

# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITORS

General Purpose Series (4V to 100V)

0201 to 1812 Sizes

NP0, X7R, Y5V, X6S, X7S & X5R Dielectrics

Halogen Free & RoHS Compliance



\*Contents in this sheet are subject to change without prior notice.

## Multilayer Ceramic Capacitors

## Approval Sheet

### 1. DESCRIPTION

MLCC consists of a conducting material and electrodes. To manufacture a chip-type SMT and achieve miniaturization, high density and high efficiency, ceramic condensers are used.

WTC's MLCC is made by NP0, X7R, X6S, X5R and Y5V dielectric material and which provides product with high electrical precision, stability and reliability.

### 2. FEATURES

- A wide selection of sizes is available (0201 to 1812).
- High capacitance in given case size.
- Capacitor with lead-free termination (pure Tin).

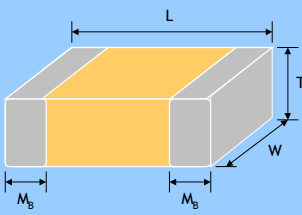
### 3. APPLICATIONS

- For general digital circuit.
- For power supply bypass capacitors.
- For consumer electronics.
- For telecommunication.

### 4. HOW TO ORDER

| <u>1206</u> | <u>B</u>          | <u>104</u>             | <u>K</u>         | <u>500</u>           | <u>C</u>           | <u>I</u>               |
|-------------|-------------------|------------------------|------------------|----------------------|--------------------|------------------------|
| <u>Size</u> | <u>Dielectric</u> | <u>Capacitance</u>     | <u>Tolerance</u> | <u>Rated voltage</u> | <u>Termination</u> | <u>Packaging style</u> |
| Inch (mm)   | N=NP0             | Two significant        | A=±0.05pF        | Two significant      | C=Cu/Ni/Sn         | T=7" reeled            |
| 0201 (0603) | (C0G)             | digits followed by     | B=±0.1pF         | digits followed by   |                    | G=13" reeled           |
| 0402 (1005) | B=X7R             | no. of zeros. And      | C=±0.25pF        | no. of zeros. And    |                    |                        |
| 0603 (1608) | F=Y5V             | R is in place of       | D=±0.5pF         | R is in place of     |                    |                        |
| 0805 (2012) | X=X5R             | decimal point.         | F=±1%            | decimal point.       |                    |                        |
| 1206 (3216) | S=X6S             |                        | G=±2%            |                      |                    |                        |
| 1210 (3225) | A=X7S             | eg.: 0R5=0.5pF         | J=±5%            | 4R0=4 VDC            |                    |                        |
| 1812 (4532) |                   | 1R0=1.0pF              | K=±10%           | 6R3=6.3 VDC          |                    |                        |
|             |                   | 104=10x10 <sup>4</sup> | M=±20%           | 100=10 VDC           |                    |                        |
|             |                   | =100nF                 | Z=-20/+80%       | 160=16 VDC           |                    |                        |
|             |                   |                        |                  | 250=25 VDC           |                    |                        |
|             |                   |                        |                  | 500=50 VDC           |                    |                        |
|             |                   |                        |                  | 101=100 VDC          |                    |                        |

