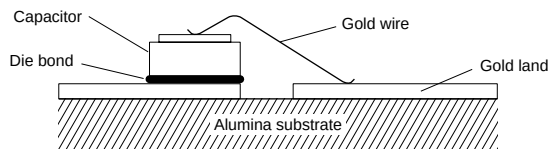
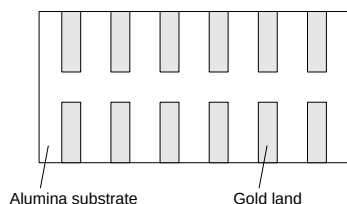
Continued on the following page. 

## Specifications and Test Methods

Continued from the preceding page.

| No. | Item                  | Specifications                                                        | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----|-----------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14  | Humidity Load         | The measured values should satisfy the values in the following table. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|     |                       |                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|     |                       | Item                                                                  | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|     |                       | Appearance                                                            | No marked defect                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|     |                       | Capacitance Change                                                    | R7 ..... Within±12.5%<br>F5 ..... Within±30%                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|     |                       | I.R.                                                                  | More than 500MΩ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|     |                       | D.F.                                                                  | R7 ..... 0.05 max.<br>F5 ..... 0.125 max.(for 16V)<br>0.15 max.(for 10V)                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|     |                       | Dielectric Strength                                                   | No failure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|     |                       |                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|     |                       |                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 15  | High Temperature Load | The measured values should satisfy the values in the following table. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|     |                       |                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|     |                       | Item                                                                  | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|     |                       | Appearance                                                            | No marked defect                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|     |                       | Capacitance Change                                                    | R7 ..... Within±12.5%<br>F5 ..... Within±30%                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|     |                       | I.R.                                                                  | More than 1,000MΩ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|     |                       | D.F.                                                                  | R7 ..... 0.05 max.<br>F5 ..... 0.125 max.(for 16V)<br>0.15 max.(for 10V)                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|     |                       | Dielectric Strength                                                   | No failure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|     |                       |                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|     |                       |                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|     |                       |                                                                       | Apply the rated voltage for 500±12 hours at 40±20℃, in 90 to 95% humidity and set it for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA.<br>• Initial measurement for Y5V<br>Perform a heat treatment at 150 ±10 ℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.                                                                                                                                                      |
|     |                       |                                                                       | A voltage treatment should be given to the capacitor, in which a DC voltage of 200% the rated voltage is applied for one hour at the maximum operating temperature ±3℃ then it should be set for 48±4 hours at room temperature and the initial measurement should be conducted.<br>Then apply the above mentioned voltage continuously for 1000±12 hours at the same temperature, remove it from the bath, and set it for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA. |

Mounting for testing : The capacitors should be mounted on the substrate as shown below using die bonding and wire bonding when tests No. 11 to 15 are performed.



# Chip Monolithic Ceramic Capacitors

**muRata**

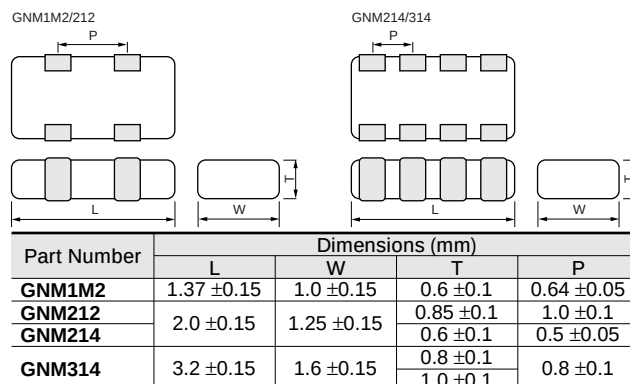
## Capacitor Arrays

### ■ Features

1. High density mounting due to mounting space saving
2. Mounting cost saving

### ■ Applications

General electronic equipment



8

## Temperature Compensating Type

| Part Number                                                                                          | GNM31       |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|
| L x W                                                                                                | 3.2x1.6     |            |
| TC                                                                                                   | C0G<br>(5C) |            |
| Rated Volt.                                                                                          | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |
| 10pF(100)                                                                                            | 0.8(4)      | 0.8(4)     |
| 11pF(110)                                                                                            | 0.8(4)      | 0.8(4)     |
| 12pF(120)                                                                                            | 0.8(4)      | 0.8(4)     |
| 13pF(130)                                                                                            | 0.8(4)      | 0.8(4)     |
| 15pF(150)                                                                                            | 0.8(4)      | 0.8(4)     |
| 16pF(160)                                                                                            | 0.8(4)      | 0.8(4)     |
| 18pF(180)                                                                                            | 0.8(4)      | 0.8(4)     |
| 20pF(200)                                                                                            | 0.8(4)      | 0.8(4)     |
| 22pF(220)                                                                                            | 0.8(4)      | 0.8(4)     |
| 24pF(240)                                                                                            | 0.8(4)      | 0.8(4)     |
| 27pF(270)                                                                                            | 0.8(4)      | 0.8(4)     |
| 30pF(300)                                                                                            | 0.8(4)      | 0.8(4)     |
| 33pF(330)                                                                                            | 0.8(4)      | 0.8(4)     |
| 36pF(360)                                                                                            | 0.8(4)      | 0.8(4)     |
| 39pF(390)                                                                                            | 0.8(4)      | 0.8(4)     |
| 43pF(430)                                                                                            | 0.8(4)      | 0.8(4)     |
| 47pF(470)                                                                                            | 0.8(4)      | 0.8(4)     |
| 51pF(510)                                                                                            | 0.8(4)      | 0.8(4)     |
| 56pF(560)                                                                                            | 0.8(4)      | 0.8(4)     |
| 62pF(620)                                                                                            | 0.8(4)      | 0.8(4)     |
| 68pF(680)                                                                                            | 0.8(4)      | 0.8(4)     |
| 75pF(750)                                                                                            | 0.8(4)      | 0.8(4)     |
| 82pF(820)                                                                                            | 0.8(4)      | 0.8(4)     |
| 91pF(910)                                                                                            | 0.8(4)      | 0.8(4)     |
| 100pF(101)                                                                                           | 0.8(4)      | 0.8(4)     |
| 110pF(111)                                                                                           | 0.8(4)      | 0.8(4)     |
| 120pF(121)                                                                                           | 0.8(4)      | 0.8(4)     |
| 130pF(131)                                                                                           | 0.8(4)      | 0.8(4)     |
| 150pF(151)                                                                                           | 0.8(4)      | 0.8(4)     |
| 160pF(161)                                                                                           |             | 0.8(4)     |
| 180pF(181)                                                                                           |             | 0.8(4)     |

Continued on the following page.

Continued from the preceding page.

| Part Number                                                                                          | GNM31       |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|
| L x W                                                                                                | 3.2x1.6     |            |
| TC                                                                                                   | C0G<br>(5C) |            |
| Rated Volt.                                                                                          | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |
| 200pF(201)                                                                                           |             | 0.8(4)     |
| 220pF(221)                                                                                           |             | 0.8(4)     |
| 240pF(241)                                                                                           |             | 0.8(4)     |
| 270pF(271)                                                                                           |             | 0.8(4)     |
| 300pF(301)                                                                                           |             | 0.8(4)     |
| 330pF(331)                                                                                           |             | 0.8(4)     |
| 360pF(361)                                                                                           |             | 0.8(4)     |

The part numbering code is shown in each ( ). The (4) code in T(mm) means number of elements (four).  
Dimensions are shown in mm and Rated Voltage in Vdc.

## High Dielectric Constant Type GNM1 Series

| Part Number                                                                                          | GNM1M       |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|
| L x W                                                                                                | 1.37x1.00   |            |
| TC                                                                                                   | X7R<br>(R7) |            |
| Rated Volt.                                                                                          | 16<br>(1C)  | 10<br>(1A) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |
| 22000pF(223)                                                                                         | 0.6(2)      |            |
| 47000pF(473)                                                                                         | 0.6(2)      |            |
| 0.10μF(104)                                                                                          |             | 0.6(2)     |

The part numbering code is shown in each ( ). The (2) code in T(mm) means number of elements (two).  
Dimensions are shown in mm and Rated Voltage in Vdc.

## High Dielectric Constant Type GNM2 Series

|                                                                                                      |             |
|------------------------------------------------------------------------------------------------------|-------------|
| Part Number                                                                                          | GNM21       |
| L x W                                                                                                | 2.0x1.25    |
| TC                                                                                                   | X7R<br>(R7) |
| Rated Volt.                                                                                          | 50<br>(1H)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |
| 1000pF(102)                                                                                          | 0.6(4)      |
| 10000pF(103)                                                                                         | 0.6(4)      |

The part numbering code is shown in each ( ). The (4) code in T(mm) means number of elements (four).  
Dimensions are shown in mm and Rated Voltage in Vdc.

## High Dielectric Constant Type GNM3 Series

| Part Number                                                                                          | GNM31       |            |            |            |             |            |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|------------|------------|-------------|------------|------------|
| L x W                                                                                                | 3.2x1.6     |            |            |            |             |            |            |
| TC                                                                                                   | X7R<br>(R7) |            |            |            | Y5V<br>(F5) |            |            |
| Rated Volt.                                                                                          | 100<br>(2A) | 50<br>(1H) | 25<br>(1E) | 16<br>(1C) | 100<br>(2A) | 50<br>(1H) | 16<br>(1C) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |            |            |             |            |            |
| 220pF(221)                                                                                           | 0.8(4)      |            |            |            |             |            |            |

Continued on the following page. 

Continued from the preceding page.

| Part Number                                                                                          | GNM31       |            |            |            |             |            |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|------------|------------|-------------|------------|------------|
| L x W                                                                                                | 3.2x1.6     |            |            |            |             |            |            |
| TC                                                                                                   | X7R<br>(R7) |            |            |            | Y5V<br>(F5) |            |            |
| Rated Volt.                                                                                          | 100<br>(2A) | 50<br>(1H) | 25<br>(1E) | 16<br>(1C) | 100<br>(2A) | 50<br>(1H) | 16<br>(1C) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |            |            |             |            |            |
| 270pF(271)                                                                                           | 0.8(4)      |            |            |            |             |            |            |
| 330pF(331)                                                                                           | 0.8(4)      |            |            |            |             |            |            |
| 390pF(391)                                                                                           | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 470pF(471)                                                                                           | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 560pF(561)                                                                                           | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 680pF(681)                                                                                           | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 820pF(821)                                                                                           | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 1000pF(102)                                                                                          | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 1200pF(122)                                                                                          | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 1500pF(152)                                                                                          | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 1800pF(182)                                                                                          | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 2200pF(222)                                                                                          | 0.8(4)      | 0.8(4)     |            |            | 0.8(4)      |            |            |
| 2700pF(272)                                                                                          | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 3300pF(332)                                                                                          | 0.8(4)      | 0.8(4)     |            |            | 0.8(4)      |            |            |
| 3900pF(392)                                                                                          | 0.8(4)      | 0.8(4)     |            |            |             |            |            |
| 4700pF(472)                                                                                          | 0.8(4)      | 0.8(4)     |            |            | 0.8(4)      |            |            |
| 5600pF(562)                                                                                          |             | 0.8(4)     |            |            |             |            |            |
| 6800pF(682)                                                                                          |             | 0.8(4)     |            |            |             |            |            |
| 8200pF(822)                                                                                          |             | 0.8(4)     |            |            |             |            |            |
| 10000pF(103)                                                                                         |             | 0.8(4)     |            |            |             |            |            |
| 12000pF(123)                                                                                         |             | 0.8(4)     |            |            |             |            |            |
| 15000pF(153)                                                                                         |             | 0.8(4)     |            |            |             |            |            |
| 18000pF(183)                                                                                         |             |            | 0.8(4)     |            |             |            |            |
| 22000pF(223)                                                                                         |             |            |            | 0.8(4)     |             | 0.8(4)     |            |
| 27000pF(273)                                                                                         |             |            |            | 0.8(4)     |             |            |            |
| 33000pF(333)                                                                                         |             |            |            | 0.8(4)     |             | 0.8(4)     |            |
| 39000pF(393)                                                                                         |             |            |            | 0.8(4)     |             |            |            |
| 47000pF(473)                                                                                         |             |            |            | 1.0(4)     |             | 0.8(4)     |            |
| 68000pF(683)                                                                                         |             |            |            | 1.0(4)     |             |            | 0.8(4)     |
| 0.10μF(104)                                                                                          |             |            |            | 1.0(4)     |             |            | 0.8(4)     |
| 0.15μF(154)                                                                                          |             |            |            |            |             |            | 0.8(4)     |

The part numbering code is shown in each ( ). The (4) code in T(mm) means number of elements (four).  
Dimensions are shown in mm and Rated Voltage in Vdc.

## Specifications and Test Methods

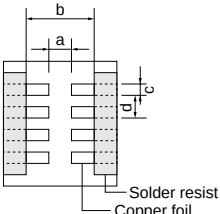
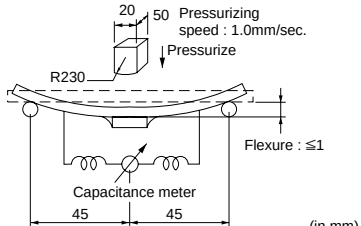
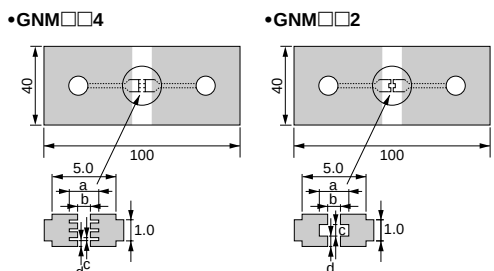
| No.                                                                                 | Item                                           | Specifications                                                                                |                                                                                                                                                                                                                                | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
|-------------------------------------------------------------------------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------|-----------------|-------------|------------|--------------|------------|------------|-----------|-------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|--------|-----------|------------------------------------|----------|---------|-----------------|------------------------------|---|------|
|                                                                                     |                                                | Temperature Compensating Type                                                                 | High Dielectric Type                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 1                                                                                   | Operating Temperature Range                    | 5C : -55℃ to +125℃                                                                            | R7 : -55℃ to +125℃<br>F5 : -30℃ to +85℃                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 2                                                                                   | Rated Voltage                                  | See the previous pages.                                                                       |                                                                                                                                                                                                                                | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, $V^{P-P}$ or $V^{O-P}$ , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 3                                                                                   | Appearance                                     | No defects or abnormalities                                                                   |                                                                                                                                                                                                                                | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 4                                                                                   | Dimension                                      | Within the specified dimensions                                                               |                                                                                                                                                                                                                                | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 5                                                                                   | Dielectric Strength                            | No defects or abnormalities                                                                   |                                                                                                                                                                                                                                | No failure should be observed when 300% of the rated voltage (5C) or 250% of the rated voltage (R7, F5) is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 6                                                                                   | Insulation Resistance                          | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                         |                                                                                                                                                                                                                                | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 2 minutes of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 7                                                                                   | Capacitance                                    | Within the specified tolerance                                                                |                                                                                                                                                                                                                                | The capacitance/Q/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 8                                                                                   | Q/Dissipation Factor (D.F.)                    | 30pF min. : $Q \geq 1000$<br>30pF max. : $Q \geq 400+20C$<br><br>C : Nominal Capacitance (pF) | <table><tr><td>Char.</td><td>25V min.</td><td>16V</td><td>10V</td></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td><td>0.035 max.</td></tr><tr><td>F5</td><td>0.05 max.</td><td>0.07 max.</td><td>—</td></tr></table> | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 25V min.        | 16V                        | 10V             | R7          | 0.025 max. | 0.035 max.   | 0.035 max. | F5         | 0.05 max. | 0.07 max.   | —                          | <table><tr><td>Item \ Char.</td><td>5C</td><td>R7, F5</td></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</td><td>1.0±0.2Vr.m.s.</td></tr></table> | Item \ Char.    | 5C   | R7, F5 | Frequency | 1±0.1MHz                           | 1±0.1kHz | Voltage | 0.5 to 5Vr.m.s. | 1.0±0.2Vr.m.s.               |   |      |
|                                                                                     |                                                | Char.                                                                                         | 25V min.                                                                                                                                                                                                                       | 16V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 10V             |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| R7                                                                                  | 0.025 max.                                     | 0.035 max.                                                                                    | 0.035 max.                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| F5                                                                                  | 0.05 max.                                      | 0.07 max.                                                                                     | —                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| Item \ Char.                                                                        | 5C                                             | R7, F5                                                                                        |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| Frequency                                                                           | 1±0.1MHz                                       | 1±0.1kHz                                                                                      |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| Voltage                                                                             | 0.5 to 5Vr.m.s.                                | 1.0±0.2Vr.m.s.                                                                                |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 9                                                                                   | Capacitance Temperature Characteristics        | Capacitance Change                                                                            | Within the specified tolerance (Table A)                                                                                                                                                                                       | <table><tr><td>Char.</td><td>Temp. Range</td><td>Reference Temp.</td><td>Cap. Change</td></tr><tr><td>R7</td><td>-55 to +125℃</td><td rowspan="2">25℃</td><td>Within±15%</td></tr><tr><td>F5</td><td>-30 to +85℃</td><td>Within<math>\pm_{-82}^{+22}</math> %</td></tr></table> <p>The capacitance change should be measured after 5 min. at each specified temperature stage.</p> <p>(1) Temperature Compensating Type</p> <p>The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A.</p> <p>The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.</p> <table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>-55±3 (for 5C/ R7), -30±3 (for F5)</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3 (for 5C/R7), 85±3 (F5)</td></tr><tr><td>5</td><td>25±2</td></tr></table> <p>(2) High Dielectric Constant Type</p> <p>The ranges of capacitance change compared with the above 25℃ value over the temperature ranges shown in the table should be within the specified ranges.</p> | Char.           | Temp. Range                | Reference Temp. | Cap. Change | R7         | -55 to +125℃ | 25℃        | Within±15% | F5        | -30 to +85℃ | Within $\pm_{-82}^{+22}$ % | Step                                                                                                                                                                                                         | Temperature (℃) | 1    | 25±2   | 2         | -55±3 (for 5C/ R7), -30±3 (for F5) | 3        | 25±2    | 4               | 125±3 (for 5C/R7), 85±3 (F5) | 5 | 25±2 |
|                                                                                     |                                                | Char.                                                                                         | Temp. Range                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reference Temp. | Cap. Change                |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
|                                                                                     |                                                | R7                                                                                            | -55 to +125℃                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 25℃             | Within±15%                 |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
|                                                                                     |                                                | F5                                                                                            | -30 to +85℃                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 | Within $\pm_{-82}^{+22}$ % |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| Step                                                                                | Temperature (℃)                                |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 1                                                                                   | 25±2                                           |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 2                                                                                   | -55±3 (for 5C/ R7), -30±3 (for F5)             |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 3                                                                                   | 25±2                                           |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 4                                                                                   | 125±3 (for 5C/R7), 85±3 (F5)                   |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 5                                                                                   | 25±2                                           |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| Temperature Coefficient                                                             | Within the specified tolerance (Table A)       |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| Capacitance Drift                                                                   | Within ±0.2% or ±0.05 pF (Whichever is larger) |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
|                                                                                     |                                                |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| 10                                                                                  | Adhesive Strength of Termination               | No removal of the terminations or other defect should occur.                                  |                                                                                                                                                                                                                                | <p>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply 5N force in parallel with the test jig for 10±1 sec.</p> <p>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p> <table><tr><th>Type</th><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>GNM1M</td><td>0.5</td><td>—</td><td>0.32</td><td>0.32</td></tr><tr><td>GNM21</td><td>0.4</td><td>1.6</td><td>0.25</td><td>0.5</td></tr><tr><td>GNM31</td><td>0.8</td><td>2.5</td><td>0.4</td><td>0.8</td></tr></table> <p>(in mm)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Type            | a                          | b               | c           | d          | GNM1M        | 0.5        | —          | 0.32      | 0.32        | GNM21                      | 0.4                                                                                                                                                                                                          | 1.6             | 0.25 | 0.5    | GNM31     | 0.8                                | 2.5      | 0.4     | 0.8             |                              |   |      |
|                                                                                     |                                                | Type                                                                                          | a                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | b               | c                          | d               |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| GNM1M                                                                               | 0.5                                            | —                                                                                             | 0.32                                                                                                                                                                                                                           | 0.32                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| GNM21                                                                               | 0.4                                            | 1.6                                                                                           | 0.25                                                                                                                                                                                                                           | 0.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
| GNM31                                                                               | 0.8                                            | 2.5                                                                                           | 0.4                                                                                                                                                                                                                            | 0.8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |
|  |                                                |                                                                                               |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                            |                 |             |            |              |            |            |           |             |                            |                                                                                                                                                                                                              |                 |      |        |           |                                    |          |         |                 |                              |   |      |

Fig. 1

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No.                | Item                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Specifications                                                                                |                                                   |                              |            | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|--------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------|------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---|---|---|---|------------|------------------------------|------------|------------------------------|------------|-------------|----------|----------|----------|----------|-------|----------|----------|----------|----------|
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Temperature Compensating Type                                                                 |                                                   | High Dielectric Type         |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| 11                 | Vibration Resistance                                                                          | Appearance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No defects or abnormalities                                                                   |                                                   |                              |            | <p>Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10). The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | Capacitance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Within the specified tolerance                                                                |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | Q/D.F.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 30pF min. : $Q \geq 1000$<br>30pF max. : $Q \geq 400+20C$<br><br>C : Nominal Capacitance (pF) | Char.                                             | 25V min.                     | 16V        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 10V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R7                                                                                            | 0.025 max.                                        | 0.035 max.                   | 0.035 max. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | F5                                                                                            | 0.05 max.                                         | 0.07 max.                    | —          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| 12                 | Deflection                                                                                    | No cracking or marking defects should occur.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3 for <math>5 \pm 1</math> sec. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p>  <p>Fig. 3</p> <p>t=0.8mm (GNM21), 1.6mm (GNM31)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |  <table><thead><tr><th>Type</th><th>a</th><th>b</th><th>c</th><th>d</th></tr></thead><tbody><tr><td>GNM1M</td><td>2.0±0.05</td><td>0.5±0.05</td><td>0.32±0.05</td><td>0.32±0.05</td></tr><tr><td>GNM21</td><td>2.0±0.05</td><td>0.7±0.05</td><td>0.3±0.05</td><td>0.2±0.05</td></tr><tr><td>GNM31</td><td>2.5±0.05</td><td>0.8±0.05</td><td>0.4±0.05</td><td>0.4±0.05</td></tr></tbody></table> <p>Fig. 2</p> <p>(in mm)</p> |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Type | a | b | c | d | GNM1M      | 2.0±0.05                     | 0.5±0.05   | 0.32±0.05                    | 0.32±0.05  | GNM21       | 2.0±0.05 | 0.7±0.05 | 0.3±0.05 | 0.2±0.05 | GNM31 | 2.5±0.05 | 0.8±0.05 | 0.4±0.05 | 0.4±0.05 |
|                    |                                                                                               | Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | a                                                                                             | b                                                 | c                            | d          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| GNM1M              | 2.0±0.05                                                                                      | 0.5±0.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.32±0.05                                                                                     | 0.32±0.05                                         |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| GNM21              | 2.0±0.05                                                                                      | 0.7±0.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.3±0.05                                                                                      | 0.2±0.05                                          |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| GNM31              | 2.5±0.05                                                                                      | 0.8±0.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.4±0.05                                                                                      | 0.4±0.05                                          |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| 13                 | Solderability of Termination                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 75% of the terminations are to be soldered evenly and continuously.                           |                                                   |                              |            | <p>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for <math>2 \pm 0.5</math> seconds at <math>230 \pm 5^\circ\text{C}</math>.</p>                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| 14                 | Resistance to Soldering Heat                                                                  | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in a eutectic solder solution at <math>270 \pm 5^\circ\text{C}</math> for <math>10 \pm 0.5</math> seconds. Let sit at room temperature for <math>24 \pm 2</math> hours (temperature compensating type) or <math>48 \pm 4</math> hours (high dielectric constant type), then measure.</p> <p>• Initial measurement for high dielectric constant type<br/>Perform a heat treatment at <math>150 \pm 5^\circ\text{C}</math> for one hour and then let sit for <math>48 \pm 4</math> hours at room temperature. Perform the initial measurement.</p>                                                                                                                                                                                                                                                                                                                                                                             |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | Appearance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No marking defects                                                                            |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | Capacitance Change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ (Whichever is larger)                               | R7 : Within $\pm 7.5\%$<br>F5 : Within $\pm 20\%$ |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | Q/D.F.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 30pF min. : $Q \geq 1000$<br>30pF max. : $Q \geq 400+20C$<br><br>C : Nominal Capacitance (pF) | Char.                                             | 25V min.                     | 16V        | 10V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | I.R.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                         |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| 15                 | Temperature Cycle                                                                             | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for <math>24 \pm 2</math> hours (temperature compensating type) or <math>48 \pm 4</math> hours (high dielectric constant type) at room temperature, then measure</p> <table><thead><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr></thead><tbody><tr><td>Temp. (°C)</td><td>Min. Operating Temp. <math>\pm 5</math></td><td>Room Temp.</td><td>Max. Operating Temp. <math>\pm 5</math></td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></tbody></table> <p>• Initial measurement for high dielectric constant type<br/>Perform a heat treatment at <math>150 \pm 5^\circ\text{C}</math> for one hour and then let sit for <math>48 \pm 4</math> hours at room temperature. Perform the initial measurement.</p> | Step | 1 | 2 | 3 | 4 | Temp. (°C) | Min. Operating Temp. $\pm 5$ | Room Temp. | Max. Operating Temp. $\pm 5$ | Room Temp. | Time (min.) | 30±3     | 2 to 3   | 30±3     | 2 to 3   |       |          |          |          |          |
|                    |                                                                                               | Step                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1                                                                                             | 2                                                 | 3                            | 4          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | Temp. (°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Min. Operating Temp. $\pm 5$                                                                  | Room Temp.                                        | Max. Operating Temp. $\pm 5$ | Room Temp. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | Time (min.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 30±3                                                                                          | 2 to 3                                            | 30±3                         | 2 to 3     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               | Appearance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No marking defects                                                                            |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| Capacitance Change | Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ (Whichever is larger)                               | R7 : Within $\pm 7.5\%$<br>F5 : Within $\pm 20\%$                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| Q/D.F.             | 30pF min. : $Q \geq 1000$<br>30pF max. : $Q \geq 400+20C$<br><br>C : Nominal Capacitance (pF) | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 25V min.                                                                                      | 16V                                               | 10V                          |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
| I.R.               | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | R7                                                                                            | 0.025 max.                                        | 0.035 max.                   | 0.035 max. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | F5                                                                                            | 0.05 max.                                         | 0.07 max.                    | —          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |
|                    |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                               |                                                   |                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |   |   |   |   |            |                              |            |                              |            |             |          |          |          |          |       |          |          |          |          |

Continued on the following page. 

## Specifications and Test Methods

Continued from the preceding page.

| No. | Item                  | Specifications                                                                                      |                                                                                                                                         | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----|-----------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     |                       | Temperature Compensating Type                                                                       | High Dielectric Type                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 16  | Humidity Steady State | The measured and observed characteristics should satisfy the specifications in the following table. |                                                                                                                                         | Let the capacitor sit at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.                                                                                                                                                                                                                                                                                                           |
|     |                       | Appearance                                                                                          | No marking defects                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Capacitance Change                                                                                  | Within ±5% or ±0.5pF (Whichever is larger)<br>R7 : Within ±12.5%<br>F5 : Within ±30%                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Q/D.F.                                                                                              | 30pF and over : Q≥350<br>10pF and over, 30pF and below :<br>Q≥275+5C/2<br>10pF and below :<br>Q≥200+10C<br>C : Nominal Capacitance (pF) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | I.R.                                                                                                | More than 1,000MΩ or 50Ω • F (Whichever is smaller)                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Dielectric Strength                                                                                 | No failure                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 17  | Humidity Load         | The measured and observed characteristics should satisfy the specifications in the following table. |                                                                                                                                         | Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                         |
|     |                       | Appearance                                                                                          | No marking defects                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Capacitance Change                                                                                  | Within ±7.5% or ±0.75pF (Whichever is larger)<br>R7 : Within ±12.5%<br>F5 : Within ±30%                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Q/D.F.                                                                                              | 30pF and over : Q≥200<br>30pF and below :<br>Q≥100+10C/3<br>C : Nominal Capacitance (pF)                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | I.R.                                                                                                | More than 500MΩ or 25Ω • F (Whichever is smaller)                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Dielectric Strength                                                                                 | No failure                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 18  | High Temperature Load | The measured and observed characteristics should satisfy the specifications in the following table. |                                                                                                                                         | Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.<br><br>•Initial measurement for high dielectric constant type.<br>Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3°C. Remove and let sit for 48±4 hours at room temperature. Perform initial measurement. |
|     |                       | Appearance                                                                                          | No marking defects                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Capacitance Change                                                                                  | Within ±3% or ±0.3pF (Whichever is larger)<br>R7 : Within ±12.5%<br>F5 : Within ±30%                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Q/D.F.                                                                                              | 30pF and over : Q≥350<br>10pF and over, 30pF and below :<br>Q≥275+5C/2<br>10pF and below :<br>Q≥200+10C<br>C : Nominal Capacitance (pF) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | I.R.                                                                                                | More than 1,000MΩ or 50Ω • F (Whichever is smaller)                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|     |                       | Dielectric Strength                                                                                 | No failure                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

Table A

| Char. | Nominal Values (ppm/°C) Note 1 | Capacitance Change from 25°C (%) |       |      |       |      |       |
|-------|--------------------------------|----------------------------------|-------|------|-------|------|-------|
|       |                                | -55                              |       | -30  |       | -10  |       |
|       |                                | Max.                             | Min.  | Max. | Min.  | Max. | Min.  |
| 5C    | 0±30                           | 0.58                             | -0.24 | 0.40 | -0.17 | 0.25 | -0.11 |

Note 1 : Nominal values denote the temperature coefficient within a range of 25°C to 125°C.

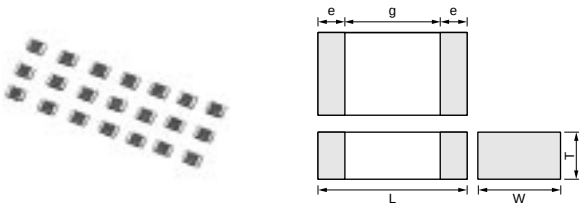
Chip Monolithic Ceramic Capacitors



for Ultrasonic Sensors

- Features
1. Proper compensation for ultrasonic sensors

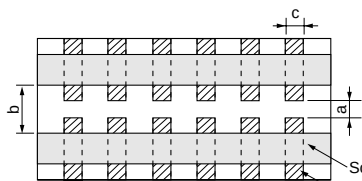
2. Small chip size and high capacitance value
- Application
- Ultrasonic sensor  
(back sonar, corner sonar, etc.)



| Part Number | Dimensions (mm) |           |           |            |        |
|-------------|-----------------|-----------|-----------|------------|--------|
|             | L               | W         | T         | e          | g min. |
| GRM219      | 2.0 ±0.1        | 1.25 ±0.1 | 0.85 ±0.1 | 0.2 to 0.7 | 0.7    |

| Part Number       | TC Code      | Rated Voltage (Vdc) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) |
|-------------------|--------------|---------------------|------------------|---------------|--------------|------------------|
| GRM2199E2A102KD42 | ZLM (Murata) | 100                 | 1000 ±10%        | 2.0           | 1.25         | 0.85             |
| GRM2199E2A152KD42 | ZLM (Murata) | 100                 | 1500 ±10%        | 2.0           | 1.25         | 0.85             |

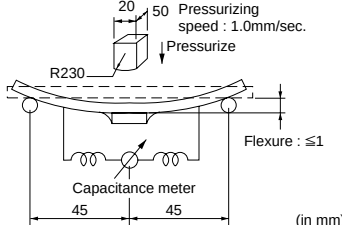
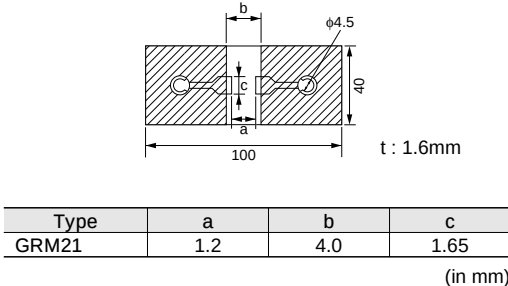
## Specifications and Test Methods

| No.   | Item                                    |             | Specifications                                                                                       | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                |   |      |       |       |     |      |   |      |   |      |
|-------|-----------------------------------------|-------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|---|------|-------|-------|-----|------|---|------|---|------|
| 1     | Operating Temperature                   |             | −25℃ to +85℃                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 2     | Rated Voltage                           |             | See the previous pages.                                                                              | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, $V^{P-P}$ or $V^{O-P}$ , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                           |      |                |   |      |       |       |     |      |   |      |   |      |
| 3     | Appearance                              |             | No defects or abnormalities                                                                          | Visual inspection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |                |   |      |       |       |     |      |   |      |   |      |
| 4     | Dimensions                              |             | Within the specified dimensions                                                                      | Using calipers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 5     | Dielectric Strength                     |             | No defects or abnormalities                                                                          | No failure should be observed when 300% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |                |   |      |       |       |     |      |   |      |   |      |
| 6     | Insulation Resistance (I.R.)            |             | More than 10,000MΩ or 500Ω • F. (Whichever is smaller)                                               | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 20℃ and 75%RH max. and within 2 minutes of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |                |   |      |       |       |     |      |   |      |   |      |
| 7     | Capacitance                             |             | Within the specified tolerance                                                                       | The capacitance/D.F. should be measured at 20℃ with 1±0.1kHz in frequency and 1±0.2Vr.m.s. in voltage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |                |   |      |       |       |     |      |   |      |   |      |
| 8     | Dissipation Factor (D.F.)               |             | 0.01 max.                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 9     | Capacitance Temperature Characteristics |             | Within −4,700 $\pm$ 1,999 ppm/℃ (at −25 to +20℃)<br>Within −4,700 $\pm$ 5,999 ppm/℃ (at +20 to +85℃) | <p>The temperature coefficient is determined using the capacitance measured in step 1 as a reference.<br/>When cycling the temperature sequentially from step 1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient.<br/>The capacitance change should be measured after 5 min. at each specified temperature stage.</p> <table><tr><th>Step</th><th>Temperature(℃)</th></tr><tr><td>1</td><td>20±2</td></tr><tr><td>2</td><td>−25±3</td></tr><tr><td>3</td><td>20±2</td></tr><tr><td>4</td><td>85±3</td></tr><tr><td>5</td><td>20±2</td></tr></table>                                                                 | Step | Temperature(℃) | 1 | 20±2 | 2     | −25±3 | 3   | 20±2 | 4 | 85±3 | 5 | 20±2 |
| Step  | Temperature(℃)                          |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 1     | 20±2                                    |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 2     | −25±3                                   |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 3     | 20±2                                    |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 4     | 85±3                                    |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 5     | 20±2                                    |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 10    | Adhesive Strength of Termination        |             | No removal of the terminations or other defect should occur.                                         | <p>Solder the capacitor to the test jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply 10N force in the direction of the arrow.<br/>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p> <div><p>Solder resist<br/>Baked electrode or copper foil</p><table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr></table><p>(in mm)</p><p>Fig.1</p></div> | Type | a              | b | c    | GRM21 | 1.2   | 4.0 | 1.65 |   |      |   |      |
| Type  | a                                       | b           | c                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| GRM21 | 1.2                                     | 4.0         | 1.65                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
| 11    | Vibration Resistance                    | Appearance  | No defects or abnormalities                                                                          | <p>Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10).<br/>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</p>                                                                                                                    |      |                |   |      |       |       |     |      |   |      |   |      |
|       |                                         | Capacitance | Within the specified tolerance                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |
|       |                                         | D.F.        | 0.01 max.                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                |   |      |       |       |     |      |   |      |   |      |

Continued on the following page. ↗

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                  |                     | Specifications                                                                                  | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|---------------------|-------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------|-----------|---|---|------------|--------|-----------|-------|-----------|-------------|------|--------|------|--------|
| 12                  | Deflection                                            |                     | No cracking or marking defects should occur.                                                    | <p>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig. 2 using a eutectic solder.</p> <p>Then apply a force in the direction shown in Fig. 3.</p> <p>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p>  <p>Fig.3</p>                                                                   |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       |                     |  <p>Fig. 2</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| 13                  | Solderability of Termination                          |                     | 75% of the terminations are to be soldered evenly and continuously                              | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C.                                                                                                                                                                                                                                                                                  |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| 14                  | Resistance to Soldering Heat                          | Appearance          | No defects or abnormalities                                                                     | <p>Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5°C for 10±0.5 seconds. Let sit at room temperature for 24±2 hours, then measure.</p>                                                                                                                                                                                                                                                                                                                                |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Capacitance Change  | Within ±7.5%                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | D.F.                | 0.01 max.                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | I.R.                | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Dielectric Strength | No failure                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| 15                  | Temperature Cycle                                     | Appearance          | No defects or abnormalities                                                                     | <p>Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11).</p> <p>Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure.</p> <table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (°C)</td><td>-25 ±3</td><td>RoomTemp.</td><td>85 ±3</td><td>RoomTemp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table> | Step      | 1     | 2         | 3 | 4 | Temp. (°C) | -25 ±3 | RoomTemp. | 85 ±3 | RoomTemp. | Time (min.) | 30±3 | 2 to 3 | 30±3 | 2 to 3 |
|                     |                                                       | Step                | 1                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2         | 3     | 4         |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Temp. (°C)          | -25 ±3                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | RoomTemp. | 85 ±3 | RoomTemp. |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Time (min.)         | 30±3                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2 to 3    | 30±3  | 2 to 3    |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Capacitance Change  | Within ±7.5%                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| D.F.                | 0.01 max.                                             |                     |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| I.R.                | More than 10,000MΩ or 500Ω • F (Whichever is smaller) |                     |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| Dielectric Strength | No failure                                            |                     |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| 16                  | Humidity, Steady State                                | Appearance          | No defects or abnormalities                                                                     | <p>Sit the capacitor at 40±2°C and 90 to 95% humidity for 500±12 hours.</p> <p>Remove and let sit for 24±2 hours at room temperature, then measure.</p>                                                                                                                                                                                                                                                                                                                                                                                |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Capacitance Change  | Within ±12.5%                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | D.F.                | 0.02 max.                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | I.R.                | More than 1,000MΩ or 50Ω • F (Whichever is smaller)                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Dielectric Strength | No failure                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| 17                  | Humidity Load                                         | Appearance          | No defects or abnormalities                                                                     | <p>Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.</p>                                                                                                                                                                                                                                                                                                                                 |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Capacitance Change  | Within ±12.5%                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | D.F.                | 0.02 max.                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | I.R.                | More than 500MΩ or 25Ω • F (Whichever is smaller)                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
| 18                  | High Temperature Load                                 | Appearance          | No defects or abnormalities                                                                     | <p>Apply 200% of the rated voltage for 1,000±12 hours at 85±3°C. Let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.</p>                                                                                                                                                                                                                                                                                                                                                         |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | Capacitance Change  | Within ±12.5%                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | D.F.                | 0.02 max.                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |
|                     |                                                       | I.R.                | More than 1,000MΩ or 50Ω • F (Whichever is smaller)                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |       |           |   |   |            |        |           |       |           |             |      |        |      |        |

# Chip Monolithic Ceramic Capacitors



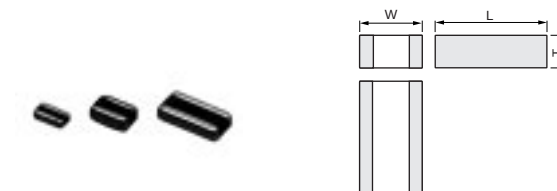
## Low ESL

### ■ Features

1. Low ESL, good for noise reduction for high frequency
2. Small, high capacitance

### ■ Applications

1. High speed micro processors
2. High frequency digital equipment



| Part Number   | Dimensions (mm) |           |           |
|---------------|-----------------|-----------|-----------|
|               | L               | W         | T         |
| <b>LLL185</b> | 1.6 ±0.1        | 0.8 ±0.1  | 0.6 max.  |
| <b>LLL216</b> | 2.0 ±0.1        | 1.25 ±0.1 | 0.6 ±0.1  |
| <b>LLL219</b> |                 |           | 0.85 ±0.1 |
| <b>LLL317</b> | 3.2 ±0.15       | 1.6 ±0.15 | 0.7 ±0.1  |
| <b>LLL31M</b> |                 |           | 1.15 ±0.1 |

### LLL18 Series

| Part Number                                                                                          | LLL18       |            |            |            |             |
|------------------------------------------------------------------------------------------------------|-------------|------------|------------|------------|-------------|
| L x W                                                                                                | 1.6x0.8     |            |            |            |             |
| TC                                                                                                   | X7R<br>(R7) |            |            |            | Y5V<br>(F5) |
| Rated Volt.                                                                                          | 50<br>(1H)  | 25<br>(1E) | 16<br>(1C) | 10<br>(1A) | 25<br>(1E)  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |            |            |             |
| 2200pF(222)                                                                                          | 0.5(5)      |            |            |            |             |
| 3300pF(332)                                                                                          | 0.5(5)      |            |            |            |             |
| 4700pF(472)                                                                                          | 0.5(5)      |            |            |            |             |
| 6800pF(682)                                                                                          |             | 0.5(5)     |            |            |             |
| 10000pF(103)                                                                                         |             | 0.5(5)     |            |            |             |
| 15000pF(153)                                                                                         |             | 0.5(5)     |            |            |             |
| 22000pF(223)                                                                                         |             | 0.5(5)     |            |            | 0.5(5)      |
| 33000pF(333)                                                                                         |             |            | 0.5(5)     |            |             |
| 47000pF(473)                                                                                         |             |            | 0.5(5)     |            |             |
| 68000pF(683)                                                                                         |             |            | 0.5(5)     |            |             |
| 0.10μF(104)                                                                                          |             |            |            | 0.5(5)     |             |

The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

### LLL21 Series

| Part Number                                                                                          | LLL21       |            |            |            |  |
|------------------------------------------------------------------------------------------------------|-------------|------------|------------|------------|--|
| L x W                                                                                                | 2.0x1.25    |            |            |            |  |
| TC                                                                                                   | X7R<br>(R7) |            |            |            |  |
| Rated Volt.                                                                                          | 50<br>(1H)  | 25<br>(1E) | 16<br>(1C) | 10<br>(1A) |  |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |            |            |  |
| 4700pF(472)                                                                                          | 0.6(6)      |            |            |            |  |
| 6800pF(682)                                                                                          | 0.6(6)      |            |            |            |  |
| 10000pF(103)                                                                                         | 0.6(6)      |            |            |            |  |
| 15000pF(153)                                                                                         | 0.6(6)      |            |            |            |  |
| 22000pF(223)                                                                                         | 0.6(6)      |            |            |            |  |
| 33000pF(333)                                                                                         | 0.85(9)     | 0.6(6)     | 0.6(6)     |            |  |
| 47000pF(473)                                                                                         |             | 0.6(6)     | 0.6(6)     |            |  |

Continued on the following page.

 Continued from the preceding page.

| Part Number                                                                                          | LLL21       |            |            |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|------------|------------|
| L x W                                                                                                | 2.0x1.25    |            |            |            |
| TC                                                                                                   | X7R<br>(R7) |            |            |            |
| Rated Volt.                                                                                          | 50<br>(1H)  | 25<br>(1E) | 16<br>(1C) | 10<br>(1A) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |            |            |
| 68000pF(683)                                                                                         |             | 0.6(6)     | 0.6(6)     |            |
| 0.10μF(104)                                                                                          |             | 0.6(6)     | 0.6(6)     |            |
| 0.15μF(154)                                                                                          |             | 0.85(9)    | 0.6(6)     |            |
| 0.22μF(224)                                                                                          |             |            | 0.85(9)    | 0.6(6)     |
| 0.33μF(334)                                                                                          |             |            |            | 0.6(6)     |
| 0.47μF(474)                                                                                          |             |            |            | 0.85(9)    |

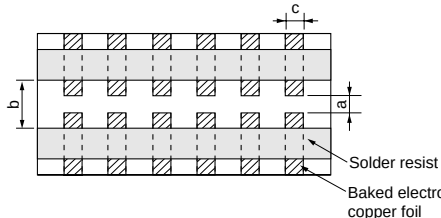
The part numbering code is shown in ( ).  
Dimensions are shown in mm and Rated Voltage in Vdc.

LLL31 Series

| Part Number                                                                                          | LLL31       |            |            |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|------------|------------|
| L x W                                                                                                | 3.2x1.6     |            |            |            |
| TC                                                                                                   | X7R<br>(R7) |            |            |            |
| Rated Volt.                                                                                          | 50<br>(1H)  | 25<br>(1E) | 16<br>(1C) | 10<br>(1A) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |            |            |
| 10000pF(103)                                                                                         | 0.7(7)      |            |            |            |
| 15000pF(153)                                                                                         | 0.7(7)      |            |            |            |
| 22000pF(223)                                                                                         | 0.7(7)      |            |            |            |
| 33000pF(333)                                                                                         | 0.7(7)      |            |            |            |
| 47000pF(473)                                                                                         | 0.7(7)      |            |            |            |
| 68000pF(683)                                                                                         | 0.7(7)      |            |            |            |
| 0.10μF(104)                                                                                          | 1.15(M)     | 0.7(7)     | 0.7(7)     |            |
| 0.15μF(154)                                                                                          |             | 0.7(7)     | 0.7(7)     |            |
| 0.22μF(224)                                                                                          |             | 1.15(M)    | 0.7(7)     |            |
| 0.33μF(334)                                                                                          |             | 1.15(M)    | 0.7(7)     |            |
| 0.47μF(474)                                                                                          |             | 1.15(M)    | 0.7(7)     |            |
| 0.68μF(684)                                                                                          |             |            | 1.15(M)    | 0.7(7)     |
| 1.0μF(105)                                                                                           |             |            | 1.15(M)    | 0.7(7)     |
| 1.5μF(155)                                                                                           |             |            |            | 1.15(M)    |
| 2.2μF(225)                                                                                           |             |            |            | 1.15(M)    |

The part numbering code is shown in ( ).  
Dimensions are shown in mm and Rated Voltage in Vdc.