## 5. EXTERNAL DIMENSIONS

| Outline                                                                                                             | Size<br>Inch (mm) | L (mm)                                    | W (mm)                  | T (mm)/Symbol                          | Soldering<br>Method * | M <sub>B</sub> (mm) |                                        |
|---------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------------------------|-------------------------|----------------------------------------|-----------------------|---------------------|----------------------------------------|
|  <p>Fig. 1 The outline of MLCC</p> | 01R5 (0402)       | 0.4±0.02                                  | 0.2±0.02                | 0.2±0.02                               | V                     | R                   | 0.10±0.03                              |
|                                                                                                                     | 0201 (0603)       | 0.6±0.03                                  | 0.3±0.03                | 0.3±0.03                               | L                     | R                   | 0.15±0.05                              |
|                                                                                                                     |                   | 0.6±0.05 <sup>#2</sup>                    | 0.3±0.05 <sup>#2</sup>  | 0.3±0.05 <sup>#2</sup>                 |                       |                     | 0.15+0.1/-0.05                         |
|                                                                                                                     |                   | 0.6±0.09 <sup>#3</sup>                    | 0.3±0.09 <sup>#3</sup>  | 0.3±0.09 <sup>#3</sup>                 |                       |                     |                                        |
|                                                                                                                     | 0402 (1005)       | 1.00±0.05                                 | 0.50±0.05               | 0.50±0.05                              | N                     | R                   | 0.25<br>+0.05/-0.10                    |
|                                                                                                                     |                   |                                           |                         | 0.50+0.02/-0.05                        | Q                     | R                   |                                        |
|                                                                                                                     | 0603 (1608)       | 1.00±0.20                                 | 0.50±0.20               | 0.5±0.20                               | E                     | R                   | 0.40±0.15                              |
|                                                                                                                     |                   | 1.60±0.10                                 | 0.80±0.10               | 0.80±0.07                              | S                     | R / W               |                                        |
|                                                                                                                     |                   | 1.60+0.15/-0.10                           | 0.80+0.15/-0.10         | 0.50±0.10                              | H                     | R / W               |                                        |
|                                                                                                                     | 0805 (2012)       | 1.60±0.20 <sup>#1</sup>                   | 0.80±0.20 <sup>#1</sup> | 0.8±0.20 <sup>#1</sup>                 | X                     | R / W               | 0.50±0.20                              |
|                                                                                                                     |                   | 2.00±0.15                                 | 1.25±0.10               | 0.50±0.10                              | H                     | R / W               |                                        |
|                                                                                                                     |                   |                                           |                         | 0.60±0.10                              | A                     | R / W               |                                        |
|                                                                                                                     |                   |                                           |                         | 0.80±0.10                              | B                     | R / W               |                                        |
|                                                                                                                     |                   |                                           |                         | 1.25±0.10                              | D                     | R                   |                                        |
|                                                                                                                     |                   | 2.00±0.20                                 | 1.25±0.20               | 0.85±0.10                              | T                     | R / W               |                                        |
|                                                                                                                     | 1.25±0.20         | I                                         | R                       | 0.60±0.20<br>(0.5±0.25) <sup>***</sup> |                       |                     |                                        |
|                                                                                                                     | 1206 (3216)       | 3.20±0.15                                 | 1.60±0.15               |                                        | 0.80±0.10             | B                   | R / W                                  |
|                                                                                                                     |                   |                                           |                         |                                        | 0.95±0.10             | C                   | R                                      |
|                                                                                                                     |                   |                                           |                         |                                        | 1.25±0.10             | D                   | R                                      |
|                                                                                                                     |                   | 3.20±0.20                                 | 1.60±0.20               |                                        | 1.15±0.15             | J                   | R                                      |
|                                                                                                                     |                   |                                           |                         |                                        | 1.60±0.20             | G                   | R                                      |
|                                                                                                                     | 3.20+0.30/-0.10   | 1.60+0.30/-0.10                           | 1.60+0.30/-0.10         | P                                      | R                     | 0.75±0.25           |                                        |
|                                                                                                                     | 1210 (3225)       | 3.20±0.30                                 | 2.50±0.20               | 0.95±0.10                              | C                     |                     | R                                      |
|                                                                                                                     |                   |                                           |                         | 0.85±0.10                              | T                     |                     | R                                      |
|                                                                                                                     |                   |                                           |                         | 1.25±0.10                              | D                     |                     | R                                      |
|                                                                                                                     |                   | 3.20±0.40                                 | 2.50±0.30               | 1.60±0.20                              | G                     |                     | R                                      |
|                                                                                                                     |                   |                                           |                         | 2.00±0.20                              | K                     |                     | R                                      |
|                                                                                                                     |                   | 3.20±0.60 <sup>#4</sup>                   | 2.50±0.50 <sup>#4</sup> | 2.50±0.50 <sup>#4</sup>                | M                     | R                   |                                        |
|                                                                                                                     | 1808 (4520)       | 4.50±0.40<br>(4.5+0.5/-0.3) <sup>**</sup> | 2.03±0.25               | 1.25±0.10                              | D                     | R                   | 0.75±0.25<br>(0.5±0.25) <sup>***</sup> |
|                                                                                                                     |                   |                                           |                         | 1.40±0.15                              | F                     | R                   |                                        |
|                                                                                                                     |                   |                                           |                         | 1.60±0.20                              | G                     | R                   |                                        |
|                                                                                                                     |                   |                                           |                         | 2.00±0.20                              | K                     | R                   |                                        |
|                                                                                                                     | 1812 (4532)       | 4.50±0.40<br>(4.5+0.5/-0.3) <sup>**</sup> | 3.20±0.30               | 1.25±0.10                              | D                     | R                   | 0.75±0.25<br>(0.5±0.25) <sup>***</sup> |
|                                                                                                                     |                   |                                           |                         | 1.60±0.20                              | G                     | R                   |                                        |
|                                                                                                                     |                   |                                           |                         | 2.00±0.20                              | K                     | R                   |                                        |
|                                                                                                                     |                   |                                           | 3.20±0.40               | 2.50±0.30                              | M                     | R                   |                                        |
|                                                                                                                     |                   |                                           |                         | 2.80±0.30                              | U                     | R                   |                                        |