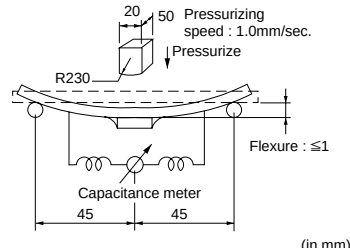
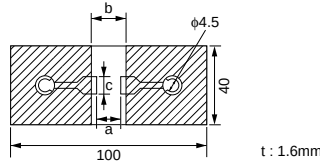
## Specifications and Test Methods

| No.          | Item                                                                                                                                                                          | Specifications                                                                                                                                                                                                                                                                                                                                                  | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------|--------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1            | Operating Temperature Range                                                                                                                                                   | R7 : -55℃ to +125℃<br>F5 : -30℃ to +85℃                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 2            | Rated Voltage                                                                                                                                                                 | See the previous pages.                                                                                                                                                                                                                                                                                                                                         | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, $V^{P-P}$ or $V^{O-P}$ , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 3            | Appearance                                                                                                                                                                    | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                     | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 4            | Dimensions                                                                                                                                                                    | Within the specified dimension                                                                                                                                                                                                                                                                                                                                  | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 5            | Dielectric Strength                                                                                                                                                           | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                     | No failure should be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 6            | Insulation Resistance (I.R.)                                                                                                                                                  | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                                                                                                                                                                                                                                                                                           | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 2 minutes of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 7            | Capacitance                                                                                                                                                                   | Within the specified tolerance                                                                                                                                                                                                                                                                                                                                  | The capacitance/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 8            | Dissipation Factor (D.F.)                                                                                                                                                     | <table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>F5</td><td>0.05 max.</td><td>—</td></tr></table>                                                                                                                                                                                   | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 25V min.                    | 16V             | R7                             | 0.025 max. | 0.035 max.                                                                                                                                                                    | F5        | 0.05 max.  | —   | <table><tr><th>Item \ Char.</th><th>R7</th></tr><tr><td>Frequency</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>1±0.2Vr.m.s.</td></tr></table> | Item \ Char. | R7             | Frequency                                                                                                                                                                                                                                         | 1±0.1kHz  | Voltage | 1±0.2Vr.m.s.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |
| Char.        | 25V min.                                                                                                                                                                      | 16V                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| R7           | 0.025 max.                                                                                                                                                                    | 0.035 max.                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| F5           | 0.05 max.                                                                                                                                                                     | —                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| Item \ Char. | R7                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| Frequency    | 1±0.1kHz                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| Voltage      | 1±0.2Vr.m.s.                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 9            | Capacitance Temperature Characteristics                                                                                                                                       | <table><tr><th>Char.</th><th>Temp. Range (℃)</th><th>Reference Temp.</th><th>Cap. Change.</th></tr><tr><td>R7</td><td>-55 to +125</td><td>25℃</td><td>Within±15%</td></tr><tr><td>F5</td><td>-30 to +85</td><td>25℃</td><td>Within+22/-82%</td></tr></table>                                                                                                    | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Temp. Range (℃)             | Reference Temp. | Cap. Change.                   | R7         | -55 to +125                                                                                                                                                                   | 25℃       | Within±15% | F5  | -30 to +85                                                                                                                                         | 25℃          | Within+22/-82% | The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table should be within the specified ranges.<br>The capacitance change should be measured after 5 min. at each specified temperature stage. |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| Char.        | Temp. Range (℃)                                                                                                                                                               | Reference Temp.                                                                                                                                                                                                                                                                                                                                                 | Cap. Change.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| R7           | -55 to +125                                                                                                                                                                   | 25℃                                                                                                                                                                                                                                                                                                                                                             | Within±15%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| F5           | -30 to +85                                                                                                                                                                    | 25℃                                                                                                                                                                                                                                                                                                                                                             | Within+22/-82%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 10           | Adhesive Strength of Termination                                                                                                                                              | No removal of the terminations or other defect should occur.                                                                                                                                                                                                                                                                                                    | <p>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply 10N* force in the direction of the arrow. *5N: LLL18<br/>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p> <div><p>Solder resist<br/>Baked electrode or copper foil</p><table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>LLL18</td><td>0.3</td><td>1.2</td><td>2.0</td></tr><tr><td>LLL21</td><td>0.6</td><td>1.6</td><td>2.4</td></tr><tr><td>LLL31</td><td>1.0</td><td>3.0</td><td>3.7</td></tr></table><p>(in mm)</p><p>Fig. 1</p></div> | Type                        | a               | b                              | c          | LLL18                                                                                                                                                                         | 0.3       | 1.2        | 2.0 | LLL21                                                                                                                                              | 0.6          | 1.6            | 2.4                                                                                                                                                                                                                                               | LLL31     | 1.0     | 3.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3.7 |
| Type         | a                                                                                                                                                                             | b                                                                                                                                                                                                                                                                                                                                                               | c                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| LLL18        | 0.3                                                                                                                                                                           | 1.2                                                                                                                                                                                                                                                                                                                                                             | 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| LLL21        | 0.6                                                                                                                                                                           | 1.6                                                                                                                                                                                                                                                                                                                                                             | 2.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| LLL31        | 1.0                                                                                                                                                                           | 3.0                                                                                                                                                                                                                                                                                                                                                             | 3.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| 11           | Vibration Resistance                                                                                                                                                          | <table><tr><td>Appearance</td><td>No defects or abnormalities</td></tr><tr><td>Capacitance</td><td>Within the specified tolerance</td></tr><tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>F5</td><td>0.05 max.</td><td>—</td></tr></table></td></tr></table> | Appearance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | No defects or abnormalities | Capacitance     | Within the specified tolerance | D.F.       | <table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>F5</td><td>0.05 max.</td><td>—</td></tr></table> | Char.     | 25V min.   | 16V | R7                                                                                                                                                 | 0.025 max.   | 0.035 max.     | F5                                                                                                                                                                                                                                                | 0.05 max. | —       | <p>Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10).<br/>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute.<br/>This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</p> |     |
| Appearance   | No defects or abnormalities                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| Capacitance  | Within the specified tolerance                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| D.F.         | <table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>F5</td><td>0.05 max.</td><td>—</td></tr></table> | Char.                                                                                                                                                                                                                                                                                                                                                           | 25V min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 16V                         | R7              | 0.025 max.                     | 0.035 max. | F5                                                                                                                                                                            | 0.05 max. | —          |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| Char.        | 25V min.                                                                                                                                                                      | 16V                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| R7           | 0.025 max.                                                                                                                                                                    | 0.035 max.                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |
| F5           | 0.05 max.                                                                                                                                                                     | —                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             |                 |                                |            |                                                                                                                                                                               |           |            |     |                                                                                                                                                    |              |                |                                                                                                                                                                                                                                                   |           |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |     |

Continued on the following page. ➞

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                  | Specifications                                                                                                                                                                                                                                                                                                                                                      | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |          |     |    |            |            |     |            |       |     |     |     |       |
|---------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|-----|----|------------|------------|-----|------------|-------|-----|-----|-----|-------|
| 12                  | Deflection                                            | No crack or marked defect should occur.                                                                                                                                                                                                                                                                                                                             | <p>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig. 2 using a eutectic solder.</p> <p>Then apply a force in the direction shown in Fig. 3.</p> <p>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p>  <p>(in mm)</p> <p>Fig. 3</p> |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       |  <table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>LLL18</td><td>0.3</td><td>1.2</td><td>2.0</td></tr><tr><td>LLL21</td><td>0.6</td><td>1.6</td><td>2.4</td></tr><tr><td>LLL31</td><td>1.0</td><td>3.0</td><td>3.7</td></tr></table> <p>(in mm)</p> <p>Fig. 2</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Type       | a        | b   | c  | LLL18      | 0.3        | 1.2 | 2.0        | LLL21 | 0.6 | 1.6 | 2.4 | LLL31 |
| Type                | a                                                     | b                                                                                                                                                                                                                                                                                                                                                                   | c                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |          |     |    |            |            |     |            |       |     |     |     |       |
| LLL18               | 0.3                                                   | 1.2                                                                                                                                                                                                                                                                                                                                                                 | 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |          |     |    |            |            |     |            |       |     |     |     |       |
| LLL21               | 0.6                                                   | 1.6                                                                                                                                                                                                                                                                                                                                                                 | 2.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |          |     |    |            |            |     |            |       |     |     |     |       |
| LLL31               | 1.0                                                   | 3.0                                                                                                                                                                                                                                                                                                                                                                 | 3.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |          |     |    |            |            |     |            |       |     |     |     |       |
| 13                  | Solderability of Termination                          | 75% of the terminations are to be soldered evenly and continuously.                                                                                                                                                                                                                                                                                                 | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C.                                                                                                                                                                                                                                |            |          |     |    |            |            |     |            |       |     |     |     |       |
| 14                  | Resistance to Soldering Heat                          | Appearance                                                                                                                                                                                                                                                                                                                                                          | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | Capacitance Change                                                                                                                                                                                                                                                                                                                                                  | R7 : Within±7.5%<br>F5 : Within±20%                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | D.F.                                                                                                                                                                                                                                                                                                                                                                | <table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>F5</td><td>0.05 max.</td><td>—</td></tr></table>                                                                                                                                                                                                                                                                                                        | Char.      | 25V min. | 16V | R7 | 0.025 max. | 0.035 max. | F5  | 0.05 max.  | —     |     |     |     |       |
|                     |                                                       | Char.                                                                                                                                                                                                                                                                                                                                                               | 25V min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 16V        |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | R7                                                                                                                                                                                                                                                                                                                                                                  | 0.025 max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.035 max. |          |     |    |            |            |     |            |       |     |     |     |       |
| F5                  | 0.05 max.                                             | —                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| I.R.                | More than 10,000MΩ or 500Ω • F (Whichever is smaller) |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| Dielectric Strength | No failure                                            |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| 15                  | Temperature Cycle                                     | Appearance                                                                                                                                                                                                                                                                                                                                                          | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | Capacitance Change                                                                                                                                                                                                                                                                                                                                                  | R7 : Within±7.5%<br>F5 : Within±20%                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | D.F.                                                                                                                                                                                                                                                                                                                                                                | <table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>F5</td><td>0.05 max.</td><td>—</td></tr></table>                                                                                                                                                                                                                                                                                                        | Char.      | 25V min. | 16V | R7 | 0.025 max. | 0.035 max. | F5  | 0.05 max.  | —     |     |     |     |       |
|                     |                                                       | Char.                                                                                                                                                                                                                                                                                                                                                               | 25V min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 16V        |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | R7                                                                                                                                                                                                                                                                                                                                                                  | 0.025 max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.035 max. |          |     |    |            |            |     |            |       |     |     |     |       |
| F5                  | 0.05 max.                                             | —                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| I.R.                | More than 10,000MΩ or 500Ω • F (Whichever is smaller) |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| Dielectric Strength | No failure                                            |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| 16                  | Humidity, Steady State                                | Appearance                                                                                                                                                                                                                                                                                                                                                          | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | Capacitance Change                                                                                                                                                                                                                                                                                                                                                  | R7 : Within±12.5%<br>F5 : Within±30%                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | D.F.                                                                                                                                                                                                                                                                                                                                                                | <table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>F5</td><td>0.075 max.</td><td>—</td></tr></table>                                                                                                                                                                                                                                                                                                         | Char.      | 25V min. | 16V | R7 | 0.05 max.  | 0.05 max.  | F5  | 0.075 max. | —     |     |     |     |       |
|                     |                                                       | Char.                                                                                                                                                                                                                                                                                                                                                               | 25V min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 16V        |          |     |    |            |            |     |            |       |     |     |     |       |
| R7                  | 0.05 max.                                             | 0.05 max.                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| F5                  | 0.075 max.                                            | —                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| I.R.                | More than 1,000MΩ or 50Ω • F (Whichever is smaller)   |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| 17                  | Humidity Load                                         | Appearance                                                                                                                                                                                                                                                                                                                                                          | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | Capacitance Change                                                                                                                                                                                                                                                                                                                                                  | R7 : Within±12.5%<br>F5 : Within±30%                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | D.F.                                                                                                                                                                                                                                                                                                                                                                | <table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>F5</td><td>0.075 max.</td><td>—</td></tr></table>                                                                                                                                                                                                                                                                                                         | Char.      | 25V min. | 16V | R7 | 0.05 max.  | 0.05 max.  | F5  | 0.075 max. | —     |     |     |     |       |
|                     |                                                       | Char.                                                                                                                                                                                                                                                                                                                                                               | 25V min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 16V        |          |     |    |            |            |     |            |       |     |     |     |       |
|                     |                                                       | R7                                                                                                                                                                                                                                                                                                                                                                  | 0.05 max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.05 max.  |          |     |    |            |            |     |            |       |     |     |     |       |
| F5                  | 0.075 max.                                            | —                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| I.R.                | More than 500MΩ or 25Ω • F (Whichever is smaller)     |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |
| Dielectric Strength | No failure                                            |                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |          |     |    |            |            |     |            |       |     |     |     |       |

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                  |                    | Specifications                                      |            |           | Test Method                                                                                                                                                                                                           |
|---------------------|-----------------------|--------------------|-----------------------------------------------------|------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18                  | High Temperature Load | Appearance         | No defects or abnormalities                         |            |           | Apply 200% of the rated voltage for 1,000±12 hours at maximum operating temperature ±3°C. Let sit for 48±4 hours at room temperature, then measure.<br><br>The charge/discharge current is less than 50mA.            |
|                     |                       | Capacitance Change | R7 : Within±12.5%<br>F5 : Within±30%                |            |           |                                                                                                                                                                                                                       |
|                     |                       | D.F.               | Char.                                               | 25V min.   | 16V       | •Initial measurement.<br><br>Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3°C.<br><br>Remove and let sit for 48±4 hours at room temperature.<br>Perform initial measurement. |
|                     |                       |                    | R7                                                  | 0.05 max.  | 0.05 max. |                                                                                                                                                                                                                       |
|                     |                       |                    | F5                                                  | 0.075 max. | —         |                                                                                                                                                                                                                       |
|                     |                       | I.R.               | More than 1,000MΩ or 50Ω • F (Whichever is smaller) |            |           |                                                                                                                                                                                                                       |
| Dielectric Strength | No failure            |                    |                                                     |            |           |                                                                                                                                                                                                                       |

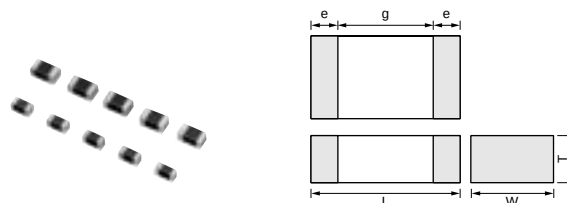
# Chip Monolithic Ceramic Capacitors



## High Frequency for Flow/Reflow Soldering

### ■ Features

1. HiQ and low ESR at VHF, UHF, Microwave
2. Feature improvement, low power consumption for mobile telecommunication. (Base station, terminal, etc.)



### ■ Applications

High frequency circuit (Mobile telecommunication, etc.)

| Part Number   | Dimensions (mm) |           |           |            |        |
|---------------|-----------------|-----------|-----------|------------|--------|
|               | L               | W         | T         | e          | g min. |
| <b>GQM188</b> | 1.6 ±0.1        | 0.8 ±0.1  | 0.8 ±0.1  | 0.2 to 0.5 | 0.5    |
| <b>GQM219</b> | 2.0 ±0.1        | 1.25 ±0.1 | 0.85 ±0.1 | 0.2 to 0.7 | 0.7    |

| Part Number                                                                                          | <b>GQM18</b>     |                  | <b>GQM21</b>     |            |
|------------------------------------------------------------------------------------------------------|------------------|------------------|------------------|------------|
| L x W                                                                                                | 1.60x0.80        |                  | 2.00x1.25        |            |
| TC                                                                                                   | C0G<br>(5C)      |                  | C0G<br>(5C)      |            |
| Rated Volt.                                                                                          | 100<br>(2A)      | 50<br>(1H)       | 100<br>(2A)      | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |                  |                  |            |
| 0.50pF( <b>R50</b> )                                                                                 | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 0.75pF( <b>R75</b> )                                                                                 | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 1.0pF( <b>1R0</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 1.1pF( <b>1R1</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 1.2pF( <b>1R2</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 1.3pF( <b>1R3</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 1.5pF( <b>1R5</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 1.6pF( <b>1R6</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 1.8pF( <b>1R8</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 2.0pF( <b>2R0</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 2.2pF( <b>2R2</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 2.4pF( <b>2R4</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 2.7pF( <b>2R7</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 3.0pF( <b>3R0</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 3.3pF( <b>3R3</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 3.6pF( <b>3R6</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 3.9pF( <b>3R9</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 4.0pF( <b>4R0</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 4.3pF( <b>4R3</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 4.7pF( <b>4R7</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 5.0pF( <b>5R0</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 5.1pF( <b>5R1</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 5.6pF( <b>5R6</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 6.0pF( <b>6R0</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 6.2pF( <b>6R2</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 6.8pF( <b>6R8</b> )                                                                                  | 0.80( <b>8</b> ) |                  | 0.85( <b>9</b> ) |            |
| 7.0pF( <b>7R0</b> )                                                                                  |                  | 0.80( <b>8</b> ) | 0.85( <b>9</b> ) |            |
| 7.5pF( <b>7R5</b> )                                                                                  |                  | 0.80( <b>8</b> ) | 0.85( <b>9</b> ) |            |
| 8.0pF( <b>8R0</b> )                                                                                  |                  | 0.80( <b>8</b> ) | 0.85( <b>9</b> ) |            |
| 8.2pF( <b>8R2</b> )                                                                                  |                  | 0.80( <b>8</b> ) | 0.85( <b>9</b> ) |            |
| 9.0pF( <b>9R0</b> )                                                                                  |                  | 0.80( <b>8</b> ) | 0.85( <b>9</b> ) |            |
| 9.1pF( <b>9R1</b> )                                                                                  |                  | 0.80( <b>8</b> ) | 0.85( <b>9</b> ) |            |
| 10pF( <b>100</b> )                                                                                   |                  | 0.80( <b>8</b> ) | 0.85( <b>9</b> ) |            |

Continued on the following page.

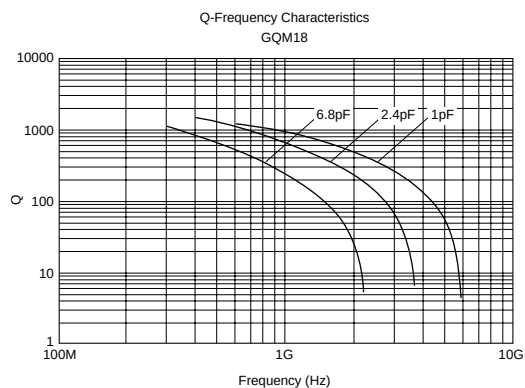
Continued from the preceding page.

| Part Number                                                                                          | GQM18       |            | GQM21       |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|-------------|------------|
| L x W                                                                                                | 1.60x0.80   |            | 2.00x1.25   |            |
| TC                                                                                                   | C0G<br>(5C) |            | C0G<br>(5C) |            |
| Rated Volt.                                                                                          | 100<br>(2A) | 50<br>(1H) | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |             |            |
| 11pF(110)                                                                                            |             | 0.80(8)    | 0.85(9)     |            |
| 12pF(120)                                                                                            |             | 0.80(8)    | 0.85(9)     |            |
| 13pF(130)                                                                                            |             | 0.80(8)    | 0.85(9)     |            |
| 15pF(150)                                                                                            |             | 0.80(8)    | 0.85(9)     |            |
| 16pF(160)                                                                                            |             | 0.80(8)    | 0.85(9)     |            |
| 18pF(180)                                                                                            |             | 0.80(8)    | 0.85(9)     |            |
| 20pF(200)                                                                                            |             | 0.80(8)    |             | 0.85(9)    |
| 22pF(220)                                                                                            |             | 0.80(8)    |             | 0.85(9)    |
| 24pF(240)                                                                                            |             | 0.80(8)    |             | 0.85(9)    |
| 27pF(270)                                                                                            |             |            |             | 0.85(9)    |
| 30pF(300)                                                                                            |             |            |             | 0.85(9)    |
| 33pF(330)                                                                                            |             |            |             | 0.85(9)    |
| 36pF(360)                                                                                            |             |            |             | 0.85(9)    |
| 39pF(390)                                                                                            |             |            |             | 0.85(9)    |
| 43pF(430)                                                                                            |             |            |             | 0.85(9)    |
| 47pF(470)                                                                                            |             |            |             | 0.85(9)    |

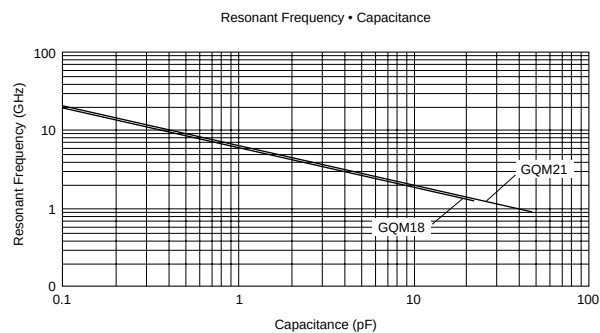
The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

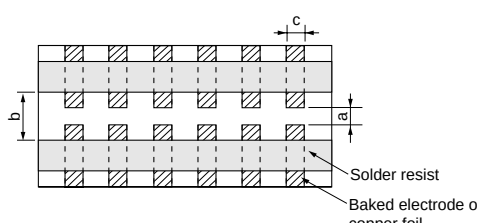
## Q-Frequency Characteristics



## Resonant Frequency-Capacitance



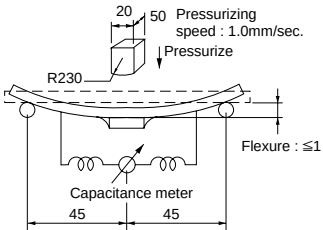
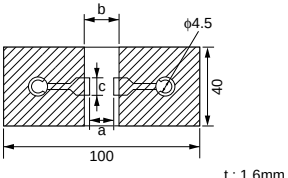
## Specifications and Test Methods

| No.                                                                                                                                             | Item                                           |                                                              | Specifications                                                                                  | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------|-----------------------|-----------|-------|----------|---------|------|--------------|-------|-----|------|-------|-----|-----|-----|
| 1                                                                                                                                               | Operating Temperature                          |                                                              | 5C : −55℃ to 125℃                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 2                                                                                                                                               | Rated Voltage                                  |                                                              | See the previous page.                                                                          | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, $V^{P-P}$ or $V^{O-P}$ , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 3                                                                                                                                               | Appearance                                     |                                                              | No defects or abnormalities                                                                     | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 4                                                                                                                                               | Dimension                                      |                                                              | Within the specified dimensions                                                                 | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 5                                                                                                                                               | Dielectric Strength                            |                                                              | No defects or abnormalities                                                                     | No failure should be observed when 300% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 6                                                                                                                                               | Insulation Resistance                          |                                                              | More than 10,000MΩ or 500Ω • F (whichever is smaller)                                           | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 2 minutes of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 7                                                                                                                                               | Capacitance                                    |                                                              | Within the specified tolerance                                                                  | The capacitance/Q should be measured at 25℃ at the frequency and voltage shown in the table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 8                                                                                                                                               | Q                                              |                                                              | 30pF min. : $Q \geq 1000$<br>30pF max. : $Q \geq 400 + 20C$<br><br>C : Nominal Capacitance (pF) | <table><tr><th>Item</th><th>Char.</th><th>5C (1000pF and below)</th></tr><tr><td>Frequency</td><td></td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td></td><td>0.5 to 5Vrms</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Item | Char.           | 5C (1000pF and below) | Frequency |       | 1±0.1MHz | Voltage |      | 0.5 to 5Vrms |       |     |      |       |     |     |     |
| Item                                                                                                                                            | Char.                                          | 5C (1000pF and below)                                        |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| Frequency                                                                                                                                       |                                                | 1±0.1MHz                                                     |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| Voltage                                                                                                                                         |                                                | 0.5 to 5Vrms                                                 |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 9                                                                                                                                               | Capacitance Temperature Characteristics        | Capacitance Change                                           | Within the specified tolerance (Table A)                                                        | The temperature coefficient is determined using the capacitance measured in step 3 as a reference.<br>When cycling the temperature sequentially from step 1 through 5 the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as in Table A. The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the steps 1, 3 and 5 by the capacitance. value in step 3.<br><table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>−55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table> | Step | Temperature (℃) | 1                     | 25±2      | 2     | −55±3    | 3       | 25±2 | 4            | 125±3 | 5   | 25±2 |       |     |     |     |
|                                                                                                                                                 |                                                | Step                                                         | Temperature (℃)                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
|                                                                                                                                                 |                                                | 1                                                            | 25±2                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 2                                                                                                                                               | −55±3                                          |                                                              |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 3                                                                                                                                               | 25±2                                           |                                                              |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 4                                                                                                                                               | 125±3                                          |                                                              |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 5                                                                                                                                               | 25±2                                           |                                                              |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| Temperature Coefficient                                                                                                                         | Within the specified tolerance (Table A)       |                                                              |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| Capacitance Drift                                                                                                                               | Within ±0.2% or ±0.05pF (Whichever is larger.) |                                                              |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 10                                                                                                                                              | Adhesive Strength of Termination               | No removal of the terminations or other defect should occur. |                                                                                                 | Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1sec.<br>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br><div>*5N (GQM188)</div> <table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GQM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GQM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GQM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr></table> <div>(in mm)</div> <div>Fig .1</div>                                   | Type | a               | b                     | c         | GQM18 | 1.0      | 3.0     | 1.2  | GQM21        | 1.2   | 4.0 | 1.65 | GQM32 | 2.2 | 5.0 | 2.9 |
|                                                                                                                                                 |                                                | Type                                                         | a                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | b    | c               |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| GQM18                                                                                                                                           | 1.0                                            | 3.0                                                          | 1.2                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| GQM21                                                                                                                                           | 1.2                                            | 4.0                                                          | 1.65                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| GQM32                                                                                                                                           | 2.2                                            | 5.0                                                          | 2.9                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
|  <div>Solder resist<br/>Baked electrode or copper foil</div> |                                                |                                                              |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
| 11                                                                                                                                              | Vibration Resistance                           | Appearance                                                   | No defects or abnormalities                                                                     | Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10).<br>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute.<br>This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).                                                                                                                                                                       |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
|                                                                                                                                                 |                                                | Capacitance                                                  | Within the specified tolerance                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |
|                                                                                                                                                 |                                                | Q                                                            | 30pF min. : $Q \geq 1000$<br>30pF max. : $Q \geq 400 + 20C$<br><br>C : NominalCapacitance (pF)  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                 |                       |           |       |          |         |      |              |       |     |      |       |     |     |     |

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                                            | Specifications                                                                                                                                                                                                                                                                                                                                                                                                     | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|---------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------|---------------------------|------------|-------|------------|---------------------------|------------|---------------------------|------------|-------------|------|--------|------|--------|
| 12                  | Deflection                                                                      | No crack or marked defect should occur.                                                                                                                                                                                                                                                                                                                                                                            | <p>Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2 using a eutectic solder.</p> <p>Then apply a force in the direction shown in Fig. 3.</p> <p>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p>  <p>Fig. 3</p>                                                                                                                                          |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 |  <p>t: 1.6mm</p> <table><thead><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr></thead><tbody><tr><td>GQM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GQM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GQM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr></tbody></table> <p>(in mm)</p> <p>Fig. 2</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Type                                                                                                                         | a          | b                         | c          | GQM18 | 1.0        | 3.0                       | 1.2        | GQM21                     | 1.2        | 4.0         | 1.65 | GQM32  | 2.2  | 5.0    |
| Type                | a                                                                               | b                                                                                                                                                                                                                                                                                                                                                                                                                  | c                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| GQM18               | 1.0                                                                             | 3.0                                                                                                                                                                                                                                                                                                                                                                                                                | 1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| GQM21               | 1.2                                                                             | 4.0                                                                                                                                                                                                                                                                                                                                                                                                                | 1.65                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| GQM32               | 2.2                                                                             | 5.0                                                                                                                                                                                                                                                                                                                                                                                                                | 2.9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| 13                  | Solderability of Termination                                                    | 75% of the terminations are to be soldered evenly and continuously.                                                                                                                                                                                                                                                                                                                                                | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C.                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| 14                  | Resistance to Soldering Heat                                                    | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                                                                | <p>Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5°C for 10±0.5 seconds. Let sit at room temperature for 24±2 hours.</p>                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Appearance                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | No marking defects                                                                                                           |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Capacitance Change                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Within ±2.5% or ±0.25 pF (Whichever is larger)                                                                               |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Q                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 30pF min. : Q≥1000<br>30pF max. : Q≥400+20C<br><br>C : Nominal Capacitance (pF)                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | I.R.                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                                                                        |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| Dielectric Strength | No failure                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| 15                  | Temperature Cycle                                                               | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                                                                | <p>Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table.</p> <p>Let sit for 24±2 hours at room temperature, then measure.</p> <table><thead><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr></thead><tbody><tr><td>Temp. (°C)</td><td>Min. Operating Temp.+0/-3</td><td>Room Temp.</td><td>Max. operating Temp.+3/-0</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></tbody></table> | Step                                                                                                                         | 1          | 2                         | 3          | 4     | Temp. (°C) | Min. Operating Temp.+0/-3 | Room Temp. | Max. operating Temp.+3/-0 | Room Temp. | Time (min.) | 30±3 | 2 to 3 | 30±3 | 2 to 3 |
|                     |                                                                                 | Step                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                                                                                                                            | 2          | 3                         | 4          |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Temp. (°C)                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Min. Operating Temp.+0/-3                                                                                                    | Room Temp. | Max. operating Temp.+3/-0 | Room Temp. |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Time (min.)                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 30±3                                                                                                                         | 2 to 3     | 30±3                      | 2 to 3     |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Appearance                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | No marking defects                                                                                                           |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Capacitance Change                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Within ±2.5% or ±0.25pF (Whichever is larger)                                                                                |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| Q                   | 30pF min. : Q≥1000<br>30pF max. : Q≥400+20C<br><br>C : Nominal Capacitance (pF) |                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| I.R.                | More than 10,000MΩ or 500Ω • F (Whichever is smaller)                           |                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| Dielectric Strength | No failure                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
| 16                  | Humidity Steady State                                                           | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                                                                | <p>Let the capacitor sit at 40±2°C and 90 to 95% humidity for 500±12 hours.</p> <p>Remove and let sit for 24±2 hours (temperature compensating type) at room temperature, then measure.</p>                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                              |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Appearance                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | No marking defects                                                                                                           |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Capacitance Change                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Within ±5% or ±0.5pF (Whichever is larger)                                                                                   |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Q                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 30pF min. : Q≥350<br>10pF and over, 30pF and below : Q≥275+5C/2<br>10pF max. : Q≥200+10C<br><br>C : Nominal Capacitance (pF) |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | I.R.                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | More than 1,000MΩ or 50Ω • F (Whichever is smaller)                                                                          |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |
|                     |                                                                                 | Dielectric Strength                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | No failure                                                                                                                   |            |                           |            |       |            |                           |            |                           |            |             |      |        |      |        |

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No. | Item                  | Specifications                                                                                      | Test Method                                                                                                                                                                                                                            |
|-----|-----------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17  | Humidity Load         | The measured and observed characteristics should satisfy the specifications in the following table. | Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature then measure. The charge/discharge current is less than 50mA.                                         |
|     |                       | Appearance                                                                                          |                                                                                                                                                                                                                                        |
|     |                       | Capacitance Change                                                                                  |                                                                                                                                                                                                                                        |
|     |                       | Q                                                                                                   |                                                                                                                                                                                                                                        |
|     |                       | I.R.                                                                                                |                                                                                                                                                                                                                                        |
|     |                       | Dielectric Strength                                                                                 |                                                                                                                                                                                                                                        |
| 18  | High Temperature Load | The measured and observed characteristics should satisfy the specifications in the following table. | Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 hours (temperature compensating type) at room temperature, then measure. The charge/discharge current is less than 50mA. |
|     |                       | Appearance                                                                                          |                                                                                                                                                                                                                                        |
|     |                       | Capacitance Change                                                                                  |                                                                                                                                                                                                                                        |
|     |                       | Q                                                                                                   |                                                                                                                                                                                                                                        |
|     |                       | I.R.                                                                                                |                                                                                                                                                                                                                                        |
|     |                       | Dielectric Strength                                                                                 |                                                                                                                                                                                                                                        |

Table A

| Char. | Nominal Values (ppm/°C) Note 1 | Capacitance Change from 25°C (%) |       |      |       |      |       |
|-------|--------------------------------|----------------------------------|-------|------|-------|------|-------|
|       |                                | -55                              |       | -30  |       | -10  |       |
|       |                                | Max.                             | Min.  | Max. | Min.  | Max. | Min.  |
| 5C    | 0±30                           | 0.58                             | -0.24 | 0.40 | -0.17 | 0.25 | -0.11 |

Note1 : Nominal values denote the temperature coefficient within a range of 25°C to 125°C (for 5C)

# Chip Monolithic Ceramic Capacitors

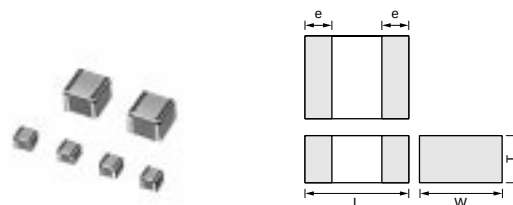
**muRata**

## High-Q & High Power Type

### SMD Type

#### ■ Features (ERF Series)

1. The dielectric is composed of low dielectric loss ceramic. This series is perfectly suited to high frequency applications (VHS-microwave band).
2. The series is ultraminiature, yet has a high-power capacity. This is the best capacitor available for transmitter and amplifier circuits such as those in broadcasting equipment and mobile base stations.
3. ERF1D type is designed for both flow and reflow soldering and ERF22 type is designed for reflow soldering.



| Part Number | Dimensions (mm)                     |                                     |                                        |                                        |
|-------------|-------------------------------------|-------------------------------------|----------------------------------------|----------------------------------------|
|             | L                                   | W                                   | T                                      | e                                      |
| ERF1DM      | 1.4 <sup>+0.6</sup> <sub>-0.4</sub> | 1.4 <sup>+0.6</sup> <sub>-0.4</sub> | 1.15 <sup>+0.50</sup> <sub>-0.35</sub> | 0.25 <sup>+0.25</sup> <sub>-0.15</sub> |
| ERF22X      | 2.8 <sup>+0.6</sup> <sub>-0.4</sub> | 2.8 <sup>+0.6</sup> <sub>-0.4</sub> | 2.3 <sup>+0.5</sup> <sub>-0.3</sub>    | 0.4 <sup>+0.4</sup> <sub>-0.3</sub>    |

#### ■ Applications

High frequency and high power circuits

| Part Number                                                                                          | ERF1D       |            | ERF22       |             |             |             |            |             |             |             |             |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|
| L x W                                                                                                | 1.40x1.40   |            | 2.80x2.80   |             |             |             |            |             |             |             |             |            |
| TC                                                                                                   | C0G<br>(5C) | CH<br>(6C) | C0G<br>(5C) |             |             |             |            | CH<br>(6C)  |             |             |             |            |
| Rated Volt.                                                                                          | 50<br>(1H)  | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |             |             |             |             |            |             |             |             |             |            |
| 0.50pF(R50)                                                                                          | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 0.6pF(R60)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 0.7pF(R70)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 0.75pF(R75)                                                                                          |             | 1.15(M)    |             |             |             |             |            | 2.30(X)     |             |             |             |            |
| 0.8pF(R80)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 0.9pF(R90)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 1.0pF(1R0)                                                                                           | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 1.1pF(1R1)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 1.2pF(1R2)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 1.3pF(1R3)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 1.4pF(1R4)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 1.5pF(1R5)                                                                                           | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 1.6pF(1R6)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 1.7pF(1R7)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 1.8pF(1R8)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 1.9pF(1R9)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 2.0pF(2R0)                                                                                           | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 2.1pF(2R1)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 2.2pF(2R2)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 2.4pF(2R4)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 2.7pF(2R7)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 3.0pF(3R0)                                                                                           | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 3.3pF(3R3)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 3.6pF(3R6)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 3.9pF(3R9)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 4.0pF(4R0)                                                                                           |             | 1.15(M)    |             |             |             |             |            | 2.30(X)     |             |             |             |            |
| 4.3pF(4R3)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 4.7pF(4R7)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |

Continued on the following page.

**muRata**

Continued from the preceding page.

| Part Number                                                                                          | ERF1D       |            | ERF22       |             |             |             |            |             |             |             |             |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|
| L x W                                                                                                | 1.40x1.40   |            | 2.80x2.80   |             |             |             |            |             |             |             |             |            |
| TC                                                                                                   | COG<br>(5C) | CH<br>(6C) | COG<br>(5C) |             |             |             |            | CH<br>(6C)  |             |             |             |            |
| Rated Volt.                                                                                          | 50<br>(1H)  | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |             |             |             |             |            |             |             |             |             |            |
| 5.0pF(5R0)                                                                                           |             | 1.15(M)    |             |             |             |             |            | 2.30(X)     |             |             |             |            |
| 5.1pF(5R1)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 5.6pF(5R6)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 6.0pF(6R0)                                                                                           |             | 1.15(M)    |             |             |             |             |            | 2.30(X)     |             |             |             |            |
| 6.2pF(6R2)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 6.8pF(6R8)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 7.0pF(7R0)                                                                                           |             | 1.15(M)    |             |             |             |             |            | 2.30(X)     |             |             |             |            |
| 7.5pF(7R5)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 8.0pF(8R0)                                                                                           |             | 1.15(M)    |             |             |             |             |            | 2.30(X)     |             |             |             |            |
| 8.2pF(8R2)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 9.0pF(9R0)                                                                                           |             | 1.15(M)    |             |             |             |             |            | 2.30(X)     |             |             |             |            |
| 9.1pF(9R1)                                                                                           | 1.15(M)     |            | 2.30(X)     |             |             |             |            |             |             |             |             |            |
| 10pF(100)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 11pF(110)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 12pF(120)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 13pF(130)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 15pF(150)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 16pF(160)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 18pF(180)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 20pF(200)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 22pF(220)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 24pF(240)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 27pF(270)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 30pF(300)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 33pF(330)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 36pF(360)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 39pF(390)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 43pF(430)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 47pF(470)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 51pF(510)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 56pF(560)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 62pF(620)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 68pF(680)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 75pF(750)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 82pF(820)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 91pF(910)                                                                                            | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 100pF(101)                                                                                           | 1.15(M)     | 1.15(M)    | 2.30(X)     |             |             |             |            | 2.30(X)     |             |             |             |            |
| 110pF(111)                                                                                           |             |            |             | 2.30(X)     |             |             |            |             | 2.30(X)     |             |             |            |
| 120pF(121)                                                                                           |             |            |             | 2.30(X)     |             |             |            |             | 2.30(X)     |             |             |            |
| 130pF(131)                                                                                           |             |            |             | 2.30(X)     |             |             |            |             | 2.30(X)     |             |             |            |
| 150pF(151)                                                                                           |             |            |             | 2.30(X)     |             |             |            |             | 2.30(X)     |             |             |            |
| 160pF(161)                                                                                           |             |            |             | 2.30(X)     |             |             |            |             | 2.30(X)     |             |             |            |
| 180pF(181)                                                                                           |             |            |             | 2.30(X)     |             |             |            |             | 2.30(X)     |             |             |            |
| 200pF(201)                                                                                           |             |            |             | 2.30(X)     |             |             |            |             | 2.30(X)     |             |             |            |
| 220pF(221)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |
| 240pF(241)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |
| 270pF(271)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |
| 300pF(301)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |
| 330pF(331)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |
| 360pF(361)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |
| 390pF(391)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |
| 430pF(431)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |

Continued on the following page. ➤

Continued from the preceding page.

| Part Number                                                                                          | ERF1D       |            | ERF22       |             |             |             |            |             |             |             |             |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|
| L x W                                                                                                | 1.40x1.40   |            | 2.80x2.80   |             |             |             |            |             |             |             |             |            |
| TC                                                                                                   | COG<br>(5C) | CH<br>(6C) | COG<br>(5C) |             |             |             |            | CH<br>(6C)  |             |             |             |            |
| Rated Volt.                                                                                          | 50<br>(1H)  | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |             |             |             |             |            |             |             |             |             |            |
| 470pF(471)                                                                                           |             |            |             |             | 2.30(X)     |             |            |             |             | 2.30(X)     |             |            |
| 510pF(511)                                                                                           |             |            |             |             |             | 2.30(X)     |            |             |             |             | 2.30(X)     |            |
| 560pF(561)                                                                                           |             |            |             |             |             | 2.30(X)     |            |             |             |             | 2.30(X)     |            |
| 620pF(621)                                                                                           |             |            |             |             |             | 2.30(X)     |            |             |             |             | 2.30(X)     |            |
| 680pF(681)                                                                                           |             |            |             |             |             | 2.30(X)     |            |             |             |             | 2.30(X)     |            |
| 750pF(751)                                                                                           |             |            |             |             |             |             | 2.30(X)    |             |             |             |             | 2.30(X)    |
| 820pF(821)                                                                                           |             |            |             |             |             |             | 2.30(X)    |             |             |             |             | 2.30(X)    |
| 910pF(911)                                                                                           |             |            |             |             |             |             | 2.30(X)    |             |             |             |             | 2.30(X)    |
| 1000pF(102)                                                                                          |             |            |             |             |             |             | 2.30(X)    |             |             |             |             | 2.30(X)    |

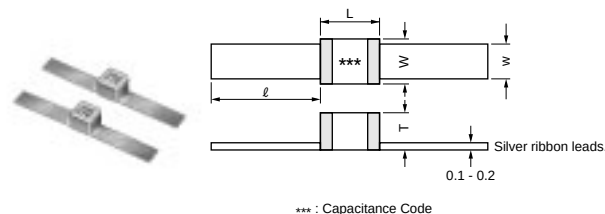
The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

## Ribbon Terminal

### ■ Features (ERH Series)

1. The dielectric is composed of low dielectric loss ceramics. This series is perfectly suited to high frequency applications (VHS-microwave band).
2. The series is ultraminiature, yet has a high power capacity. This is the best capacitor available for transmitter and amplifier circuits such as those in broadcasting equipment and mobile base stations.
3. ERH1X/3X Series capacitors withstand high temperatures because ribbon leads are attached with silver paste.
4. ERH1X/3X Series capacitors are easily soldered and especially well suited in applications where only a soldering iron can be used.



| Part Number | Dimensions (mm) |          |        |          |            |
|-------------|-----------------|----------|--------|----------|------------|
|             | L               | W        | T max. | ℓ        | w          |
| ERH1XC      | 1.6 ±0.4        | 1.4 ±0.4 | 1.6    | 5.0 min. | 1.3 ±0.4   |
| ERH3XX      | 3.2 ±0.4        | 2.8 ±0.4 | 3.0    | 9.0 ±2.0 | 2.35 ±0.15 |

### ■ Applications

High frequency and high power circuits

| Part Number                                                                                          | ERH1X       |            | ERH3X       |             |             |             |            |             |             |             |             |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|
| L x W                                                                                                | 1.60x1.40   |            | 3.20x2.80   |             |             |             |            |             |             |             |             |            |
| TC                                                                                                   | COG<br>(5C) | CH<br>(6C) | COG<br>(5C) |             |             |             |            | CH<br>(6C)  |             |             |             |            |
| Rated Volt.                                                                                          | 50<br>(1H)  | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |             |             |             |             |            |             |             |             |             |            |
| 0.50pF(R50)                                                                                          | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 0.6pF(R60)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 0.7pF(R70)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 0.75pF(R75)                                                                                          |             | 1.60(C)    |             |             |             |             |            | 3.00(X)     |             |             |             |            |
| 0.8pF(R80)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 0.9pF(R90)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 1.0pF(1R0)                                                                                           | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 1.1pF(1R1)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 1.2pF(1R2)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 1.3pF(1R3)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 1.4pF(1R4)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 1.5pF(1R5)                                                                                           | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |

Continued on the following page. ➤

Continued from the preceding page.

| Part Number                                                                                          | ERH1X       |            | ERH3X       |             |             |             |            |             |             |             |             |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|
| L x W                                                                                                | 1.60x1.40   |            | 3.20x2.80   |             |             |             |            |             |             |             |             |            |
| TC                                                                                                   | COG<br>(5C) | CH<br>(6C) | COG<br>(5C) |             |             |             |            | CH<br>(6C)  |             |             |             |            |
| Rated Volt.                                                                                          | 50<br>(1H)  | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |             |             |             |             |            |             |             |             |             |            |
| 1.6pF(1R6)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 1.7pF(1R7)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 1.8pF(1R8)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 1.9pF(1R9)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 2.0pF(2R0)                                                                                           | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 2.1pF(2R1)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 2.2pF(2R2)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 2.4pF(2R4)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 2.7pF(2R7)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 3.0pF(3R0)                                                                                           | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 3.3pF(3R3)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 3.6pF(3R6)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 3.9pF(3R9)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 4.0pF(4R0)                                                                                           |             | 1.60(C)    |             |             |             |             |            | 3.00(X)     |             |             |             |            |
| 4.3pF(4R3)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 4.7pF(4R7)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 5.0pF(5R0)                                                                                           |             | 1.60(C)    |             |             |             |             |            | 3.00(X)     |             |             |             |            |
| 5.1pF(5R1)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 5.6pF(5R6)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 6.0pF(6R0)                                                                                           |             | 1.60(C)    |             |             |             |             |            | 3.00(X)     |             |             |             |            |
| 6.2pF(6R2)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 6.8pF(6R8)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 7.0pF(7R0)                                                                                           |             | 1.60(C)    |             |             |             |             |            | 3.00(X)     |             |             |             |            |
| 7.5pF(7R5)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 8.0pF(8R0)                                                                                           |             | 1.60(C)    |             |             |             |             |            | 3.00(X)     |             |             |             |            |
| 8.2pF(8R2)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 9.0pF(9R0)                                                                                           |             | 1.60(C)    |             |             |             |             |            | 3.00(X)     |             |             |             |            |
| 9.1pF(9R1)                                                                                           | 1.60(C)     |            | 3.00(X)     |             |             |             |            |             |             |             |             |            |
| 10pF(100)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 11pF(110)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 12pF(120)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 13pF(130)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 15pF(150)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 16pF(160)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 18pF(180)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 20pF(200)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 22pF(220)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 24pF(240)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 27pF(270)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 30pF(300)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 33pF(330)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 36pF(360)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 39pF(390)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 43pF(430)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 47pF(470)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 51pF(510)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 56pF(560)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 62pF(620)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 68pF(680)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 75pF(750)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 82pF(820)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 91pF(910)                                                                                            | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |

Continued on the following page. ➤

Continued from the preceding page.

| Part Number                                                                                          | ERH1X       |            | ERH3X       |             |             |             |            |             |             |             |             |            |
|------------------------------------------------------------------------------------------------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|
| L x W                                                                                                | 1.60x1.40   |            | 3.20x2.80   |             |             |             |            |             |             |             |             |            |
| TC                                                                                                   | C0G<br>(5C) | CH<br>(6C) | C0G<br>(5C) |             |             |             |            | CH<br>(6C)  |             |             |             |            |
| Rated Volt.                                                                                          | 50<br>(1H)  | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 500<br>(2H) | 300<br>(YD) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |            |             |             |             |             |            |             |             |             |             |            |
| 100pF(101)                                                                                           | 1.60(C)     | 1.60(C)    | 3.00(X)     |             |             |             |            | 3.00(X)     |             |             |             |            |
| 110pF(111)                                                                                           |             |            |             | 3.00(X)     |             |             |            |             | 3.00(X)     |             |             |            |
| 120pF(121)                                                                                           |             |            |             | 3.00(X)     |             |             |            |             | 3.00(X)     |             |             |            |
| 130pF(131)                                                                                           |             |            |             | 3.00(X)     |             |             |            |             | 3.00(X)     |             |             |            |
| 150pF(151)                                                                                           |             |            |             | 3.00(X)     |             |             |            |             | 3.00(X)     |             |             |            |
| 160pF(161)                                                                                           |             |            |             | 3.00(X)     |             |             |            |             | 3.00(X)     |             |             |            |
| 180pF(181)                                                                                           |             |            |             | 3.00(X)     |             |             |            |             | 3.00(X)     |             |             |            |
| 200pF(201)                                                                                           |             |            |             | 3.00(X)     |             |             |            |             | 3.00(X)     |             |             |            |
| 220pF(221)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 240pF(241)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 270pF(271)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 300pF(301)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 330pF(331)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 360pF(361)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 390pF(391)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 430pF(431)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 470pF(471)                                                                                           |             |            |             |             | 3.00(X)     |             |            |             |             | 3.00(X)     |             |            |
| 510pF(511)                                                                                           |             |            |             |             |             | 3.00(X)     |            |             |             |             | 3.00(X)     |            |
| 560pF(561)                                                                                           |             |            |             |             |             | 3.00(X)     |            |             |             |             | 3.00(X)     |            |
| 620pF(621)                                                                                           |             |            |             |             |             | 3.00(X)     |            |             |             |             | 3.00(X)     |            |
| 680pF(681)                                                                                           |             |            |             |             |             | 3.00(X)     |            |             |             |             | 3.00(X)     |            |
| 750pF(751)                                                                                           |             |            |             |             |             |             | 3.00(X)    |             |             |             |             | 3.00(X)    |
| 820pF(821)                                                                                           |             |            |             |             |             |             | 3.00(X)    |             |             |             |             | 3.00(X)    |
| 910pF(911)                                                                                           |             |            |             |             |             |             | 3.00(X)    |             |             |             |             | 3.00(X)    |
| 1000pF(102)                                                                                          |             |            |             |             |             |             | 3.00(X)    |             |             |             |             | 3.00(X)    |

The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

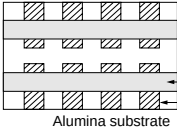
## Specifications and Test Methods

| No.       | Item                                    |                                                               | Specifications                                                                                                                                                                              | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                 |           |          |         |                 |   |      |   |       |   |      |
|-----------|-----------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------|-----------|----------|---------|-----------------|---|------|---|-------|---|------|
| 1         | Operating Temperature Range             |                                                               | −55℃ to +125℃                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 2         | Rated Voltage                           |                                                               | See the previous pages.                                                                                                                                                                     | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, $V^{P-P}$ or $V^{O-P}$ , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 3         | Appearance                              |                                                               | No defects or abnormalities                                                                                                                                                                 | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 4         | Dimensions                              |                                                               | Within the specified dimension                                                                                                                                                              | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 5         | Dielectric Strength                     |                                                               | No defects or abnormalities                                                                                                                                                                 | No failure should be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 6         | Insulation Resistance (I.R.)            | 25℃                                                           | $C \leq 470\text{pF}$ : 1,000,000MΩ min.<br>$470\text{pF} < C \leq 1,000\text{pF}$ : 100,000MΩ min.                                                                                         | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and 125℃ standard humidity and within 2 minutes of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                 |           |          |         |                 |   |      |   |       |   |      |
|           |                                         | 125℃                                                          | $C \leq 470\text{pF}$ : 100,000MΩ min.<br>$470\text{pF} < C \leq 1,000\text{pF}$ : 10,000MΩ min.                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 7         | Capacitance                             |                                                               | Within the specified tolerance.                                                                                                                                                             | The capacitance/Q should be measured at 25℃ at the frequency and voltage shown in the table. <table><tr><th>Item</th><th></th></tr><tr><td>Frequency</td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Item |                 | Frequency | 1±0.1MHz | Voltage | 0.5 to 5Vr.m.s. |   |      |   |       |   |      |
| Item      |                                         |                                                               |                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| Frequency | 1±0.1MHz                                |                                                               |                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| Voltage   | 0.5 to 5Vr.m.s.                         |                                                               |                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 8         | Q                                       |                                                               | $C \leq 220\text{pF}$ : $Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF}$ : $Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF}$ : $Q \geq 3,000$<br>C : Nominal Capacitance (pF) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 9         | Capacitance Temperature Characteristics | Capacitance Variation Rate                                    | Within the specified tolerance (Table A-7)                                                                                                                                                  | The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step 1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A.<br>The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.<br>The capacitance change should be measured after 5 min. at each specified temperature stage. <table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>−55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table> | Step | Temperature (℃) | 1         | 25±2     | 2       | −55±3           | 3 | 25±2 | 4 | 125±3 | 5 | 25±2 |
|           |                                         | Step                                                          | Temperature (℃)                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
|           |                                         | 1                                                             | 25±2                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
|           |                                         | 2                                                             | −55±3                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 3         | 25±2                                    |                                                               |                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 4         | 125±3                                   |                                                               |                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 5         | 25±2                                    |                                                               |                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 10        | Terminal Strength                       | Temperature Coefficient                                       | Within the specified tolerance (Table A-7)                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
|           |                                         | Capacitance Drift                                             | Within ±0.2% or ±0.05pF (Whichever is larger)                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
|           |                                         | Adhesive Strength of Termination (for chip type)              | No removal of the terminations or other defects should occur.                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
| 10        | Terminal Strength                       | Tensile Strength (for micro-strip type)                       | Capacitor should not be broken or damaged.                                                                                                                                                  | The capacitor body is fixed and a load is applied gradually in the axial direction until its value reaches 10N (5N for ERH1X).<br><br>Position the main body of the capacitor so the lead wire terminal is perpendicular, and load 2.5N to the lead wire terminal. Bend the main body by 90 degrees, bend back to original position, bend 90 degrees in the reverse direction, and then bend back to original position.                                                                                                                                                                                                                                                                                                                                                                                   |      |                 |           |          |         |                 |   |      |   |       |   |      |
|           |                                         | Bending Strength of lead wire terminal (for micro-strip type) | Lead wire should not be cut or broken.                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |
|           |                                         |                                                               |                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                 |           |          |         |                 |   |      |   |       |   |      |

Continued on the following page. 

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Specifications                                                                                                                                                                                                                                                                                                                                                 | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------|------------------|--------------------|-----------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---|---|---|---|-----------|-------|-----------|-------|-----------|------------|------|--------|------|--------|
| 11                  | Vibration Resistance                                                                                                                                  | Appearance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                    | <p>Solder the capacitor to the test jig (alumina substrate) shown in Fig. 2 using solder containing 2.5% silver. The soldering should be done either with an iron or using the reflow method and should be conducted with care so the soldering is uniform and free of defects such as heat shock. The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</p> <div><p>Solder resist<br/>Ag/Pd<br/>Alumina substrate</p></div> <p>Fig. 2</p> |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
|                     |                                                                                                                                                       | Capacitance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Within the specified tolerance                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
|                     |                                                                                                                                                       | Q                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>Satisfies the initial value.</p> <p><math>C \leq 220\text{pF} : Q \geq 10,000</math><br/><math>220\text{pF} &lt; C \leq 470\text{pF} : Q \geq 5,000</math><br/><math>470\text{pF} &lt; C \leq 1,000\text{pF} : Q \geq 3,000</math><br/>C : Nominal Capacitance (pF)</p>                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| 12                  | Solderability of Termination                                                                                                                          | 95% of the terminations are to be soldered evenly and continuously.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating immerse in solder containing 2.5% silver for 5±0.5 seconds at 230±5°C. The dipping depth for microstrip type capacitors is up to 1 mm from the root of the terminal.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| 13                  | Resistance to Soldering Heat                                                                                                                          | <p>The measured and observed characteristics should satisfy the specifications in the following table.</p> <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td><math>C \leq 220\text{pF} : Q \geq 10,000</math><br/><math>220\text{pF} &lt; C \leq 470\text{pF} : Q \geq 5,000</math><br/><math>470\text{pF} &lt; C \leq 1,000\text{pF} : Q \geq 3,000</math></td></tr><tr><td>I.R.</td><td>More than 30% of the initial specification value at 25°C.</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table> <p>C : Nominal Capacitance (pF)</p> |                                                                                                                                                                                                                                                                                                                                                                | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Specifications | Appearance | No marked defect | Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | Q | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$ | I.R. | More than 30% of the initial specification value at 25°C. | Dielectric Strength                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No failure | <p>Preheat the capacitor at 80 to 100°C for 2 minutes and then at 150 to 200°C for 5 minutes.</p> <p>Immerse in solder containing 2.5% silver for 3±0.5 seconds at 270±5°C. Set at room temperature for 24±2 hours, then measure. The dipping depth for microstrip type capacitors is up to 2mm from the root of the terminal.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
|                     |                                                                                                                                                       | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Specifications                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Appearance          | No marked defect                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Capacitance Change  | Within ±2.5% or ±0.25pF (Whichever is larger)                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Q                   | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$ |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| I.R.                | More than 30% of the initial specification value at 25°C.                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Dielectric Strength | No failure                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| 14                  | Temperature Cycle                                                                                                                                     | <p>The measured and observed characteristics should satisfy the specifications in the following table.</p> <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±1% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td><math>C \leq 220\text{pF} : Q \geq 10,000</math><br/><math>220\text{pF} &lt; C \leq 470\text{pF} : Q \geq 5,000</math><br/><math>470\text{pF} &lt; C \leq 1,000\text{pF} : Q \geq 3,000</math></td></tr><tr><td>I.R.</td><td>More than 30% of the initial specification value at 25°C.</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table> <p>C : Nominal Capacitance (pF)</p>   |                                                                                                                                                                                                                                                                                                                                                                | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Specifications | Appearance | No marked defect | Capacitance Change | Within ±1% or ±0.25pF (Whichever is larger)   | Q | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$ | I.R. | More than 30% of the initial specification value at 25°C. | Dielectric Strength                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No failure | <p>Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11). Perform the five cycles according to the four heat treatments listed in the following table. Then, repeat twice the successive cycles of immersion, each cycle consisting of immersion in a fresh water at 65±3°C for 15 minutes and immersion in a saturated aqueous solution of salt at 0±3°C for 15 minutes.</p> <p>The capacitor is promptly washed with running water, dried with a dry cloth, and allowed to sit at room temperature for 24±2 hours.</p> <table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp.(°C)</td><td>-55±3</td><td>RoomTemp.</td><td>125±3</td><td>RoomTemp.</td></tr><tr><td>Time(min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table> | Step | 1 | 2 | 3 | 4 | Temp.(°C) | -55±3 | RoomTemp. | 125±3 | RoomTemp. | Time(min.) | 30±3 | 2 to 3 | 30±3 | 2 to 3 |
|                     |                                                                                                                                                       | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Specifications                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Appearance          | No marked defect                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Capacitance Change  | Within ±1% or ±0.25pF (Whichever is larger)                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Q                   | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$ |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| I.R.                | More than 30% of the initial specification value at 25°C.                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Dielectric Strength | No failure                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Step                | 1                                                                                                                                                     | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3                                                                                                                                                                                                                                                                                                                                                              | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Temp.(°C)           | -55±3                                                                                                                                                 | RoomTemp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 125±3                                                                                                                                                                                                                                                                                                                                                          | RoomTemp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Time(min.)          | 30±3                                                                                                                                                  | 2 to 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 30±3                                                                                                                                                                                                                                                                                                                                                           | 2 to 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| 15                  | Humidity                                                                                                                                              | <p>The measured and observed characteristics should satisfy the specifications in the following table.</p> <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td></tr><tr><td>Q</td><td><math>C \leq 220\text{pF} : Q \geq 10,000</math><br/><math>220\text{pF} &lt; C \leq 470\text{pF} : Q \geq 5,000</math><br/><math>470\text{pF} &lt; C \leq 1,000\text{pF} : Q \geq 3,000</math></td></tr><tr><td>I.R.</td><td>More than 30% of the initial specification value at 25°C.</td></tr></table> <p>C : Nominal Capacitance (pF)</p>                                                            |                                                                                                                                                                                                                                                                                                                                                                | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Specifications | Appearance | No marked defect | Capacitance Change | Within ±5% or ±0.5pF (Whichever is larger)    | Q | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$ | I.R. | More than 30% of the initial specification value at 25°C. | <p>Apply the 24-hour heat (-10 to +65°C) and humidity (80 to 98%) treatment shown below, 10 consecutive times. Remove, let sit for 24±2 hours at room temperature, and measure.</p> <div><p>Temperature</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98%</p><p>Humidity 80-98%</p><p>Humidity 90-98</p></div> |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
|                     |                                                                                                                                                       | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Specifications                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Appearance          | No marked defect                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Capacitance Change  | Within ±5% or ±0.5pF (Whichever is larger)                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| Q                   | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$ |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |
| I.R.                | More than 30% of the initial specification value at 25°C.                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |      |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |   |   |   |   |           |       |           |       |           |            |      |        |      |        |

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No.                          | Item                  | Specifications                                                                                                                                                                                                                                                                                                                                                                                                        | Test Method                                                                                                                                                                           |                                                                                 |                |            |                  |                    |                                               |   |                                                                                 |      |                                                          |
|------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------|------------|------------------|--------------------|-----------------------------------------------|---|---------------------------------------------------------------------------------|------|----------------------------------------------------------|
| 16                           | High Temperature Load | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                                                                   | Apply 150% of the rated voltage for 2,000±12 hours at 125±3℃. Remove and let sit for 24±2 hours at room temperature, then measure.<br>The charge/discharge current is less than 50mA. |                                                                                 |                |            |                  |                    |                                               |   |                                                                                 |      |                                                          |
|                              |                       | <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td>C ≤ 220pF : Q≥10,000<br/>220pF&lt;C≤ 470pF : Q≥ 5,000<br/>470pF&lt;C≤1,000pF : Q≥ 3,000</td></tr><tr><td>I.R.</td><td>More than 30% of the initial specification value at 25℃.</td></tr></table> |                                                                                                                                                                                       | Item                                                                            | Specifications | Appearance | No marked defect | Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | Q | C ≤ 220pF : Q≥10,000<br>220pF<C≤ 470pF : Q≥ 5,000<br>470pF<C≤1,000pF : Q≥ 3,000 | I.R. | More than 30% of the initial specification value at 25℃. |
|                              |                       | Item                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                       | Specifications                                                                  |                |            |                  |                    |                                               |   |                                                                                 |      |                                                          |
|                              |                       | Appearance                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                       | No marked defect                                                                |                |            |                  |                    |                                               |   |                                                                                 |      |                                                          |
|                              |                       | Capacitance Change                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                       | Within ±2.5% or ±0.25pF (Whichever is larger)                                   |                |            |                  |                    |                                               |   |                                                                                 |      |                                                          |
|                              |                       | Q                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                       | C ≤ 220pF : Q≥10,000<br>220pF<C≤ 470pF : Q≥ 5,000<br>470pF<C≤1,000pF : Q≥ 3,000 |                |            |                  |                    |                                               |   |                                                                                 |      |                                                          |
|                              |                       | I.R.                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                       | More than 30% of the initial specification value at 25℃.                        |                |            |                  |                    |                                               |   |                                                                                 |      |                                                          |
| C : Nominal Capacitance (pF) |                       |                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                       |                                                                                 |                |            |                  |                    |                                               |   |                                                                                 |      |                                                          |

Table A

| Char. Code | Temp. Coeff.<br>(ppm/°C) Note 1 | Capacitance Change from 25°C Value (%) |       |       |       |       |       |
|------------|---------------------------------|----------------------------------------|-------|-------|-------|-------|-------|
|            |                                 | -55°C                                  |       | -30°C |       | -10°C |       |
|            |                                 | Max.                                   | Min.  | Max.  | Min.  | Max.  | Min.  |
| 5C         | 0 $\pm$ 30                      | 0.58                                   | -0.24 | 0.40  | -0.17 | 0.25  | -0.11 |

Note 1 : Nominal values denote the temperature coefficient within a range of 25 to 125°C.

# Chip Monolithic Ceramic Capacitors

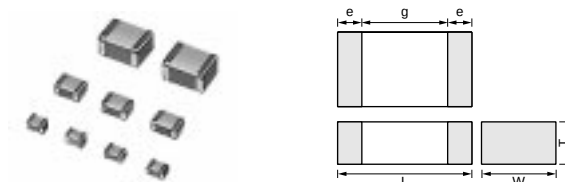
**muRata**

## High Frequency Type

### SMD Type

#### ■ Features (ERA Series)

1. Negligible inductance is achieved by its monolithic structure so the series can be used at frequencies above 1GHz.
2. Nickel barriered terminations of ERA series improve solderability and decrease solder leaching.
3. ERA11A/21A series are designed for both flow and reflow soldering and ERA32 series are designed for reflow soldering.



| Part Number | Dimensions (mm)                      |                                      |          |           |        |
|-------------|--------------------------------------|--------------------------------------|----------|-----------|--------|
|             | L                                    | W                                    | T max.   | e         | g min. |
| ERA11A      | 1.25 <sup>+0.5</sup> <sub>-0.3</sub> | 1.0 <sup>+0.5</sup> <sub>-0.3</sub>  | 1.0±0.2  | 0.15 min. | 0.3    |
| ERA21A      | 2.0 <sup>+0.5</sup> <sub>-0.3</sub>  | 1.25 <sup>+0.5</sup> <sub>-0.3</sub> | 1.0±0.2  | 0.2 min.  | 0.5    |
| ERA21B      |                                      |                                      | 1.25±0.2 |           |        |
| ERA32X      | 3.2 <sup>+0.6</sup> <sub>-0.4</sub>  | 2.5 <sup>+0.5</sup> <sub>-0.3</sub>  | 1.7±0.2  | 0.3 min.  | 0.5    |

#### ■ Applications

High frequency and high power circuits

| Part Number                                                                                          | ERA11       |             |            |             |             |            |             |             | ERA21       |             |            |             |             |            |             |             | ERA32       |             |            |             |             |            |             |             |
|------------------------------------------------------------------------------------------------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|
| L x W                                                                                                | 1.25x1.00   |             |            |             |             |            |             |             | 2.00x1.25   |             |            |             |             |            |             |             | 3.20x2.50   |             |            |             |             |            |             |             |
| TC                                                                                                   | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  |
| Rated Volt.                                                                                          | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |             |            |             |             |            |             |             |             |             |            |             |             |            |             |             |             |             |            |             |             |            |             |             |
| 0.50pF<br>(R50)                                                                                      | 1.00<br>(A) |             |            |             |             |            |             | 1.20<br>(A) | 1.00<br>(A) |             |            |             |             |            |             | 1.00<br>(A) | 1.70<br>(X) |             |            |             |             |            |             | 1.70<br>(X) |
| 0.6pF<br>(R60)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 0.7pF<br>(R70)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 0.75pF<br>(R75)                                                                                      |             |             |            |             |             |            |             | 1.20<br>(A) |             |             |            |             |             |            |             | 1.00<br>(A) |             |             |            |             |             |            |             | 1.70<br>(X) |
| 0.8pF<br>(R80)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 0.9pF<br>(R90)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 1.0pF<br>(1R0)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             | 1.20<br>(A) | 1.00<br>(A) |             |            |             |             |            |             | 1.00<br>(A) | 1.70<br>(X) |             |            |             |             |            |             | 1.70<br>(X) |
| 1.1pF<br>(1R1)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 1.2pF<br>(1R2)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 1.3pF<br>(1R3)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 1.4pF<br>(1R4)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 1.5pF<br>(1R5)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             | 1.20<br>(A) | 1.00<br>(A) |             |            |             |             |            |             | 1.00<br>(A) | 1.70<br>(X) |             |            |             |             |            |             | 1.70<br>(X) |
| 1.6pF<br>(1R6)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 1.7pF<br>(1R7)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 1.8pF<br>(1R8)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |

Continued on the following page.

Continued from the preceding page.

| Part Number                                                                                          | ERA11       |             |            |             |             |            |             |             | ERA21       |             |            |             |             |            |             |             | ERA32       |             |            |             |             |            |             |             |
|------------------------------------------------------------------------------------------------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|
| L x W                                                                                                | 1.25x1.00   |             |            |             |             |            |             |             | 2.00x1.25   |             |            |             |             |            |             |             | 3.20x2.50   |             |            |             |             |            |             |             |
| TC                                                                                                   | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  |
| Rated Volt.                                                                                          | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |             |            |             |             |            |             |             |             |             |            |             |             |            |             |             |             |             |            |             |             |            |             |             |
| 1.9pF<br>(1R9)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 2.0pF<br>(2R0)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             | 1.20<br>(A) | 1.00<br>(A) |             |            |             |             |            |             | 1.00<br>(A) | 1.70<br>(X) |             |            |             |             |            |             | 1.70<br>(X) |
| 2.1pF<br>(2R1)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 2.2pF<br>(2R2)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 2.4pF<br>(2R4)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 2.7pF<br>(2R7)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 3.0pF<br>(3R0)                                                                                       | 1.00<br>(A) |             |            |             |             |            | 1.20<br>(A) |             | 1.00<br>(A) |             |            |             |             |            | 1.00<br>(A) |             | 1.70<br>(X) |             |            |             |             |            | 1.70<br>(X) |             |
| 3.3pF<br>(3R3)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 3.6pF<br>(3R6)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 3.9pF<br>(3R9)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 4.0pF<br>(4R0)                                                                                       |             |             |            | 1.00<br>(A) |             |            |             |             |             |             |            | 1.00<br>(A) |             |            |             |             |             |             |            | 1.70<br>(X) |             |            |             |             |
| 4.3pF<br>(4R3)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 4.7pF<br>(4R7)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 5.0pF<br>(5R0)                                                                                       |             |             |            | 1.00<br>(A) |             |            |             |             |             |             |            | 1.00<br>(A) |             |            |             |             |             |             |            | 1.70<br>(X) |             |            |             |             |
| 5.1pF<br>(5R1)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 5.6pF<br>(5R6)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 6.0pF<br>(6R0)                                                                                       |             |             |            | 1.00<br>(A) |             |            |             |             |             |             |            | 1.00<br>(A) |             |            |             |             |             |             |            | 1.70<br>(X) |             |            |             |             |
| 6.2pF<br>(6R2)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 6.8pF<br>(6R8)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 7.0pF<br>(7R0)                                                                                       |             |             |            | 1.20<br>(A) |             |            |             |             |             |             |            | 1.00<br>(A) |             |            |             |             |             |             |            | 1.70<br>(X) |             |            |             |             |
| 7.5pF<br>(7R5)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 8.0pF<br>(8R0)                                                                                       |             |             |            | 1.20<br>(A) |             |            |             |             |             |             |            | 1.00<br>(A) |             |            |             |             |             |             |            | 1.70<br>(X) |             |            |             |             |
| 8.2pF<br>(8R2)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.00<br>(A) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 9.0pF<br>(9R0)                                                                                       |             |             |            | 1.20<br>(A) | 1.00<br>(A) |            |             |             |             |             |            | 1.25<br>(B) |             |            |             |             |             |             |            | 1.70<br>(X) |             |            |             |             |
| 9.1pF<br>(9R1)                                                                                       | 1.00<br>(A) |             |            |             |             |            |             |             | 1.25<br>(B) |             |            |             |             |            |             |             | 1.70<br>(X) |             |            |             |             |            |             |             |
| 10pF<br>(100)                                                                                        | 1.00<br>(A) |             |            | 1.00<br>(A) | 1.00<br>(A) |            |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |

Continued on the following page. ➤

Continued from the preceding page.

| Part Number                                                                                          | ERA11       |             |             |             |             |             |             |             | ERA21       |             |            |             |             |            |             |             | ERA32       |             |            |             |             |            |             |             |
|------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|
| L x W                                                                                                | 1.25x1.00   |             |             |             |             |             |             |             | 2.00x1.25   |             |            |             |             |            |             |             | 3.20x2.50   |             |            |             |             |            |             |             |
| TC                                                                                                   | C0G<br>(5C) |             |             | CH<br>(6C)  |             |             | CJ<br>(7C)  | CK<br>(8C)  | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  |
| Rated Volt.                                                                                          | 200<br>(2D) | 100<br>(2A) | 50<br>(1H)  | 200<br>(2D) | 100<br>(2A) | 50<br>(1H)  | 200<br>(2D) | 200<br>(2D) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |             |             |             |             |             |             |             |             |             |            |             |             |            |             |             |             |             |            |             |             |            |             |             |
| 11pF<br>(110)                                                                                        | 1.00<br>(A) |             |             | 1.00<br>(A) | 1.00<br>(A) |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 12pF<br>(120)                                                                                        | 1.00<br>(A) |             |             | 1.00<br>(A) | 1.00<br>(A) |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 13pF<br>(130)                                                                                        | 1.00<br>(A) |             |             | 1.00<br>(A) | 1.00<br>(A) |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 15pF<br>(150)                                                                                        |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 16pF<br>(160)                                                                                        |             | 1.00<br>(A) |             |             | 1.00<br>(A) | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.00<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 18pF<br>(180)                                                                                        |             | 1.00<br>(A) |             |             | 1.00<br>(A) | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 20pF<br>(200)                                                                                        |             | 1.00<br>(A) |             |             | 1.00<br>(A) | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 22pF<br>(220)                                                                                        |             | 1.00<br>(A) |             |             | 1.00<br>(A) | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 24pF<br>(240)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 27pF<br>(270)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 30pF<br>(300)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 33pF<br>(330)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 36pF<br>(360)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 39pF<br>(390)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 43pF<br>(430)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 47pF<br>(470)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 51pF<br>(510)                                                                                        |             |             | 1.00<br>(A) |             |             | 1.00<br>(A) |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 56pF<br>(560)                                                                                        |             |             |             |             |             |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 62pF<br>(620)                                                                                        |             |             |             |             |             |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 68pF<br>(680)                                                                                        |             |             |             |             |             |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 75pF<br>(750)                                                                                        |             |             |             |             |             |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 82pF<br>(820)                                                                                        |             |             |             |             |             |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 91pF<br>(910)                                                                                        |             |             |             |             |             |             |             |             | 1.25<br>(B) |             |            | 1.25<br>(B) |             |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 100pF<br>(101)                                                                                       |             |             |             |             |             |             |             |             |             | 1.00<br>(A) |            |             | 1.00<br>(A) |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 110pF<br>(111)                                                                                       |             |             |             |             |             |             |             |             |             | 1.25<br>(B) |            |             | 1.25<br>(B) |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 120pF<br>(121)                                                                                       |             |             |             |             |             |             |             |             |             | 1.25<br>(B) |            |             | 1.25<br>(B) |            |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |

Continued on the following page. ➤

Continued from the preceding page.

| Part Number                                                                                          | ERA11       |             |            |             |             |            |             |             | ERA21       |             |             |             |             |             |             |             | ERA32       |             |            |             |             |            |             |             |
|------------------------------------------------------------------------------------------------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|
| L x W                                                                                                | 1.25x1.00   |             |            |             |             |            |             |             | 2.00x1.25   |             |             |             |             |             |             |             | 3.20x2.50   |             |            |             |             |            |             |             |
| TC                                                                                                   | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  | C0G<br>(5C) |             |             | CH<br>(6C)  |             |             | CJ<br>(7C)  | CK<br>(8C)  | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  |
| Rated Volt.                                                                                          | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H)  | 200<br>(2D) | 100<br>(2A) | 50<br>(1H)  | 200<br>(2D) | 200<br>(2D) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             |             |             |            |             |             |            |             |             |
| 130pF<br>(131)                                                                                       |             |             |            |             |             |            |             |             |             |             | 1.25<br>(B) |             |             | 1.25<br>(B) |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 150pF<br>(151)                                                                                       |             |             |            |             |             |            |             |             |             |             | 1.25<br>(B) |             |             | 1.25<br>(B) |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 160pF<br>(161)                                                                                       |             |             |            |             |             |            |             |             |             |             | 1.25<br>(B) |             |             | 1.25<br>(B) |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 180pF<br>(181)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 200pF<br>(201)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 220pF<br>(221)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 240pF<br>(241)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 270pF<br>(271)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 300pF<br>(301)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 330pF<br>(331)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 360pF<br>(361)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 390pF<br>(391)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 430pF<br>(431)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 470pF<br>(471)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 510pF<br>(511)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |             |            | 1.70<br>(X) |             |            |             |             |
| 560pF<br>(561)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |            |             | 1.70<br>(X) |            |             |             |
| 620pF<br>(621)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |            |             | 1.70<br>(X) |            |             |             |
| 680pF<br>(681)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |            |             | 1.70<br>(X) |            |             |             |
| 750pF<br>(751)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |            |             | 1.70<br>(X) |            |             |             |
| 820pF<br>(821)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |            |             | 1.70<br>(X) |            |             |             |
| 910pF<br>(911)                                                                                       |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |            |             | 1.70<br>(X) |            |             |             |
| 1000pF<br>(102)                                                                                      |             |             |            |             |             |            |             |             |             |             |             |             |             |             |             |             |             | 1.70<br>(X) |            |             | 1.70<br>(X) |            |             |             |

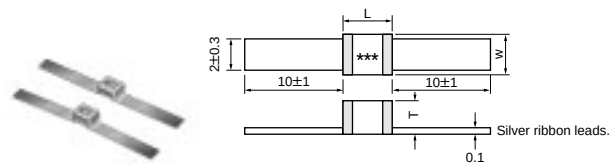
The part numbering code is shown in ( ).

Dimensions are shown in mm and Rated Voltage in Vdc.

## Ribbon Terminal

### ■ Features (ERD Series)

1. Negligible inductance is achieved by its monolithic structure so the series can be used at frequencies above 1GHz.
2. ERD Series capacitors withstand at high temperatures because ribbon leads are attached with silver paste.
3. ERD Series capacitors are easily soldered and are especially well suited in applications where only a soldering iron can be used.



\*\*\* : Capacitance Code

| Part Number   | Dimensions (mm) |        |        |
|---------------|-----------------|--------|--------|
|               | L max.          | W max. | T max. |
| <b>ERD32D</b> | 4.0             | 3.0    | 2.3    |

### ■ Application

High frequency and high power circuits

| Part Number                                                                                          | ERD32            |             |            |                  |             |            |                  |                  |
|------------------------------------------------------------------------------------------------------|------------------|-------------|------------|------------------|-------------|------------|------------------|------------------|
| L x W                                                                                                | 4.00x3.00        |             |            |                  |             |            |                  |                  |
| TC                                                                                                   | C0G<br>(5C)      |             |            | CH<br>(6C)       |             |            | CJ<br>(7C)       | CK<br>(8C)       |
| Rated Volt.                                                                                          | 200<br>(2D)      | 100<br>(2A) | 50<br>(1H) | 200<br>(2D)      | 100<br>(2A) | 50<br>(1H) | 200<br>(2D)      | 200<br>(2D)      |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |                  |             |            |                  |             |            |                  |                  |
| 0.50pF( <b>R50</b> )                                                                                 | 2.30( <b>D</b> ) |             |            |                  |             |            |                  | 2.30( <b>D</b> ) |
| 0.6pF( <b>R60</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 0.7pF( <b>R70</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 0.75pF( <b>R75</b> )                                                                                 |                  |             |            |                  |             |            |                  | 2.30( <b>D</b> ) |
| 0.8pF( <b>R80</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 0.9pF( <b>R90</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 1.0pF( <b>1R0</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  | 2.30( <b>D</b> ) |
| 1.1pF( <b>1R1</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 1.2pF( <b>1R2</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 1.3pF( <b>1R3</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 1.4pF( <b>1R4</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 1.5pF( <b>1R5</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  | 2.30( <b>D</b> ) |
| 1.6pF( <b>1R6</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 1.7pF( <b>1R7</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 1.8pF( <b>1R8</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 1.9pF( <b>1R9</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 2.0pF( <b>2R0</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  | 2.30( <b>D</b> ) |
| 2.1pF( <b>2R1</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 2.2pF( <b>2R2</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 2.4pF( <b>2R4</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 2.7pF( <b>2R7</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 3.0pF( <b>3R0</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            | 2.30( <b>D</b> ) |                  |
| 3.3pF( <b>3R3</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 3.6pF( <b>3R6</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 3.9pF( <b>3R9</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 4.0pF( <b>4R0</b> )                                                                                  |                  |             |            | 2.30( <b>D</b> ) |             |            |                  |                  |
| 4.3pF( <b>4R3</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 4.7pF( <b>4R7</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 5.0pF( <b>5R0</b> )                                                                                  |                  |             |            | 2.30( <b>D</b> ) |             |            |                  |                  |
| 5.1pF( <b>5R1</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 5.6pF( <b>5R6</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 6.0pF( <b>6R0</b> )                                                                                  |                  |             |            | 2.30( <b>D</b> ) |             |            |                  |                  |
| 6.2pF( <b>6R2</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 6.8pF( <b>6R8</b> )                                                                                  | 2.30( <b>D</b> ) |             |            |                  |             |            |                  |                  |
| 7.0pF( <b>7R0</b> )                                                                                  |                  |             |            | 2.30( <b>D</b> ) |             |            |                  |                  |

Continued on the following page.

Continued from the preceding page.

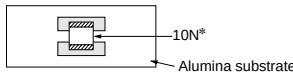
| Part Number                                                                                          | ERD32       |             |            |             |             |            |             |             |
|------------------------------------------------------------------------------------------------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|
| L x W                                                                                                | 4.00x3.00   |             |            |             |             |            |             |             |
| TC                                                                                                   | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  |
| Rated Volt.                                                                                          | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |             |            |             |             |            |             |             |
| 7.5pF(7R5)                                                                                           | 2.30(D)     |             |            |             |             |            |             |             |
| 8.0pF(8R0)                                                                                           |             |             |            | 2.30(D)     |             |            |             |             |
| 8.2pF(8R2)                                                                                           | 2.30(D)     |             |            |             |             |            |             |             |
| 9.0pF(9R0)                                                                                           |             |             |            | 2.30(D)     |             |            |             |             |
| 9.1pF(9R1)                                                                                           | 2.30(D)     |             |            |             |             |            |             |             |
| 10pF(100)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 11pF(110)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 12pF(120)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 13pF(130)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 15pF(150)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 16pF(160)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 18pF(180)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 20pF(200)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 22pF(220)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 24pF(240)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 27pF(270)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 30pF(300)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 33pF(330)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 36pF(360)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 39pF(390)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 43pF(430)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 47pF(470)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 51pF(510)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 56pF(560)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 62pF(620)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 68pF(680)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 75pF(750)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 82pF(820)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 91pF(910)                                                                                            | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 100pF(101)                                                                                           | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 110pF(111)                                                                                           | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 120pF(121)                                                                                           | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 130pF(131)                                                                                           | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 150pF(151)                                                                                           | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 160pF(161)                                                                                           | 2.30(D)     |             |            | 2.30(D)     |             |            |             |             |
| 180pF(181)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 200pF(201)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 220pF(221)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 240pF(241)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 270pF(271)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 300pF(301)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 330pF(331)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 360pF(361)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 390pF(391)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 430pF(431)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 470pF(471)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 510pF(511)                                                                                           |             | 2.30(D)     |            |             | 2.30(D)     |            |             |             |
| 560pF(561)                                                                                           |             |             | 2.30(D)    |             |             | 2.30(D)    |             |             |
| 620pF(621)                                                                                           |             |             | 2.30(D)    |             |             | 2.30(D)    |             |             |
| 680pF(681)                                                                                           |             |             | 2.30(D)    |             |             | 2.30(D)    |             |             |
| 750pF(751)                                                                                           |             |             | 2.30(D)    |             |             | 2.30(D)    |             |             |
| 820pF(821)                                                                                           |             |             | 2.30(D)    |             |             | 2.30(D)    |             |             |

Continued on the following page. ➤

|                                                                                                      |             |             |            |             |             |            |             |             |
|------------------------------------------------------------------------------------------------------|-------------|-------------|------------|-------------|-------------|------------|-------------|-------------|
| Part Number                                                                                          | ERD32       |             |            |             |             |            |             |             |
| L x W                                                                                                | 4.00x3.00   |             |            |             |             |            |             |             |
| TC                                                                                                   | C0G<br>(5C) |             |            | CH<br>(6C)  |             |            | CJ<br>(7C)  | CK<br>(8C)  |
| Rated Volt.                                                                                          | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 100<br>(2A) | 50<br>(1H) | 200<br>(2D) | 200<br>(2D) |
| Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code) |             |             |            |             |             |            |             |             |
| 910pF(911)                                                                                           |             |             | 2.30(D)    |             |             | 2.30(D)    |             |             |
| 1000pF(102)                                                                                          |             |             | 2.30(D)    |             |             | 2.30(D)    |             |             |

13

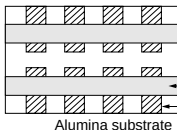
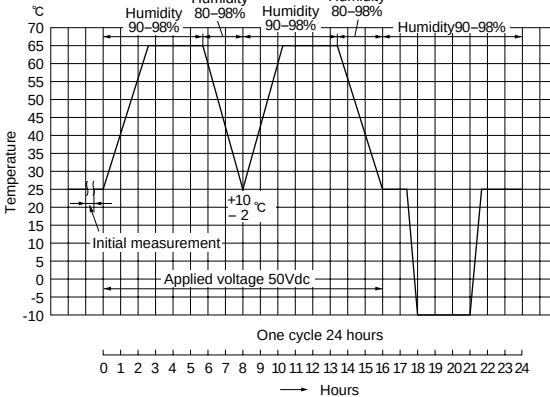
## Specifications and Test Methods

| No.                     | Item                                          |                                                               | Specifications                                                                                                                                                                        | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |                |                         |           |   |          |         |      |                 |       |   |      |
|-------------------------|-----------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|-------------------------|-----------|---|----------|---------|------|-----------------|-------|---|------|
| 1                       | Operating Temperature Range                   |                                                               | −55℃ to +125℃                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 2                       | Rated Voltage                                 |                                                               | See the previous pages.                                                                                                                                                               | The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.<br>When AC voltage is superimposed on DC voltage, $V^{P-P}$ or $V^{O-P}$ , whichever is larger, should be maintained within the rated voltage range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 3                       | Appearance                                    |                                                               | No defects or abnormalities                                                                                                                                                           | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 4                       | Dimensions                                    |                                                               | Within the specified dimension                                                                                                                                                        | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 5                       | Dielectric Strength                           |                                                               | No defects or abnormalities                                                                                                                                                           | No failure should be observed when 300% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 6                       | Insulation Resistance (I.R.)                  |                                                               | 10,000MΩ min.                                                                                                                                                                         | The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and standard humidity and within 2 minutes of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 7                       | Capacitance                                   |                                                               | Within the specified tolerance                                                                                                                                                        | The capacitance/Q should be measured at 25℃ at the frequency and voltage shown in the table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 8                       | Q                                             |                                                               | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$<br>C : Nominal Capacitance (pF) | <table><tr><th>Item</th><th>Char.</th><th>C0G (1,000pF and below)</th></tr><tr><td>Frequency</td><td></td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td></td><td>0.5 to 5Vr.m.s.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Item | Char.          | C0G (1,000pF and below) | Frequency |   | 1±0.1MHz | Voltage |      | 0.5 to 5Vr.m.s. |       |   |      |
| Item                    | Char.                                         | C0G (1,000pF and below)                                       |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| Frequency               |                                               | 1±0.1MHz                                                      |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| Voltage                 |                                               | 0.5 to 5Vr.m.s.                                               |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 9                       | Capacitance Temperature Characteristics       | Capacitance Variation Rate                                    | Within the specified tolerance (Table A-6)                                                                                                                                            | The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step 1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A.<br>The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.<br>The capacitance change should be measured after 5 min. at each specified temperature stage.<br><table><tr><th>Step</th><th>Temperature(℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>−55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table> | Step | Temperature(℃) | 1                       | 25±2      | 2 | −55±3    | 3       | 25±2 | 4               | 125±3 | 5 | 25±2 |
|                         |                                               | Step                                                          | Temperature(℃)                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
|                         |                                               | 1                                                             | 25±2                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 2                       | −55±3                                         |                                                               |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 3                       | 25±2                                          |                                                               |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 4                       | 125±3                                         |                                                               |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 5                       | 25±2                                          |                                                               |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| Temperature Coefficient | Within the specified tolerance (Table A-6)    |                                                               |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| Capacitance Drift       | Within ±0.2% or ±0.05pF (Whichever is larger) |                                                               |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                |                         |           |   |          |         |      |                 |       |   |      |
| 10                      | Terminal Strength                             | Adhesive Strength of Termination (for chip type)              | No removal of the terminations or other defects should occur.                                                                                                                         | Solder the capacitor to the test jig (alumina substrate) shown in Fig.1 using solder containing 2.5% silver. The soldering should be done either with an iron or in furnace and be conducted with care so the soldering is uniform and free of defects such as heat shock. Then apply a 10N* force in the direction of the arrow.<br>*5N (ERA11)<br><br>Fig.1                                                                                                                                                                                                                                                                                                                                                          |      |                |                         |           |   |          |         |      |                 |       |   |      |
|                         |                                               | Tensile Strength (for micro-strip type)                       | Capacitor should not be broken or damaged.                                                                                                                                            | The capacitor body is fixed and a load is applied gradually in the axial direction until its value reaches 5N.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |      |                |                         |           |   |          |         |      |                 |       |   |      |
|                         |                                               | Bending Strength of lead wire terminal (for micro-strip type) | Lead wire should not be cut or broken.                                                                                                                                                | Position the main body of the capacitor so the lead wire terminal is perpendicular, and load 2.5N to the lead wire terminal. Bend the main body by 90 degrees, bend back to original position, bend 90 degrees in the reverse direction, and then bend back to original position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                |                         |           |   |          |         |      |                 |       |   |      |

Continued on the following page. 

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                                                                                                                  |             | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------|------------------|--------------------|-----------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------|-----------|-----------------------------------------------------|---|-----------|---------|-----------|---------|-----------|------------|------|--------|------|--------|
| 11                  | Vibration Resistance                                                                                                                                  | Appearance  | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Solder the capacitor to the test jig (alumina substrate) shown in Fig. 2 using solder containing 2.5% silver. The soldering should be done either with an iron or using the reflow method and should be conducted with care so the soldering is uniform and free of defects such as heat shock. The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</p> <div><p>Solder resist<br/>Ag/Pd<br/>Alumina substrate</p></div> <p>Fig. 2</p> |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
|                     |                                                                                                                                                       | Capacitance | Within the specified tolerance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
|                     |                                                                                                                                                       | Q           | Satisfies the initial value.<br>$C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$<br>C : Nominal Capacitance (pF)                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| 12                  | Solderability of Termination                                                                                                                          |             | 75% of the terminations are to be soldered evenly and continuously.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating immerse in solder containing 2.5% silver for 5±0.5 seconds at 230±5°C. The dipping depth for microstrip type capacitors is up to 1 mm from the root of the terminal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| 13                  | Resistance to Soldering Heat                                                                                                                          |             | <p>The measured and observed characteristics should satisfy the specifications in the following table.</p> <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td><math>C \leq 220\text{pF} : Q \geq 10,000</math><br/><math>220\text{pF} &lt; C \leq 470\text{pF} : Q \geq 5,000</math><br/><math>470\text{pF} &lt; C \leq 1,000\text{pF} : Q \geq 3,000</math></td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table> <p>C : Nominal Capacitance (pF)</p>                                | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Specifications | Appearance | No marked defect | Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | Q | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$ | Dielectric Strength | No failure   | <p>Preheat according to the conditions listed in the table below. Immerse in solder containing 2.5% silver for 3±0.5 seconds at 270±5°C. Set at room temperature for 24±2 hours, then measure. The dipping depth for microstrip type capacitors is up to 2mm from the root of the terminal.</p> <table><tr><th>Chip Size</th><th>Preheat Condition</th></tr><tr><td>2.0X1.25mm max.</td><td>1minute at 120 to 150°C</td></tr><tr><td>3.2X2.5mm</td><td>Each 1 minute at 100 to 120°C and then 170 to 200°C</td></tr></table> | Chip Size  | Preheat Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2.0X1.25mm max. | 1minute at 120 to 150°C | 3.2X2.5mm | Each 1 minute at 100 to 120°C and then 170 to 200°C |   |           |         |           |         |           |            |      |        |      |        |
| Item                | Specifications                                                                                                                                        |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Appearance          | No marked defect                                                                                                                                      |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Capacitance Change  | Within ±2.5% or ±0.25pF (Whichever is larger)                                                                                                         |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Q                   | $C \leq 220\text{pF} : Q \geq 10,000$<br>$220\text{pF} < C \leq 470\text{pF} : Q \geq 5,000$<br>$470\text{pF} < C \leq 1,000\text{pF} : Q \geq 3,000$ |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Dielectric Strength | No failure                                                                                                                                            |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Chip Size           | Preheat Condition                                                                                                                                     |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| 2.0X1.25mm max.     | 1minute at 120 to 150°C                                                                                                                               |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| 3.2X2.5mm           | Each 1 minute at 100 to 120°C and then 170 to 200°C                                                                                                   |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| 14                  | Temperature Cycle                                                                                                                                     |             | <p>The measured and observed characteristics should satisfy the specifications in the following table.</p> <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td></tr><tr><td>Q</td><td><math>C \geq 30\text{pF} : Q \geq 350</math><br/><math>10\text{pF} \leq C &lt; 30\text{pF} : Q \geq 275 + \frac{5}{2} C</math><br/><math>C &lt; 10\text{pF} : Q \geq 200 + 10C</math></td></tr><tr><td>I.R.</td><td>1,000MΩ min.</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table> <p>C : Nominal Capacitance (pF)</p> | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Specifications | Appearance | No marked defect | Capacitance Change | Within ±5% or ±0.5pF (Whichever is larger)    | Q | $C \geq 30\text{pF} : Q \geq 350$<br>$10\text{pF} \leq C < 30\text{pF} : Q \geq 275 + \frac{5}{2} C$<br>$C < 10\text{pF} : Q \geq 200 + 10C$          | I.R.                | 1,000MΩ min. | Dielectric Strength                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | No failure | <p>Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure.</p> <table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp.(°C)</td><td>-55 ± 5</td><td>RoomTemp.</td><td>125 ± 3</td><td>RoomTemp.</td></tr><tr><td>Time(min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table> | Step            | 1                       | 2         | 3                                                   | 4 | Temp.(°C) | -55 ± 5 | RoomTemp. | 125 ± 3 | RoomTemp. | Time(min.) | 30±3 | 2 to 3 | 30±3 | 2 to 3 |
| Item                | Specifications                                                                                                                                        |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Appearance          | No marked defect                                                                                                                                      |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Capacitance Change  | Within ±5% or ±0.5pF (Whichever is larger)                                                                                                            |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Q                   | $C \geq 30\text{pF} : Q \geq 350$<br>$10\text{pF} \leq C < 30\text{pF} : Q \geq 275 + \frac{5}{2} C$<br>$C < 10\text{pF} : Q \geq 200 + 10C$          |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| I.R.                | 1,000MΩ min.                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Dielectric Strength | No failure                                                                                                                                            |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Step                | 1                                                                                                                                                     | 2           | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Temp.(°C)           | -55 ± 5                                                                                                                                               | RoomTemp.   | 125 ± 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | RoomTemp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Time(min.)          | 30±3                                                                                                                                                  | 2 to 3      | 30±3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2 to 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| 15                  | Humidity                                                                                                                                              |             | <p>The measured and observed characteristics should satisfy the specifications in the following table.</p> <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td></tr><tr><td>Q</td><td><math>C \geq 30\text{pF} : Q \geq 350</math><br/><math>10\text{pF} \leq C &lt; 30\text{pF} : Q \geq 275 + \frac{5}{2} C</math><br/><math>C &lt; 10\text{pF} : Q \geq 200 + 10C</math></td></tr><tr><td>I.R.</td><td>1,000MΩ min.</td></tr></table> <p>C : Nominal Capacitance (pF)</p>                                                         | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Specifications | Appearance | No marked defect | Capacitance Change | Within ±5% or ±0.5pF (Whichever is larger)    | Q | $C \geq 30\text{pF} : Q \geq 350$<br>$10\text{pF} \leq C < 30\text{pF} : Q \geq 275 + \frac{5}{2} C$<br>$C < 10\text{pF} : Q \geq 200 + 10C$          | I.R.                | 1,000MΩ min. | <p>Apply the 24-hour heat (-10 to +65°C) and humidity (80 to 98%) treatment shown below, 10 consecutive times. Remove, let sit for 24±2 hours at room temperature, and measure.</p> <div></div>                                                                                                                                                                                                                                          |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Item                | Specifications                                                                                                                                        |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Appearance          | No marked defect                                                                                                                                      |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Capacitance Change  | Within ±5% or ±0.5pF (Whichever is larger)                                                                                                            |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| Q                   | $C \geq 30\text{pF} : Q \geq 350$<br>$10\text{pF} \leq C < 30\text{pF} : Q \geq 275 + \frac{5}{2} C$<br>$C < 10\text{pF} : Q \geq 200 + 10C$          |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |
| I.R.                | 1,000MΩ min.                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |            |                  |                    |                                               |   |                                                                                                                                                       |                     |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                         |           |                                                     |   |           |         |           |         |           |            |      |        |      |        |

Continued on the following page.