\* R = Reflow soldering process ; W = Wave soldering process.

\*\* For 1808\_200V ~3kV, 1812\_200V~3kV and safety certificated products.

\*\*\* For 1206\_1000V ~3kV,1808\_200V ~3kV, 1812\_200V~3kV and safety certificated products.

#1 : For 0603/Cap ≥ 10μF or 0603/Cap ≥ 4.7μF (≤ 6.3V) or 0603/Cap > 1μF (> 10V) products.

#2 : For 0201/ 0.1μF < Cap < 0.68μF products.

#3 : For 0201/Cap ≥ 0.68μF products.

#4 : For 1210\_100V: Cap > 1μF, 250V: Cap > 0.47μF, 400V~630V: Cap > 0.22μF.

## 6. GENERAL ELECTRICAL DATA

| Dielectric                 | NP0                                                                                                                                                                   | X7R                               | Y5V                       | X5R                   | X6S                   | X7S                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------|-----------------------|-----------------------|-----------------------|
| Size                       | 0201, 0402, 0603, 0805, 1206, 1210, 1812                                                                                                                              |                                   |                           |                       |                       |                       |
| Capacitance range*         | 0.1pF to 0.1μF                                                                                                                                                        | 100pF to 47μF                     | 0.01μF to 100μF           | 100pF to 220μF        | 0.1μF to 100μF        | 1μF to 100μF          |
| Capacitance tolerance**    | Cap≤5pF <sup>#1</sup> :<br>A (±0.05pF), B (±0.1pF),<br>C (±0.25pF)<br>5pF<Cap<10pF:<br>C (±0.25pF), D (±0.5pF)<br>Cap≥10pF:<br>F (±1%), G (±2%),<br>J (±5%), K (±10%) | J (±5%),<br>K (±10%),<br>M (±20%) | M (±20%),<br>Z (-20/+80%) | K (±10%),<br>M (±20%) | K (±10%),<br>M (±20%) | K (±10%),<br>M (±20%) |
| Rated voltage (WVDC)       | 10V, 16V, 25V, 50V, 100V                                                                                                                                              | 6.3V, 10V, 16V, 25V, 50V, 100V    |                           |                       |                       |                       |
| DF(Tan δ)*                 | Cap<30pF: Q≥400+20C<br>Cap≥30pF: Q≥1000                                                                                                                               | Note 1                            |                           |                       |                       |                       |
| Operating temperature      | -55 to +125°C                                                                                                                                                         | -25 to +85°C                      | -55 to +85°C              | -55 to +105°C         | -55 to +125°C         | -55 to +125°C         |
| Capacitance characteristic | ±30ppm                                                                                                                                                                | ±15%                              | +30/-80%                  | ±15%                  | ±22%                  | ±22%                  |
| Termination                | Ni/Sn (lead-free termination)                                                                                                                                         |                                   |                           |                       |                       |                       |