## Specifications and Test Methods

Continued from the preceding page.

| No.                          | Item                  | Specifications                                                                                                                                                                                                                                                                                                                                                                  | Test Method                                                                                                                                                                                |                                                                               |                |            |                  |                    |                                            |   |                                                                               |      |              |
|------------------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------|------------|------------------|--------------------|--------------------------------------------|---|-------------------------------------------------------------------------------|------|--------------|
| 16                           | High Temperature Load | The measured and observed characteristics should satisfy the specifications in the following table.                                                                                                                                                                                                                                                                             | Apply 200% of the rated voltage for 1,000±12 hours at 125±3°C. Remove and let sit for 24±2 hours at room temperature, then measure.<br><br>The charge/discharge current is less than 50mA. |                                                                               |                |            |                  |                    |                                            |   |                                                                               |      |              |
|                              |                       | <table><tr><th>Item</th><th>Specifications</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±3% or ±0.3pF (Whichever is larger)</td></tr><tr><td>Q</td><td>C≥30pF : Q≥350<br/>10pF≤C&lt;30pF : Q≥275+ <math>\frac{C}{10}</math> C<br/>C&lt;10pF : Q≥200+10C</td></tr><tr><td>I.R.</td><td>1,000MΩ min.</td></tr></table> |                                                                                                                                                                                            | Item                                                                          | Specifications | Appearance | No marked defect | Capacitance Change | Within ±3% or ±0.3pF (Whichever is larger) | Q | C≥30pF : Q≥350<br>10pF≤C<30pF : Q≥275+ $\frac{C}{10}$ C<br>C<10pF : Q≥200+10C | I.R. | 1,000MΩ min. |
|                              |                       | Item                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                            | Specifications                                                                |                |            |                  |                    |                                            |   |                                                                               |      |              |
|                              |                       | Appearance                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                            | No marked defect                                                              |                |            |                  |                    |                                            |   |                                                                               |      |              |
|                              |                       | Capacitance Change                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                            | Within ±3% or ±0.3pF (Whichever is larger)                                    |                |            |                  |                    |                                            |   |                                                                               |      |              |
|                              |                       | Q                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                            | C≥30pF : Q≥350<br>10pF≤C<30pF : Q≥275+ $\frac{C}{10}$ C<br>C<10pF : Q≥200+10C |                |            |                  |                    |                                            |   |                                                                               |      |              |
|                              |                       | I.R.                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                            | 1,000MΩ min.                                                                  |                |            |                  |                    |                                            |   |                                                                               |      |              |
| C : Nominal Capacitance (pF) |                       |                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                            |                                                                               |                |            |                  |                    |                                            |   |                                                                               |      |              |

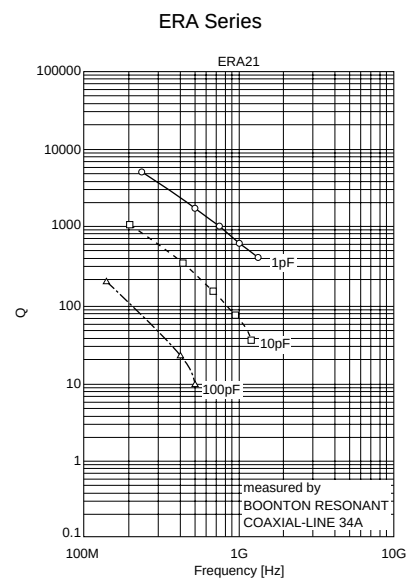
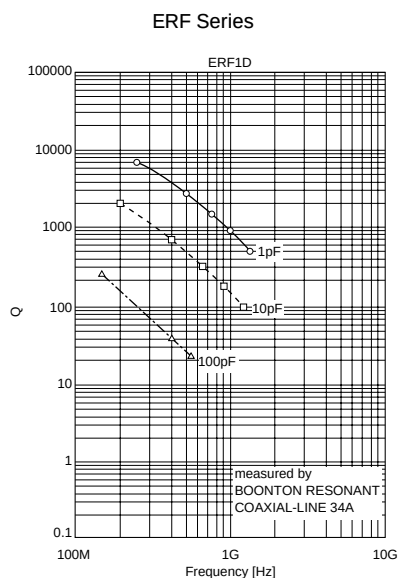
Table A

| Char. Code | Temperature Coefficient (ppm/ $^{\circ}\text{C}$ ) Note 1 | Capacitance Change from 25 $^{\circ}\text{C}$ Value (%) |       |                        |       |                        |       |
|------------|-----------------------------------------------------------|---------------------------------------------------------|-------|------------------------|-------|------------------------|-------|
|            |                                                           | -55 $^{\circ}\text{C}$                                  |       | -30 $^{\circ}\text{C}$ |       | -10 $^{\circ}\text{C}$ |       |
|            |                                                           | Max.                                                    | Min.  | Max.                   | Min.  | Max.                   | Min.  |
| 5C         | 0 $\pm$ 30                                                | 0.58                                                    | -0.24 | 0.40                   | -0.17 | 0.25                   | -0.11 |

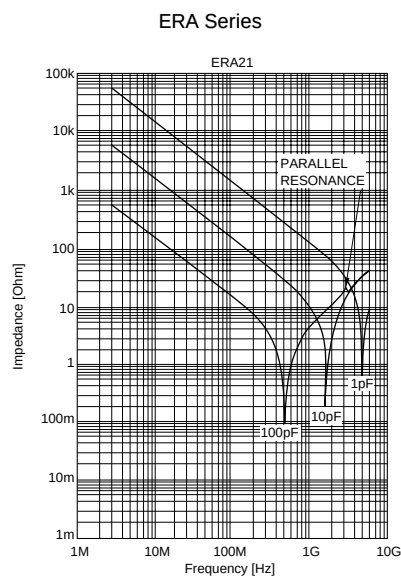
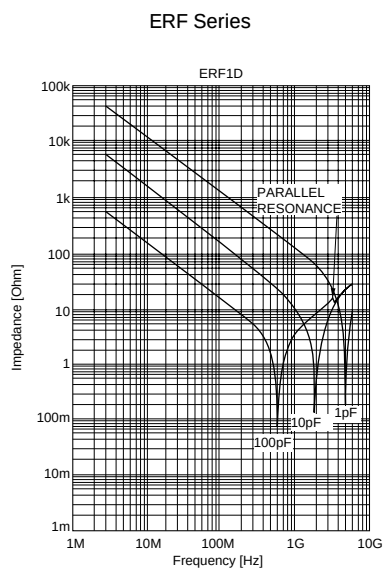
Note 1 : Nominal values denote the temperature coefficient within a range of 25 to 125 $^{\circ}\text{C}$ .

## ERA/ERD/ERF/ERH Series Data

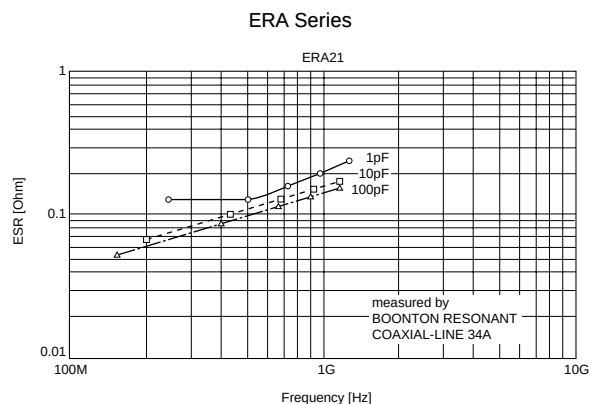
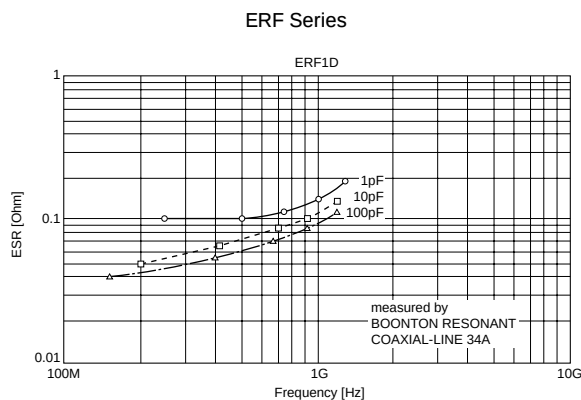
### ■ Q-Frequency Characteristics



### ■ Impedance-Frequency Characteristics



### ■ ESR-Frequency Characteristics



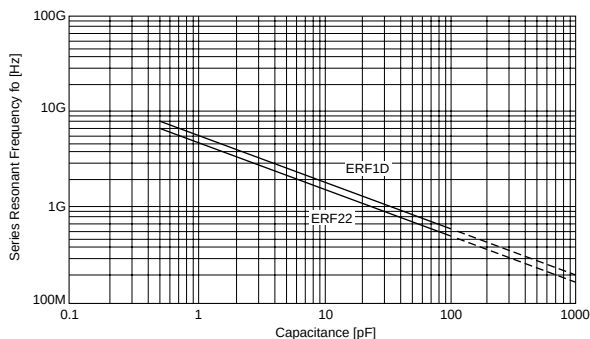
Continued on the following page. ↗

## ERA/ERD/ERF/ERH Series Data

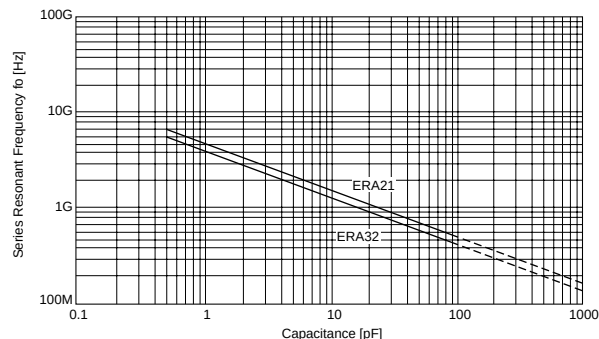
Continued from the preceding page.

### Resonant Frequency-Capacitance

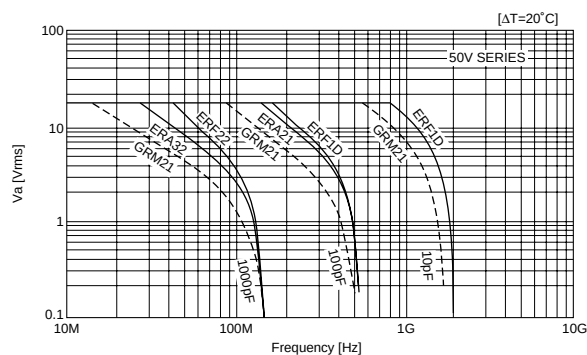
ERF Series



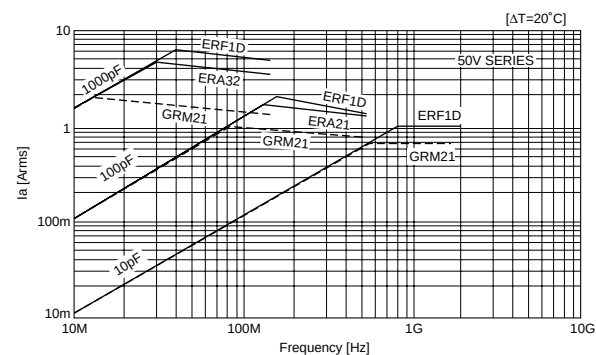
ERA Series



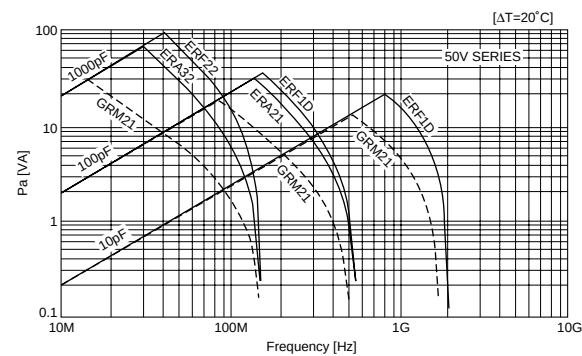
### Allowable Voltage-Frequency



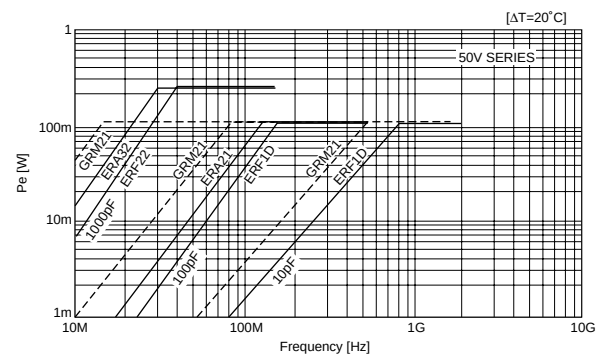
### Allowable Current-Frequency



### Allowable Apparent Power-Frequency



### Allowable Effective Power-Frequency



## Package

### ■ Packaging Code

| Packaging Type | Tape Carrier Packaging | Bulk Case Packaging | Bulk Packaging          |                          |
|----------------|------------------------|---------------------|-------------------------|--------------------------|
|                |                        |                     | Bulk Packaging in a bag | Bulk Packaging in a tray |
| Packaging Code | D, L, K, J, E, F       | C                   | B                       | T                        |

### ■ Minimum Quantity Guide

| Part Number             |           | Dimensions (mm) |      |          | Quantity (pcs.) |              |             |              |                     |                   |
|-------------------------|-----------|-----------------|------|----------|-----------------|--------------|-------------|--------------|---------------------|-------------------|
|                         |           |                 |      |          | ø180mm reel     |              | ø330mm reel |              | Bulk Case           | Bulk Bag          |
|                         |           | L               | W    | T        | Paper Tape      | Plastic Tape | Paper Tape  | Plastic Tape |                     |                   |
| Ultra Miniaturized      | GRM03     | 0.6             | 0.3  | 0.3      | 15,000          | -            | 50,000      | -            | -                   | 1,000             |
|                         | GRM18     | 1.6             | 0.8  | 0.8      | 4,000           | -            | 10,000      | -            | 15,000              | 1,000             |
|                         | GRM21     | 2.0             | 1.25 | 0.6      | 4,000           | -            | 10,000      | -            | 10,000              | 1,000             |
|                         |           |                 |      | 0.85     | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
|                         |           |                 |      | 1.0      | -               | 3,000        | -           | 10,000       | -                   | 1,000             |
|                         |           |                 |      | 1.25     | -               | 3,000        | -           | 10,000       | 5,000 <sup>3)</sup> | 1,000             |
|                         | GRM31     | 3.2             | 1.6  | 0.6      | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
|                         |           |                 |      | 0.85     | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
|                         |           |                 |      | 1.15     | -               | 3,000        | -           | 10,000       | -                   | 1,000             |
|                         |           |                 |      | 1.6      | -               | 2,000        | -           | 6,000        | -                   | 1,000             |
| For Reflow              | GRM155    | 1.0             | 0.5  | 0.5      | 10,000          | -            | 50,000      | -            | 50,000              | 1,000             |
|                         | GRM15X    | 1.0             | 0.5  | 0.25     | 10,000          | -            | 50,000      | -            | -                   | 1,000             |
|                         | GRM32     | 3.2             | 2.5  | 1.15     | -               | 3,000        | -           | 10,000       | -                   | 1,000             |
|                         |           |                 |      | 1.35     | -               | 2,000        | -           | 8,000        | -                   | 1,000             |
|                         |           |                 |      | 1.8/1.6  | -               | 1,000        | -           | 4,000        | -                   | 1,000             |
|                         |           |                 |      | 2.0      | -               | 1,000        | -           | 4,000        | -                   | 1,000             |
|                         |           |                 |      | 2.5      | -               | 1,000        | -           | 4,000        | -                   | 1,000             |
|                         | GRM43     | 4.5             | 3.2  | 1.15     | -               | 1,000        | -           | 5,000        | -                   | 1,000             |
|                         |           |                 |      | 1.35/1.6 | -               | 1,000        | -           | 4,000        | -                   | 1,000             |
|                         |           |                 |      | 1.8/2.0  | -               | 500          | -           | 2,000        | -                   | 1,000             |
|                         |           |                 |      | 2.5      | -               | 500          | -           | 1,500        | -                   | 1,000             |
|                         | GRM55     | 5.7             | 5.0  | 1.15     | -               | 1,000        | -           | 5,000        | -                   | 1,000             |
|                         |           |                 |      | 1.35/1.6 | -               | 1,000        | -           | 4,000        | -                   | 1,000             |
|                         |           |                 |      | 1.8/2.0  | -               | 500          | -           | 2,000        | -                   | 500               |
|                         |           |                 |      | 2.5      | -               | 300          | -           | 1,500        | -                   | 500               |
| High Power Type         | GJM03     | 0.6             | 0.3  | 0.3      | 15,000          | -            | 50,000      | -            | -                   | 1,000             |
|                         | GJ6/GJM15 | 1.0             | 0.5  | 0.5      | 10,000          | -            | 50,000      | -            | 50,000              | 1,000             |
| Smoothing <sup>1)</sup> | GJ221     | 2.0             | 1.25 | 1.25     | -               | 3,000        | -           | 10,000       | -                   | -                 |
|                         | GJ231     | 3.2             | 1.6  | 1.15     | -               | 3,000        | -           | 10,000       | -                   | -                 |
|                         |           |                 |      | 1.35     | -               | 2,000        | -           | 8,000        | -                   | -                 |
|                         | GJ232     | 3.2             | 2.5  | 1.6      | -               | 2,000        | -           | 6,000        | -                   | -                 |
|                         |           |                 |      | 1.8      | -               | 1,000        | -           | 4,000        | -                   | -                 |
|                         | GJ243     | 4.5             | 3.2  | 1.8      | -               | 1,000        | -           | 3,000        | -                   | -                 |
|                         |           |                 |      | 2.2      | -               | 500          | -           | 2,000        | -                   | -                 |
| High Frequency          | GQM18     | 1.6             | 0.8  | 0.8      | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
|                         | GQM21     | 2.0             | 1.25 | 0.85     | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
|                         | ERA11     | 1.25            | 1.0  | 1.0      | -               | -            | -           | -            | -                   | 1,000             |
|                         | ERA21     | 2.0             | 1.25 | 1.0/1.25 | -               | 3,000        | -           | -            | -                   | 1,000             |
|                         | ERA32     | 3.2             | 2.5  | 1.7      | -               | 2,000        | -           | -            | -                   | 1,000             |
|                         | ERF1D     | 1.4             | 1.4  | 1.15     | -               | 2,000        | -           | -            | -                   | 1,000             |
|                         | ERF22     | 2.8             | 2.8  | 2.3      | -               | 1,000        | -           | -            | -                   | 1,000             |
| For Ultrasonic          | GRM21     | 2.0             | 1.25 | 0.85     | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
| Micro Chip              | GMA05     | 0.5             | 0.5  | 0.35     | -               | -            | -           | -            | -                   | 400 <sup>2)</sup> |
|                         | GMA08     | 0.8             | 0.8  | 0.5      | -               | -            | -           | -            | -                   | 400 <sup>2)</sup> |
| Array                   | GNM1M     | 1.37            | 1.0  | 0.6      | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
|                         | GNM31     | 3.2             | 1.6  | 0.8      | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
|                         |           |                 |      | 1.0      | -               | 3,000        | -           | 10,000       | -                   | 1,000             |
|                         | GNM21     | 2.0             | 1.25 | 0.6/0.85 | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
| Low ESL                 | LLL18     | 0.8             | 1.6  | 0.6      | 4,000           | -            | 10,000      | -            | -                   | 1,000             |
|                         | LLL21     | 1.25            | 2.0  | 0.6      | -               | 4,000        | -           | 10,000       | -                   | 1,000             |
|                         |           |                 |      | 0.85     | -               | 3,000        | -           | 10,000       | -                   | 1,000             |
|                         | LLL31     | 1.6             | 3.2  | 0.7      | -               | 4,000        | -           | 10,000       | -                   | 1,000             |
|                         |           |                 |      | 1.15     | -               | 3,000        | -           | 10,000       | -                   | 1,000             |

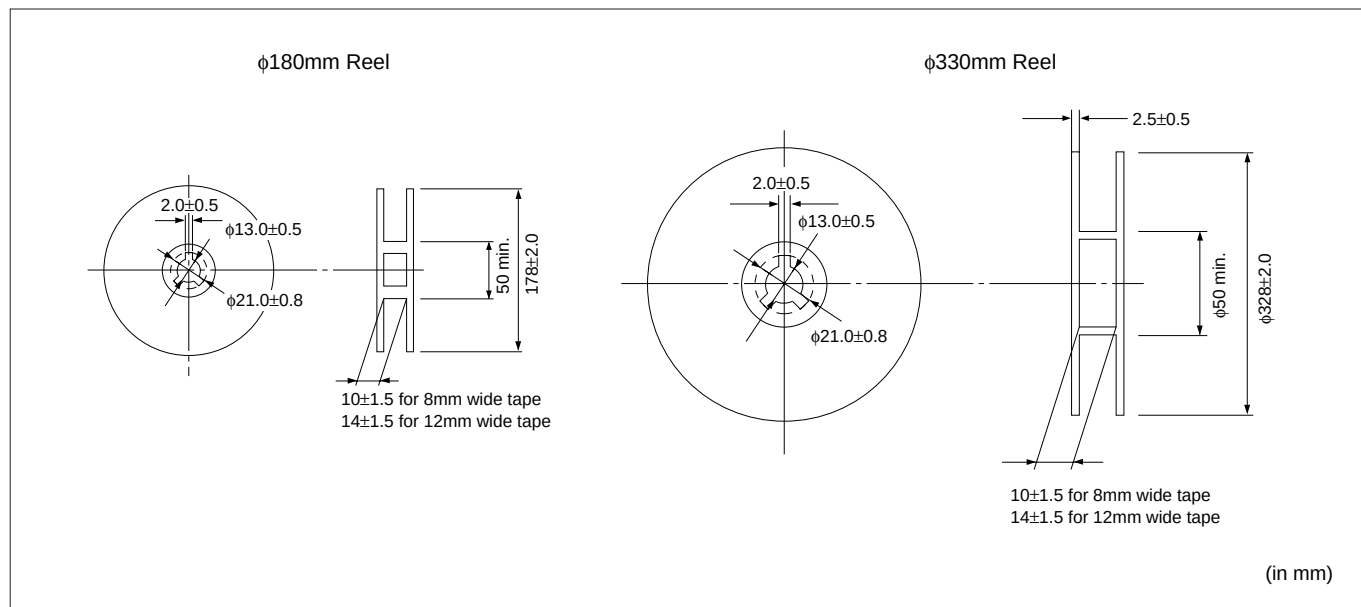
1) Available in tape/reel only. 2) Tray 3) 3.3/4.7μF of 6.3 R6 rated are not available by bulk case.

## Package

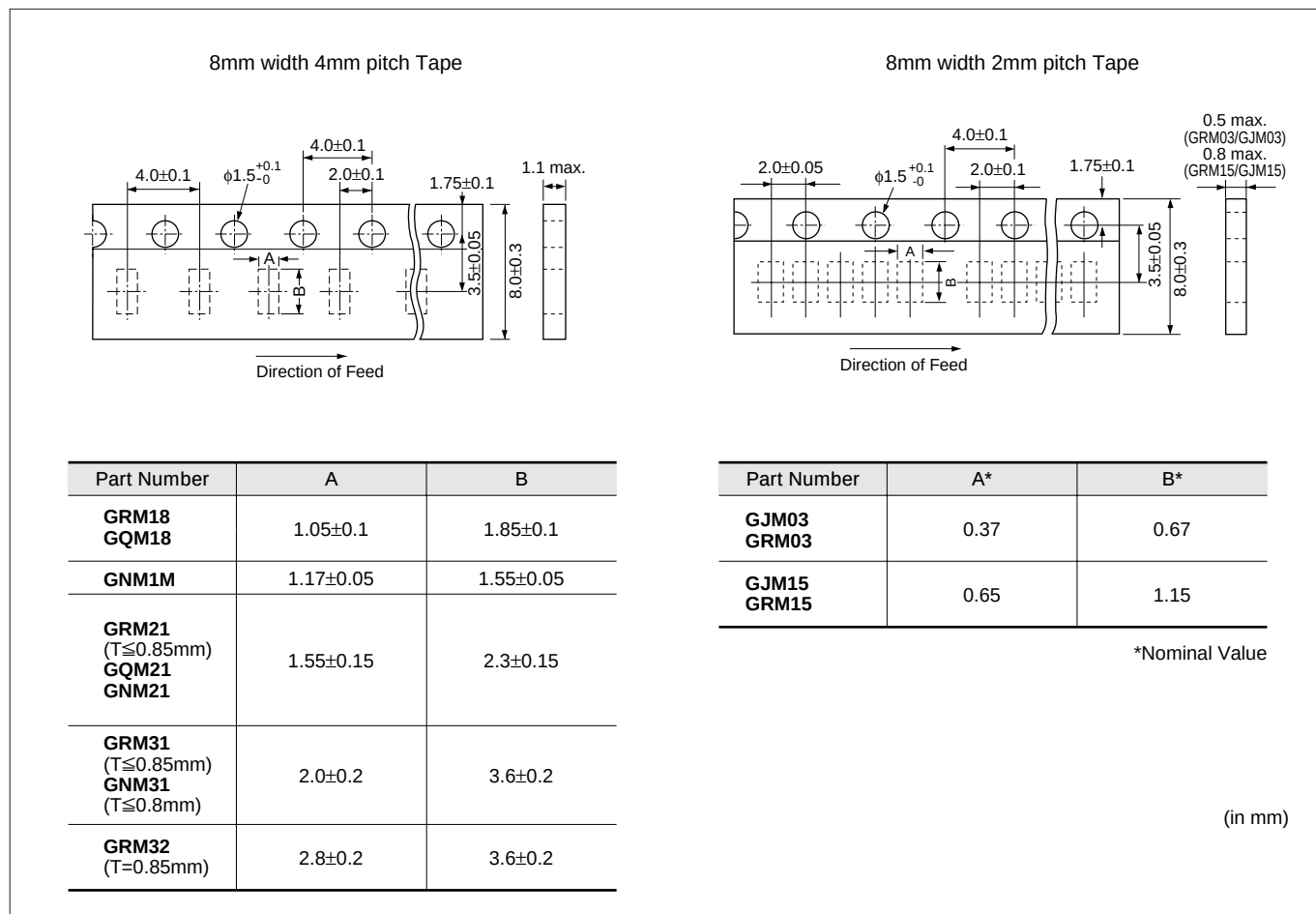
Continued from the preceding page.

### ■ Tape Carrier Packaging

#### (1) Dimensions of Reel



#### (2) Dimensions of Paper Tape



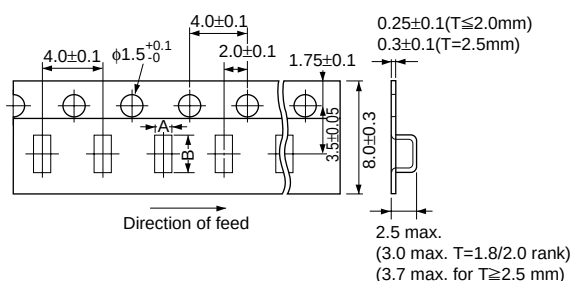
Continued on the following page. ➤

## Package

Continued from the preceding page.

### (3) Dimensions of Plastic Tape

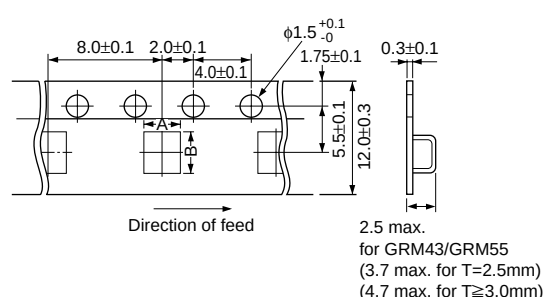
8mm width 4mm pitch Tape



| Part Number                                                 | A        | B        |
|-------------------------------------------------------------|----------|----------|
| LLL18                                                       | 1.05±0.1 | 1.85±0.1 |
| GRM21<br>(T≥1.0mm)<br>LLL21, GJ221                          | 1.45±0.2 | 2.25±0.2 |
| GRM31<br>(T≥1.15mm)<br>LLL31<br>GNM31<br>(T≥1.0mm)<br>GJ231 | 1.9±0.2  | 3.5±0.2  |
| GRM32<br>(T≥1.15mm)<br>GJ232                                | 2.8±0.2  | 3.5±0.2  |
| ERA21                                                       | 1.8*     | 2.6*     |
| ERA32                                                       | 2.8*     | 3.5*     |
| ERF1D                                                       | 2.0*     | 2.1*     |
| ERF22                                                       | 3.1*     | 3.2*     |

\*Nominal Value

12mm width 8mm pitch Tape



| Part Number  | A*  | B*  |
|--------------|-----|-----|
| GRM43, GJ243 | 3.6 | 4.9 |
| GRM55        | 5.2 | 6.1 |

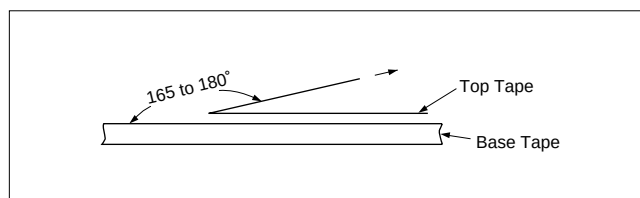
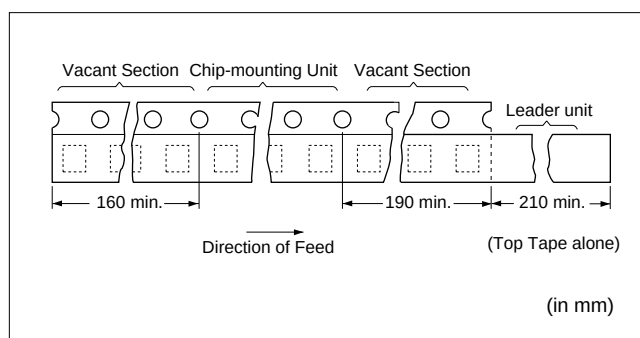
\*Nominal Value

(in mm)

### (4) Taping Method

- Tapes for capacitors are wound clockwise. The sprocket holes are to the right as the tape is pulled toward the user.
- Part of the leader and part of the empty tape should be attached to the end of the tape as follows.
- The top tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.
- Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.
- The top tape and bottom tape should not protrude beyond the edges of the tape and should not cover sprocket holes.
- Cumulative tolerance of sprocket holes, 10 pitches : ±0.3mm.
- Peeling off force : 0.1 to 0.6N\* in the direction shown below.
 

|        |                  |
|--------|------------------|
| *GRM03 | } : 0.05 to 0.5N |
| GJM03  |                  |



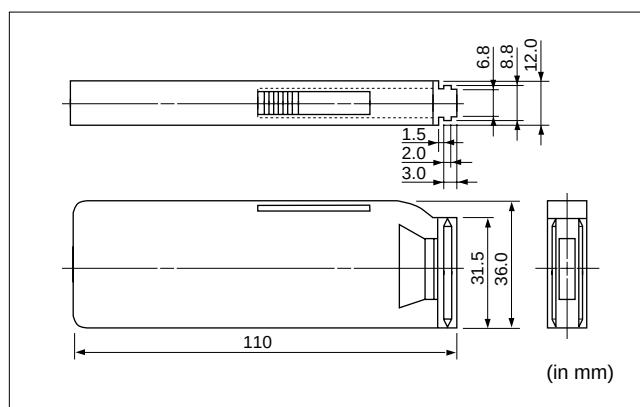
Continued on the following page.

## Package

Continued from the preceding page.

### ■ Dimensions of Bulk Case Packaging

The bulk case uses antistatic materials. Please contact Murata for details.



## **Caution**

### ■ Storage and Operating Conditions

Chip monolithic ceramic capacitors (chips) can experience degradation of termination solderability when subjected to high temperature or humidity, or if exposed to sulfur or chlorine gases.

Storage environment must be at an ambient temperature of 5-40 degree C and an ambient humidity of 20-70%RH.

Use chip within 6 months. If 6 months or more have elapsed, check solderability before use.

(Reference Data 1. Solderability)

FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCTS IS USED.

### ■ Handling

#### 1. Inspection

Thrusting force of the test probe can flex the PCB, resulting in cracked chips or open solder joints. Provide support pins on the back side of the PCB to prevent warping or flexing.

#### 2. Board Separation (or depenalization)

(1) Board flexing at the time of separation causes cracked chips or broken solder.

(2) Severity of stresses imposed on the chip at the time of board break is in the order of :  
Pushback<Slitter<V Slot<Perforator.

(3) Board separation must be performed using special jigs, not with hands.

#### 3. Reel and bulk case

In the handling of reel and case, please be careful and do not drop it.

Please do not use chips from a case which has been dropped.

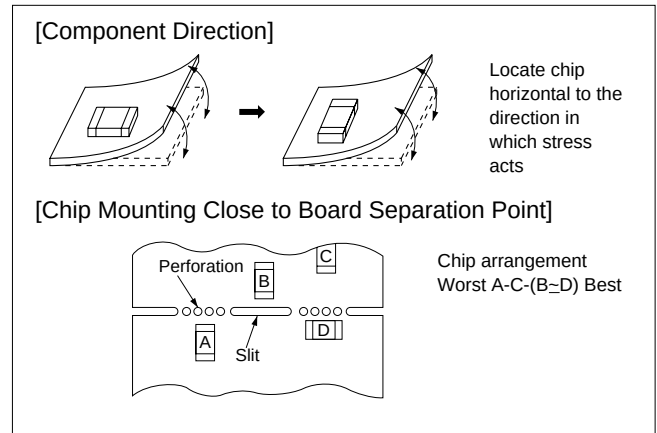
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCTS IS USED.

## ⚠Caution

### ■ Soldering and Mounting

#### 1. Mounting Position

Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.



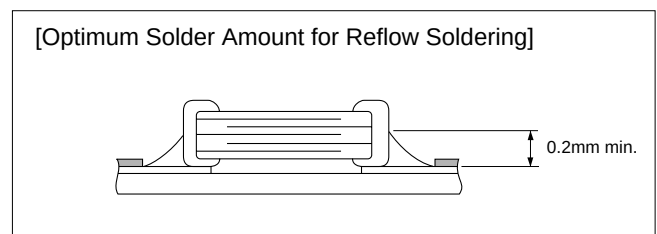
(Reference Data 2. Board bending strength for solder fillet height)

(Reference Data 3. Temperature cycling for solder fillet height)

(Reference Data 4. Board bending strength for board material)

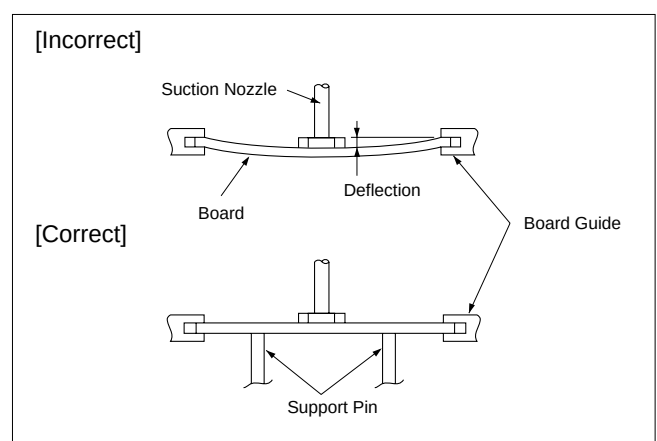
#### 2. Solder Paste Printing

- Overly thick application of solder paste results in excessive fillet height solder.  
This makes the chip more susceptible to mechanical and thermal stress on the board and may cause cracked chips.
- Too little solder paste results in a lack of adhesive strength on the outer electrode, which may result in chips breaking loose from the PCB.
- Make sure the solder has been applied smoothly to the end surface to a height of 0.2mm min.



#### 3. Chip Placing

- An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips. So adjust the suction nozzle's bottom dead point by correcting warp in the board. Normally, the suction nozzle's bottom dead point must be set on the upper surface of the board. Nozzle pressure for chip mounting must be a 1 to 3N static load.
- Dirt particles and dust accumulated between the suction nozzle and the cylinder inner wall prevent the nozzle from moving smoothly. This imposes great force on the chip during mounting, causing cracked chips. And the locating claw, when worn out, imposes uneven forces on the chip when positioning, causing cracked chips. The suction nozzle and the locating claw must be maintained, checked and replaced periodically.  
(Reference Data 5. Break strength)



Continued on the following page. ➤



Continued from the preceding page.

#### 4. Reflow Soldering

- Sudden heating of the chip results in distortion due to excessive expansion and construction forces within the chip causing cracked chips. So when preheating, keep temperature differential,  $\Delta T$ , within the range shown in Table 1. The smaller the  $\Delta T$ , the less stress on the chip.
- When components are immersed in solvent after mounting, be sure to maintain the temperature difference ( $\Delta T$ ) between the component and solvent within the range shown in the above table.

Table 1

| Part Number                                                                           | Temperature Differential          |
|---------------------------------------------------------------------------------------|-----------------------------------|
| GRM03/15/18/21/31<br>GJ615, GJ221/31<br>LLL18/21/31<br>ERA11/21/32, ERF1D<br>GQM18/21 | $\Delta T \leq 190^\circ\text{C}$ |
| GRM32/43/55<br>GNM, GJ232/43<br>ERA32, ERF22                                          | $\Delta T \leq 130^\circ\text{C}$ |

#### Inverting the PCB

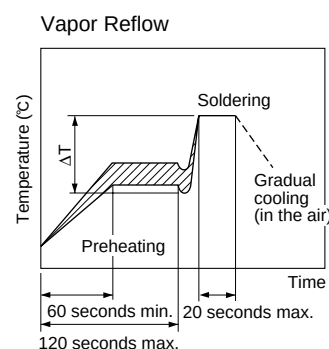
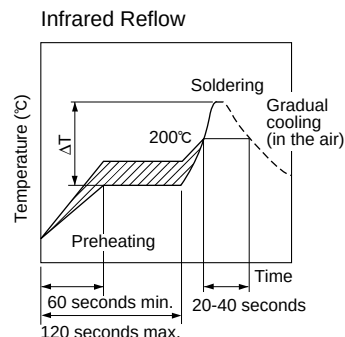
Make sure not to impose an abnormal mechanical shock on the PCB.

#### 5. Leaded Component Insertion

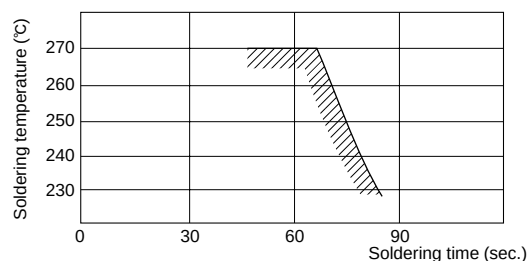
If the PCB is flexed when leaded components (such as transformers and ICs) are being mounted, chips may crack and solder joints may break.

Before mounting leaded components, support the PCB using backup pins or special jigs to prevent warping.

#### [Standard Conditions for Reflow Soldering]



#### [Allowable Soldering Temperature and Time]



In case of repeated soldering, the accumulated soldering time must be within the range shown above.

Continued on the following page. ↗

## ⚠Caution

Continued from the preceding page.

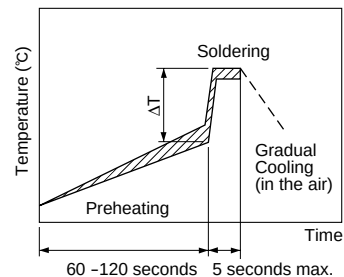
### 6. Flow Soldering

- Sudden heating of the chip results in thermal distortion causing cracked chips. And an excessively long soldering time or high soldering temperature results in leaching of the outer electrodes, causing poor adhesion or a reduction in capacitance value due to loss of contact between electrodes and end termination.
- When preheating, keep the temperature differential between solder temperature and chip surface temperature,  $\Delta T$ , within the range shown in Table 2. The smaller the  $\Delta T$ , the less stress on the chip. When components are immersed in solvent after mounting, be sure to maintain the temperature difference between the component and solvent within the range shown in Table 2.  
Do not apply flow soldering to chips not listed in Table 5.

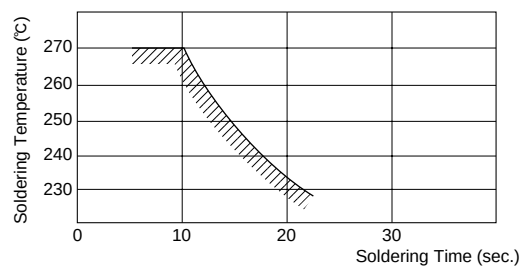
Table 2

| Part Number                                            | Temperature Differential          |
|--------------------------------------------------------|-----------------------------------|
| GRM18/21/31<br>LLL21/31<br>ERA11/21, ERF1D<br>GQM18/21 | $\Delta T \leq 150^\circ\text{C}$ |

#### [Standard Conditions for Flow Soldering]

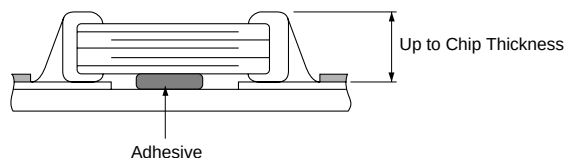


#### [Allowable Soldering Temperature and Time]



In case of repeated soldering, the accumulated soldering time must be within the range shown above.

- Optimum Solder Amount for Flow Soldering



Continued on the following page. ➤

**⚠Caution**

Continued from the preceding page.

## 7. Correction with a Soldering Iron

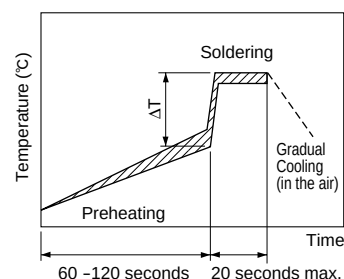
(1) For Chip Type Capacitors <Except GJ2 Series>

- Sudden heating of the chip results in distortion due to a high internal temperature differential, causing cracked chips. When preheating, keep temperature differential,  $\Delta T$ , within the range shown in Table 3. The smaller the  $\Delta T$ , the less stress on the chip.

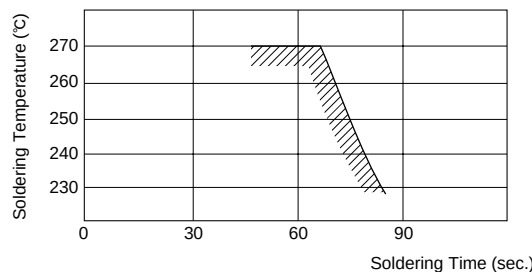
Table 3

| Part Number                                                           | Temperature Differential          |
|-----------------------------------------------------------------------|-----------------------------------|
| GRM15/18/21/31<br>GJ615<br>LLL18/21/31<br>GQM18/21<br>ERA11/21, ERF1D | $\Delta T \leq 190^\circ\text{C}$ |
| GRM32/43/55<br>GNM<br>ERA32, ERF22                                    | $\Delta T \leq 130^\circ\text{C}$ |

[Standard Conditions for Soldering Iron Temperature]

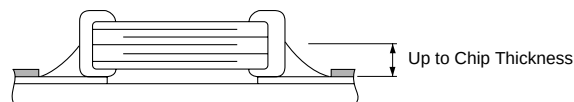


[Allowable Time and Temperature for Making Corrections with a Soldering Iron]



The accumulated soldering Time / temperature including reflow / flow soldering must be within the range shown above.

- Optimum Solder Amount when Corrections Are Made Using a Soldering Iron



(2) For GJ2 Series

- When solder GJ2 series chip capacitor, keep the following conditions.

<Soldering iron method>

| Part Number    | Pre-heating                     | Temperature of iron tip | Soldering iron wattage | Diameter of iron tip | Soldering time | Soldering amount             | Restriction                                                      |
|----------------|---------------------------------|-------------------------|------------------------|----------------------|----------------|------------------------------|------------------------------------------------------------------|
| GJ221/31/32/43 | $\Delta \leq 130^\circ\text{C}$ | 300°C max.              | 20W max.               | $\phi$ 3mm max.      | 5 sec. max.    | $\leq 1/2$ of chip thickness | Do not allow the iron tip to directly touch the ceramic element. |

(3) For Microstrip Types

- Solder 1mm away from the ribbon terminal base, being careful that the solder tip does not directly contact the capacitor. Preheating is unnecessary.
- Complete soldering within 3 seconds with a soldering tip less than 270°C in temperature.

Continued on the following page. ➤

## **Caution**

 Continued from the preceding page.

### **8. Washing**

Excessive output of ultrasonic oscillation during cleaning causes PCBs to resonate, resulting in cracked chips or broken solder. Take note not to vibrate PCBs.

Failure to follow the above cautions may result, worst case, in a short circuit and fuming when the product is used.

## Notice

### ■ Rating

#### Die Bonding/Wire Bonding (GMA Series)

##### 1. Die Bonding of Capacitors

- Use the following materials Braze alloy :

- Au-Si (98/2) 400 to 420 degree C in N2 atmosphere

- Au-Sn (80/20) 300 to 320 degree C in N2 atmosphere

- Au-Ge (88/12) 380 to 400 degree C in N2 atmosphere

- Mounting

- (1) Control the temperature of the substrate so that it matches the temperature of the braze alloy.

- (2) Place braze alloy on substrate and place the capacitor on the alloy. Hold the capacitor and

gently apply the load. Be sure to complete the operation in 1 minute.

##### 2. Wire Bonding

- Wire

- Gold wire :

- 20mm (0.0008 inch), 25mm (0.001 inch) diameter

- Bonding

- (1) Thermocompression, ultrasonic ball bonding.

- (2) Required stage temperature : 150 to 250 degree C

- (3) Required wedge or capillary weight : 0.5N to 2N.

- (4) Bond the capacitor and base substrate or other devices with gold wire.

## Notice

### ■ Soldering and Mounting

#### 1. PCB Design

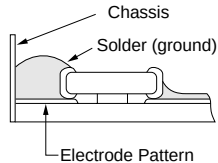
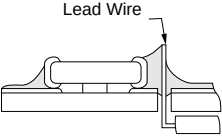
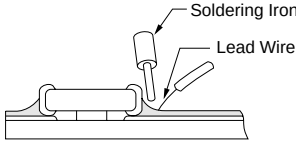
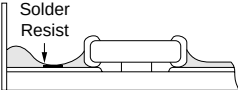
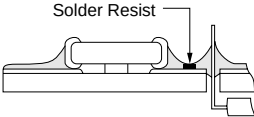
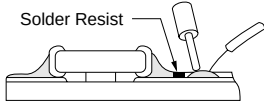
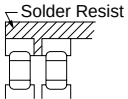
##### (1) Notice for Pattern Forms

Unlike leaded components, chip components are susceptible to flexing stresses since they are mounted directly on the substrate.

They are also more sensitive to mechanical and thermal stresses than leaded components.

Excess solder fillet height can multiply these stresses and cause chip cracking. When designing substrates, take land patterns and dimensions into consideration to eliminate the possibility of excess solder fillet height.

#### Pattern Forms

|           | Placing Close to Chassis                                                            | Placing of Chip Components and Leaded Components                                    | Placing of Leaded Components after Chip Component                                     | Lateral Mounting                                                                      |
|-----------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Incorrect |    |    |     |    |
| Correct   |  |  |  |  |

Continued on the following page. ↗

## Notice

Continued from the preceding page.

### (2) Land Dimensions

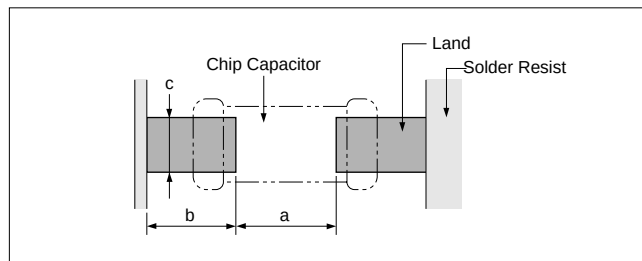


Table 1 Flow Soldering Method

| Part Number    | Dimensions (L×W) | a       | b       | c       |
|----------------|------------------|---------|---------|---------|
| GRM18<br>GQM18 | 1.6×0.8          | 0.6–1.0 | 0.8–0.9 | 0.6–0.8 |
| GRM21<br>GQM21 | 2.0×1.25         | 1.0–1.2 | 0.9–1.0 | 0.8–1.1 |
| GRM31          | 3.2×1.6          | 2.2–2.6 | 1.0–1.1 | 1.0–1.4 |
| LLL21          | 1.25×2.0         | 0.4–0.7 | 0.5–0.7 | 1.4–1.8 |
| LLL31          | 1.6×3.2          | 0.6–1.0 | 0.8–0.9 | 2.6–2.8 |
| ERA11          | 1.25×1.0         | 0.4–0.6 | 0.6–0.8 | 0.8–1.0 |
| ERA21          | 2.0×1.25         | 1.0–1.2 | 0.9–1.0 | 0.8–1.0 |
| ERF1D          | 1.4×1.4          | 0.5–0.8 | 0.8–0.9 | 1.0–1.2 |

(in mm)

Table 2 Reflow Soldering Method

| Part Number             | Dimensions (L×W) | a       | b         | c       |
|-------------------------|------------------|---------|-----------|---------|
| GRM03                   | 0.6×0.3          | 0.2–0.3 | 0.2–0.35  | 0.2–0.4 |
| GRM15                   | 1.0×0.5          | 0.3–0.5 | 0.35–0.45 | 0.4–0.6 |
| GRM18<br>GQM18          | 1.6×0.8          | 0.6–0.8 | 0.6–0.7   | 0.6–0.8 |
| GRM21<br>GQM21<br>GJ221 | 2.0×1.25         | 1.0–1.2 | 0.6–0.7   | 0.8–1.1 |
| GRM31<br>GJ231          | 3.2×1.6          | 2.2–2.4 | 0.8–0.9   | 1.0–1.4 |
| GRM32<br>GJ232          | 3.2×2.5          | 2.0–2.4 | 1.0–1.2   | 1.8–2.3 |
| GRM43<br>GJ243          | 4.5×3.2          | 3.0–3.5 | 1.2–1.4   | 2.3–3.0 |
| GRM55                   | 5.7×5.0          | 4.0–4.6 | 1.4–1.6   | 3.5–4.8 |
| LLL18                   | 0.8×1.6          | 0.2–0.4 | 0.3–0.4   | 1.0–1.4 |
| LLL21                   | 1.25×2.0         | 0.4–0.6 | 0.3–0.5   | 1.4–1.8 |
| LLL31                   | 1.6×3.2          | 0.6–0.8 | 0.6–0.7   | 2.6–2.8 |
| ERA11                   | 1.25×1.0         | 0.4–0.6 | 0.6–0.8   | 0.8–1.0 |
| ERA21                   | 2.0×1.25         | 1.0–1.2 | 0.6–0.8   | 0.8–1.0 |
| ERA32                   | 3.2×2.5          | 2.2–2.5 | 0.8–1.0   | 1.9–2.3 |
| ERF1D                   | 1.4×1.4          | 0.4–0.8 | 0.6–0.8   | 1.0–1.2 |
| ERF22                   | 2.8×2.8          | 1.8–2.1 | 0.7–0.9   | 2.2–2.6 |

(in mm)

Continued on the following page. ➤

## Notice

Continued from the preceding page.

### ● GNM Series for reflow soldering method

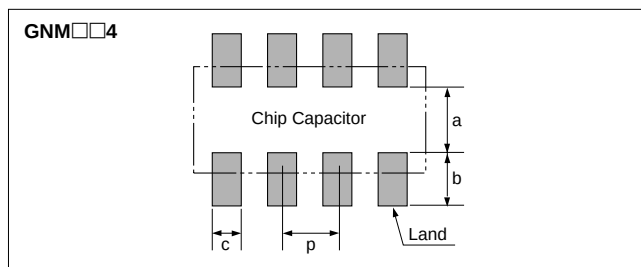
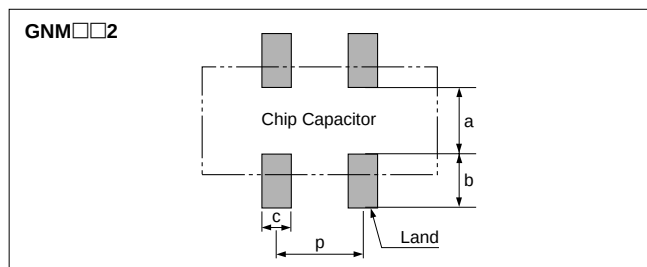
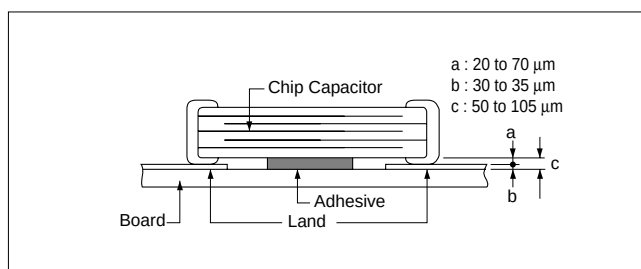


Table 3

| Part Number   | Dimensions (mm) |      |          |          |           |            |
|---------------|-----------------|------|----------|----------|-----------|------------|
|               | L               | W    | a        | b        | c         | p          |
| <b>GNM1M2</b> | 1.37            | 1.0  | 0.45~0.5 | 0.5~0.55 | 0.3~0.35  | 0.64+/-0.1 |
| <b>GNM212</b> | 2.0             | 1.25 | 0.6~0.7  | 0.5~0.7  | 0.4~0.5   | 1.0+/-0.1  |
| <b>GNM214</b> | 2.0             | 1.25 | 0.6~0.7  | 0.5~0.7  | 0.25~0.35 | 0.5+/-0.05 |
| <b>GNM314</b> | 3.2             | 1.6  | 0.8~1.0  | 0.7~0.9  | 0.3~0.4   | 0.8+/-0.05 |

## 2. Adhesive Application

- Thin or insufficient adhesive causes chips to loosen or become disconnected when flow soldered. The amount of adhesive must be more than dimension C shown in the drawing below to obtain enough bonding strength. The chip's electrode thickness and land thickness must be taken into consideration.
- Low viscosity adhesive causes chips to slip after mounting. Adhesive must have a viscosity of 5000Pa•s (500ps) min. (at 25°C)
- Adhesive Coverage\*



| Part Number                  | Adhesive Coverage* |
|------------------------------|--------------------|
| <b>GRM18</b><br><b>GQM18</b> | 0.05mg Min.        |
| <b>GRM21</b><br><b>GQM21</b> | 0.1mg Min.         |
| <b>GRM31</b>                 | 0.15mg Min.        |

\*Nominal Value

## 3. Adhesive Curing

Insufficient curing of the adhesive causes chips to disconnect during flow soldering and causes deteriorated insulation resistance between outer electrodes due to moisture absorption.

Control curing temperature and time in order to prevent insufficient hardening.

### Inverting the PCB

Make sure not to impose an abnormal mechanical shock on the PCB.

Continued on the following page. ➤

## Notice

☐ Continued from the preceding page.

### 4. Flux Application

- An excessive amount of flux generates a large quantity of flux gas, causing deteriorated solderability. So apply flux thinly and evenly throughout. (A foaming system is generally used for flow soldering).
- Flux containing too high a percentage of halide may cause corrosion of the outer electrodes unless sufficiently

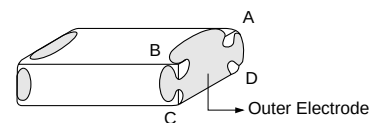
cleaned. Use flux with a halide content of 0.2wt% max.  
But do not use strong acidic flux.

Wash thoroughly because water soluble flux causes deteriorated insulation resistance between outer electrodes unless sufficiently cleaned.

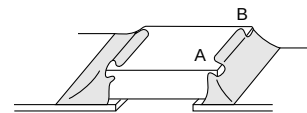
### 5. Flow Soldering

- Set temperature and time to ensure that leaching of the outer electrode does not exceed 25% of the chip end area as a single chip (full length of the edge A-B-C-D shown below) and 25% of the length A-B shown below as mounted on substrate.

[As a Single Chip]



[As Mounted on Substrate]



(Reference Data 6. Thermal shock)

(Reference Data 7. Solder heat resistance)

## Notice

### ■ Others

#### 1. Resin Coating

When selecting resin materials, select those with low contraction.

#### 2. Circuit Design

The capacitors listed in the previous sections of this catalog are not safety recognized products.

#### 3. Remarks

The above notices are for standard applications and conditions. Contact us when the products are used in special mounting conditions. Select optimum conditions for operation as they determine the reliability of the product after assembly.

The data herein are given in typical values, not guaranteed ratings.

## Reference Data

### 1. Solderability

#### (1) Test Method

Subject the chip capacitor to the following conditions.  
Then apply flux (a ethanol solution of 25% rosin) to the chip and dip it in 230°C eutectic solder for 2 seconds.

Conditions :

Expose prepared at room temperature (for 6 months and 12 months, respectively)

Prepared at high temperature (for 100 hours at 85°C)

Prepared left at high humidity (for 100 hours under 90%RH to 95%RH at 40°C)

#### (2) Test Samples

GRM21 : Products for flow/reflow soldering.

#### (3) Acceptance Criteria

With a 60-power optical microscope, measure the surface area of the outer electrode that is covered with solder.

#### (4) Results

Refer to Table 1.

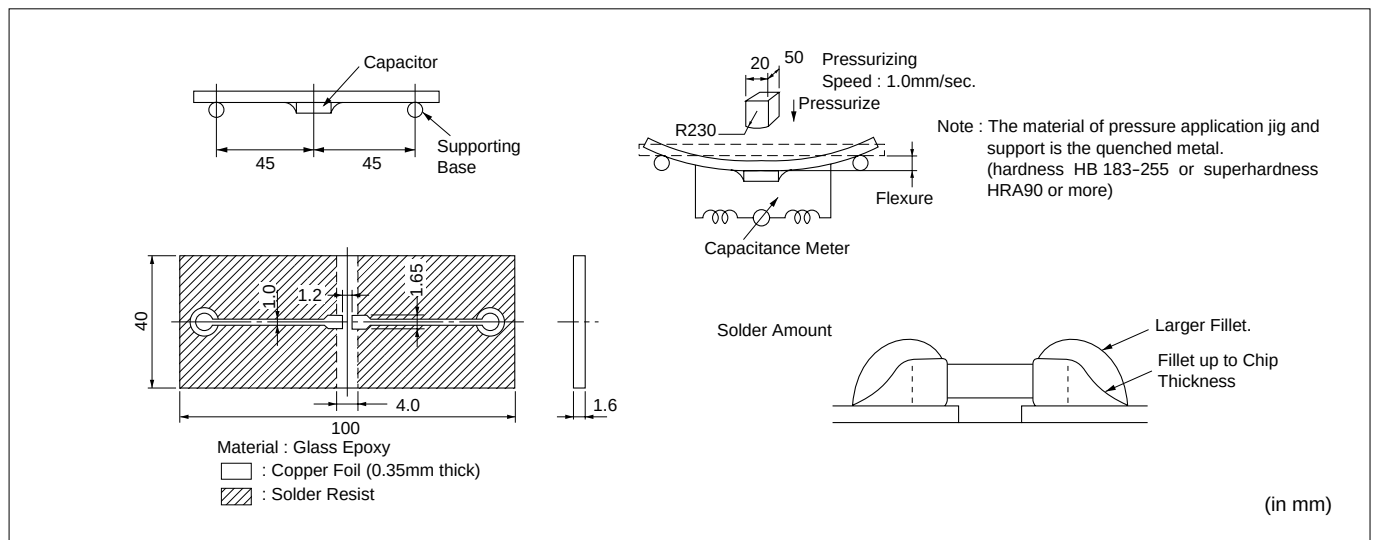
Table 1

| Sample                          | Initial State | Prepared at Room Temperature |           | Prepared at High Temperature for 100 Hours at 85°C | Prepared at High Humidity for 100 Hours at 90 to 95% RH and 40°C |
|---------------------------------|---------------|------------------------------|-----------|----------------------------------------------------|------------------------------------------------------------------|
|                                 |               | 6 months                     | 12 months |                                                    |                                                                  |
| GRM21 for flow/reflow soldering | 95 to 100%    | 95 to 100%                   | 95%       | 90 to 95%                                          | 95%                                                              |

### 2. Board Bending Strength for Solder Fillet Height

#### (1) Test Method

Solder the chip capacitor to the test PCB with the amount of solder paste necessary to achieve the fillet heights.  
Then bend the PCB using the method illustrated and measure capacitance.



#### (2) Test Samples

GRM21 C0G/X7R/Y5V Characteristics T=0.6mm

#### (3) Acceptance Criteria

Products shall be determined to be defective if the change in capacitance has exceeded the values specified in Table 2.

Table 2

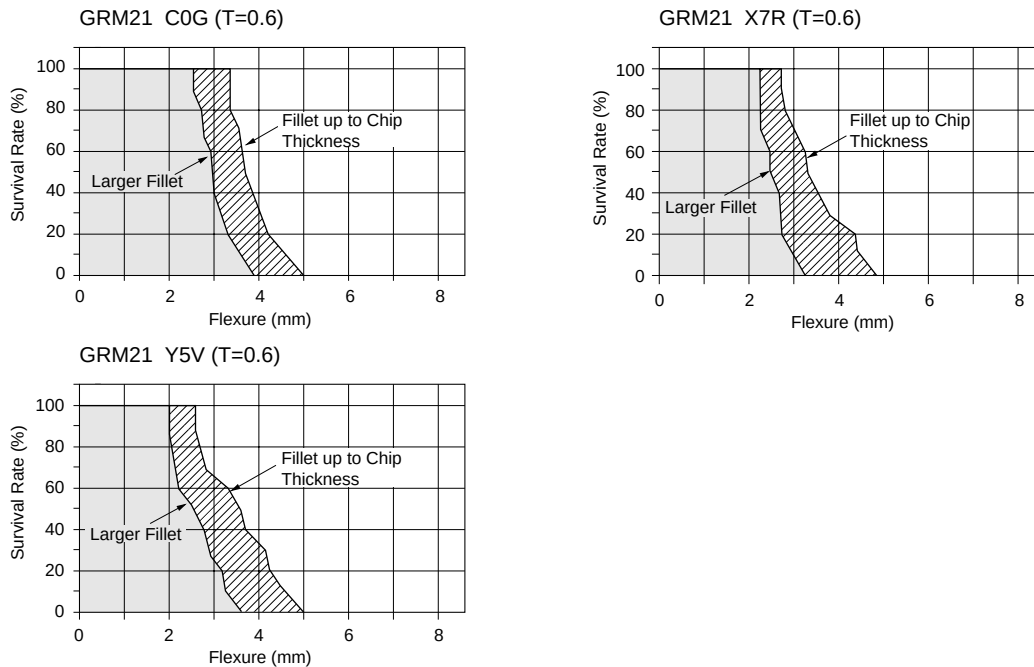
| Characteristics | Change in Capacitance                                         |
|-----------------|---------------------------------------------------------------|
| C0G             | Within $\pm 5\%$ or $\pm 0.5\text{pF}$ , whichever is greater |
| X7R             | Within $\pm 12.5\%$                                           |
| Y5V             | Within $\pm 20\%$                                             |

Continued on the following page.

## Reference Data

Continued from the preceding page.

### (4) Results

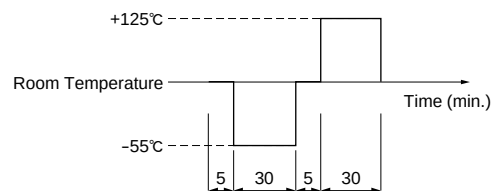


## 3. Temperature Cycling for Solder Fillet Height

### (1) Test Method

Solder the chips to the substrate various test fixtures using sufficient amounts of solder to achieve the required fillet height. Then subject the fixtures to the cycle illustrated below 200 times.

#### [Temperature Cycling]



### ① Solder Amount

Alumina substrates are typically designed for reflow soldering.

Glass epoxy or paper phenol substrates are typically used for flow soldering.

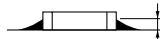
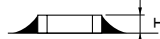
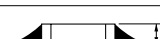
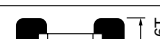
### ② Material

Alumina (Thickness : 0.64mm)

Glass epoxy (Thickness : 1.6 mm)

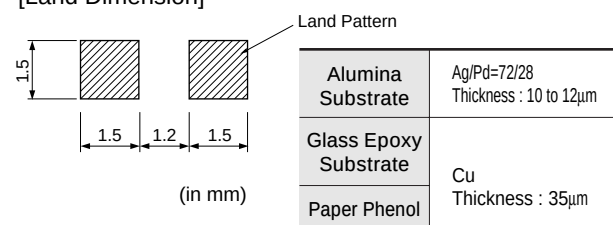
Paper phenol (Thickness : 1.6 mm)

#### [Solder Amount]

| Substrate         |   | Alumina                                                                                    | Glass Epoxy or Paper Phenol                                                                |
|-------------------|---|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Solder Amount     | ① |  0.5T |  T    |
|                   | ② |  0.7T |  1.3T |
|                   | ③ |  T    |  1.6T |
| Solder to be used |   | 6X4 Eutectic solder                                                                        |                                                                                            |

### ③ Land Dimension

#### [Land Dimension]



Continued on the following page. ➤

## Reference Data

Continued from the preceding page.

### (2) Test Samples

GRM40 C0G/X7R/Y5V Characteristics T=0.6mm

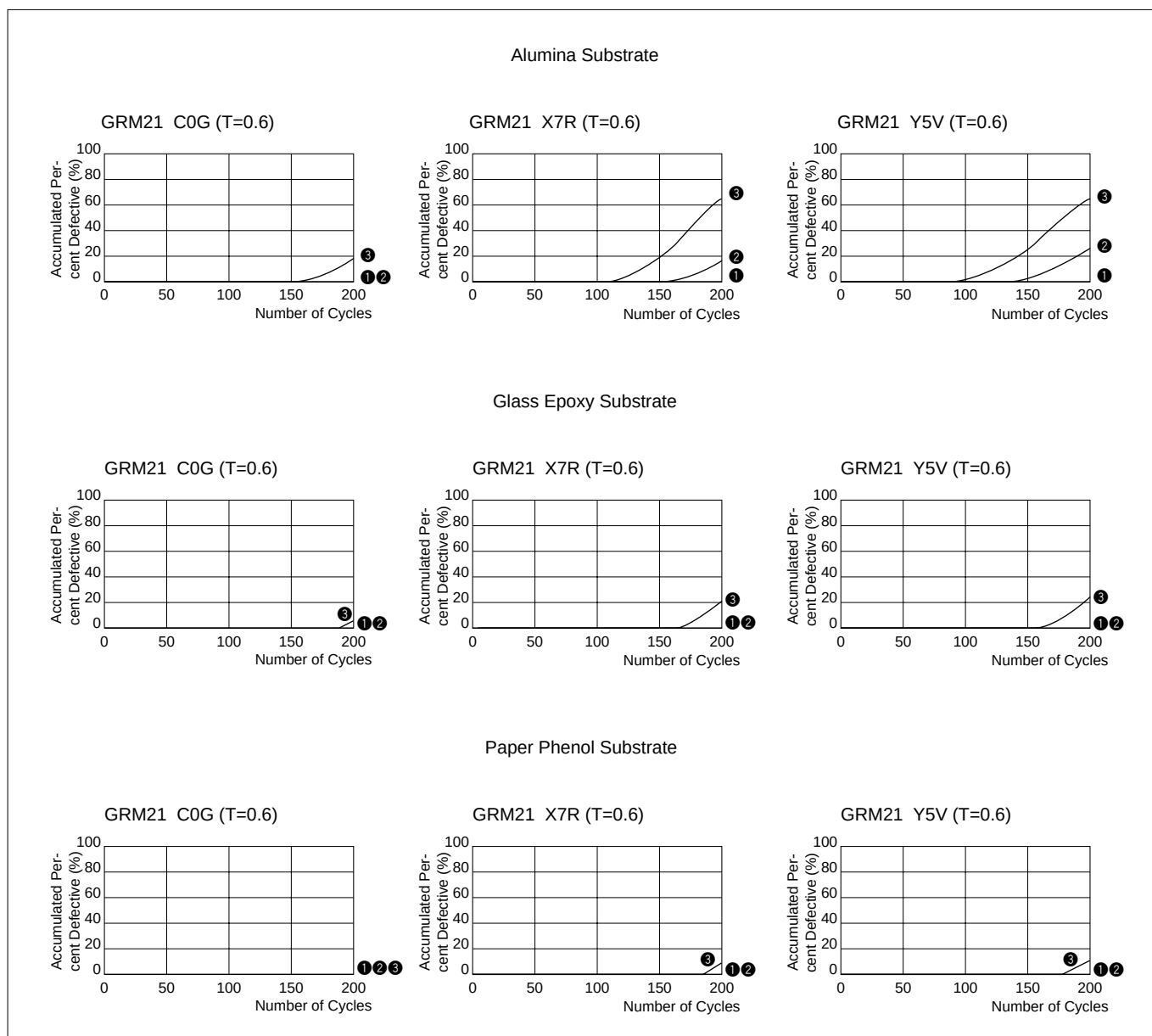
### (3) Acceptance Criteria

Products are determined to be defective if the change in capacitance has exceeded the values specified in Table 3.

Table 3

| Characteristics | Change in Capacitance                                            |
|-----------------|------------------------------------------------------------------|
| <b>C0G</b>      | Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ , whichever is greater |
| <b>X7R</b>      | Within $\pm 7.5\%$                                               |
| <b>Y5V</b>      | Within $\pm 20\%$                                                |

### (4) Results



Continued on the following page. ➤

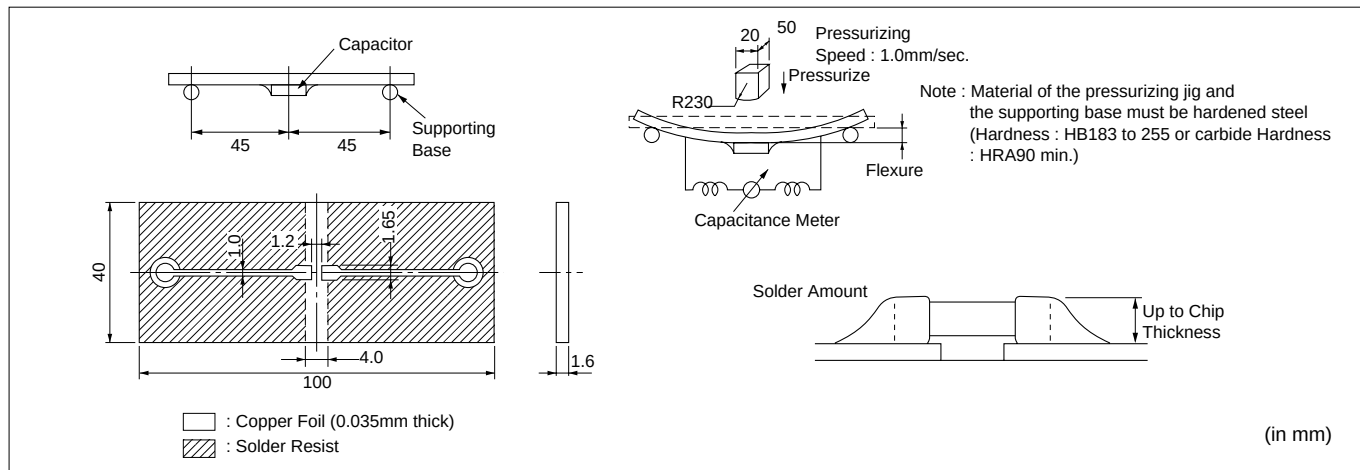
## Reference Data

Continued from the preceding page.

### 4. Board Bending Strength for Board Material

#### (1) Test Method

Solder the chip to the test board. Then bend the board using the method illustrated below, to measure capacitance.



#### (2) Test Samples

GRM21 C0G/X7R/Y5V Characteristics T=0.6mm typical

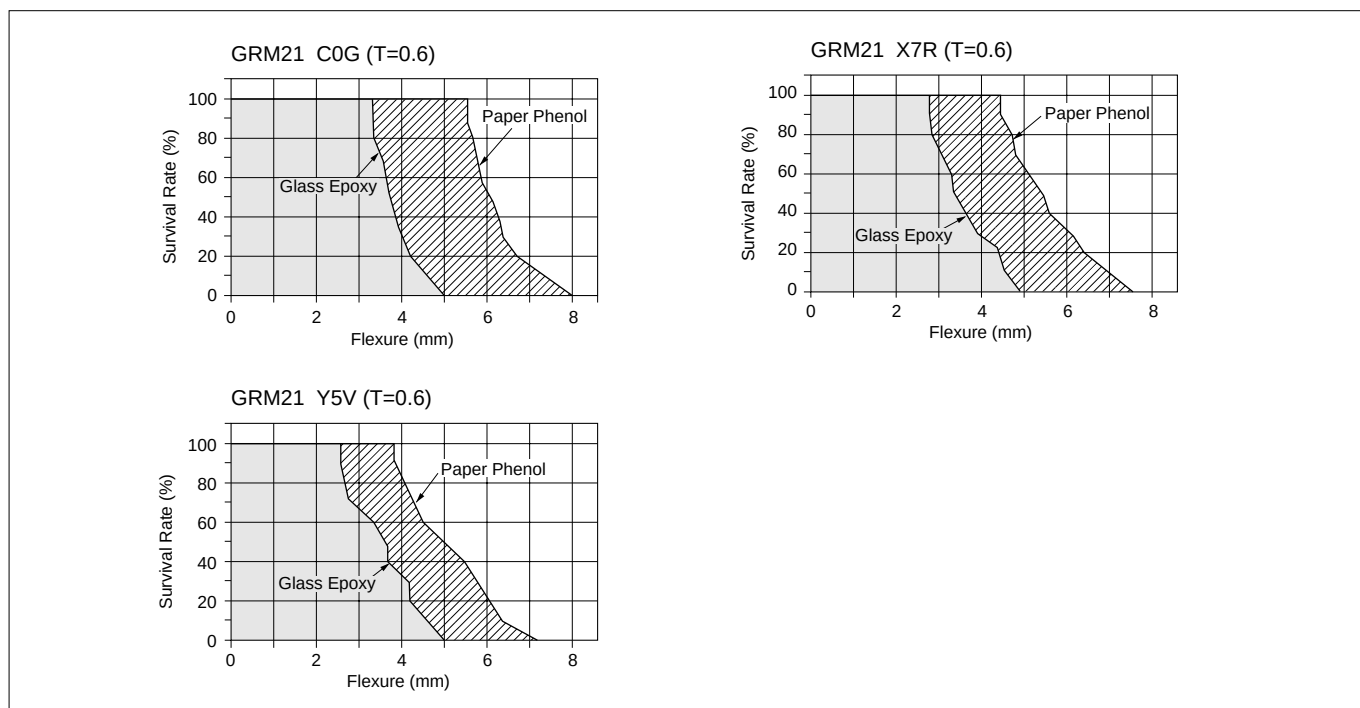
#### (3) Acceptance Criteria

Products shall be determined to be defective if the change in capacitance has exceeded the values specified in Table 4.

Table 4

| Characteristics | Change in Capacitance                                         |
|-----------------|---------------------------------------------------------------|
| <b>C0G</b>      | Within $\pm 5\%$ or $\pm 0.5\text{pF}$ , whichever is greater |
| <b>X7R</b>      | Within $\pm 12.5\%$                                           |
| <b>Y5V</b>      | Within $\pm 20\%$                                             |

#### (4) Results



Continued on the following page. ➤

## Reference Data

Continued from the preceding page.

### 5. Break Strength

#### (1) Test Method

Place the chip on a steel plate as illustrated on the right. Increase load applied to a point near the center of the test sample.

#### (2) Test Samples

GRM21 C0G/X7R/Y5V Characteristics  
GRM31 C0G/X7R/Y5V Characteristics

#### (3) Acceptance Criteria

Define the load that has caused the chip to break or crack, as the bending force.

#### (4) Explanation

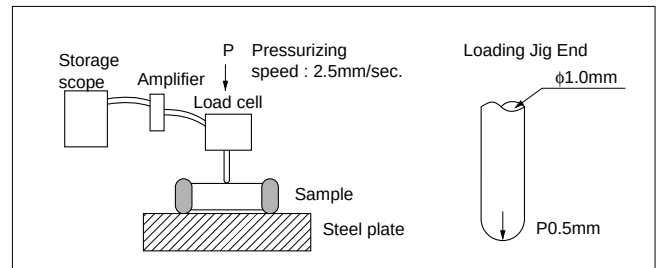
Break strength, P, is proportionate to the square of the thickness of the ceramic element and is expressed as a curve of secondary degree.

The formula is :

$$P = \frac{2\gamma WT^2}{3L} \quad (N)$$

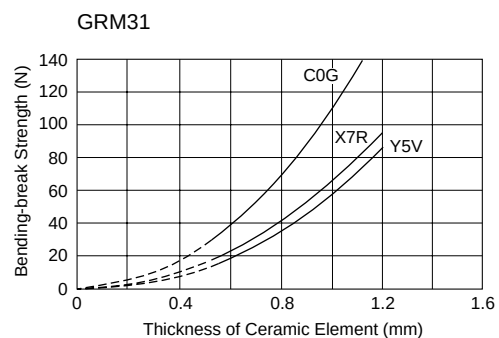
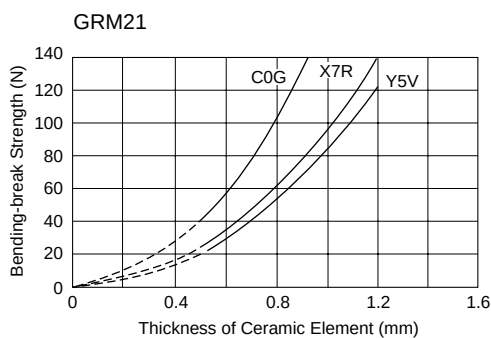
W : Width of ceramic element (mm)  
T : Thickness of element (mm)  
L : Distance between fulcrums (mm)  
 $\gamma$  : Bending stress (N/mm<sup>2</sup>)

#### (5) Results



| Chip Size | L   | W   | $\gamma$            |                     |                     |
|-----------|-----|-----|---------------------|---------------------|---------------------|
|           |     |     | C0G Characteristics | X7R Characteristics | Y5V Characteristics |
| GRM21     | 1.5 | 1.2 | 300                 | 180                 | 160                 |
| GRM31     | 2.7 | 1.5 |                     |                     |                     |

(in mm)



### 6. Thermal Shock

#### (1) Test method

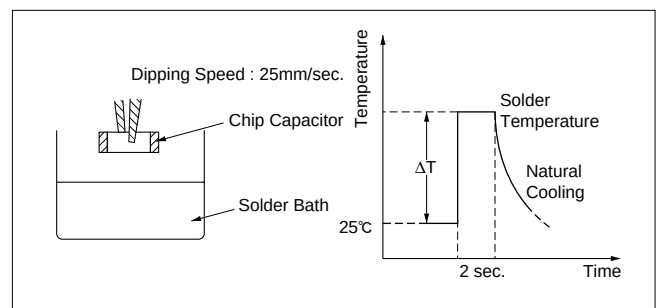
After applying flux (an ethanol solution of 25% rosin), dip the chip in a solder bath (6X4 eutectic solder) in accordance with the following conditions :

#### (2) Test samples

GRM21 C0G/X7R/Y5V Characteristics T=0.6mm typical

#### (3) Acceptance criteria

Visually inspect the test sample with a 60-power optical microscope. Chips exhibiting breaks or cracks shall be determined to be defective.

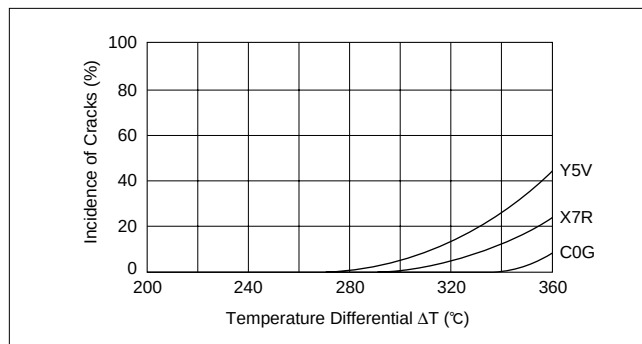


Continued on the following page. ➤

## Reference Data

Continued from the preceding page.

### (4) Results



## 7. Solder Heat Resistance

### (1) Test Method

#### ① Reflow soldering :

Apply about 300  $\mu\text{m}$  of solder paste over the alumina substrate. After reflow soldering, remove the chip and check for leaching that may have occurred on the outer electrode.

#### ② Flow soldering :

After dipping the test sample with a pair of tweezers in wave solder (eutectic solder), check for leaching that may have occurred on the outer electrode.

#### ③ Dip soldering :

After dipping the test sample with a pair of tweezers in static solder (eutectic solder), check for leaching that may have occurred on the outer electrode.

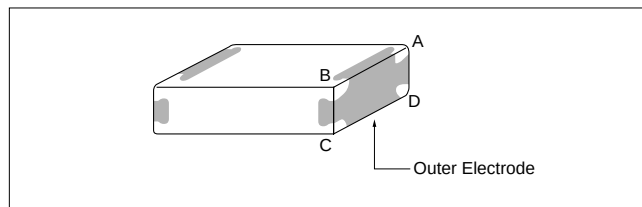
#### ④ Flux to be used : An ethanol solution of 25% rosin.

### (2) Test samples

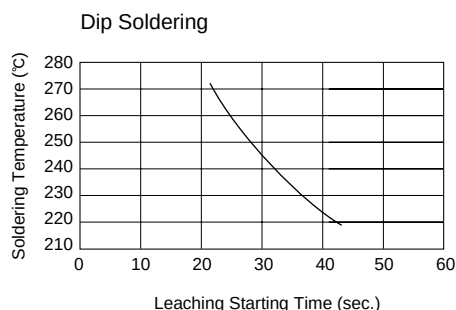
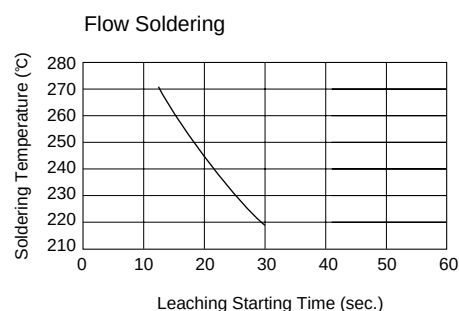
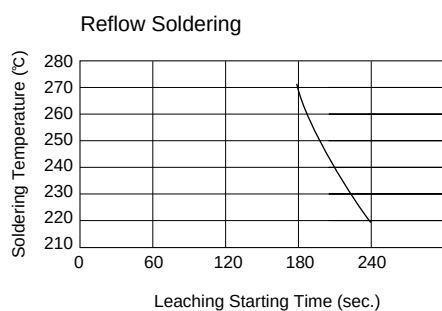
GRM21 : For flow/reflow soldering  $T=0.6\text{mm}$

### (3) Acceptance criteria

The starting time of leaching should be defined as the time when the outer electrode has lost 25 % of the total edge length of A-B-C-D as illustrated :



### (4) Results



Continued on the following page.

## Reference Data

Continued from the preceding page.

### 8. Thermal Shock when Making Corrections with a Soldering Iron

#### (1) Test Method

Apply a soldering iron meeting the conditions below to the soldered joint of a chip that has been soldered to a paper phenol board, while supplying wire solder. (Note: the soldering iron tip should not directly touch the ceramic element of the chip.)

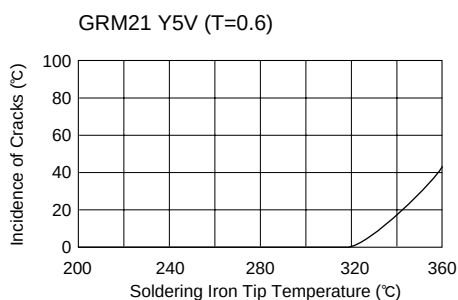
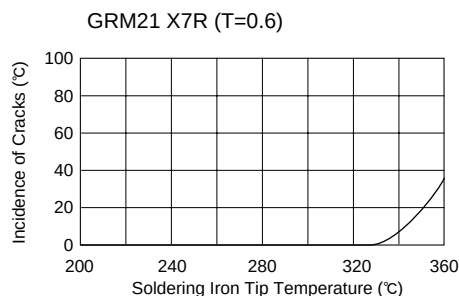
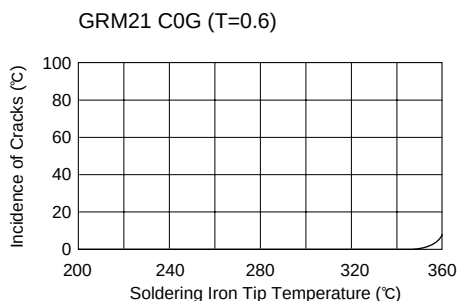
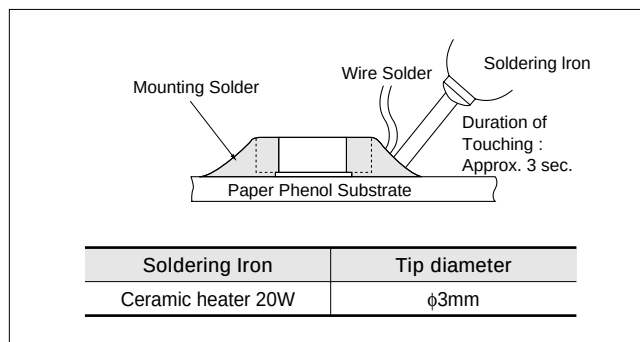
#### (2) Test Samples

GRM21 C0G/X7R/Y5V Characteristics T=0.6mm

#### (3) Acceptance Criteria for Defects

Observe the appearance of the test sample with a 60-power optical microscope. Those units displaying any breaks or cracks are determined to be defective.

#### (4) Results



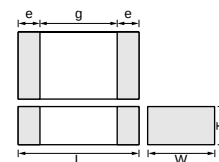
# Chip Monolithic Ceramic Capacitors



## Medium-voltage Low Dissipation Factor

### ■ Features

1. Murata's original internal electrode structure realizes high flash-over voltage.
2. A new monolithic structure for small, surface-mountable devices capable of operating at high voltage levels.
3. Sn-plated external electrodes realize good solderability.
4. Use the GRM31 type with flow or reflow soldering, and other types with reflow soldering only.
5. Low-loss and suitable for high frequency circuits.
6. The temperature characteristics C0G and SL are temperature compensating type, and R is high dielectric constant type.



| Part Number | Dimensions (mm) |          |                |        |        |
|-------------|-----------------|----------|----------------|--------|--------|
|             | L               | W        | T              | e min. | g min. |
| GRM31A      | 3.2 ±0.2        | 1.6 ±0.2 | 1.0 +0.0,-0.3  | 0.3    | 1.5*   |
| GRM31B      | 3.2 ±0.2        | 1.6 ±0.2 | 1.25 +0.0,-0.3 |        | 1.8    |
| GRM32Q      | 3.2 ±0.2        | 2.5 ±0.2 | 1.5 +0.0,-0.3  |        | 2.9    |
| GRM42A      | 4.5 ±0.3        | 2.0 ±0.2 | 1.0 +0.0,-0.3  |        | 2.9    |
| GRM42B      |                 |          | 1.25 +0.0,-0.3 |        |        |
| GRM42D      |                 |          | 2.0 ±0.3       |        |        |
| GRM43D      | 4.5 ±0.3        | 3.2 ±0.3 | 2.0 +0.0,-0.3  | 0.3    | 2.9    |
| GRM43E      |                 |          | 2.5 +0.0,-0.3  |        |        |

\* GRM31B1X3D : 1.8mm min.

### ■ Applications

1. Ideal for use on high frequency pulse circuits such as snubber circuits for switching power supplies, DC/DC converters, ballasts (inverter fluorescent lamps), etc.
2. Ideal for use as the ballast in liquid crystal back lighting inverters.
3. Please contact our sales representatives or engineers before using our products for other applications not specified above.

| Part Number        | Rated Voltage (V) | TC Code (Standard) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|--------------------|-------------------|--------------------|------------------|---------------|--------------|------------------|-----------------------|------------------|
| GRM31AR32J101KY01D | DC630             | R (JIS)            | 100 ±10%         | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31AR32J151KY01D | DC630             | R (JIS)            | 150 ±10%         | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31AR32J221KY01D | DC630             | R (JIS)            | 220 ±10%         | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31AR32J331KY01D | DC630             | R (JIS)            | 330 ±10%         | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31BR32J471KY01L | DC630             | R (JIS)            | 470 ±10%         | 3.2           | 1.6          | 1.25             | 1.5                   | 0.3 min.         |
| GRM31BR32J681KY01L | DC630             | R (JIS)            | 680 ±10%         | 3.2           | 1.6          | 1.25             | 1.5                   | 0.3 min.         |
| GRM31BR32J102KY01L | DC630             | R (JIS)            | 1000 ±10%        | 3.2           | 1.6          | 1.25             | 1.5                   | 0.3 min.         |
| GRM31AR33A470KY01D | DC1000            | R (JIS)            | 47 ±10%          | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31AR33A680KY01D | DC1000            | R (JIS)            | 68 ±10%          | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31AR33A101KY01D | DC1000            | R (JIS)            | 100 ±10%         | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31AR33A151KY01D | DC1000            | R (JIS)            | 150 ±10%         | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31AR33A221KY01D | DC1000            | R (JIS)            | 220 ±10%         | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31AR33A331KY01D | DC1000            | R (JIS)            | 330 ±10%         | 3.2           | 1.6          | 1.0              | 1.5                   | 0.3 min.         |
| GRM31BR33A471KY01L | DC1000            | R (JIS)            | 470 ±10%         | 3.2           | 1.6          | 1.25             | 1.5                   | 0.3 min.         |
| GRM31B1X3D100JY01L | DC2000            | SL (JIS)           | 10 ±5%           | 3.2           | 1.6          | 1.25             | 1.8                   | 0.3 min.         |
| GRM31B1X3D120JY01L | DC2000            | SL (JIS)           | 12 ±5%           | 3.2           | 1.6          | 1.25             | 1.8                   | 0.3 min.         |
| GRM31B1X3D150JY01L | DC2000            | SL (JIS)           | 15 ±5%           | 3.2           | 1.6          | 1.25             | 1.8                   | 0.3 min.         |
| GRM31B1X3D180JY01L | DC2000            | SL (JIS)           | 18 ±5%           | 3.2           | 1.6          | 1.25             | 1.8                   | 0.3 min.         |
| GRM31B1X3D220JY01L | DC2000            | SL (JIS)           | 22 ±5%           | 3.2           | 1.6          | 1.25             | 1.8                   | 0.3 min.         |
| GRM32Q1X3D270JY01L | DC2000            | SL (JIS)           | 27 ±5%           | 3.2           | 2.5          | 1.5              | 1.8                   | 0.3 min.         |
| GRM32Q1X3D330JY01L | DC2000            | SL (JIS)           | 33 ±5%           | 3.2           | 2.5          | 1.5              | 1.8                   | 0.3 min.         |
| GRM32Q1X3D390JY01L | DC2000            | SL (JIS)           | 39 ±5%           | 3.2           | 2.5          | 1.5              | 1.8                   | 0.3 min.         |
| GRM32Q1X3D470JY01L | DC2000            | SL (JIS)           | 47 ±5%           | 3.2           | 2.5          | 1.5              | 1.8                   | 0.3 min.         |
| GRM32Q1X3D560JY01L | DC2000            | SL (JIS)           | 56 ±5%           | 3.2           | 2.5          | 1.5              | 1.8                   | 0.3 min.         |

Continued on the following page.

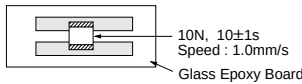
Continued from the preceding page.

| Part Number        | Rated Voltage (V) | TC Code (Standard) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|--------------------|-------------------|--------------------|------------------|---------------|--------------|------------------|-----------------------|------------------|
| GRM32Q1X3D680JY01L | DC2000            | SL (JIS)           | 68 ±5%           | 3.2           | 2.5          | 1.5              | 1.8                   | 0.3 min.         |
| GRM32Q1X3D820JY01L | DC2000            | SL (JIS)           | 82 ±5%           | 3.2           | 2.5          | 1.5              | 1.8                   | 0.3 min.         |
| GRM43D1X3D121JY01L | DC2000            | SL (JIS)           | 120 ±5%          | 4.5           | 3.2          | 2.0              | 2.9                   | 0.3 min.         |
| GRM43D1X3D151JY01L | DC2000            | SL (JIS)           | 150 ±5%          | 4.5           | 3.2          | 2.0              | 2.9                   | 0.3 min.         |
| GRM43D1X3D181JY01L | DC2000            | SL (JIS)           | 180 ±5%          | 4.5           | 3.2          | 2.0              | 2.9                   | 0.3 min.         |
| GRM43D1X3D221JY01L | DC2000            | SL (JIS)           | 220 ±5%          | 4.5           | 3.2          | 2.0              | 2.9                   | 0.3 min.         |
| GRM42A5C3F100JW01L | DC3150            | C0G (EIA)          | 10 ±5%           | 4.5           | 2.0          | 1.0              | 2.9                   | 0.3 min.         |
| GRM42A5C3F120JW01L | DC3150            | C0G (EIA)          | 12 ±5%           | 4.5           | 2.0          | 1.0              | 2.9                   | 0.3 min.         |
| GRM42A5C3F150JW01L | DC3150            | C0G (EIA)          | 15 ±5%           | 4.5           | 2.0          | 1.0              | 2.9                   | 0.3 min.         |
| GRM42A5C3F180JW01L | DC3150            | C0G (EIA)          | 18 ±5%           | 4.5           | 2.0          | 1.0              | 2.9                   | 0.3 min.         |
| GRM42A5C3F220JW01L | DC3150            | C0G (EIA)          | 22 ±5%           | 4.5           | 2.0          | 1.0              | 2.9                   | 0.3 min.         |
| GRM42D1X3F560JY02L | DC3150            | SL (JIS)           | 56 ±5%           | 4.5           | 2.0          | 2.0              | 2.9                   | 0.3 min.         |
| GRM42D1X3F680JY02L | DC3150            | SL (JIS)           | 68 ±5%           | 4.5           | 2.0          | 2.0              | 2.9                   | 0.3 min.         |
| GRM42D1X3F820JY02L | DC3150            | SL (JIS)           | 82 ±5%           | 4.5           | 2.0          | 2.0              | 2.9                   | 0.3 min.         |
| GRM43E1X3F101JY01L | DC3150            | SL (JIS)           | 100 ±5%          | 4.5           | 3.2          | 2.5              | 2.9                   | 0.3 min.         |

Please contact us for SL characteristics information.

DC3150V items are considered to use for the application which is not LCD back lighting inverters circuit.

## Specifications and Test Methods

| No.           | Item                                    | Specifications                                                                                                                               |                                         | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
|---------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|--------|---------------------------|--------------|---------------------------|----------|---------------------------|---|------------------------|---|---------------------------|
|               |                                         | Temperature Compensating Type (C0G, SL Char.)                                                                                                | High Dielectric Constant Type (R Char.) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 1             | Operating Temperature Range             | -55 to +125℃                                                                                                                                 |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 2             | Appearance                              | No defects or abnormalities                                                                                                                  |                                         | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 3             | Dimensions                              | Within the specified dimension                                                                                                               |                                         | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 4             | Dielectric Strength                     | No defects or abnormalities                                                                                                                  |                                         | No failure should be observed when voltage in Table is applied between the terminations for 1 to 5 sec., provided the charge/ discharge current is less than 50mA. <table><tr><th>Rated voltage</th><th>Test voltage</th></tr><tr><td>DC630V</td><td>150% of the rated voltage</td></tr><tr><td>DC1kV, DC2kV</td><td>120% of the rated voltage</td></tr><tr><td>DC3.15kV</td><td>DC4095V</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Rated voltage | Test voltage    | DC630V | 150% of the rated voltage | DC1kV, DC2kV | 120% of the rated voltage | DC3.15kV | DC4095V                   |   |                        |   |                           |
| Rated voltage | Test voltage                            |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| DC630V        | 150% of the rated voltage               |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| DC1kV, DC2kV  | 120% of the rated voltage               |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| DC3.15kV      | DC4095V                                 |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 5             | Insulation Resistance (I.R.)            | More than 10,000MΩ                                                                                                                           |                                         | The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 6             | Capacitance                             | Within the specified tolerance                                                                                                               |                                         | The capacitance/Q/D.F. should be measured at 20℃ at the frequency and voltage shown as follows.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 7             | Q/ Dissipation Factor (D.F.)            | C0G char. : Q≥1,000<br>SL char. : C≥30pF : Q≥1,000<br>C<30pF : Q≥400+20C*2                                                                   | D.F.≤0.01                               | (1) Temperature Compensating Type<br>Frequency : 1±0.2MHz<br>Voltage : AC0.5 to 5V (r.m.s.)<br>(2) High Dielectric Constant Type<br>Frequency : 1±0.2kHz<br>Voltage : AC1±0.2V (r.m.s.)<br>•Pretreatment<br>Perform a heat treatment at 150 ±10 °℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 8             | Capacitance Temperature Characteristics | Temp. Coefficient<br>C0G char. : 0±30ppm/℃<br>(Temp. Range : -55 to +125℃)<br>SL char. : +350 to -1,000 ppm/℃<br>(Temp. Range : +20 to +85℃) | Cap. Change Within ±15%                 | (1) Temperature Compensating Type<br>The temperature coefficient is determined using the capacitance measured in step 3 as a reference.<br>When cycling the temperature sequentially from step 1 through 5 (SL : +20 to +85 ℃) the capacitance should be within the specified tolerance for the temperature coefficient. <table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>20±2 (25±2 for C0G char.)</td></tr><tr><td>2</td><td>Min. Operating Temp.±3</td></tr><tr><td>3</td><td>20±2 (25±2 for C0G char.)</td></tr><tr><td>4</td><td>Max. Operating Temp.±2</td></tr><tr><td>5</td><td>20±2 (25±2 for C0G char.)</td></tr></table> (2) High Dielectric Constant Type<br>The range of capacitance change compared to the 20℃ value within -55 to +125℃ should be within the specified range.<br>•Pretreatment<br>Perform a heat treatment at 150 ±10 °℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition. | Step          | Temperature (℃) | 1      | 20±2 (25±2 for C0G char.) | 2            | Min. Operating Temp.±3    | 3        | 20±2 (25±2 for C0G char.) | 4 | Max. Operating Temp.±2 | 5 | 20±2 (25±2 for C0G char.) |
| Step          | Temperature (℃)                         |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 1             | 20±2 (25±2 for C0G char.)               |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 2             | Min. Operating Temp.±3                  |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 3             | 20±2 (25±2 for C0G char.)               |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 4             | Max. Operating Temp.±2                  |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 5             | 20±2 (25±2 for C0G char.)               |                                                                                                                                              |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |
| 9             | Adhesive Strength of Termination        | No removal of the terminations or other defect should occur.                                                                                 |                                         | Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1 using a eutectic solder.<br>Then apply 10N force in the direction of the arrow.<br>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock. <div><p>10N, 10±1s<br/>Speed : 1.0mm/s<br/>Glass Epoxy Board</p></div> <p>Fig. 1</p>                                                                                                                                                                                                                                                                                                                                                                                                                |               |                 |        |                           |              |                           |          |                           |   |                        |   |                           |

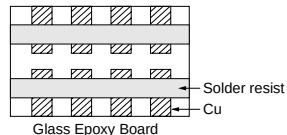
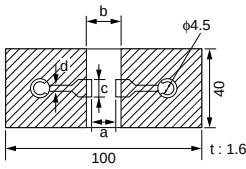
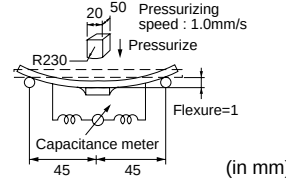
\*1 "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

\*2 "C" expresses nominal capacitance value (pF).