#1: NP0, 0.1pF product only provide B tolerance; 0603N0R4 provide B&C tolerance; 0603N0R3 only provide C tolerance.

\* Measured at the condition of 30~70% related humidity.

NP0: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25°C at ambient temperature

X7R/X6S/X5R/X7S: Please refer to page 13 "Reliability test conditions and requirements" for detail.

Y5V: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 20°C ambient temperature.

\*\* Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour and then leave in ambient condition for 24±2 hours before measurement.

Note 1:

X7R/X5R/X6S/X7S

| Rated vol. | D.F. ≤ | Exception of D.F. ≤                                                                                                       |
|------------|--------|---------------------------------------------------------------------------------------------------------------------------|
| ≥ 100V     | ≤ 2.5% | ≤ 3% 1206 ≥ 0.47μF                                                                                                        |
|            |        | ≤ 5% 0805 ≥ 0.1μF; 0603 ≥ 0.068μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF; TT series                                                    |
|            |        | ≤ 10% 0805 ≥ 0.22μF; 1210 ≥ 3.3μF                                                                                         |
| 50V        | ≤ 2.5% | ≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF                                                              |
|            |        | ≤ 5% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF                                                                                          |
|            |        | ≤ 10% 0402 ≥ 0.012μF; 0603 ≥ 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series                                      |
| 35V        | ≤ 3.5% | ≤ 10% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                                                 |
| 25V        | ≤ 3.5% | ≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF                                                                               |
|            |        | ≤ 7% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF                                                                                          |
|            |        | ≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series                                                       |
|            |        | ≤ 12.5% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF                                                            |
| 16V        | ≤ 3.5% | ≤ 5% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF                              |
|            |        | ≤ 10% 0201 ≥ 0.1μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series |
|            |        | ≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF                                                                                            |
| 10V        | ≤ 5%   | ≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); TT series                                                        |
| 6.3V       | ≤ 10%  | ≤ 15% 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5                                                        |
|            |        | ≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series                           |
|            |        | ≤ 20% 0402 ≥ 2.2μF                                                                                                        |
| 4V         | ≤ 15%  | ---                                                                                                                       |

Y5V

| Rated vol.    | D.F. ≤  | Exception of D.F. ≤                                                                  |
|---------------|---------|--------------------------------------------------------------------------------------|
| ≥ 50V         | ≤ 5%    | ≤ 7% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF; TT series                            |
| 35V           | ≤ 7%    | ≤ 12.5% 1210 ≥ 6.8μF                                                                 |
|               |         | ---                                                                                  |
| 25V           | ≤ 5%    | ≤ 7% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF           |
|               |         | ≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series             |
| 16V           | ≤ 7%    | ≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF                                                   |
| 16V (C<1.0μF) | ≤ 7%    | ≤ 12.5% 0402 ≥ 0.22μF                                                                |
| 16V (C>1.0μF) | ≤ 9%    | ≤ 12.5% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF; TT series |
| 10V           | ≤ 12.5% | ≤ 20% 0402 ≥ 0.47μF                                                                  |
| 6.3V          | ≤ 20%   | ---                                                                                  |