Continued on the following page. 

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                                          |                                                                     | Specifications                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|---------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------|------|---|----------------|--------|---|----------------|---------|-----|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|
|                     |                                                                               |                                                                     | Temperature Compensating Type (C0G, SL Char.)                                 | High Dielectric Constant Type (R Char.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 10                  | Vibration Resistance                                                          | Appearance                                                          | No defects or abnormalities                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>Solder the capacitor to the test jig (glass epoxy board).<br/>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 min. This motion should be applied for a period of 2 hrs. in each 3 mutually perpendicular directions (total of 6 hrs.).</p>                                                                                                                                                                                     |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                               | Capacitance                                                         | Within the specified tolerance                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                               | Q/D.F.                                                              | C0G char. : Q≥1,000<br>SL char. :<br>C≥30pF : Q≥1,000<br>C<30pF : Q≥400+20C*2 | D.F.≤0.01                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 11                  | Deflection                                                                    | No cracking or marking defects should occur.                        |                                                                               | <p>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2 using a eutectic solder.<br/>Then apply a force in the direction shown in Fig. 3.<br/>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p>  <table border="1" data-bbox="363 927 874 1084"><thead><tr><th rowspan="2">L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th></tr></thead><tbody><tr><td>3.2×1.6</td><td>2.2</td><td>5.0</td><td>2.0</td><td rowspan="4">1.0</td></tr><tr><td>3.2×2.5</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr></tbody></table> <p>Fig. 2</p>  <p>Fig. 3</p> | L×W (mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Dimension (mm) |             |      |   | a              | b      | c | d              | 3.2×1.6 | 2.2 | 5.0 | 2.0 | 1.0 | 3.2×2.5 | 2.2 | 5.0 | 2.9 | 4.5×2.0 | 3.5 | 7.0 | 2.4 | 4.5×3.2 | 3.5 | 7.0 | 3.7 |
|                     |                                                                               | L×W (mm)                                                            | Dimension (mm)                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| a                   | b                                                                             |                                                                     | c                                                                             | d                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 3.2×1.6             | 2.2                                                                           | 5.0                                                                 | 2.0                                                                           | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 3.2×2.5             | 2.2                                                                           | 5.0                                                                 | 2.9                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 4.5×2.0             | 3.5                                                                           | 7.0                                                                 | 2.4                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 4.5×3.2             | 3.5                                                                           | 7.0                                                                 | 3.7                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 12                  | Solderability of Termination                                                  | 75% of the terminations are to be soldered evenly and continuously. |                                                                               | <p>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 2±0.5 sec. at 235±5°C.<br/>Immersing speed : 25±2.5mm/s</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 13                  | Resistance to Soldering Heat                                                  | Appearance                                                          | No marking defects                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>Preheat the capacitor at 120 to 150°C* for 1 min.<br/>Immerse the capacitor in eutectic solder solution at 260±5°C for 10±1 sec. Let sit at *room condition for 24±2 hrs., then measure.</p> <ul style="list-style-type: none"><li>Immersing speed : 25±2.5mm/s</li><li>Pretreatment for high dielectric constant type<br/>Perform a heat treatment at 150±10°C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</li></ul> <p>*Preheating for more than 3.2×2.5mm</p> <table border="1" data-bbox="938 1476 1449 1554"><thead><tr><th>Step</th><th>Temperature</th><th>Time</th></tr></thead><tbody><tr><td>1</td><td>100°C to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170°C to 200°C</td><td>1 min.</td></tr></tbody></table> | Step           | Temperature | Time | 1 | 100°C to 120°C | 1 min. | 2 | 170°C to 200°C | 1 min.  |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                               | Step                                                                | Temperature                                                                   | Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                               | 1                                                                   | 100°C to 120°C                                                                | 1 min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                               | 2                                                                   | 170°C to 200°C                                                                | 1 min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                               | Capacitance Change                                                  | Within ±2.5% or ±0.25pF (Whichever is larger)                                 | Within ±10%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| Q/D.F.              | C0G char. : Q≥1,000<br>SL char. :<br>C≥30pF : Q≥1,000<br>C<30pF : Q≥400+20C*2 | D.F.≤0.01                                                           |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| I.R.                | More than 10,000MΩ                                                            |                                                                     |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| Dielectric Strength | In accordance with item No.4                                                  |                                                                     |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |             |      |   |                |        |   |                |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |

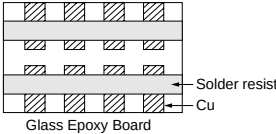
\*1 "Room condition" Temperature : 15 to  $35^\circ\text{C}$ , Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

\*2 "C" expresses nominal capacitance value (pF).

Continued on the following page. 

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                                                |                     | Specifications                                                                      |                                         | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|---------------------|-------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------|-----------------|---------------|------------------------|---------------------------|---|------------|--------|---|------------------------|------|---|------------|--------|
|                     |                                                                                     |                     | Temperature Compensating Type (C0G, SL Char.)                                       | High Dielectric Constant Type (R Char.) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| 14                  | Temperature Cycle                                                                   | Appearance          | No marking defects                                                                  |                                         | <p>Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4 using a eutectic solder.</p> <p>Perform the 5 cycles according to the 4 heat treatments listed in the following table.</p> <p>Let sit for 24±2 hrs. at *room condition, then measure.</p> <table><tr><th>Step</th><th>Temperature (°C)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table> <p>•Pretreatment for high dielectric constant type</p> <p>Perform a heat treatment at 150 ±<sub>10</sub><sup>+9</sup> °C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p> <div><p>Fig. 4</p></div> | Step          | Temperature (°C) | Time (min.)     | 1             | Min. Operating Temp.±3 | 30±3                      | 2 | Room Temp. | 2 to 3 | 3 | Max. Operating Temp.±2 | 30±3 | 4 | Room Temp. | 2 to 3 |
|                     |                                                                                     | Step                | Temperature (°C)                                                                    | Time (min.)                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | 1                   | Min. Operating Temp.±3                                                              | 30±3                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | 2                   | Room Temp.                                                                          | 2 to 3                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | 3                   | Max. Operating Temp.±2                                                              | 30±3                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| 4                   | Room Temp.                                                                          | 2 to 3              |                                                                                     |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| Capacitance Change  | Within ±2.5% or ±0.25pF (Whichever is larger)                                       | Within ±10%         |                                                                                     |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| Q/D.F.              | C0G char. : Q≥1,000<br>SL char. : C≥30pF : Q≥1,000<br>C<30pF : Q≥400+20C*2          | D.F.≤0.01           |                                                                                     |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| I.R.                | More than 10,000MΩ                                                                  |                     |                                                                                     |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| Dielectric Strength | In accordance with item No.4                                                        |                     |                                                                                     |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| 15                  | Humidity (Steady State)                                                             | Appearance          | No marking defects                                                                  |                                         | <p>Let the capacitor sit at 40±2°C and relative humidity of 90 to 95% for 500 ±<sub>8</sub><sup>+24</sup> hrs.</p> <p>Remove and let sit for 24±2 hrs. at *room condition, then measure.</p> <p>•Pretreatment for high dielectric constant type</p> <p>Perform a heat treatment at 150 ±<sub>10</sub><sup>+9</sup> °C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | Capacitance Change  | Within ±5.0% or ±0.5pF (Whichever is larger)                                        | Within ±10%                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | Q/D.F.              | C0G char. : Q≥350<br>SL char. : C≥30pF : Q≥350<br>C<30pF : Q≥275+ $\frac{5}{2}$ C*2 | D.F.≤0.01                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | I.R.                | More than 1,000MΩ                                                                   |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | Dielectric Strength | In accordance with item No.4                                                        |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| 16                  | Life                                                                                | Appearance          | No marking defects                                                                  |                                         | <p>Apply the voltage in following table for 1,000 ±<sub>8</sub><sup>+48</sup> hrs. at maximum operating temperature ±3°C.</p> <p>Remove and let sit for 24±2 hrs. at *room condition, then measure.</p> <p>The charge/discharge current is less than 50mA.</p> <p>•Pretreatment for high dielectric constant type</p> <p>Apply test voltage for 60±5 min. at test temperature.</p> <p>Remove and let sit for 24±2 hrs. at *room condition.</p> <table><tr><th>Rated voltage</th><th>Test voltage</th></tr><tr><td>More than DC1kV</td><td>Rated voltage</td></tr><tr><td>Less than DC1kV</td><td>120% of the rated voltage</td></tr></table>                                                                                                                                                                                                                                                                  | Rated voltage | Test voltage     | More than DC1kV | Rated voltage | Less than DC1kV        | 120% of the rated voltage |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | Rated voltage       | Test voltage                                                                        |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | More than DC1kV     | Rated voltage                                                                       |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | Less than DC1kV     | 120% of the rated voltage                                                           |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
|                     |                                                                                     | Capacitance Change  | Within ±3.0% or ±0.3pF (Whichever is larger)                                        | Within ±10%                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| Q/D.F.              | C0G char. : Q≥350<br>SL char. : C≥30pF : Q≥350<br>C<30pF : Q≥275+ $\frac{5}{2}$ C*2 | D.F.≤0.02           |                                                                                     |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| I.R.                | More than 1,000MΩ                                                                   |                     |                                                                                     |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |
| Dielectric Strength | In accordance with item No.4                                                        |                     |                                                                                     |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                  |                 |               |                        |                           |   |            |        |   |                        |      |   |            |        |

\*1 "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

\*2 "C" expresses nominal capacitance value (pF).

# Chip Monolithic Ceramic Capacitors



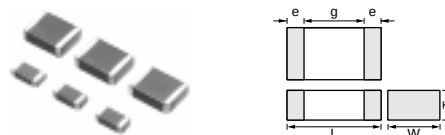
## Medium-voltage High-Capacitance for General-Use

### ■ Features

1. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
2. Sn-plated external electrodes realized good solderability.
3. Use the GRM18/21/31 types with flow or reflow soldering, and other types with reflow soldering only.

### ■ Applications

1. Ideal for use as a hot-cold coupling for DC/DC converter.
2. Ideal for use on line filters and ringer detectors for telephones, facsimiles and modems.
3. Ideal for use on diode-snubber circuits for switching power supplies.



| Part Number | Dimensions (mm) |           |              |            |        |
|-------------|-----------------|-----------|--------------|------------|--------|
|             | L               | W         | T            | e          | g min. |
| GRM188      | 1.6 ±0.1        | 0.8 ±0.1  | 0.8 ±0.1     | 0.2 to 0.5 | 0.4    |
| GRM21A      | 2.0 ±0.2        | 1.25 ±0.2 | 1.0 +0,-0.3  | 0.3 min.   | 0.7    |
| GRM21B      |                 |           | 1.25 ±0.2    |            |        |
| GRM31B      |                 |           | 1.25 +0,-0.3 |            |        |
| GRM31C      | 3.2 ±0.2        | 1.6 ±0.2  | 1.6 ±0.2     |            | 1.2    |
| GRM32Q      |                 |           | 1.5 +0,-0.3  |            |        |
| GRM32D      | 3.2 ±0.3        | 2.5 ±0.2  | 2.0 +0,-0.3  |            |        |
| GRM43Q      |                 |           | 1.5 +0,-0.3  | 2.2        |        |
| GRM43D      | 4.5 ±0.4        | 3.2 ±0.3  | 2.0 +0,-0.3  |            |        |
| GRM55D      | 5.7 ±0.4        | 5.0 ±0.4  | 2.0 +0,-0.3  |            | 3.2*   |

\* GRM55DR73A : 2.5mm min.

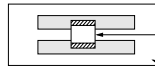
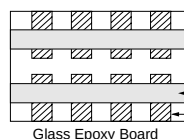
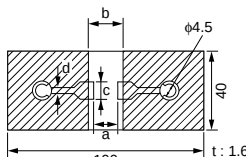
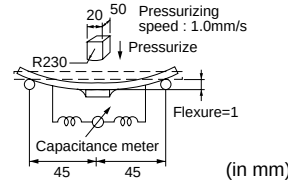
| Part Number        | Rated Voltage (V) | TC Code (Standard) | Capacitance  | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|--------------------|-------------------|--------------------|--------------|---------------|--------------|------------------|-----------------------|------------------|
| GRM188R72E221KW07D | DC250             | X7R (EIA)          | 220pF ±10%   | 1.6           | 0.8          | 0.8              | 0.4                   | 0.2 to 0.5       |
| GRM188R72E331KW07D | DC250             | X7R (EIA)          | 330pF ±10%   | 1.6           | 0.8          | 0.8              | 0.4                   | 0.2 to 0.5       |
| GRM188R72E471KW07D | DC250             | X7R (EIA)          | 470pF ±10%   | 1.6           | 0.8          | 0.8              | 0.4                   | 0.2 to 0.5       |
| GRM188R72E681KW07D | DC250             | X7R (EIA)          | 680pF ±10%   | 1.6           | 0.8          | 0.8              | 0.4                   | 0.2 to 0.5       |
| GRM188R72E102KW07D | DC250             | X7R (EIA)          | 1000pF ±10%  | 1.6           | 0.8          | 0.8              | 0.4                   | 0.2 to 0.5       |
| GRM21AR72E102KW01D | DC250             | X7R (EIA)          | 1000pF ±10%  | 2.0           | 1.25         | 1.0              | 0.7                   | 0.3 min.         |
| GRM188R72E152KW07D | DC250             | X7R (EIA)          | 1500pF ±10%  | 1.6           | 0.8          | 0.8              | 0.4                   | 0.2 to 0.5       |
| GRM21AR72E152KW01D | DC250             | X7R (EIA)          | 1500pF ±10%  | 2.0           | 1.25         | 1.0              | 0.7                   | 0.3 min.         |
| GRM188R72E222KW07D | DC250             | X7R (EIA)          | 2200pF ±10%  | 1.6           | 0.8          | 0.8              | 0.4                   | 0.2 to 0.5       |
| GRM21AR72E222KW01D | DC250             | X7R (EIA)          | 2200pF ±10%  | 2.0           | 1.25         | 1.0              | 0.7                   | 0.3 min.         |
| GRM21AR72E332KW01D | DC250             | X7R (EIA)          | 3300pF ±10%  | 2.0           | 1.25         | 1.0              | 0.7                   | 0.3 min.         |
| GRM21AR72E472KW01D | DC250             | X7R (EIA)          | 4700pF ±10%  | 2.0           | 1.25         | 1.0              | 0.7                   | 0.3 min.         |
| GRM21AR72E682KW01D | DC250             | X7R (EIA)          | 6800pF ±10%  | 2.0           | 1.25         | 1.0              | 0.7                   | 0.3 min.         |
| GRM21BR72E103KW03L | DC250             | X7R (EIA)          | 10000pF ±10% | 2.0           | 1.25         | 1.25             | 0.7                   | 0.3 min.         |
| GRM31BR72E153KW01L | DC250             | X7R (EIA)          | 15000pF ±10% | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR72E223KW01L | DC250             | X7R (EIA)          | 22000pF ±10% | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31CR72E333KW03L | DC250             | X7R (EIA)          | 33000pF ±10% | 3.2           | 1.6          | 1.6              | 1.2                   | 0.3 min.         |
| GRM31CR72E473KW03L | DC250             | X7R (EIA)          | 47000pF ±10% | 3.2           | 1.6          | 1.6              | 1.2                   | 0.3 min.         |
| GRM32QR72E683KW01L | DC250             | X7R (EIA)          | 68000pF ±10% | 3.2           | 2.5          | 1.5              | 1.2                   | 0.3 min.         |
| GRM31CR72E104KW03L | DC250             | X7R (EIA)          | 0.10μF ±10%  | 3.2           | 1.6          | 1.6              | 1.2                   | 0.3 min.         |
| GRM32DR72E104KW01L | DC250             | X7R (EIA)          | 0.10μF ±10%  | 3.2           | 2.5          | 2.0              | 1.2                   | 0.3 min.         |
| GRM43QR72E154KW01L | DC250             | X7R (EIA)          | 0.15μF ±10%  | 4.5           | 3.2          | 1.5              | 2.2                   | 0.3 min.         |
| GRM32DR72E224KW01L | DC250             | X7R (EIA)          | 0.22μF ±10%  | 3.2           | 2.5          | 2.0              | 1.2                   | 0.3 min.         |
| GRM43DR72E224KW01L | DC250             | X7R (EIA)          | 0.22μF ±10%  | 4.5           | 3.2          | 2.0              | 2.2                   | 0.3 min.         |
| GRM43DR72E334KW01L | DC250             | X7R (EIA)          | 0.33μF ±10%  | 4.5           | 3.2          | 2.0              | 2.2                   | 0.3 min.         |
| GRM55DR72E334KW01L | DC250             | X7R (EIA)          | 0.33μF ±10%  | 5.7           | 5.0          | 2.0              | 3.2                   | 0.3 min.         |
| GRM43DR72E474KW01L | DC250             | X7R (EIA)          | 0.47μF ±10%  | 4.5           | 3.2          | 2.0              | 2.2                   | 0.3 min.         |
| GRM55DR72E474KW01L | DC250             | X7R (EIA)          | 0.47μF ±10%  | 5.7           | 5.0          | 2.0              | 3.2                   | 0.3 min.         |
| GRM55DR72E105KW01L | DC250             | X7R (EIA)          | 1.0μF ±10%   | 5.7           | 5.0          | 2.0              | 3.2                   | 0.3 min.         |
| GRM31BR72J102KW01L | DC630             | X7R (EIA)          | 1000pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR72J152KW01L | DC630             | X7R (EIA)          | 1500pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR72J222KW01L | DC630             | X7R (EIA)          | 2200pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |

Continued on the following page.

Continued from the preceding page.

| Part Number        | Rated Voltage (V) | TC Code (Standard) | Capacitance  | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|--------------------|-------------------|--------------------|--------------|---------------|--------------|------------------|-----------------------|------------------|
| GRM31BR72J332KW01L | DC630             | X7R (EIA)          | 3300pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR72J472KW01L | DC630             | X7R (EIA)          | 4700pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR72J682KW01L | DC630             | X7R (EIA)          | 6800pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR72J103KW01L | DC630             | X7R (EIA)          | 10000pF ±10% | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31CR72J153KW03L | DC630             | X7R (EIA)          | 15000pF ±10% | 3.2           | 1.6          | 1.6              | 1.2                   | 0.3 min.         |
| GRM32QR72J223KW01L | DC630             | X7R (EIA)          | 22000pF ±10% | 3.2           | 2.5          | 1.5              | 1.2                   | 0.3 min.         |
| GRM32DR72J333KW01L | DC630             | X7R (EIA)          | 33000pF ±10% | 3.2           | 2.5          | 2.0              | 1.2                   | 0.3 min.         |
| GRM32DR72J473KW01L | DC630             | X7R (EIA)          | 47000pF ±10% | 3.2           | 2.5          | 2.0              | 1.2                   | 0.3 min.         |
| GRM43QR72J683KW01L | DC630             | X7R (EIA)          | 68000pF ±10% | 4.5           | 3.2          | 1.5              | 2.2                   | 0.3 min.         |
| GRM43DR72J104KW01L | DC630             | X7R (EIA)          | 0.10μF ±10%  | 4.5           | 3.2          | 2.0              | 2.2                   | 0.3 min.         |
| GRM55DR72J154KW01L | DC630             | X7R (EIA)          | 0.15μF ±10%  | 5.7           | 5.0          | 2.0              | 3.2                   | 0.3 min.         |
| GRM55DR72J224KW01L | DC630             | X7R (EIA)          | 0.22μF ±10%  | 5.7           | 5.0          | 2.0              | 3.2                   | 0.3 min.         |
| GRM31BR73A102KW01L | DC1000            | X7R (EIA)          | 1000pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR73A152KW01L | DC1000            | X7R (EIA)          | 1500pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR73A222KW01L | DC1000            | X7R (EIA)          | 2200pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR73A332KW01L | DC1000            | X7R (EIA)          | 3300pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM31BR73A472KW01L | DC1000            | X7R (EIA)          | 4700pF ±10%  | 3.2           | 1.6          | 1.25             | 1.2                   | 0.3 min.         |
| GRM32QR73A682KW01L | DC1000            | X7R (EIA)          | 6800pF ±10%  | 3.2           | 2.5          | 1.5              | 1.2                   | 0.3 min.         |
| GRM32QR73A103KW01L | DC1000            | X7R (EIA)          | 10000pF ±10% | 3.2           | 2.5          | 1.5              | 1.2                   | 0.3 min.         |
| GRM32DR73A153KW01L | DC1000            | X7R (EIA)          | 15000pF ±10% | 3.2           | 2.5          | 2.0              | 1.2                   | 0.3 min.         |
| GRM32DR73A223KW01L | DC1000            | X7R (EIA)          | 22000pF ±10% | 3.2           | 2.5          | 2.0              | 1.2                   | 0.3 min.         |
| GRM43DR73A333KW01L | DC1000            | X7R (EIA)          | 33000pF ±10% | 4.5           | 3.2          | 2.0              | 2.2                   | 0.3 min.         |
| GRM43DR73A473KW01L | DC1000            | X7R (EIA)          | 47000pF ±10% | 4.5           | 3.2          | 2.0              | 2.2                   | 0.3 min.         |
| GRM55DR73A104KW01L | DC1000            | X7R (EIA)          | 0.10μF ±10%  | 5.7           | 5.0          | 2.0              | 2.5                   | 0.3 min.         |

## Specifications and Test Methods

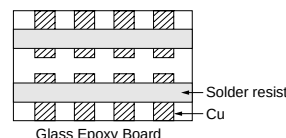
| No.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Item                                    |                                              | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--|--|---|---|---|---|---------|-----|-----|-----|-----|----------|-----|-----|------|---------|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                               | Operating Temperature Range             |                                              | −55 to +125℃                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                               | Appearance                              |                                              | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                               | Dimensions                              |                                              | Within the specified dimensions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                               | Dielectric Strength                     |                                              | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | No failure should be observed when 150% of the rated voltage (200% of the rated voltage in case of rated voltage : DC250V, 120% of the rated voltage in case of rated voltage : DC1kV) is applied between the terminations for 1 to 5 sec., provided the charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                               | Insulation Resistance (I.R.)            |                                              | C≥0.01μF : More than 100MΩ・μF<br>C<0.01μF : More than 10,000MΩ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The insulation resistance should be measured with DC500±50V (DC250±50V in case of rated voltage : DC250V) and within 60±5 sec. of charging.                                                                                                                                                                                                                                                                                                                                                                                                                         |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                               | Capacitance                             |                                              | Within the specified tolerance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The capacitance/D.F. should be measured at 25℃ at a frequency of 1±0.2kHz and a voltage of AC1±0.2V (r.m.s.)                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                               | Dissipation Factor (D.F.)               |                                              | 0.025 max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | •Pretreatment<br>Perform a heat treatment at 150±10℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 8                                                                                                                                                                                                                                                                                                                                                                                                                                               | Capacitance Temperature Characteristics |                                              | Cap. Change Within ±15% (Temp. Range : −55 to +125℃)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The range of capacitance change compared with the 25℃ value within −55 to +125℃ should be within the specified range.<br>•Pretreatment<br>Perform a heat treatment at 150±10℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                      |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 9                                                                                                                                                                                                                                                                                                                                                                                                                                               | Adhesive Strength of Termination        |                                              | No removal of the terminations or other defect should occur.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1 using a eutectic solder.<br>Then apply 10N force in the direction of the arrow.<br>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br><br>10N (5N : Size 1.6×0.8mm only), 10±1s<br>Speed : 1.0mm/s<br>Glass Epoxy Board<br>Fig. 1                            |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                              | Vibration Resistance                    | Appearance                                   | No defects or abnormalities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Solder the capacitor to the test jig (glass epoxy board).<br>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 min. This motion should be applied for a period of 2 hrs. in each 3 mutually perpendicular directions (total of 6 hrs.).<br> |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                         | Capacitance                                  | Within the specified tolerance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                         | D.F.                                         | 0.025 max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 11                                                                                                                                                                                                                                                                                                                                                                                                                                              | Deflection                              | No cracking or marking defects should occur. |  <table><tr><th rowspan="2">L×W (mm)</th><th colspan="3">Dimension (mm)</th><th rowspan="2">d</th></tr><tr><th>a</th><th>b</th><th>c</th></tr><tr><td>1.6×0.8</td><td>1.0</td><td>3.0</td><td>1.2</td><td rowspan="6">1.0</td></tr><tr><td>2.0×1.25</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>3.2×1.6</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>3.2×2.5</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>5.7×5.0</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table><br>Fig. 2 | L×W (mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Dimension (mm) |  |  | d | a | b | c | 1.6×0.8 | 1.0 | 3.0 | 1.2 | 1.0 | 2.0×1.25 | 1.2 | 4.0 | 1.65 | 3.2×1.6 | 2.2 | 5.0 | 2.0 | 3.2×2.5 | 2.2 | 5.0 | 2.9 | 4.5×3.2 | 3.5 | 7.0 | 3.7 | 5.7×5.0 | 4.5 | 8.0 | 5.6 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                         | L×W (mm)                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Dimension (mm) |  |  |   | d |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| a                                                                                                                                                                                                                                                                                                                                                                                                                                               | b                                       |                                              | c                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 1.6×0.8                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.0                                     | 3.0                                          | 1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 2.0×1.25                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.2                                     | 4.0                                          | 1.65                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 3.2×1.6                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.2                                     | 5.0                                          | 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 3.2×2.5                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.2                                     | 5.0                                          | 2.9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 4.5×3.2                                                                                                                                                                                                                                                                                                                                                                                                                                         | 3.5                                     | 7.0                                          | 3.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 5.7×5.0                                                                                                                                                                                                                                                                                                                                                                                                                                         | 4.5                                     | 8.0                                          | 5.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2 using a eutectic solder.<br>Then apply a force in the direction shown in Fig. 3.<br>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br> |                                         |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |  |  |   |   |   |   |         |     |     |     |     |          |     |     |      |         |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |

\* "Room condition" Temperature : 15 to 35℃, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

Continued on the following page. 

## Specifications and Test Methods

Continued from the preceding page.

| No.                | Item                                                             |                              | Specifications                                                                      | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|--------------------|------------------------------------------------------------------|------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------|-------------|---|------------------------|--------|---|----------------|--------|---|------------------------|------|---|------------|--------|
| 12                 | Solderability of Termination                                     |                              | 75% of the terminations are to be soldered evenly and continuously.                 | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 2±0.5 sec. at 235±5°C. Immersing speed : 25±2.5mm/s                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| 13                 | Resistance to Soldering Heat                                     | Appearance                   | No marking defects                                                                  | Preheat the capacitor at 120 to 150°C* for 1 min.<br>Immerse the capacitor in eutectic solder solution at 260±5°C for 10±1 sec. Let sit at *room condition for 24±2 hrs., then measure.<br>•Immersing speed : 25±2.5mm/s<br>•Pretreatment<br>Perform a heat treatment at 150 ± <sub>1</sub> 8°C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.<br><br>*Preheating for more than 3.2X2.5mm <table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100°C to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170°C to 200°C</td><td>1 min.</td></tr></table>                                                                                                                                                                                                                                | Step        | Temperature      | Time        | 1 | 100°C to 120°C         | 1 min. | 2 | 170°C to 200°C | 1 min. |   |                        |      |   |            |        |
|                    |                                                                  | Step                         | Temperature                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Time        |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | 1                            | 100°C to 120°C                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1 min.      |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | 2                            | 170°C to 200°C                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1 min.      |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | Capacitance Change           | Within ±10%                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| D.F.               | 0.025 max.                                                       |                              |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| I.R.               | C≥0.01μF : More than 100MΩ • μF<br>C<0.01μF : More than 10,000MΩ |                              |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    | Dielectric Strength                                              | In accordance with item No.4 |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| 14                 | Temperature Cycle                                                | Appearance                   | No marking defects                                                                  | Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4 using a eutectic solder.<br>Perform the 5 cycles according to the 4 heat treatments listed in the following table.<br>Let sit for 24±2 hrs. at *room condition, then measure. <table><tr><th>Step</th><th>Temperature (°C)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table><br>•Pretreatment<br>Perform a heat treatment at 150 ± <sub>1</sub> 8°C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.<br><br><br>Fig. 4 | Step        | Temperature (°C) | Time (min.) | 1 | Min. Operating Temp.±3 | 30±3   | 2 | Room Temp.     | 2 to 3 | 3 | Max. Operating Temp.±2 | 30±3 | 4 | Room Temp. | 2 to 3 |
|                    |                                                                  | Step                         | Temperature (°C)                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Time (min.) |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | 1                            | Min. Operating Temp.±3                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 30±3        |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | 2                            | Room Temp.                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2 to 3      |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | 3                            | Max. Operating Temp.±2                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 30±3        |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| 4                  | Room Temp.                                                       | 2 to 3                       |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| Capacitance Change | Within ±7.5%                                                     |                              |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| D.F.               | 0.025 max.                                                       |                              |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| I.R.               | C≥0.01μF : More than 100MΩ • μF<br>C<0.01μF : More than 10,000MΩ |                              |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    | Dielectric Strength                                              | In accordance with item No.4 |                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| 15                 | Humidity (Steady State)                                          | Appearance                   | No marking defects                                                                  | Let the capacitor sit at 40±2°C and relative humidity of 90 to 95% for 500 ± <sub>2</sub> 4 hrs.<br>Remove and let sit for 24±2 hrs. at *room condition, then measure.<br>•Pretreatment<br>Perform a heat treatment at 150 ± <sub>1</sub> 8°C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | Capacitance Change           | Within ±15%                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | D.F.                         | 0.05 max.                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | I.R.                         | C≥0.01μF : More than 10MΩ • μF<br>C<0.01μF : More than 1,000MΩ                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | Dielectric Strength          | In accordance with item No.4                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| 16                 | Life                                                             | Appearance                   | No marking defects                                                                  | Apply 120% of the rated voltage (150% of the rated voltage in case of rated voltage : DC250V, 110% of the rated voltage in case of rated voltage : DC1kV) for 1,000 ± <sub>4</sub> 8 hrs. at maximum operating temperature ±3°C. Remove and let sit for 24 ±2 hrs. at *room condition, then measure.<br>The charge/discharge current is less than 50mA.<br>•Pretreatment<br>Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                              |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | Capacitance Change           | Within ±15% (rated voltage : DC250V, DC630V)<br>Within ±20% (rated voltage : DC1kV) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | D.F.                         | 0.05 max.                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | I.R.                         | C≥0.01μF : More than 10MΩ • μF<br>C<0.01μF : More than 1,000MΩ                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | Dielectric Strength          | In accordance with item No.4                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
| 17                 | Humidity Loading (Application : DC250V, DC630V item)             | Appearance                   | No marking defects                                                                  | Apply the rated voltage at 40±2°C and relative humidity of 90 to 95% for 500 ± <sub>2</sub> 4 hrs.<br>Remove and let sit for 24±2 hrs. at *room condition, then measure.<br>•Pretreatment<br>Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | Capacitance Change           | Within ±15%                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | D.F.                         | 0.05 max.                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | I.R.                         | C≥0.01μF : More than 10MΩ • μF<br>C<0.01μF : More than 1,000MΩ                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |
|                    |                                                                  | Dielectric Strength          | In accordance with item No.4                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                  |             |   |                        |        |   |                |        |   |                        |      |   |            |        |

\* "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

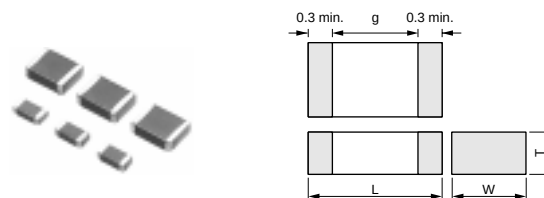
# Chip Monolithic Ceramic Capacitors

**muRata**

## Only for Information Devices/Tip & Ring

### ■ Features

1. These items are designed specifically for telecommunication devices (IEEE802.3) in Ethernet LAN.
2. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
3. Sn-plated external electrodes realizes good solderability.
4. Only for reflow soldering.
5. The low-profile type (thickness: 1.5mm max.) is available. Fit for use on thinner type equipment.



| Part Number | Dimensions (mm) |          |              |        |
|-------------|-----------------|----------|--------------|--------|
|             | L               | W        | T            | g min. |
| GR442Q      | 4.5 ±0.3        | 2.0 ±0.2 | 1.5 +0, -0.3 | 2.5    |
| GR443D      | 4.5 ±0.4        | 3.2 ±0.3 | 2.0 +0, -0.3 | 2.2*   |
| GR443Q      |                 |          | 1.5 +0, -0.3 | 2.5    |

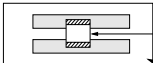
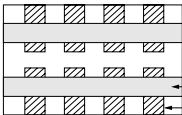
\* GR443DR73D : 2.5mm min.

### ■ Applications

Ideal for use on telecommunication devices in Ethernet LAN.

| Part Number        | Rated Voltage (V) | TC Code (Standard) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|--------------------|-------------------|--------------------|------------------|---------------|--------------|------------------|-----------------------|------------------|
| GR442QR73D101KW01L | DC2000            | X7R (EIA)          | 100 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D121KW01L | DC2000            | X7R (EIA)          | 120 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D151KW01L | DC2000            | X7R (EIA)          | 150 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D181KW01L | DC2000            | X7R (EIA)          | 180 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D221KW01L | DC2000            | X7R (EIA)          | 220 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D271KW01L | DC2000            | X7R (EIA)          | 270 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D331KW01L | DC2000            | X7R (EIA)          | 330 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D391KW01L | DC2000            | X7R (EIA)          | 390 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D471KW01L | DC2000            | X7R (EIA)          | 470 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D561KW01L | DC2000            | X7R (EIA)          | 560 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D681KW01L | DC2000            | X7R (EIA)          | 680 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D821KW01L | DC2000            | X7R (EIA)          | 820 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D102KW01L | DC2000            | X7R (EIA)          | 1000 ±10%        | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D122KW01L | DC2000            | X7R (EIA)          | 1200 ±10%        | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR442QR73D152KW01L | DC2000            | X7R (EIA)          | 1500 ±10%        | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GR443QR73D182KW01L | DC2000            | X7R (EIA)          | 1800 ±10%        | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| GR443QR73D222KW01L | DC2000            | X7R (EIA)          | 2200 ±10%        | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| GR443QR73D272KW01L | DC2000            | X7R (EIA)          | 2700 ±10%        | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| GR443QR73D332KW01L | DC2000            | X7R (EIA)          | 3300 ±10%        | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| GR443QR73D392KW01L | DC2000            | X7R (EIA)          | 3900 ±10%        | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| GR443DR73D472KW01L | DC2000            | X7R (EIA)          | 4700 ±10%        | 4.5           | 3.2          | 2.0              | 2.5                   | 0.3 min.         |

## Specifications and Test Methods

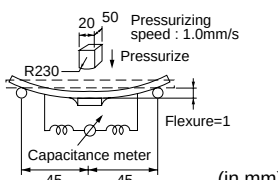
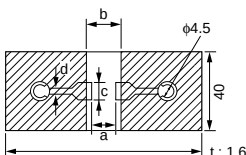
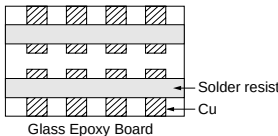
| No.           | Item                                        |             | Specifications                                                                | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |              |      |       |                           |           |                  |           |
|---------------|---------------------------------------------|-------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------|------|-------|---------------------------|-----------|------------------|-----------|
| 1             | Operating Temperature Range                 |             | −55 to +125℃                                                                  | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |              |      |       |                           |           |                  |           |
| 2             | Appearance                                  |             | No defects or abnormalities                                                   | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |              |      |       |                           |           |                  |           |
| 3             | Dimensions                                  |             | Within the specified dimensions                                               | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |              |      |       |                           |           |                  |           |
| 4             | Dielectric Strength                         |             | No defects or abnormalities                                                   | <div>No failure should be observed when voltage in table is applied between the terminations, provided the charge/discharge current is less than 50mA.</div> <table><tr><th>Rated voltage</th><th>Test Voltage</th><th>Time</th></tr><tr><td rowspan="2">DC2kV</td><td>120% of the rated voltage</td><td>60±1 sec.</td></tr><tr><td>AC1500V (r.m.s.)</td><td>60±1 sec.</td></tr></table>                                                                                                                                                                                                                                                     | Rated voltage | Test Voltage | Time | DC2kV | 120% of the rated voltage | 60±1 sec. | AC1500V (r.m.s.) | 60±1 sec. |
| Rated voltage | Test Voltage                                | Time        |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |              |      |       |                           |           |                  |           |
| DC2kV         | 120% of the rated voltage                   | 60±1 sec.   |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |              |      |       |                           |           |                  |           |
|               | AC1500V (r.m.s.)                            | 60±1 sec.   |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |              |      |       |                           |           |                  |           |
| 5             | Pulse Voltage<br>(Application : DC2kV item) |             | No self healing break downs or flash-overs have taken place in the capacitor. | 10 impulse of alternating polarity is subjected.<br>(5 impulse for each polarity)<br>The interval between impulse is 60 sec.<br>Applied Voltage : 2.5kV zero to peak                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |              |      |       |                           |           |                  |           |
| 6             | Insulation Resistance (I.R.)                |             | More than 6,000MΩ                                                             | The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |              |      |       |                           |           |                  |           |
| 7             | Capacitance                                 |             | Within the specified tolerance                                                | The capacitance/D.F. should be measured at 25℃ at a frequency of 1±0.2kHz and a voltage of AC1±0.2V (r.m.s.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |              |      |       |                           |           |                  |           |
| 8             | Dissipation Factor (D.F.)                   |             | 0.025 max.                                                                    | •Pretreatment<br>Perform a heat treatment at 150 ± 0.0℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |              |      |       |                           |           |                  |           |
| 9             | Capacitance Temperature Characteristics     |             | Cap. Change within ±15%<br>(Temp. Range : −55 to +125℃)                       | The range of capacitance change compared with the 25℃ value within the specified range.<br>•Pretreatment<br>Perform a heat treatment at 150 ± 0.0℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                                                                          |               |              |      |       |                           |           |                  |           |
| 10            | Adhesive Strength of Termination            |             | No removal of the terminations or other defect should occur.                  | <div>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1 using a eutectic solder.<br/>Then apply 10N force in the direction of the arrow.<br/>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</div> <div><div>10N, 10±1s<br/>Speed : 1.0mm/s<br/>Glass Epoxy Board</div></div> <div>Fig. 1</div>                                                                                         |               |              |      |       |                           |           |                  |           |
| 11            | Vibration Resistance                        | Appearance  | No defects or abnormalities                                                   | <div>Solder the capacitor to the test jig (glass epoxy board).<br/>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 min. This motion should be applied for a period of 2 hrs. in each 3 mutually perpendicular directions (total of 6 hrs.).</div> <div><div>Solder resist<br/>Cu<br/>Glass Epoxy Board</div></div> |               |              |      |       |                           |           |                  |           |
|               |                                             | Capacitance | Within the specified tolerance                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |              |      |       |                           |           |                  |           |
|               |                                             | D.F.        | 0.025 max.                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |              |      |       |                           |           |                  |           |

\* "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                         |                     | Specifications                                                                                                                                                                                                                                                                                                                                                                                 | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|---------------------|------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------|-------------|---|------------------------|--------|---|----------------|--------|---|------------------------|------|-----|------------|--------|---------|
| 12                  | Deflection                   |                     | No cracking or marking defects should occur.                                                                                                                                                                                                                                                                                                                                                   | <p>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2 using a eutectic solder.</p> <p>Then apply a force in the direction shown in Fig. 3.</p> <p>The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p> <div><p>(in mm)</p><p>Fig. 3</p></div>                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              |                     | <div><table><tr><th>L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr><tr><th></th><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td><td>1.0</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td><td></td></tr></table><p>Fig. 2</p></div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | L×W (mm)    | Dimension (mm)   |             |   |                        |        | a | b              | c      | d | 4.5×2.0                | 3.5  | 7.0 | 2.4        | 1.0    | 4.5×3.2 |
| L×W (mm)            | Dimension (mm)               |                     |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     | a                            | b                   | c                                                                                                                                                                                                                                                                                                                                                                                              | d                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| 4.5×2.0             | 3.5                          | 7.0                 | 2.4                                                                                                                                                                                                                                                                                                                                                                                            | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| 4.5×3.2             | 3.5                          | 7.0                 | 3.7                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| 13                  | Solderability of Termination |                     | 75% of the terminations are to be soldered evenly and continuously.                                                                                                                                                                                                                                                                                                                            | <p>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion).</p> <p>Immerse in eutectic solder solution for 2±0.5 sec. at 235±5°C.</p> <p>Immersing speed : 25±2.5mm/s</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| 14                  | Resistance to Soldering Heat | Appearance          | No marking defects                                                                                                                                                                                                                                                                                                                                                                             | <p>Preheat the capacitor at 120 to 150°C* for 1 min.</p> <p>Immerse the capacitor in eutectic solder solution at 260±5°C for 10±1 sec. Let sit at *room condition for 24±2 hrs., then measure.</p> <p>•Immersing speed : 25±2.5mm/s</p> <p>•Pretreatment</p> <p>Perform a heat treatment at 150 ± 18 °C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p> <p>*Preheating for more than 3.2×2.5mm</p> <table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100°C to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170°C to 200°C</td><td>1 min.</td></tr></table>                                                                                                                                                                                                                                       | Step        | Temperature      | Time        | 1 | 100°C to 120°C         | 1 min. | 2 | 170°C to 200°C | 1 min. |   |                        |      |     |            |        |         |
|                     |                              | Step                | Temperature                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Time        |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | 1                   | 100°C to 120°C                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 min.      |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | 2                   | 170°C to 200°C                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 min.      |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | Capacitance Change  | Within ±10%                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| D.F.                | 0.025 max.                   |                     |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| I.R.                | More than 1,000MΩ            |                     |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| Dielectric Strength | In accordance with item No.4 |                     |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| 15                  | Temperature Cycle            | Appearance          | No marking defects                                                                                                                                                                                                                                                                                                                                                                             | <p>Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4 using a eutectic solder.</p> <p>Perform the 5 cycles according to the 4 heat treatments listed in the following table.</p> <p>Let sit for 24±2 hrs. at *room condition, then measure.</p> <table><tr><th>Step</th><th>Temperature (°C)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table> <p>•Pretreatment</p> <p>Perform a heat treatment at 150 ± 18 °C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p> <div><p>Fig. 4</p></div> | Step        | Temperature (°C) | Time (min.) | 1 | Min. Operating Temp.±3 | 30±3   | 2 | Room Temp.     | 2 to 3 | 3 | Max. Operating Temp.±2 | 30±3 | 4   | Room Temp. | 2 to 3 |         |
|                     |                              | Step                | Temperature (°C)                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Time (min.) |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | 1                   | Min. Operating Temp.±3                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 30±3        |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | 2                   | Room Temp.                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2 to 3      |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | 3                   | Max. Operating Temp.±2                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 30±3        |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| 4                   | Room Temp.                   | 2 to 3              |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| Capacitance Change  | Within ±15%                  |                     |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| D.F.                | 0.05 max.                    |                     |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| I.R.                | More than 3,000MΩ            |                     |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| Dielectric Strength | In accordance with item No.4 |                     |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
| 16                  | Humidity (Steady State)      | Appearance          | No marking defects                                                                                                                                                                                                                                                                                                                                                                             | <p>Let the capacitor sit at 40±2°C and relative humidity of 90 to 95% for 500 ± 24 hrs.</p> <p>Remove and let sit for 24±2 hrs. at *room condition, then measure.</p> <p>•Pretreatment</p> <p>Perform a heat treatment at 150 ± 18 °C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | Capacitance Change  | Within ±15%                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | D.F.                | 0.05 max.                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | I.R.                | More than 1,000MΩ                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |
|                     |                              | Dielectric Strength | In accordance with item No.4                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                  |             |   |                        |        |   |                |        |   |                        |      |     |            |        |         |

\* "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

Continued on the following page. ↗

## Specifications and Test Methods

Continued from the preceding page.

| No. | Item                                         |                     | Specifications                                 | Test Method                                                                                                                                                                                                                                                                                                                                                                                         |
|-----|----------------------------------------------|---------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17  | Life                                         | Appearance          | No marking defects                             | Apply 110% of the rated voltage for $1,000 \pm 48$ hrs. at maximum operating temperature $\pm 3^{\circ}\text{C}$ . Remove and let sit for $24 \pm 2$ hrs. at *room condition, then measure.<br>The charge/discharge current is less than 50mA.<br><b>•Pretreatment</b><br>Apply test voltage for $60 \pm 5$ min. at test temperature.<br>Remove and let sit for $24 \pm 2$ hrs. at *room condition. |
|     |                                              | Capacitance Change  | Within $\pm 20\%$                              |                                                                                                                                                                                                                                                                                                                                                                                                     |
|     |                                              | D.F.                | 0.05 max.                                      |                                                                                                                                                                                                                                                                                                                                                                                                     |
|     |                                              | I.R.                | More than $2,000\text{M}\Omega$                |                                                                                                                                                                                                                                                                                                                                                                                                     |
|     |                                              | Dielectric Strength | In accordance with item No.4                   |                                                                                                                                                                                                                                                                                                                                                                                                     |
| 18  | Humidity Loading (Application : DC250V item) | Appearance          | No marking defects                             | Apply the rated voltage at $40 \pm 2^{\circ}\text{C}$ and relative humidity of 90 to 95% for $500 \pm 24$ hrs.<br>Remove and let sit for $24 \pm 2$ hrs. at *room condition, then measure.<br><b>•Pretreatment</b><br>Apply test voltage for $60 \pm 5$ min. at test temperature.<br>Remove and let sit for $24 \pm 2$ hrs. at *room condition.                                                     |
|     |                                              | Capacitance Change  | Within $\pm 15\%$                              |                                                                                                                                                                                                                                                                                                                                                                                                     |
|     |                                              | D.F.                | 0.05 max.                                      |                                                                                                                                                                                                                                                                                                                                                                                                     |
|     |                                              | I.R.                | More than $10\text{M}\Omega \cdot \mu\text{F}$ |                                                                                                                                                                                                                                                                                                                                                                                                     |
|     |                                              | Dielectric Strength | In accordance with item No.4                   |                                                                                                                                                                                                                                                                                                                                                                                                     |

\* "Room condition" Temperature : 15 to  $35^{\circ}\text{C}$ , Relative humidity : 45 to 75%, Atmospheric pressure : 86 to  $106\text{kPa}$

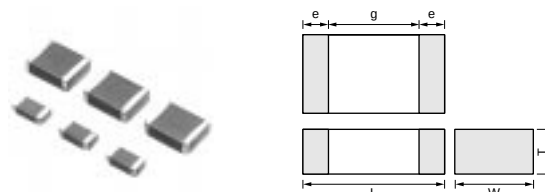
# Chip Monolithic Ceramic Capacitors



## AC250V Type (Which Meet Japanese Law)

### ■ Features

1. Chip monolithic ceramic capacitor for AC lines.
2. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
3. Sn-plated external electrodes realizes good solderability.
4. Only for reflow soldering.
5. Capacitance 0.01 to 0.1 uF for connecting lines and 470 to 4700 pF for connecting lines to earth.



| Part Number   | Dimensions (mm) |          |              |        |        |
|---------------|-----------------|----------|--------------|--------|--------|
|               | L               | W        | T            | e min. | g min. |
| <b>GA242Q</b> | 4.5 ±0.3        | 2.0 ±0.2 | 1.5 +0, -0.3 | 0.3    | 2.5    |
| <b>GA243D</b> | 4.5 ±0.4        | 3.2 ±0.3 | 2.0 +0, -0.3 |        |        |
| <b>GA243Q</b> |                 |          | 1.5 +0, -0.3 |        |        |
| <b>GA255D</b> | 5.7 ±0.4        | 5.0 ±0.4 | 2.0 +0, -0.3 |        |        |

### ■ Applications

Noise suppression filters for switching power supplies, telephones, facsimiles, modems.

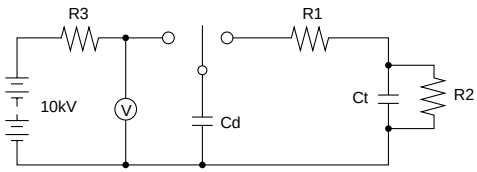
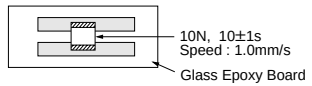
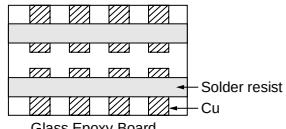
### ■ Reference Standard

GA2 series obtains no safety approval.

This series is based on JIS C 5102, JIS C 5150, and the standards of the electrical appliance and material safety law of Japan (separated table 4).

| Part Number               | Rated Voltage (V) | TC Code (Standard) | Capacitance  | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|---------------------------|-------------------|--------------------|--------------|---------------|--------------|------------------|-----------------------|------------------|
| <b>GA242QR7E2471MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 470pF ±20%   | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| <b>GA242QR7E2102MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 1000pF ±20%  | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| <b>GA243QR7E2222MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 2200pF ±20%  | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| <b>GA243QR7E2332MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 3300pF ±20%  | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| <b>GA243DR7E2472MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 4700pF ±20%  | 4.5           | 3.2          | 2.0              | 2.5                   | 0.3 min.         |
| <b>GA243QR7E2103MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 10000pF ±20% | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| <b>GA243QR7E2223MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 22000pF ±20% | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| <b>GA243DR7E2473MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 47000pF ±20% | 4.5           | 3.2          | 2.0              | 2.5                   | 0.3 min.         |
| <b>GA255DR7E2104MW01L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 0.10μF ±20%  | 5.7           | 5.0          | 2.0              | 2.5                   | 0.3 min.         |

## Specifications and Test Methods

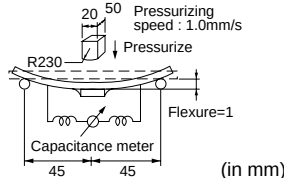
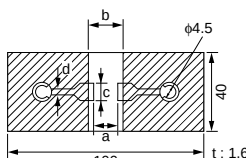
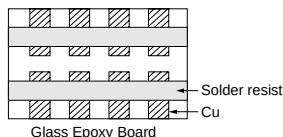
| No.                 | Item                                                            |             | Specifications                                                | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |              |            |                 |            |                  |
|---------------------|-----------------------------------------------------------------|-------------|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------|------------|-----------------|------------|------------------|
| 1                   | Operating Temperature Range                                     |             | −55 to +125℃                                                  | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |              |            |                 |            |                  |
| 2                   | Appearance                                                      |             | No defects or abnormalities                                   | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |              |            |                 |            |                  |
| 3                   | Dimensions                                                      |             | Within the specified dimensions                               | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |              |            |                 |            |                  |
| 4                   | Dielectric Strength                                             |             | No defects or abnormalities                                   | No failure should be observed when voltage in table is applied between the terminations for 60±1 sec., provided the charge/discharge current is less than 50mA. <table><tr><th>Nominal Capacitance</th><th>Test voltage</th></tr><tr><td>C≥10,000pF</td><td>AC575V (r.m.s.)</td></tr><tr><td>C&lt;10,000pF</td><td>AC1500V (r.m.s.)</td></tr></table>                                                                                                                                                                                                                                                                     | Nominal Capacitance | Test voltage | C≥10,000pF | AC575V (r.m.s.) | C<10,000pF | AC1500V (r.m.s.) |
| Nominal Capacitance | Test voltage                                                    |             |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |              |            |                 |            |                  |
| C≥10,000pF          | AC575V (r.m.s.)                                                 |             |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |              |            |                 |            |                  |
| C<10,000pF          | AC1500V (r.m.s.)                                                |             |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |              |            |                 |            |                  |
| 5                   | Insulation Resistance (I.R.)                                    |             | More than 2,000MΩ                                             | The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |              |            |                 |            |                  |
| 6                   | Capacitance                                                     |             | Within the specified tolerance                                | The capacitance/D.F. should be measured at 25℃ at a frequency of 1±0.2kHz and a voltage of AC1±0.2V (r.m.s.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |              |            |                 |            |                  |
| 7                   | Dissipation Factor (D.F.)                                       |             | 0.025 max.                                                    | •Pretreatment<br>Perform a heat treatment at 150 ± 18℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |              |            |                 |            |                  |
| 8                   | Capacitance Temperature Characteristics                         |             | Cap. Change Within ±15% (Temp. Range : −55 to +125℃)          | The range of capacitance change compared with the 25℃ value within −55 to +125℃ should be within the specified range.<br>•Pretreatment<br>Perform a heat treatment at 150 ± 18℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                          |                     |              |            |                 |            |                  |
| 9                   | Discharge Test<br>(Application: Nominal Capacitance C<10,000pF) | Appearance  | No defects or abnormalities                                   | As in Fig., discharge is made 50 times at 5 sec. intervals from the capacitor (Cd) charged at DC voltage of specified. <div><p>Ct : Capacitor under test   Cd : 0.001μF<br/>R1 : 1,000Ω   R2 : 100MΩ   R3 : Surge resistance</p></div>                                                                                                                                                                                                                                                                                                 |                     |              |            |                 |            |                  |
| 10                  | Adhesive Strength of Termination                                |             | No removal of the terminations or other defects should occur. | Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply 10N force in the direction of the arrow. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock. <div><p>10N, 10±1s<br/>Speed : 1.0mm/s<br/>Glass Epoxy Board</p></div> <p>Fig. 1</p>                                                                                                 |                     |              |            |                 |            |                  |
| 11                  | Vibration Resistance                                            | Appearance  | No defects or abnormalities                                   | Solder the capacitor to the test jig (glass epoxy board). The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 min. This motion should be applied for a period of 2 hrs. in each 3 mutually perpendicular directions (total of 6 hrs.). <div><p>Solder resist<br/>Cu<br/>Glass Epoxy Board</p></div> |                     |              |            |                 |            |                  |
|                     |                                                                 | Capacitance | Within the specified tolerance                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |              |            |                 |            |                  |
|                     |                                                                 | D.F.        | 0.025 max.                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |              |            |                 |            |                  |

\* "Room condition" Temperature : 15 to 35℃, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                         | Specifications                                                                                                                                                                                                                                                                                                                                                                                                                                           | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|---------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|-------------|---|------------------------|--------|---|----------------|---------|-----|------------------------|------|-----|------------|--------|-----|-----|---------|
| 12                  | Deflection                   | No cracking or marking defects should occur.                                                                                                                                                                                                                                                                                                                                                                                                             | <p>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p>  <p>Fig. 3</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              |  <table><tr><th rowspan="2">L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td><td rowspan="3">1.0</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>5.7×5.0</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table> <p>Fig. 2</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                           | L×W (mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Dimension (mm) |                  |             |   | a                      | b      | c | d              | 4.5×2.0 | 3.5 | 7.0                    | 2.4  | 1.0 | 4.5×3.2    | 3.5    | 7.0 | 3.7 | 5.7×5.0 |
| L×W (mm)            | Dimension (mm)               |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     | a                            | b                                                                                                                                                                                                                                                                                                                                                                                                                                                        | c                                                                                                                                                                                                                                                                                                                                                                                                                                                         | d                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| 4.5×2.0             | 3.5                          | 7.0                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2.4                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| 4.5×3.2             | 3.5                          | 7.0                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3.7                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| 5.7×5.0             | 4.5                          | 8.0                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5.6                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| 13                  | Solderability of Termination | 75% of the terminations are to be soldered evenly and continuously.                                                                                                                                                                                                                                                                                                                                                                                      | Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 2±0.5 sec. at 235±5°C. Immersing speed : 25±2.5mm/s                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| 14                  | Humidity Insulation          | Appearance                                                                                                                                                                                                                                                                                                                                                                                                                                               | No marking defects                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>The capacitor should be subjected to 40±2°C, relative humidity of 90 to 98% for 8 hrs., and then removed in *room condition for 16 hrs. until 5 cycles.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | Capacitance Change                                                                                                                                                                                                                                                                                                                                                                                                                                       | Within ±15%                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | D.F.                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.05 max.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | I.R.                                                                                                                                                                                                                                                                                                                                                                                                                                                     | More than 1,000MΩ                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | Dielectric Strength                                                                                                                                                                                                                                                                                                                                                                                                                                      | In accordance with item No.4                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| 15                  | Resistance to Soldering Heat | Appearance                                                                                                                                                                                                                                                                                                                                                                                                                                               | No marking defects                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>Preheat the capacitor as table.</p> <p>Immerse the capacitor in eutectic solder solution at 260±5°C for 10±1 sec. Let sit at *room condition for 24±2 hrs., then measure.</p> <p>•Immersing speed : 25±2.5mm/s</p> <p>•Pretreatment</p> <p>Perform a heat treatment at 150 ±1.8 °C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p> <p>*Preheating</p> <table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100°C to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170°C to 200°C</td><td>1 min.</td></tr></table>                                                                                                                                                                                                                                                                       | Step           | Temperature      | Time        | 1 | 100°C to 120°C         | 1 min. | 2 | 170°C to 200°C | 1 min.  |     |                        |      |     |            |        |     |     |         |
|                     |                              | Step                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Temperature                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Time           |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 100°C to 120°C                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1 min.         |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 170°C to 200°C                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1 min.         |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | Capacitance Change                                                                                                                                                                                                                                                                                                                                                                                                                                       | Within ±10%                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| D.F.                | 0.025 max.                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| I.R.                | More than 2,000MΩ            |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| Dielectric Strength | In accordance with item No.4 |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| 16                  | Temperature Cycle            | Appearance                                                                                                                                                                                                                                                                                                                                                                                                                                               | No marking defects                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4 using a eutectic solder.</p> <p>Perform the 5 cycles according to the 4 heat treatments listed in the following table.</p> <p>Let sit for 24±2 hrs. at *room condition, then measure.</p> <table><tr><th>Step</th><th>Temperature (°C)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table> <p>•Pretreatment</p> <p>Perform a heat treatment at 150 ±1.8 °C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p>  <p>Fig. 4</p> | Step           | Temperature (°C) | Time (min.) | 1 | Min. Operating Temp.±3 | 30±3   | 2 | Room Temp.     | 2 to 3  | 3   | Max. Operating Temp.±2 | 30±3 | 4   | Room Temp. | 2 to 3 |     |     |         |
|                     |                              | Step                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Temperature (°C)                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Time (min.)    |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Min. Operating Temp.±3                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 30±3           |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Room Temp.                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2 to 3         |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
|                     |                              | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Max. Operating Temp.±2                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 30±3           |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| 4                   | Room Temp.                   | 2 to 3                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| Capacitance Change  | Within ±15%                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| D.F.                | 0.05 max.                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| I.R.                | More than 2,000MΩ            |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |
| Dielectric Strength | In accordance with item No.4 |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                  |             |   |                        |        |   |                |         |     |                        |      |     |            |        |     |     |         |

\* "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

Continued on the following page. ➤

## Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                         |                     | Specifications               | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |           |              |            |                           |                 |            |                           |                   |
|---------------------|------------------------------|---------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------|--------------|------------|---------------------------|-----------------|------------|---------------------------|-------------------|
| 17                  | Humidity<br>(Steady State)   | Appearance          | No marking defects           | Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500 <sup>±24</sup> hrs.<br>Remove and let sit for 24±2 hrs. at *room condition, then measure.<br>•Pretreatment<br>Perform a heat treatment at 150 <sup>±18</sup> ℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                |                     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | Capacitance Change  | Within ±15%                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | D.F.                | 0.05 max.                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | I.R.                | More than 1,000MΩ            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | Dielectric Strength | In accordance with item No.4 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
| 18                  | Life                         | Appearance          | No marking defects           | Apply voltage and time as Table at 85±2℃. Remove and let sit for 24 ±2 hrs. at *room condition, then measure. The charge / discharge current is less than 50mA. <table><tr><th>Nominal Capacitance</th><th>Test Time</th><th>Test voltage</th></tr><tr><td>C≥10,000pF</td><td>1,000<sup>±48</sup> hrs.</td><td>AC300V (r.m.s.)</td></tr><tr><td>C&lt;10,000pF</td><td>1,500<sup>±48</sup> hrs.</td><td>AC500V (r.m.s.) *</td></tr></table> * Except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.<br><br>•Pretreatment<br>Apply test voltage for 60±5 min. at test temperature.<br>Remove and let sit for 24±2 hrs. at *room condition. | Nominal Capacitance | Test Time | Test voltage | C≥10,000pF | 1,000 <sup>±48</sup> hrs. | AC300V (r.m.s.) | C<10,000pF | 1,500 <sup>±48</sup> hrs. | AC500V (r.m.s.) * |
|                     |                              | Nominal Capacitance | Test Time                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Test voltage        |           |              |            |                           |                 |            |                           |                   |
|                     |                              | C≥10,000pF          | 1,000 <sup>±48</sup> hrs.    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | AC300V (r.m.s.)     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | C<10,000pF          | 1,500 <sup>±48</sup> hrs.    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | AC500V (r.m.s.) *   |           |              |            |                           |                 |            |                           |                   |
|                     |                              | Capacitance Change  | Within ±20%                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
| D.F.                | 0.05 max.                    |                     |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
| I.R.                | More than 1,000MΩ            |                     |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
| Dielectric Strength | In accordance with item No.4 |                     |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
| 19                  | Humidity Loading             | Appearance          | No marking defects           | Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95% for 500 <sup>±24</sup> hrs.<br>Remove and let sit for 24±2 hrs. at *room condition, then measure.<br>•Pretreatment<br>Apply test voltage for 60±5 min. at test temperature.<br>Remove and let sit for 24±2 hrs. at *room condition.                                                                                                                                                                                                                                                                                                                                                                  |                     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | Capacitance Change  | Within ±15%                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | D.F.                | 0.05 max.                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | I.R.                | More than 1,000MΩ            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |
|                     |                              | Dielectric Strength | In accordance with item No.4 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |              |            |                           |                 |            |                           |                   |

\* "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

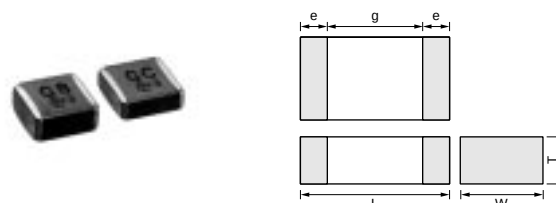
# Chip Monolithic Ceramic Capacitors

**muRata**

## Safety Standard Recognized Type GC (UL, IEC60384-14 Class X1/Y2)

### ■ Features

1. Chip monolithic ceramic capacitor (certified as conforming to safety standards) for AC lines.
2. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
3. Compared to lead type capacitors, this new capacitor is greatly downsized and low-profiled to 1/10 or less in volume, and 1/4 or less in height.
4. The type GC can be used as an X1-class and Y2-class capacitor, line-by-pass capacitor of UL1414.
5. +125 degree C guaranteed.
6. Only for reflow soldering.



| Part Number   | Dimensions (mm) |          |          |        |        |
|---------------|-----------------|----------|----------|--------|--------|
|               | L               | W        | T        | e min. | g min. |
| <b>GA355D</b> | 5.7 ±0.4        | 5.0 ±0.4 | 2.0 ±0.3 | 0.3    | 4.0    |

### ■ Applications

1. Ideal for use as Y capacitor or X capacitor for various switching power supplies
2. Ideal for modem applications

### ■ Standard Recognition

|                | Standard No. | Status of Recognition |         | Rated Voltage      |
|----------------|--------------|-----------------------|---------|--------------------|
|                |              | Type GB               | Type GC |                    |
| UL             | UL1414       | —                     | ⊙*      | AC250V<br>(r.m.s.) |
| BSI            | EN132400     | —                     | ⊙       |                    |
| VDE            |              | ⊙                     | ⊙       |                    |
| SEV            |              | ⊙                     | ⊙       |                    |
| SEMKO          |              | ⊙                     | ⊙       |                    |
| EN132400 Class |              | X2                    | X1, Y2  |                    |

\*: Line-By-Pass only

| Part Number               | Rated Voltage (V) | TC Code (Standard) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|---------------------------|-------------------|--------------------|------------------|---------------|--------------|------------------|-----------------------|------------------|
| <b>GA355DR7GC101KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 100 ±10%         | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC151KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 150 ±10%         | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC221KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 220 ±10%         | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC331KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 330 ±10%         | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC471KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 470 ±10%         | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC681KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 680 ±10%         | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC102KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 1000 ±10%        | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC152KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 1500 ±10%        | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC222KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 2200 ±10%        | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC332KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 3300 ±10%        | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GC472KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 4700 ±10%        | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |

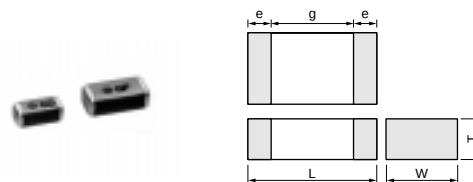
# Chip Monolithic Ceramic Capacitors



## Safety Standard Recognized Type GD (IEC60384-14 Class Y3)

### ■ Features

1. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
2. The type GD can be used as a Y3-class capacitor.
3. Available for equipment based on IEC/EN60950 and UL1950.
4. +125 degree C guaranteed.
5. Only for reflow soldering.
6. The low-profile type (thickness: 1.5mm max.) is available. Fit for use on thinner type equipment.



| Part Number | Dimensions (mm) |          |              |        |        |
|-------------|-----------------|----------|--------------|--------|--------|
|             | L               | W        | T            | e min. | g min. |
| GA342D      | 4.5 ±0.3        | 2.0 ±0.2 | 2.0 ±0.2*    | 0.3    | 2.5    |
| GA342Q      |                 |          | 1.5 +0, -0.3 |        |        |
| GA343D      | 4.5 ±0.4        | 3.2 ±0.3 | 2.0 +0, -0.3 |        |        |
| GA343Q      |                 |          | 1.5 +0, -0.3 |        |        |

\* GA342D1X : 2.0±0.3

### ■ Applications

1. Ideal for use on line filters and couplings for DAA modems without transformers.
2. Ideal for use on line filters for information equipment.

### ■ Standard Recognition

|       | Standard No. | Class | Status of Recognition | Rated Voltage   |
|-------|--------------|-------|-----------------------|-----------------|
|       |              |       | Type GD               |                 |
| SEMKO | EN132400     | Y3    | ◎                     | AC250V (r.m.s.) |

#### Applications

| Size                | Switching power supplies | Communication network devices such as a modem |
|---------------------|--------------------------|-----------------------------------------------|
| 4.5×3.2mm and under | —                        | ◎                                             |

| Part Number        | Rated Voltage (V) | TC Code (Standard) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|--------------------|-------------------|--------------------|------------------|---------------|--------------|------------------|-----------------------|------------------|
| GA342D1XGD100JY02L | AC250 (r.m.s.)    | SL (JIS)           | 10 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD120JY02L | AC250 (r.m.s.)    | SL (JIS)           | 12 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD150JY02L | AC250 (r.m.s.)    | SL (JIS)           | 15 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD180JY02L | AC250 (r.m.s.)    | SL (JIS)           | 18 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD220JY02L | AC250 (r.m.s.)    | SL (JIS)           | 22 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD270JY02L | AC250 (r.m.s.)    | SL (JIS)           | 27 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD330JY02L | AC250 (r.m.s.)    | SL (JIS)           | 33 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD390JY02L | AC250 (r.m.s.)    | SL (JIS)           | 39 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD470JY02L | AC250 (r.m.s.)    | SL (JIS)           | 47 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD560JY02L | AC250 (r.m.s.)    | SL (JIS)           | 56 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD680JY02L | AC250 (r.m.s.)    | SL (JIS)           | 68 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGD820JY02L | AC250 (r.m.s.)    | SL (JIS)           | 82 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342QR7GD101KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 100 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342QR7GD151KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 150 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342QR7GD221KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 220 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342QR7GD331KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 330 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342QR7GD471KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 470 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342QR7GD681KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 680 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342QR7GD102KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 1000 ±10%        | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342QR7GD152KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 1500 ±10%        | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA343QR7GD182KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 1800 ±10%        | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| GA343QR7GD222KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 2200 ±10%        | 4.5           | 3.2          | 1.5              | 2.5                   | 0.3 min.         |
| GA343DR7GD472KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 4700 ±10%        | 4.5           | 3.2          | 2.0              | 2.5                   | 0.3 min.         |

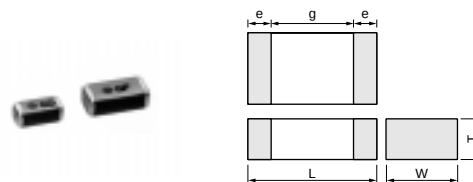
# Chip Monolithic Ceramic Capacitors

**muRata**

## Safety Standard Recognized Type GF (IEC60384-14 Class Y2)

### ■ Features

1. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
2. The type GF can be used as a Y2-class capacitor.
3. Available for equipment based on IEC/EN60950 and UL1950. Besides, the GA352/355 types are available for equipment based on IEC/EN60065, UL1492, and UL6500.
4. +125 degree C guaranteed.
5. Only for reflow soldering.
6. The low-profile type (thickness: 1.5mm max.) is available. Fit for use on thinner type equipment.



| Part Number | Dimensions (mm) |          |              |              |        |
|-------------|-----------------|----------|--------------|--------------|--------|
|             | L               | W        | T            | e min.       | g min. |
| GA342D      | 4.5 ±0.3        | 2.0 ±0.2 | 2.0 ±0.2*    | 0.3          | 2.5    |
| GA342Q      |                 |          | 1.5 +0, -0.3 |              |        |
| GA352Q      | 5.7 ±0.4        | 2.8 ±0.3 | 1.5 +0, -0.3 |              | 4.0    |
| GA355Q      |                 |          | 5.0 ±0.4     | 1.5 +0, -0.3 |        |

\* GA342D1X : 2.0±0.3

### ■ Standard Recognition

|       | Standard No. | Class  | Status of Recognition |                           | Rated Voltage   |
|-------|--------------|--------|-----------------------|---------------------------|-----------------|
|       |              |        | Type GF               |                           |                 |
|       |              |        | Size : 4.5×2.0mm      | Size : 5.7×2.8mm and over |                 |
| UL    | UL1414       | X1, Y2 | —                     | ⊙                         | AC250V (r.m.s.) |
| SEMKO | EN132400     | Y2     | ⊙                     | ⊙                         |                 |

#### Applications

| Size               | Switching power supplies | Communication network devices such as a modem |
|--------------------|--------------------------|-----------------------------------------------|
| 4.5×2.0mm          | —                        | ⊙                                             |
| 5.7×2.8mm and over | ⊙                        | ⊙                                             |

| Part Number        | Rated Voltage (V) | TC Code (Standard) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|--------------------|-------------------|--------------------|------------------|---------------|--------------|------------------|-----------------------|------------------|
| GA342D1XGF100JY02L | AC250 (r.m.s.)    | SL (JIS)           | 10 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF120JY02L | AC250 (r.m.s.)    | SL (JIS)           | 12 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF150JY02L | AC250 (r.m.s.)    | SL (JIS)           | 15 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF180JY02L | AC250 (r.m.s.)    | SL (JIS)           | 18 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF220JY02L | AC250 (r.m.s.)    | SL (JIS)           | 22 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF270JY02L | AC250 (r.m.s.)    | SL (JIS)           | 27 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF330JY02L | AC250 (r.m.s.)    | SL (JIS)           | 33 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF390JY02L | AC250 (r.m.s.)    | SL (JIS)           | 39 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF470JY02L | AC250 (r.m.s.)    | SL (JIS)           | 47 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF560JY02L | AC250 (r.m.s.)    | SL (JIS)           | 56 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF680JY02L | AC250 (r.m.s.)    | SL (JIS)           | 68 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342D1XGF820JY02L | AC250 (r.m.s.)    | SL (JIS)           | 82 ±5%           | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342QR7GF101KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 100 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342QR7GF151KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 150 ±10%         | 4.5           | 2.0          | 1.5              | 2.5                   | 0.3 min.         |
| GA342DR7GF221KW02L | AC250 (r.m.s.)    | X7R (EIA)          | 220 ±10%         | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA342DR7GF331KW02L | AC250 (r.m.s.)    | X7R (EIA)          | 330 ±10%         | 4.5           | 2.0          | 2.0              | 2.5                   | 0.3 min.         |
| GA352QR7GF471KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 470 ±10%         | 5.7           | 2.8          | 1.5              | 4.0                   | 0.3 min.         |
| GA352QR7GF681KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 680 ±10%         | 5.7           | 2.8          | 1.5              | 4.0                   | 0.3 min.         |
| GA352QR7GF102KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 1000 ±10%        | 5.7           | 2.8          | 1.5              | 4.0                   | 0.3 min.         |
| GA352QR7GF152KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 1500 ±10%        | 5.7           | 2.8          | 1.5              | 4.0                   | 0.3 min.         |
| GA355QR7GF182KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 1800 ±10%        | 5.7           | 5.0          | 1.5              | 4.0                   | 0.3 min.         |
| GA355QR7GF222KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 2200 ±10%        | 5.7           | 5.0          | 1.5              | 4.0                   | 0.3 min.         |
| GA355QR7GF332KW01L | AC250 (r.m.s.)    | X7R (EIA)          | 3300 ±10%        | 5.7           | 5.0          | 1.5              | 4.0                   | 0.3 min.         |

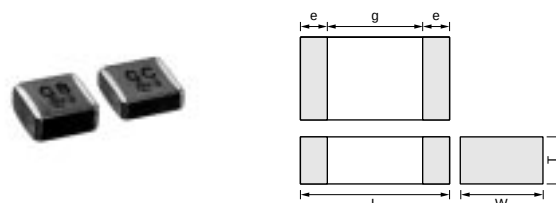
# Chip Monolithic Ceramic Capacitors



## Safety Standard Recognized Type GB (IEC60384-14 Class X2)

### ■ Features

1. Chip monolithic ceramic capacitor (certified as conforming to safety standards) for AC lines.
2. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
3. Compared to lead type capacitors, this new capacitor is greatly downsized and low-profiled to 1/10 or less in volume, and 1/4 or less in height.
4. The type GB can be used as an X2-class capacitor.
5. +125 degree C guaranteed.
6. Only for reflow soldering.



| Part Number   | Dimensions (mm) |          |          |        |        |
|---------------|-----------------|----------|----------|--------|--------|
|               | L               | W        | T        | e min. | g min. |
| <b>GA355D</b> | 5.7 ±0.4        | 5.0 ±0.4 | 2.0 ±0.3 | 0.3    | 4.0    |
| <b>GA355X</b> |                 |          | 2.7 ±0.3 |        |        |

### ■ Applications

Ideal for use as X capacitor for various switching power supplies.

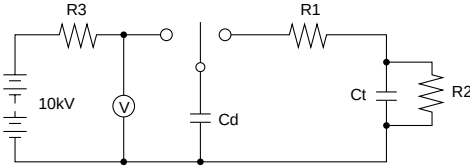
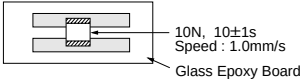
### ■ Standard Recognition

|                | Standard No. | Status of Recognition |         | Rated Voltage      |
|----------------|--------------|-----------------------|---------|--------------------|
|                |              | Type GB               | Type GC |                    |
| UL             | UL1414       | —                     | ⊙*      | AC250V<br>(r.m.s.) |
| BSI            | EN132400     | —                     | ⊙       |                    |
| VDE            |              | ⊙                     | ⊙       |                    |
| SEV            |              | ⊙                     | ⊙       |                    |
| SEMKO          |              | ⊙                     | ⊙       |                    |
| EN132400 Class |              | X2                    | X1, Y2  |                    |

\*: Line-By-Pass only

| Part Number               | Rated Voltage (V) | TC Code (Standard) | Capacitance (pF) | Length L (mm) | Width W (mm) | Thickness T (mm) | Electrode g min. (mm) | Electrode e (mm) |
|---------------------------|-------------------|--------------------|------------------|---------------|--------------|------------------|-----------------------|------------------|
| <b>GA355DR7GB103KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 10000 ±10%       | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GB153KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 15000 ±10%       | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355DR7GB223KY02L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 22000 ±10%       | 5.7           | 5.0          | 2.0              | 4.0                   | 0.3 min.         |
| <b>GA355XR7GB333KY06L</b> | AC250 (r.m.s.)    | X7R (EIA)          | 33000 ±10%       | 5.7           | 5.0          | 2.7              | 4.0                   | 0.3 min.         |

## GA3 Series Specifications and Test Methods

| No.           | Item                                    |                     | Specifications                                                                                                                                                                                                                                                                                                                               | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                              |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
|---------------|-----------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-------------|------------|-------------------------|-----------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1             | Operating Temperature Range             |                     | −55 to +125℃                                                                                                                                                                                                                                                                                                                                 | —                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 2             | Appearance                              |                     | No defects or abnormalities                                                                                                                                                                                                                                                                                                                  | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 3             | Dimensions                              |                     | Within the specified dimensions                                                                                                                                                                                                                                                                                                              | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 4             | Dielectric Strength                     |                     | No defects or abnormalities                                                                                                                                                                                                                                                                                                                  | No failure should be observed when voltage in table is applied between the terminations for 60±1 sec., provided the charge/discharge current is less than 50mA. <table><tr><td></td><td>Test voltage</td></tr><tr><td>Type GB</td><td>DC1075V</td></tr><tr><td>Type GC/GD/GF</td><td>AC1500V (r.m.s.)</td></tr></table>                                                                                                                  |                    | Test voltage  | Type GB     | DC1075V    | Type GC/GD/GF           | AC1500V (r.m.s.)                        |                    |                                                                                                                                                                                                                                                                                 |
|               | Test voltage                            |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| Type GB       | DC1075V                                 |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| Type GC/GD/GF | AC1500V (r.m.s.)                        |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 5             | Pulse Voltage (Application: Type GD/GF) |                     | No self healing break downs or flash-overs have taken place in the capacitor.                                                                                                                                                                                                                                                                | 10 impulse of alternating polarity is subjected. (5 impulse for each polarity)<br>The interval between impulse is 60 sec.<br>Applied Voltage : 2.5kV zero to peak                                                                                                                                                                                                                                                                        |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 6             | Insulation Resistance (I.R.)            |                     | More than 6,000MΩ                                                                                                                                                                                                                                                                                                                            | The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.                                                                                                                                                                                                                                                                                                                                            |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 7             | Capacitance                             |                     | Within the specified tolerance                                                                                                                                                                                                                                                                                                               | The capacitance/Q/D.F. should be measured at 20℃ at a frequency of 1±0.2kHz (SL char. : 1±0.2MHz) and a voltage of AC1±0.2V (r.m.s.).<br>•Pretreatment for X7R char.<br>Perform a heat treatment at 150 ±1.8℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.                                                                                                                                                           |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 8             | Dissipation Factor (D.F.) Q             |                     | <table><tr><td>Char.</td><td>Specification</td></tr><tr><td>X7R</td><td>D.F.≤0.025</td></tr><tr><td>SL</td><td>Q≥400+20C*2 (C&lt;30pF)<br/>Q≥1000 (C≥30pF)</td></tr></table>                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                          | Char.              | Specification | X7R         | D.F.≤0.025 | SL                      | Q≥400+20C*2 (C<30pF)<br>Q≥1000 (C≥30pF) |                    |                                                                                                                                                                                                                                                                                 |
| Char.         | Specification                           |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| X7R           | D.F.≤0.025                              |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| SL            | Q≥400+20C*2 (C<30pF)<br>Q≥1000 (C≥30pF) |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 9             | Capacitance Temperature Characteristics |                     | <table><tr><td>Char.</td><td>Capacitance Change</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr></table> Temperature characteristic guarantee is −55 to +125℃<br><table><tr><td>Char.</td><td>Temperature Coefficient</td></tr><tr><td>SL</td><td>+350 to -1000ppm/℃</td></tr></table> Temperature characteristic guarantee is +20 to +85℃ | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacitance Change | X7R           | Within ±15% | Char.      | Temperature Coefficient | SL                                      | +350 to -1000ppm/℃ | The range of capacitance change compared with the 25℃ (SL char. : 20℃) value within −55 to +125℃ should be within the specified range.<br>•Pretreatment for X7R char.<br>Perform a heat treatment at 150 ±1.8℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition. |
| Char.         | Capacitance Change                      |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| X7R           | Within ±15%                             |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| Char.         | Temperature Coefficient                 |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| SL            | +350 to -1000ppm/℃                      |                     |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 10            | Discharge Test (Application: Type GC)   | Appearance          | No defects or abnormalities                                                                                                                                                                                                                                                                                                                  | As in Fig., discharge is made 50 times at 5 sec. intervals from the capacitor (Cd) charged at DC voltage of specified.<br><br>Ct : Capacitor under test Cd : 0.001μF<br>R1 : 1,000Ω R2 : 100MΩ R3 : Surge resistance                                                                                                                                 |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
|               |                                         | I.R.                | More than 1,000MΩ                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
|               |                                         | Dielectric Strength | In accordance with item No.4                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |
| 11            | Adhesive Strength of Termination        |                     | No removal of the terminations or other defect should occur.                                                                                                                                                                                                                                                                                 | Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply 10N force in the direction of the arrow. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<br> |                    |               |             |            |                         |                                         |                    |                                                                                                                                                                                                                                                                                 |

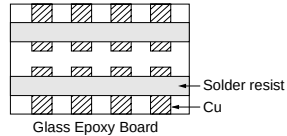
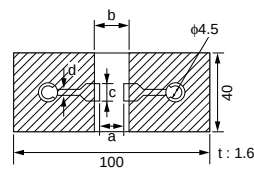
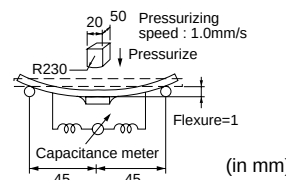
\*1 "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

\*2 "C" expresses nominal capacitance value (pF).

Continued on the following page.

## GA3 Series Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                                                                                                                                                 |                                              | Specifications                                                                                                                                                                                     | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------|-----------------------------------------------|-------------|----------------|---------------------------------------------------------------|---|----------------|--------|---------|-----|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|
| 12                  | Vibration Resistance                                                                                                                                                                 | Appearance                                   | No defects or abnormalities                                                                                                                                                                        | <p>Solder the capacitor to the test jig (glass epoxy board).</p> <p>The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 min. This motion should be applied for a period of 2 hrs. in each 3 mutually perpendicular directions (total of 6 hrs.).</p> <div><p>Solder resist<br/>Cu<br/>Glass Epoxy Board</p></div>                                                                                                                                                                                                                                                                                                                                                              |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                                                                                                                                      | Capacitance                                  | Within the specified tolerance                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                                                                                                                                      | D.F.<br>Q                                    | <table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F. ≤0.025</td></tr><tr><td>SL</td><td>Q ≥ 400 + 20C<sup>*2</sup> (C &lt; 30pF)<br/>Q ≥ 1000 (C ≥ 30pF)</td></tr></table> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Char.       | Specification  | X7R                                           | D.F. ≤0.025 | SL             | Q ≥ 400 + 20C <sup>*2</sup> (C < 30pF)<br>Q ≥ 1000 (C ≥ 30pF) |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| Char.               | Specification                                                                                                                                                                        |                                              |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| X7R                 | D.F. ≤0.025                                                                                                                                                                          |                                              |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| SL                  | Q ≥ 400 + 20C <sup>*2</sup> (C < 30pF)<br>Q ≥ 1000 (C ≥ 30pF)                                                                                                                        |                                              |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 13                  | Deflection                                                                                                                                                                           | No cracking or marking defects should occur. |                                                                                                                                                                                                    | <p>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p> <div><table><tr><th rowspan="2">LxW (mm)</th><th colspan="4">Dimension (mm)</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td><td rowspan="4">1.0</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>5.7×2.8</td><td>4.5</td><td>8.0</td><td>3.2</td></tr><tr><td>5.7×5.0</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table><p>Fig. 2</p><div><p>Fig. 3</p></div></div> | LxW (mm)    | Dimension (mm) |                                               |             |                | a                                                             | b | c              | d      | 4.5×2.0 | 3.5 | 7.0 | 2.4 | 1.0 | 4.5×3.2 | 3.5 | 7.0 | 3.7 | 5.7×2.8 | 4.5 | 8.0 | 3.2 | 5.7×5.0 | 4.5 | 8.0 | 5.6 |
|                     |                                                                                                                                                                                      | LxW (mm)                                     | Dimension (mm)                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                                                                                                                                      |                                              | a                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | b           | c              | d                                             |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 4.5×2.0             | 3.5                                                                                                                                                                                  | 7.0                                          | 2.4                                                                                                                                                                                                | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 4.5×3.2             | 3.5                                                                                                                                                                                  | 7.0                                          | 3.7                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 5.7×2.8             | 4.5                                                                                                                                                                                  | 8.0                                          | 3.2                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 5.7×5.0             | 4.5                                                                                                                                                                                  | 8.0                                          | 5.6                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 14                  | Solderability of Termination                                                                                                                                                         |                                              | 75% of the terminations are to be soldered evenly and continuously.                                                                                                                                | <p>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 2±0.5 sec. at 235±5°C. Immersing speed : 25±2.5mm/s</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| 15                  | Resistance to Soldering Heat                                                                                                                                                         | Appearance                                   | No marking defects                                                                                                                                                                                 | <p>Preheat the capacitor as table. Immerse the capacitor in eutectic solder solution at 260±5°C for 10±1 sec. Let sit at *1room condition for 24±2 hrs., then measure.</p> <p>•Immersing speed : 25±2.5mm/s</p> <p>•Pretreatment for X7R char.</p> <p>Perform a heat treatment at 150±18°C for 60±5 min. and then let sit for 24±2 hrs. at *1room condition.</p> <p>*Preheating</p> <table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100°C to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170°C to 200°C</td><td>1 min.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                       | Step        | Temperature    | Time                                          | 1           | 100°C to 120°C | 1 min.                                                        | 2 | 170°C to 200°C | 1 min. |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                                                                                                                                      | Step                                         | Temperature                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Time        |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                                                                                                                                      | 1                                            | 100°C to 120°C                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1 min.      |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
|                     |                                                                                                                                                                                      | 2                                            | 170°C to 200°C                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1 min.      |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| Capacitance Change  | <table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±10%</td></tr><tr><td>SL</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr></table> | Char.                                        | Capacitance Change                                                                                                                                                                                 | X7R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Within ±10% | SL             | Within ±2.5% or ±0.25pF (Whichever is larger) |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| Char.               | Capacitance Change                                                                                                                                                                   |                                              |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| X7R                 | Within ±10%                                                                                                                                                                          |                                              |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| SL                  | Within ±2.5% or ±0.25pF (Whichever is larger)                                                                                                                                        |                                              |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| I.R.                | More than 1,000MΩ                                                                                                                                                                    |                                              |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |
| Dielectric Strength | In accordance with item No.4                                                                                                                                                         |                                              |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                |                                               |             |                |                                                               |   |                |        |         |     |     |     |     |         |     |     |     |         |     |     |     |         |     |     |     |

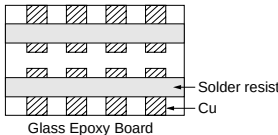
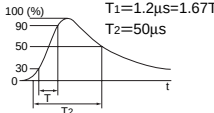
\*1 "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

\*2 "C" expresses nominal capacitance value (pF).

Continued on the following page. ➤

## GA3 Series Specifications and Test Methods

Continued from the preceding page.

| No.       | Item                                                                                                                                                                            | Specifications               | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|-------------|----------------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------|----|------------|--------|---|------------------------|------|---|------------|--------|
| 16        | Temperature Cycle                                                                                                                                                               | Appearance                   | No marking defects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | Capacitance Change           | <table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>SL</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Char.              | Capacitance Change | X7R         | Within ±15%                                                                                              | SL                     | Within ±2.5% or ±0.25pF (Whichever is larger)                                                          |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 |                              | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Capacitance Change |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | X7R                          | Within ±15%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | SL                           | Within ±2.5% or ±0.25pF (Whichever is larger)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| D.F.<br>Q | <table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F. ≤0.05</td></tr><tr><td>SL</td><td>Q ≥400+20C*2 (C&lt;30pF)<br/>Q ≥1000 (C ≥30pF)</td></tr></table> | Char.                        | Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | X7R                | D.F. ≤0.05         | SL          | Q ≥400+20C*2 (C<30pF)<br>Q ≥1000 (C ≥30pF)                                                               |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           | Char.                                                                                                                                                                           | Specification                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| X7R       | D.F. ≤0.05                                                                                                                                                                      |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| SL        | Q ≥400+20C*2 (C<30pF)<br>Q ≥1000 (C ≥30pF)                                                                                                                                      |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| I.R.      | More than 3,000MΩ                                                                                                                                                               |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           | Dielectric Strength                                                                                                                                                             | In accordance with item No.4 | <p>Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4 using a eutectic solder.</p> <p>Perform the 5 cycles according to the 4 heat treatments listed in the following table.</p> <p>Let sit for 24±2 hrs. at *room condition, then measure.</p> <table><tr><th>Step</th><th>Temperature (°C)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table> <p>•Pretreatment for X7R char.</p> <p>Perform a heat treatment at 150 ±<sub>1.8</sub>°C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p> <div><p>Fig. 4</p></div>                                                                                                                                                                                                                           | Step               | Temperature (°C)   | Time (min.) | 1                                                                                                        | Min. Operating Temp.±3 | 30±3                                                                                                   | 2  | Room Temp. | 2 to 3 | 3 | Max. Operating Temp.±2 | 30±3 | 4 | Room Temp. | 2 to 3 |
| Step      | Temperature (°C)                                                                                                                                                                | Time (min.)                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| 1         | Min. Operating Temp.±3                                                                                                                                                          | 30±3                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| 2         | Room Temp.                                                                                                                                                                      | 2 to 3                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| 3         | Max. Operating Temp.±2                                                                                                                                                          | 30±3                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| 4         | Room Temp.                                                                                                                                                                      | 2 to 3                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| 17        | Humidity (Steady State)                                                                                                                                                         | Appearance                   | No marking defects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | Capacitance Change           | <table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>SL</td><td>Within ±5.0% or ±0.5pF (Whichever is larger)</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Char.              | Capacitance Change | X7R         | Within ±15%                                                                                              | SL                     | Within ±5.0% or ±0.5pF (Whichever is larger)                                                           |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 |                              | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Capacitance Change |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | X7R                          | Within ±15%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | SL                           | Within ±5.0% or ±0.5pF (Whichever is larger)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| D.F.<br>Q | <table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F. ≤0.05</td></tr><tr><td>SL</td><td>Q ≥275+5/2C*2 (C&lt;30pF)<br/>Q ≥350 (C ≥30pF)</td></tr></table> | Char.                        | Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | X7R                | D.F. ≤0.05         | SL          | Q ≥275+5/2C*2 (C<30pF)<br>Q ≥350 (C ≥30pF)                                                               |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           | Char.                                                                                                                                                                           | Specification                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| X7R       | D.F. ≤0.05                                                                                                                                                                      |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| SL        | Q ≥275+5/2C*2 (C<30pF)<br>Q ≥350 (C ≥30pF)                                                                                                                                      |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| I.R.      | More than 3,000MΩ                                                                                                                                                               |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           | Dielectric Strength                                                                                                                                                             | In accordance with item No.4 | <p>Let the capacitor sit at 40±2°C and relative humidity of 90 to 95% for 500±12 hrs.</p> <p>Remove and let sit for 24±2 hrs. at *room condition, then measure.</p> <p>•Pretreatment for X7R char.</p> <p>Perform a heat treatment at 150 ±<sub>1.8</sub>°C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| 18        | Life                                                                                                                                                                            | Appearance                   | No marking defects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | Capacitance Change           | <table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±20%</td></tr><tr><td>SL</td><td>Within ±3.0% or ±0.3pF (Whichever is larger)</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Char.              | Capacitance Change | X7R         | Within ±20%                                                                                              | SL                     | Within ±3.0% or ±0.3pF (Whichever is larger)                                                           |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 |                              | Char.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Capacitance Change |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | X7R                          | Within ±20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           |                                                                                                                                                                                 | SL                           | Within ±3.0% or ±0.3pF (Whichever is larger)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| D.F.<br>Q | <table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F. ≤0.05</td></tr><tr><td>SL</td><td>Q ≥275+5/2C*2 (C&lt;30pF)<br/>Q ≥350 (C ≥30pF)</td></tr></table> | Char.                        | Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | X7R                | D.F. ≤0.05         | SL          | Q ≥275+5/2C*2 (C<30pF)<br>Q ≥350 (C ≥30pF)                                                               |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           | Char.                                                                                                                                                                           | Specification                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| X7R       | D.F. ≤0.05                                                                                                                                                                      |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| SL        | Q ≥275+5/2C*2 (C<30pF)<br>Q ≥350 (C ≥30pF)                                                                                                                                      |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| I.R.      | More than 3,000MΩ                                                                                                                                                               |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
|           | Dielectric Strength                                                                                                                                                             | In accordance with item No.4 | <p>Impulse Voltage</p> <p>Each individual capacitor should be subjected to a 2.5kV (Type GC/GF : 5kV) Impulses (the voltage value means zero to peak) for three times. Then the capacitors are applied to life test.</p> <div><p>T<sub>1</sub>=1.2μs=1.67T<br/>T<sub>2</sub>=50μs</p></div> <p>Apply voltage as Table for 1,000 hrs. at 125 ±<sub>2</sub>°C, relative humidity 50% max.</p> <table><tr><th>Type</th><th>Applied voltage</th></tr><tr><td>GB</td><td>AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.</td></tr><tr><td>GC</td><td rowspan="3">AC425V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.</td></tr><tr><td>GD</td></tr><tr><td>GF</td></tr></table> <p>Let sit for 24±2 hrs. at *room condition, then measure.</p> <p>•Pretreatment for X7R char.</p> <p>Perform a heat treatment at 150 ±<sub>1.8</sub>°C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.</p> | Type               | Applied voltage    | GB          | AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec. | GC                     | AC425V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec. | GD | GF         |        |   |                        |      |   |            |        |
| Type      | Applied voltage                                                                                                                                                                 |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| GB        | AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.                                                                        |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| GC        | AC425V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.                                                                          |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| GD        |                                                                                                                                                                                 |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |
| GF        |                                                                                                                                                                                 |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                    |             |                                                                                                          |                        |                                                                                                        |    |            |        |   |                        |      |   |            |        |

\*1 "Room condition" Temperature : 15 to 35°C, Relative humidity : 45 to 75%, Atmospheric pressure : 86 to 106kPa

\*2 "C" expresses nominal capacitance value (pF).