## 7. CAPACITANCE RANGE

### 7-1. NP0 Dielectric 0201, 0402, 0603, 0805 Sizes

| DIELECTRIC          |             | NP0  |    |    |      |    |    |    |     |      |    |    |    |     |      |    |    |    |     |   |
|---------------------|-------------|------|----|----|------|----|----|----|-----|------|----|----|----|-----|------|----|----|----|-----|---|
| SIZE                |             | 0201 |    |    | 0402 |    |    |    |     | 0603 |    |    |    |     | 0805 |    |    |    |     |   |
| RATED VOLTAGE (VDC) |             | 16   | 25 | 50 | 10   | 16 | 25 | 50 | 100 | 10   | 16 | 25 | 50 | 100 | 10   | 16 | 25 | 50 | 100 |   |
| Capacitance         | 0.1pF (0R1) | L    | L  | L  | N    | N  | N  | N  |     |      |    |    |    |     |      |    |    |    |     |   |
|                     | 0.2pF (0R2) | L    | L  | L  | N    | N  | N  | N  |     |      |    |    |    |     |      |    |    |    |     |   |
|                     | 0.3pF (0R3) | L    | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  |     |      |    |    |    |     |   |
|                     | 0.4pF (0R4) | L    | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  |     |      |    |    |    |     |   |
|                     | 0.5pF (0R5) | L    | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |   |
|                     | 0.6pF (0R6) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 0.7pF (0R7) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 0.8pF (0R8) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 0.9pF (0R9) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 1.0pF (1R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 1.2pF (1R2) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 1.5pF (1R5) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 1.8pF (1R8) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 2.0pF (2R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 2.2pF (2R2) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 2.7pF (2R7) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 3.0pF (3R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 3.3pF (3R3) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 3.9pF (3R9) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 4.0pF (4R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 4.7pF (4R7) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 5.0pF (5R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 5.6pF (5R6) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 6.0pF (6R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 6.8pF (6R8) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 7.0pF (7R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 8.0pF (8R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 8.2pF (8R2) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 9.0pF (9R0) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 10pF (100)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 12pF (120)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 15pF (150)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 18pF (180)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 22pF (220)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 27pF (270)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 33pF (330)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 39pF (390)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 47pF (470)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 56pF (560)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 68pF (680)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 82pF (820)  | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 100pF (101) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 120pF (121) | L    | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 150pF (151) |      | L  | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 180pF (181) |      |    |    | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 220pF (221) |      |    |    | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 270pF (271) |      |    | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 330pF (331) |      |    | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | A  | A  | A  | A   | A |
|                     | 390pF (391) |      |    | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | B  | B  | B  | B   | B |
|                     | 470pF (471) |      |    | L  | N    | N  | N  | N  | N   | N    | S  | S  | S  | S   | S    | B  | B  | B  | B   | B |
| 560pF (561)         |             |      | L  | N  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |   |
| 680pF (681)         |             |      |    | N  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |   |
| 820pF (821)         |             |      |    | N  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |   |
| 1,000pF (102)       |             |      |    | N  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |   |
| 1,200pF (122)       |             |      |    |    |      |    |    |    |     | X    | X  | X  | X  | X*  | B    | B  | B  | B  | B   |   |
| 1,500pF (152)       |             |      |    |    |      |    |    |    |     | X    | X  | X  | X  | X*  | B    | B  | B  | B  | B   |   |
| 1,800pF (182)       |             |      |    |    |      |    |    |    |     | X    | X  | X  | X  |     | B    | B  | B  | B  | B   |   |
| 2,200pF (222)       |             |      |    |    |      |    |    |    |     | X    | X  | X  | X  |     | B    | B  | B  | B  | B   |   |
| 2,700pF (272)       |             |      |    |    |      |    |    |    |     | X    | X  | X  | X  |     | D    | D  | D  | D  | D   |   |
| 3,300pF (332)       |             |      |    |    |      |    |    |    |     | X    | X  | X  | X  |     | D    | D  | D  | D  | D   |   |
| 3,900pF (392)       |             |      |    |    |      |    |    |    |     | X*   | X* | X* | X* |     | D    | D  | D  | D  | D   |   |
| 4,700pF (472)       |             |      |    |    |      |    |    |    |     | X*   | X* | X* | X* |     | D    | D  | D  | D  | D   |   |
| 5,600pF (562)       |             |      |    |    |      |    |    |    |     | X*   | X* | X* | X* |     | D    | D  | D  | D  | D   |   |
| 6,800pF (682)       |             |      |    |    |      |    |    |    |     | X*   | X* | X* | X* |     | D    | D  | D  | D  | D   |   |
| 8,200pF (822)       |             |      |    |    |      |    |    |    |     | X*   | X* | X* | X* |     | D    | D  | D  | D  | D   |   |
| 0.010uF (103)       |             |      |    |    |      |    |    |    |     | X*   | X* | X* | X* |     | D    | D  | D  | D  | D   |   |
| 0.012uF (123)       |             |      |    |    |      |    |    |    |     |      |    |    |    |     | T*   | T* | T* | T* |     |   |
| 0.015uF (153)       |             |      |    |    |      |    |    |    |     |      |    |    |    |     | T*   | T* | T* | T* |     |   |
| 0.018uF (183)       |             |      |    |    |      |    |    |    |     |      |    |    |    |     | D*   | D* | D* | D* |     |   |
| 0.022uF (223)       |             |      |    |    |      |    |    |    |     |      |    |    |    |     | D*   | D* | D* | D* |     |   |