Continued on the following page. ↗

## GA3 Series Specifications and Test Methods

Continued from the preceding page.

| No.                 | Item                                                |                    | Specifications     |                                              | Test Method                                                                                                                                                                                                                                                                                                                                      |
|---------------------|-----------------------------------------------------|--------------------|--------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19                  | Humidity Loading                                    | Appearance         | No marking defects |                                              | Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95% for 500 <sup>±2</sup> <sub>0</sub> hrs. Remove and let sit for 24±2 hrs. at *1room condition, then measure.<br>•Pretreatment for X7R char.<br>Perform a heat treatment at 150 <sup>±1</sup> <sub>0</sub> ℃ for 60±5 min. and then let sit for 24±2 hrs. at *1room condition. |
|                     |                                                     | Capacitance Change | Char.              | Capacitance Change                           |                                                                                                                                                                                                                                                                                                                                                  |
|                     |                                                     |                    | X7R                | Within ±15%                                  |                                                                                                                                                                                                                                                                                                                                                  |
|                     |                                                     |                    | SL                 | Within ±5.0% or ±0.5pF (Whichever is larger) |                                                                                                                                                                                                                                                                                                                                                  |
|                     |                                                     | D.F.<br>Q          | Char.              | Specification                                |                                                                                                                                                                                                                                                                                                                                                  |
|                     |                                                     |                    | X7R                | D.F.≤0.05                                    |                                                                                                                                                                                                                                                                                                                                                  |
| SL                  | Q≥275+5/2C* <sup>2</sup> (C<30pF)<br>Q≥350 (C≥30pF) |                    |                    |                                              |                                                                                                                                                                                                                                                                                                                                                  |
| I.R.                | More than 3,000MΩ                                   |                    |                    |                                              |                                                                                                                                                                                                                                                                                                                                                  |
| Dielectric Strength | In accordance with item No.4                        |                    |                    |                                              |                                                                                                                                                                                                                                                                                                                                                  |

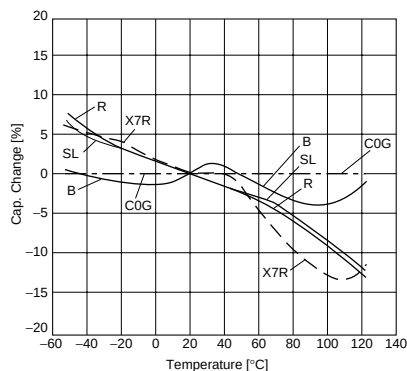
\*1 "Room condition" Temperature : 15 to  $35^{\circ}\text{C}$ , Relative humidity : 45 to 75%, Atmospheric pressure : 86 to  $106\text{kPa}$

\*2 "C" expresses nominal capacitance value (pF).

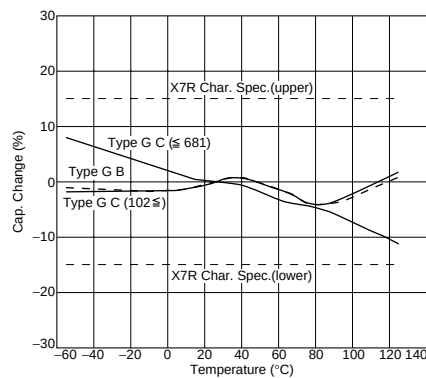
## GRM/GR4/GA2/GA3 Series Data (Typical Example)

### ■ Capacitance-Temperature Characteristics

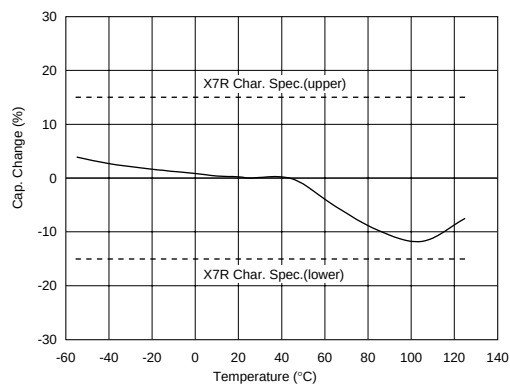
GRM/GR4/GA2 Series



GA3 Series (type GB/GC)

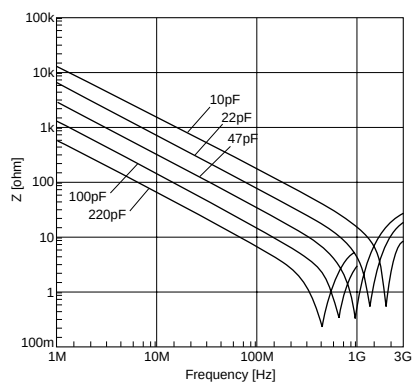


GA3 Series (type GD/GF)

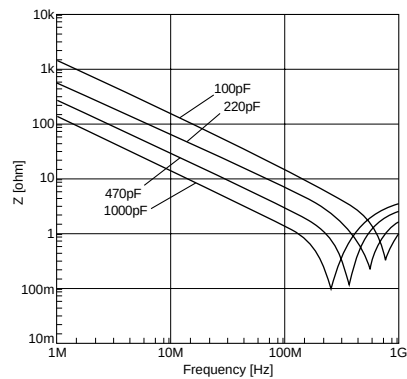


### ■ Impedance-Frequency Characteristics

GRM Series (SL Characteristics)



GRM Series (R Characteristics)



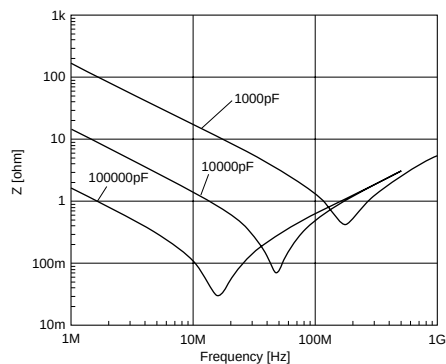
Continued on the following page. ➤

## GRM/GR4/GA2/GA3 Series Data (Typical Example)

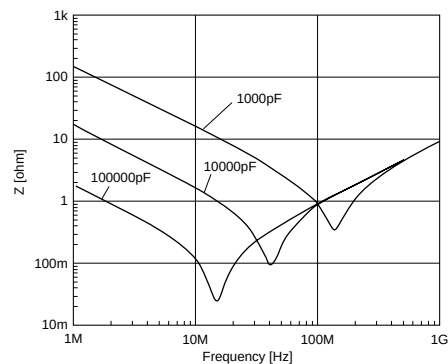
Continued from the preceding page.

### ■ Impedance-Frequency Characteristics

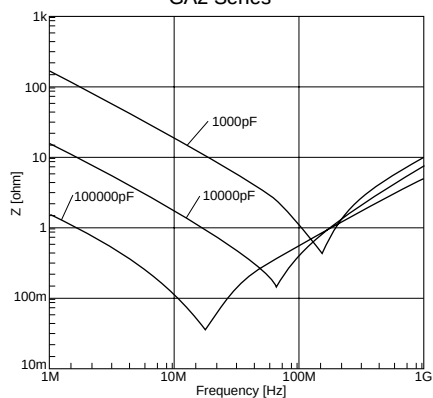
GRM Series (X7R Char. 250V)



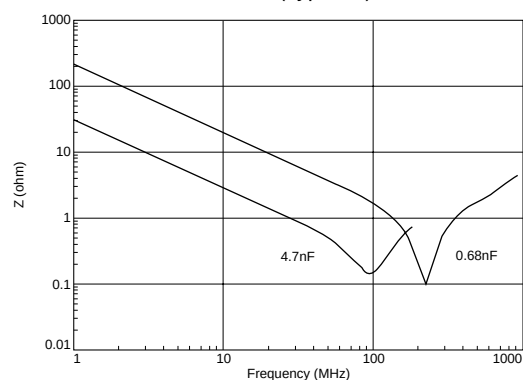
GRM Series (X7R Char. 630V)



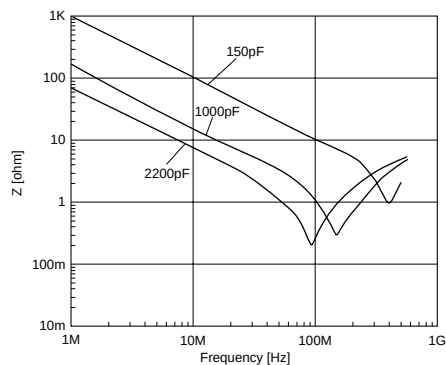
GA2 Series



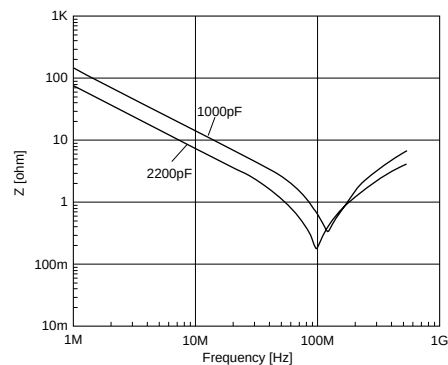
GA3 Series (Type GC)



GA3 Series (Type GD)



GA3 Series (Type GF)



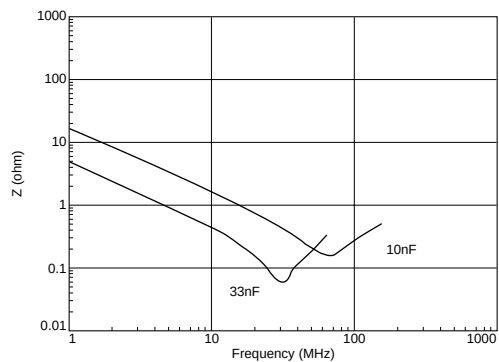
Continued on the following page. ➤

## GRM/GR4/GA2/GA3 Series Data (Typical Example)

Continued from the preceding page.

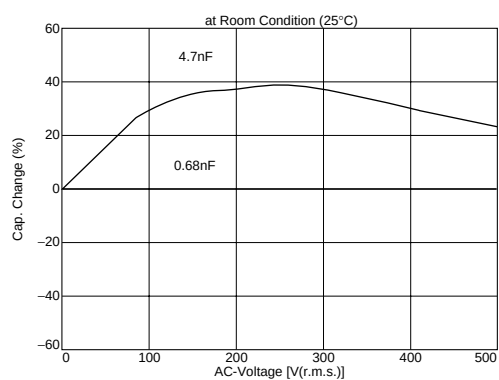
### ■ Impedance-Frequency Characteristics

GA3 Series (Type GB)

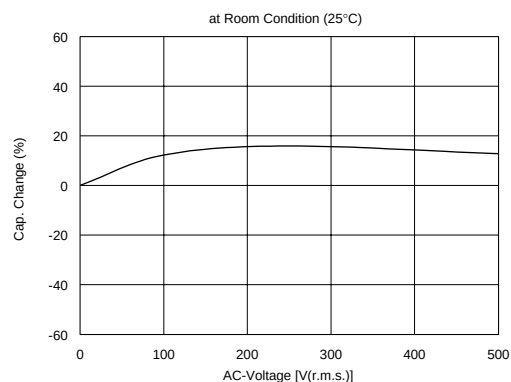


### ■ Capacitance-AC Voltage Characteristics

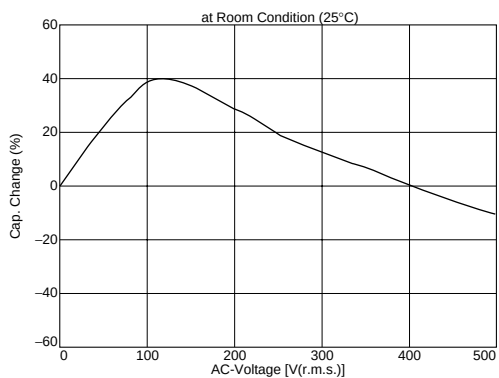
GA3 Series (Type GC)



GA3 Series (Type GD/GF, X7R char.)



GA3 Series (Type GB)



## Package

Taping is standard packaging method.

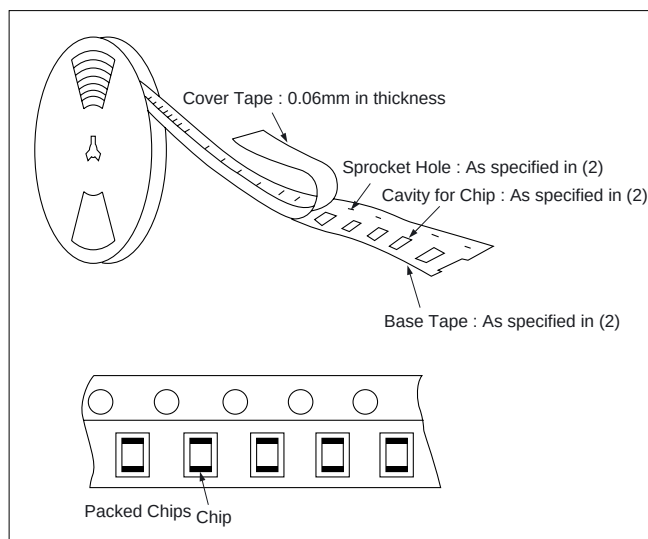
### ■ Minimum Quantity Guide

| Part Number             |             | Dimensions (mm) |      |      | Quantity (pcs.) |              |
|-------------------------|-------------|-----------------|------|------|-----------------|--------------|
|                         |             |                 |      |      | φ180mm reel     |              |
|                         |             | L               | W    | T    | Paper Tape      | Plastic Tape |
| Medium-voltage          | GRM18       | 1.6             | 0.8  | 0.8  | 4,000           | -            |
|                         | GRM21       | 2.0             | 1.25 | 1.0  | 4,000           | -            |
|                         |             |                 |      | 1.25 | -               | 3,000        |
|                         | GRM31/GR431 | 3.2             | 1.6  | 1.0  | 4,000           | -            |
|                         |             |                 |      | 1.25 | -               | 3,000        |
|                         |             |                 |      | 1.6  | -               | 2,000        |
|                         | GRM32/GR432 | 3.2             | 2.5  | 1.5  | -               | 2,000        |
|                         |             |                 |      | 2.0  | -               | 1,000        |
|                         |             |                 |      | 1.0  | -               | 3,000        |
|                         | GRM42/GR442 | 4.5             | 2.0  | 1.25 | -               | 2,000        |
|                         |             |                 |      | 1.5  | -               | 2,000        |
|                         |             |                 |      | 2.0  | -               | 2,000        |
| AC250V                  | GRM43/GR443 | 4.5             | 3.2  | 1.5  | -               | 1,000        |
|                         |             |                 |      | 2.0  | -               | 1,000        |
|                         | GRM55/GR455 | 5.7             | 5.0  | 2.5  | -               | 500          |
|                         |             |                 |      | 2.0  | -               | 1,000        |
|                         | GA242       | 4.5             | 2.0  | 1.5  | -               | 2,000        |
|                         |             |                 |      | 2.0  | -               | 1,000        |
| Safety Std. Recognition | GA243       | 4.5             | 3.2  | 1.5  | -               | 1,000        |
|                         |             |                 |      | 2.0  | -               | 1,000        |
|                         | GA255       | 5.7             | 5.0  | 2.0  | -               | 1,000        |
|                         |             |                 |      | 2.0  | -               | 1,000        |
|                         | GA342       | 4.5             | 2.0  | 1.5  | -               | 2,000        |
|                         |             |                 |      | 2.0  | -               | 2,000        |
|                         | GA343       | 4.5             | 3.2  | 1.5  | -               | 1,000        |
|                         |             |                 |      | 2.0  | -               | 1,000        |
|                         | GA352       | 5.7             | 2.8  | 1.5  | -               | 1,000        |
|                         |             |                 |      | 2.0  | -               | 1,000        |
|                         | GA355       | 5.7             | 5.0  | 1.5  | -               | 1,000        |
|                         |             |                 |      | 2.0  | -               | 1,000        |
|                         |             |                 |      | 2.7  | -               | 500          |

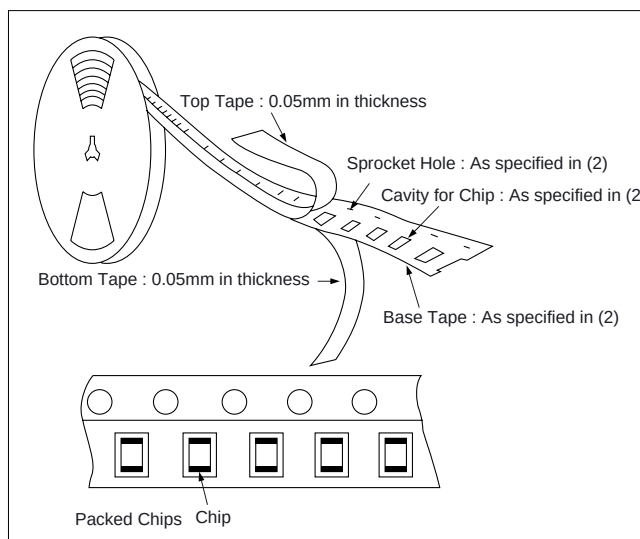
### ■ Tape Carrier Packaging

#### (1) Appearance of Taping

##### ① Plastic Tape



##### ② Paper Tape



Continued on the following page.

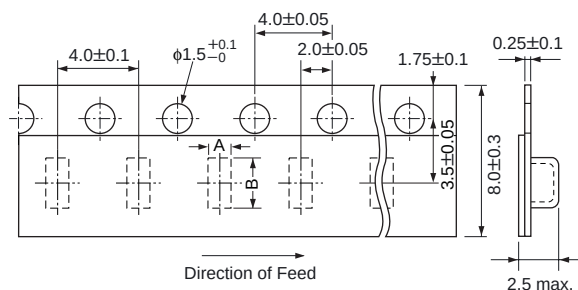
## Package

Continued from the preceding page.

### (2) Dimensions of Tape

#### ① Plastic Tape

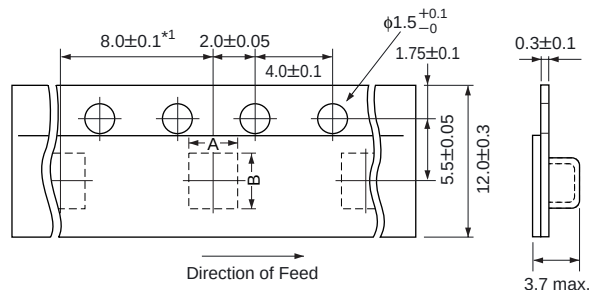
8mm width 4mm pitch Tape



| Part Number                      | A*   | B*   |
|----------------------------------|------|------|
| <b>GRM21</b><br>(T≥1.25mm)       | 1.45 | 2.25 |
| <b>GRM31/GR431</b><br>(T≥1.25mm) | 2.0  | 3.6  |
| <b>GRM32/GR432</b>               | 2.9  | 3.6  |

\*Nominal Value

12mm width 8mm/4mm pitch Tape



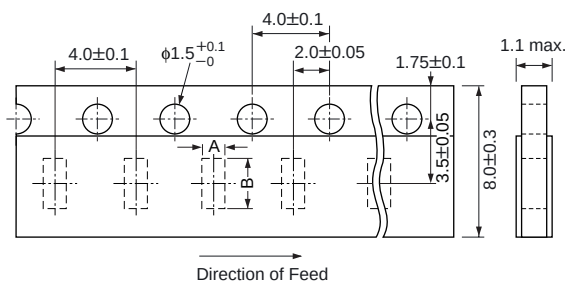
| Part Number                         | A*  | B*  |
|-------------------------------------|-----|-----|
| <b>GRM42/GR442/GA242/GA342</b>      | 2.5 | 5.1 |
| <b>GRM43/GR443/GA243/GA343</b>      | 3.6 | 4.9 |
| <b>GA252/GA352</b>                  | 3.2 | 6.1 |
| <b>GRM55/GR455/<br/>GA255/GA355</b> | 5.4 | 6.1 |

\*1 4.0±0.1mm in case of GRM42/GR442/GA242/GA342

\*Nominal Value  
(in mm)

#### ② Paper Tape

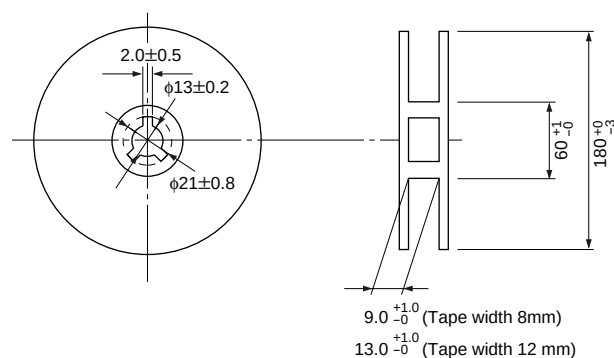
8mm width 4mm pitch Tape



| Part Number               | A*   | B*   |
|---------------------------|------|------|
| <b>GRM18</b>              | 1.05 | 1.85 |
| <b>GRM21</b><br>(T=1.0mm) | 1.45 | 2.25 |
| <b>GRM31</b><br>(T=1.0mm) | 2.0  | 3.6  |

\*Nominal value  
(in mm)

#### (3) Dimensions of Reel



(in mm)

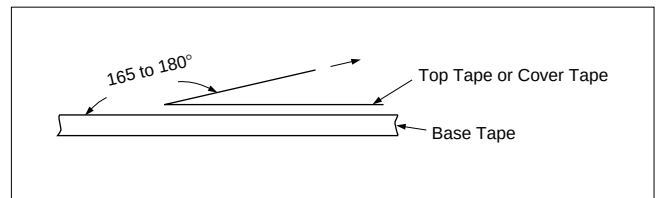
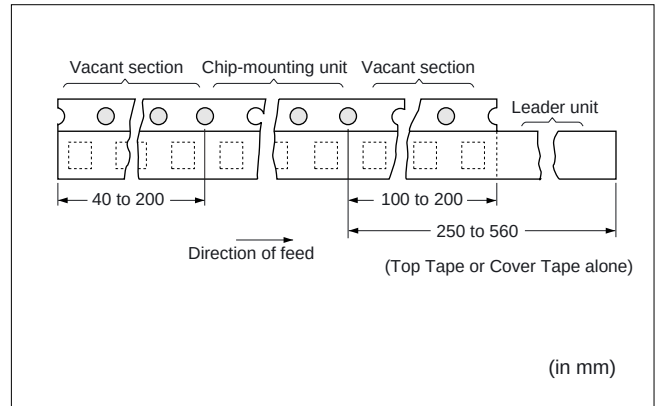
Continued on the following page. ➤

## Package

☐ Continued from the preceding page.

### (4) Taping Method

- ① Tapes for capacitors are wound clockwise. The sprocket holes are to the right as the tape is pulled toward the user.
- ② Part of the leader and part of the empty tape shall be attached to the end of the tape as shown at right.
- ③ The top tape or cover tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.
- ④ Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.
- ⑤ The top tape or cover tape and bottom tape shall not protrude beyond the edges of the tape and shall not cover sprocket holes.
- ⑥ Cumulative tolerance of sprocket holes, 10 pitches :  $\pm 0.3\text{mm}$ .
- ⑦ Peeling off force : 0.1 to 0.7N in the direction shown at right.



 **Caution**

■ **Storage and Operating Conditions**

Operating and storage environment

Do not use or store capacitors in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. And avoid exposure to moisture. Before cleaning, bonding or molding this product, verify that these processes do not affect product quality by testing the performance of a cleaned, bonded or molded product in the intended equipment. Store the capacitors

where the temperature and relative humidity do not exceed 5 to 40 degrees centigrade and 20 to 70%.

Use capacitors within 6 months. Check the solderability after 6 months or more.

FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND CAUSE FUMING OR PARTIAL DISPERSION WHEN THE PRODUCT IS USED.

■ **Handling**

1. Vibration and impact

Do not expose a capacitor to excessive shock or vibration during use.

2. Do not directly touch the chip capacitor, especially the ceramic body. Residue from hands/fingers may create a short circuit environment.

FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND CAUSE FUMING OR PARTIAL DISPERSION WHEN THE PRODUCT IS USED.

## ⚠Caution

### ■ Caution (Rating)

#### 1. Operating Voltage

When DC-rated capacitors are to be used in AC or ripple current circuits, be sure to maintain the Vp-p value of the applied voltage or the Vo-p which contains DC bias within the rated voltage range.

When the voltage is applied to the circuit, starting or stopping may generate irregular voltage for a transit period because of resonance or switching. Be sure to use a capacitor with a rated voltage range that includes these irregular voltages.

| Voltage                | DC Voltage | DC+AC Voltage | AC Voltage | Pulse Voltage (1) | Pulse Voltage (2) |
|------------------------|------------|---------------|------------|-------------------|-------------------|
| Positional Measurement |            |               |            |                   |                   |

#### 2. Operating Temperature and Self-generated Heat

##### (1) In case of X7R char. and GA3 series SL char.

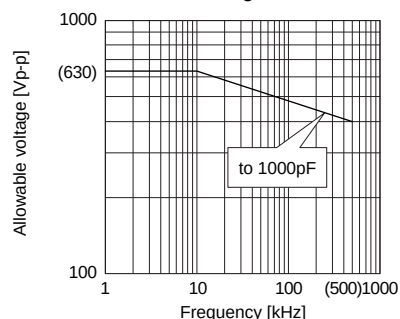
Keep the surface temperature of a capacitor below the upper limit of its rated operating temperature range. Be sure to take into account the heat generated by the capacitor itself. When the capacitor is used in a high-frequency current, pulse current or the like, it may have the self-generated heat due to dielectric-loss. Applied voltage should be the load such as self-generated heat is within 20°C on the condition of atmosphere temperature 25°C. When measuring, use a thermocouple of small thermal capacity-K of  $\phi 0.1\text{mm}$  in conditions where the capacitor is not affected by radiant heat from other components or surrounding ambient fluctuations. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running. Otherwise, accurate measurement cannot be ensured.)

##### (2) In case of C0G/R char.

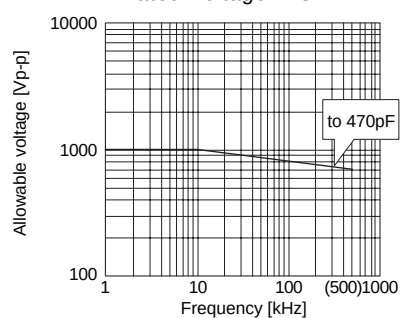
Keep the surface temperature of a capacitor below the upper limit of its rated operating temperature range. Be sure to take into account the heat generated by the capacitor itself. When the capacitor is used in a high-frequency current, pulse current or similar current, it may self-generate heat due to dielectric loss. The frequency of the applied sine wave voltage should be less than 500kHz (less than 100kHz in case of rated voltage: DC3.15kV). The applied voltage should be less than the value shown in figure at right. In case of non-sine wave which include a harmonic frequency, please contact our sales representatives or product engineers. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running. Otherwise, accurate measurement cannot be ensured.)

The temperature of the surface of capacitor: 125°C (including self-heating)

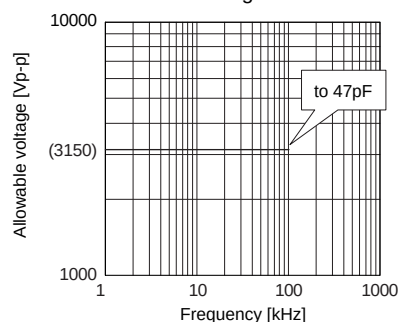
Rated Voltage: DC630V



Rated Voltage: DC1kV



Rated Voltage: DC3.15kV



The sine-wave frequency VS allowable voltage

Continued on the following page.

## ⚠Caution

Continued from the preceding page.

### (3) In case of GRM series SL char.

Keep the surface temperature of a capacitor below the upper limit of its rated operating temperature range.

Be sure to take into account the heat generated by the capacitor itself. When the capacitor is used in a high-frequency current, pulse current or similar current, it may self-generate heat due to dielectric loss.

The frequency of the applied sine wave voltage should be less than 500kHz. The applied voltage should be less than the value shown in figure at right.

In case of non-sine wave which include a harmonic frequency, please contact our sales representatives or product engineers. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running.

Otherwise, accurate measurement cannot be ensured.)

### 3. Test condition for AC withstanding Voltage

#### (1) Test Equipment

Tests for AC withstanding voltage should be made with equipment capable of creating a wave similar to a 50/60 Hz sine wave.

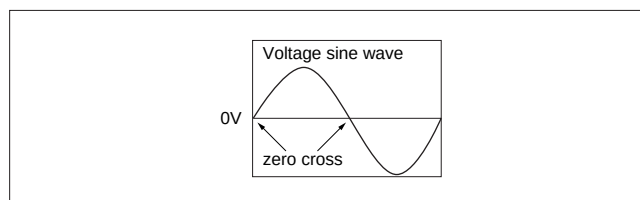
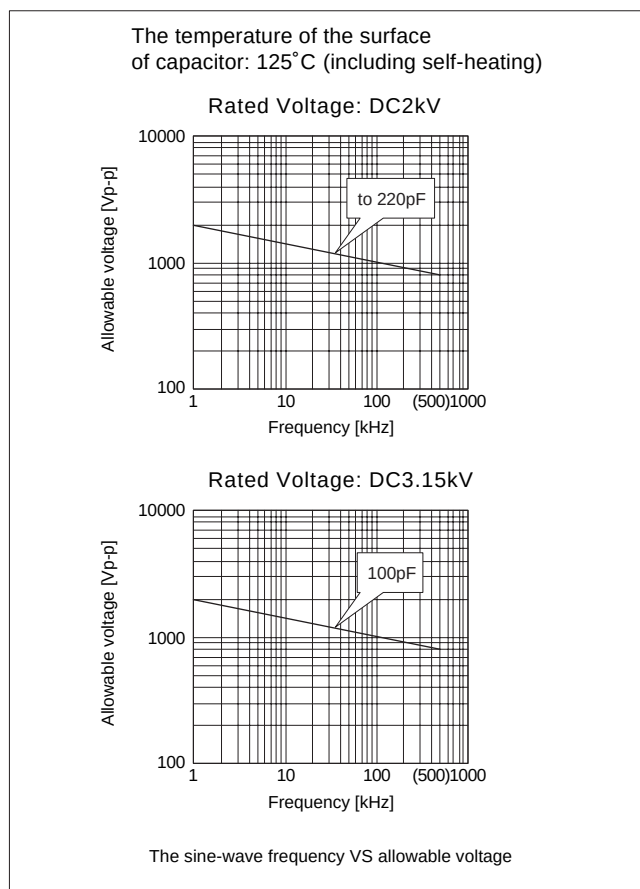
If the distorted sine wave or overload exceeding the specified voltage value is applied, a defect may be caused.

#### (2) Voltage applied method

The capacitor's leads or terminals should be firmly connected to the output of the withstanding voltage test equipment, and then the voltage should be raised from near zero to the test voltage. If the test voltage is applied directly to the capacitor without raising it from near zero, it should be applied with the \*zero cross. At the end of the test time, the test voltage should be reduced to near zero, and then the capacitor's leads or terminals should be taken off the output of the withstanding voltage test equipment. If the test voltage is applied directly to the capacitor without raising it from near zero, surge voltage may occur and cause a defect.

\*ZERO CROSS is the point where voltage sine wave pass 0V.

- See the figure at right -



Continued on the following page. ↗

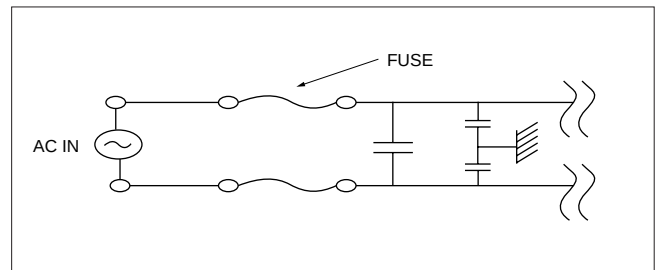
## ⚠Caution

☐ Continued from the preceding page.

### 4. Fail-Safe

Failure of a capacitor may result in a short circuit. Be sure to provide an appropriate fail-safe function such as a fuse on your product to help eliminate possible electric shock, fire, or fumes.

Please consider using fuses on each AC line if the capacitors are used between the AC input lines and earth (line bypass capacitors), to prepare for the worst case, such as a short circuit.



FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY  
RESULT, WORST CASE, IN A SHORT CIRCUIT AND  
CAUSE FUMING OR PARTIAL DISPERSION WHEN THE  
PRODUCT IS USED.

## ⚠Caution

### ■ Caution (Soldering and Mounting)

#### 1. Vibration and Impact

Do not expose a capacitor to excessive shock or vibration during use.

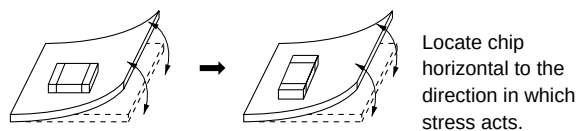
#### 2. Circuit Board Material

In case that chip size is  $4.5 \times 3.2\text{mm}$  or more, a metal-board or metal-frame such as Aluminum board is not available because soldering heat causes expansion and shrinkage of a board or frame, which will cause a chip to crack.

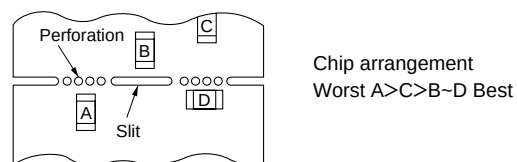
#### 3. Land Layout for Cropping PC Board

Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

##### [Component Direction]



##### [Chip Mounting Close to Board Separation Point]



Continued on the following page. ↗

## ⚠Caution

Continued from the preceding page.

### 4. Soldering (Prevention of the thermal shock)

If a chip component is heated or cooled abruptly during soldering, it may crack due to the thermal shock. To prevent this, follow our recommendations below for adequate soldering conditions.

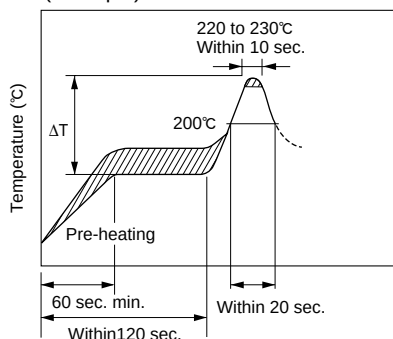
Carefully perform pre-heating so that temperature difference ( $\Delta T$ ) between the solder and component surface is in the following range. When components are immersed in solvent after mounting, pay special attention to keep the temperature difference within 100°C.

| Chip Size                              | 3.2×1.6mm and under               | 3.2×2.5mm and over                |
|----------------------------------------|-----------------------------------|-----------------------------------|
| Soldering Method                       |                                   |                                   |
| Reflow Method or Soldering Iron Method | $\Delta T \leq 190^\circ\text{C}$ | $\Delta T \leq 130^\circ\text{C}$ |
| Flow Method or Dip Soldering Method    | $\Delta T \leq 150^\circ\text{C}$ | —                                 |

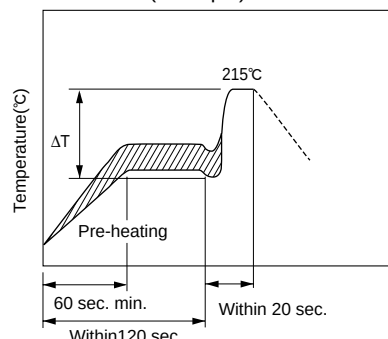
When correcting chips with a soldering iron, no preheating is required if the chip is listed in following table and the following conditions are met. Preheating should be performed on chips not listed in following table.

| Item                    | Conditions                                                       |                           |
|-------------------------|------------------------------------------------------------------|---------------------------|
| Chip Size               | $\leq 2.0 \times 1.25\text{mm}$                                  | $3.2 \times 1.6\text{mm}$ |
| Temperature of Iron tip | 300°C max.                                                       | 270°C max.                |
| Soldering Iron Wattage  | 20W max.                                                         |                           |
| Diameter of Iron tip    | $\phi 3.0\text{mm}$ max.                                         |                           |
| Soldering Time          | 3 sec. max.                                                      |                           |
| Caution                 | Do not allow the iron tip to directly touch the ceramic element. |                           |

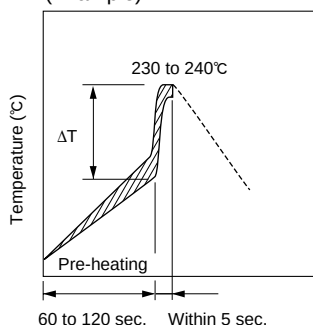
Infrared Reflow Soldering Conditions (Example)



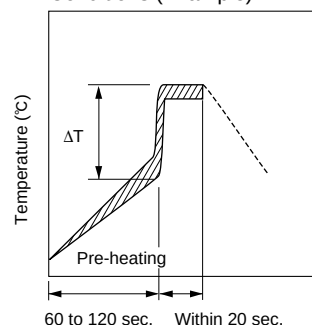
Vapor Reflow Soldering (VPS) Conditions (Example)



Flow Soldering Conditions (Example)



Dip Soldering/Soldering Iron Conditions (Example)



### 5. Soldering Method

GR/GA products whose sizes are 3.2×1.6mm and under for flow and reflow soldering, and other sizes for reflow soldering.

Be sure to contact our sales representatives or engineers in case that GR/GA products (size 3.2×2.5mm and over) are to be mounted with flow soldering. It may crack due to the thermal shock.

FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCT IS USED.

## Notice

### ■ Notice (Soldering and Mounting)

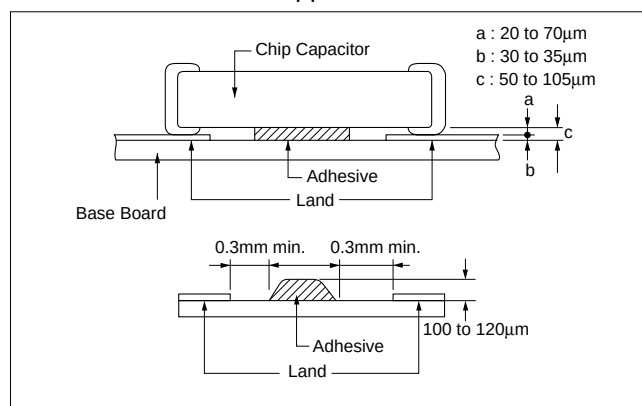
#### 1. Mounting of Chips

##### ● Mechanical shock of the chip placer

When the positioning claws and pick-up nozzle are worn, the load is applied to the chip while positioning is concentrated in one position, thus causing cracks, breakage, faulty positioning accuracy, etc. Careful checking and maintenance are necessary to prevent unexpected trouble.

An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips. Please set the suction nozzle's bottom dead point on the upper surface of the board.

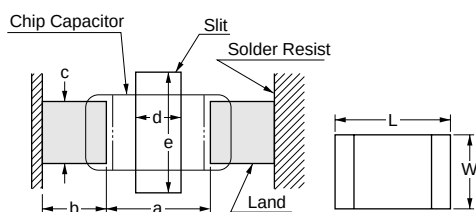
#### Termination Thickness of Chip Capacitor and Desirable Thickness of Adhesives Applied



#### 2. Construction of Board Pattern

After installing chips, if solder is excessively applied to the circuit board, mechanical stress will cause destruction resistance characteristics to lower. To prevent this, be extremely careful in determining shape and dimension before designing the circuit board diagram.

#### Construction and Dimensions of Pattern (Example)



Preparing slit helps flux cleaning and resin coating on the back of the capacitor.

#### Flow Soldering

| L×W      | a       | b       | c       |
|----------|---------|---------|---------|
| 1.6×0.8  | 0.6-1.0 | 0.8-0.9 | 0.6-0.8 |
| 2.0×1.25 | 1.0-1.2 | 0.9-1.0 | 0.8-1.1 |
| 3.2×1.6  | 2.2-2.6 | 1.0-1.1 | 1.0-1.4 |

#### Reflow Soldering

| L×W      | a       | b       | c       | d       | e       |
|----------|---------|---------|---------|---------|---------|
| 1.6×0.8  | 0.6-0.8 | 0.6-0.7 | 0.6-0.8 | -       | -       |
| 2.0×1.25 | 1.0-1.2 | 0.9-1.0 | 0.8-1.1 | -       | -       |
| 3.2×1.6  | 2.2-2.4 | 0.8-0.9 | 1.0-1.4 | 1.0-2.0 | 3.2-3.7 |
| 3.2×2.5  | 2.0-2.4 | 1.0-1.2 | 1.8-2.3 | 1.0-2.0 | 4.1-4.6 |
| 4.5×2.0  | 2.8-3.4 | 1.2-1.4 | 1.4-1.8 | 1.0-2.8 | 3.6-4.1 |
| 4.5×3.2  | 2.8-3.4 | 1.2-1.4 | 2.3-3.0 | 1.0-2.8 | 4.8-5.3 |
| 5.7×2.8  | 4.0-4.6 | 1.4-1.6 | 2.1-2.6 | 1.0-4.0 | 4.4-4.9 |
| 5.7×5.0  | 4.0-4.6 | 1.4-1.6 | 3.5-4.8 | 1.0-4.0 | 6.6-7.1 |

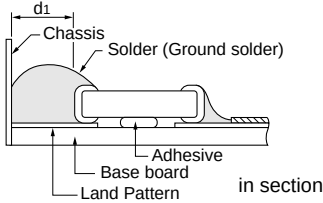
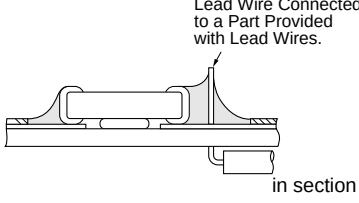
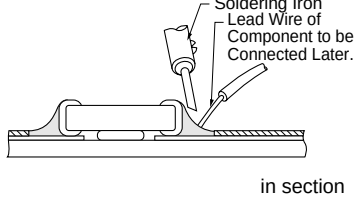
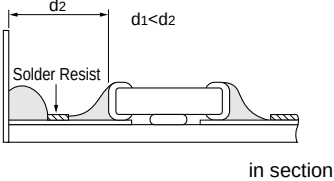
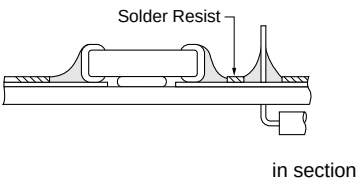
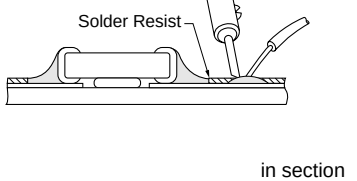
(in mm)

Continued on the following page. ➤

## Notice

☐ Continued from the preceding page.

### Land Layout to Prevent Excessive Solder

|                                               | Mounting Close to a Chassis                                                       | Mounting with Leaded Components                                                    | Mounting Leaded Components Later                                                    |
|-----------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Examples of Arrangements to be Avoided        |  |  |  |
| Examples of Improvements by the Land Division |  |  |  |

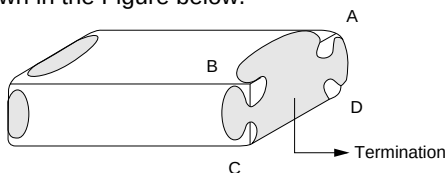
## 3. Soldering

### (1) Care for minimizing loss of the terminations.

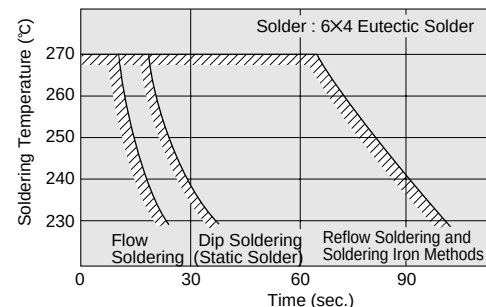
The information below illustrates the soldering conditions needed to minimize the loss of the effective area on the terminations.

Depending on the conditions of the soldering temperature and/or immersion (melting time), effective areas may be lost in some part of the terminations.

To prevent this, be careful in soldering so that any possible loss of the effective area on the terminations will securely remain at a maximum of 25% on all edge length A-B-C-D-A of part with A, B, C, D, shown in the Figure below.



Soldering Allowance Time



In case of repeated soldering, the accumulated soldering time must be within the range shown above.

### (2) Flux

- Use rosin-type flux and do not use a highly acidic flux (any containing a minimum of 0.2wt% chlorine).

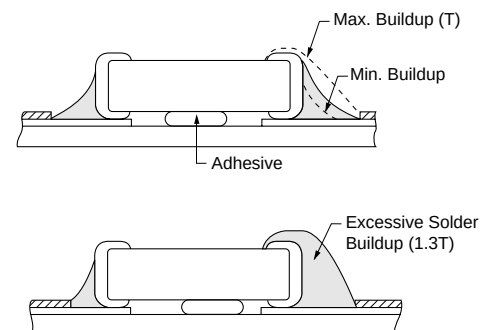
### (3) Solder Buildup

#### ① Flow soldering and iron soldering

When soldering, use less than the maximum and more than the minimum solder buildup as shown in the illustration to the right.

During the soldering process, insure that the solder is securely placed.

[Solder Buildup by Flow Method and Soldering Iron Method]



Continued on the following page. ☐

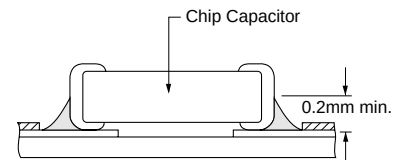
## Notice

☐ Continued from the preceding page.

### ② Reflow soldering

When soldering, confirm that the solder is placed over 0.2mm of the surface of the terminations.

[Solder Buildup by Reflow Method]



## 4. Cleaning

To perform ultrasonic cleaning, observe the following conditions.

Rinse bath capacity : Output of 20 watts per liter or less.

Rinsing time : 5 min maximum.

Do not vibrate the PWBs.

## 5. Resin Coating

- When selecting resin materials, select those with low contraction and low moisture absorption coefficient (generally epoxy resin is used).
- Buffer coat can decrease the influence of the resin shrinking (generally silicone resin).

## Notice

### ■ Rating

#### Capacitance change of capacitor

##### 1. In case of X7R char.

Capacitors have an aging characteristic, whereby the capacitor continually decreases its capacitance slightly if the capacitor is left on for a long time. Moreover, capacitance might change greatly depending on the surrounding temperature or an applied voltage. So, it is not likely to be

suitable for use in a time constant circuit.

Please contact us if you need detailed information.

##### 2. In case of C0G/R/SL char.

Capacitance might change a little depending on the surrounding temperature or an applied voltage.

Please contact us if you intend to use this product in a strict time constant circuit.

## ISO 9000 Certifications

| Plant                                                | Certified Date | Organization                  | Registration No. |
|------------------------------------------------------|----------------|-------------------------------|------------------|
| Fukui Murata Manufacturing Co., Ltd.                 | Apr. 2, '97    | UL *1<br>ISO9001              | A5287            |
| Izumo Murata Manufacturing Co., Ltd.                 | Jul. 25, '97   |                               | A5587            |
| Murata Electronics Singapore (Pte.) Ltd.             | Nov. 3, '99    | PSB *2<br>ISO9001             | 99-2-1085        |
| Murata Manufacturing (UK) Ltd.                       | Jun. 24, '98   | BSI *3<br>ISO9001             | FM 22169         |
| Murata Amazonia Industria Comercio Ltda.             | Jul. 28, '98   | FUNDACAO VANZOLINI<br>ISO9002 | SQ-480-675/98    |
| Murata Electronics North America State College Plant | Mar. 7, '96    | UL *1<br>ISO9001              | A1734            |
| Beijing Murata Electronics Co., Ltd.                 | Dec. 10, '98   | UL *1<br>ISO9002              | A7123            |

\*1 UL : Underwriters Laboratories Inc.

\*2 PSB : Singapore Productivity and Standards Board

\*3 BSI : British Standards Institution

 **Note:**

1. Export Control

〈For customers outside Japan〉

Murata products should not be used or sold for use in the development, production, stockpiling or utilization of any conventional weapons or mass-destructive weapons (nuclear weapons, chemical or biological weapons, or missiles), or any other weapons.

〈For customers in Japan〉

For products which are controlled items subject to the "Foreign Exchange and Foreign Trade Law" of Japan, the export license specified by the law is required for export.

2. Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage to a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.

- |                             |                                                                                                             |
|-----------------------------|-------------------------------------------------------------------------------------------------------------|
| ① Aircraft equipment        | ② Aerospace equipment                                                                                       |
| ③ Undersea equipment        | ④ Power plant equipment                                                                                     |
| ⑤ Medical equipment         | ⑥ Transportation equipment (vehicles, trains, ships, etc.)                                                  |
| ⑦ Traffic signal equipment  | ⑧ Disaster prevention / crime prevention equipment                                                          |
| ⑨ Data-processing equipment | ⑩ Application of similar complexity and/or reliability requirements to the applications listed in the above |

3. Product specifications in this catalog are as of August 2003. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.

4. Please read rating and  **CAUTION** (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.

5. This catalog has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.

6. Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.

7. No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.