1. The letter in cell is expressed the symbol of product thickness.

2. The letter in cell with " \* " mark is expressed capacitance tolerance "J" (±5%) only.

3. For more information about products with special capacitance or other data, please contact WTC local representative.

Multilayer Ceramic Capacitors

Approval Sheet

7-1. NP0 Dielectric 1206, 1210, 1812 Sizes

| DIELECTRIC          |               | NP0  |    |    |    |     |      |    |    |    |     |      |    |    |     |
|---------------------|---------------|------|----|----|----|-----|------|----|----|----|-----|------|----|----|-----|
| SIZE                |               | 1206 |    |    |    |     | 1210 |    |    |    |     | 1812 |    |    |     |
| RATED VOLTAGE (VDC) |               | 10   | 16 | 25 | 50 | 100 | 10   | 16 | 25 | 50 | 100 | 16   | 25 | 50 | 100 |
| Capacitance         | 1.0pF (1R0)   |      |    |    |    |     |      |    |    |    |     |      |    |    |     |
|                     | 1.2pF (1R2)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 1.5pF (1R5)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 1.8pF (1R8)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 2.2pF (2R2)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 2.7pF (2R7)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 3.3pF (3R3)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 3.9pF (3R9)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 4.7pF (4R7)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 5.6pF (5R6)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 6.8pF (6R8)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 8.2pF (8R2)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 10pF (100)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 12pF (120)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 15pF (150)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 18pF (180)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 22pF (220)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 27pF (270)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 33pF (330)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 39pF (390)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 47pF (470)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 56pF (560)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 68pF (680)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 82pF (820)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 100pF (101)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 120pF (121)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 150pF (151)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 180pF (181)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 220pF (221)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 270pF (271)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 330pF (331)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 390pF (391)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 470pF (471)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 560pF (561)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 680pF (681)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 820pF (821)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 1,000pF (102) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 1,200pF (122) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 1,500pF (152) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 1,800pF (182) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 2,200pF (222) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 2,700pF (272) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 3,300pF (332) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 3,900pF (392) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 4,700pF (472) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 5,600pF (562) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 6,800pF (682) | C    | C  | C  | C  | C   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 8,200pF (822) | D    | D  | D  | D  | D   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 0.010μF (103) | D    | D  | D  | D  | D   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 0.012μF (123) | P    | P  | P  | P  | P   | D    | D  | D  | D  | D   | D    | D  | D  | D   |
| 0.015μF (153)       | P             | P    | P  | P  | P  | D   | D    | D  | D  | D  | D   | D    | D  | D  |     |
| 0.018μF (183)       | P             | P    | P  | P  | P  | K   | K    | K  | K  | K  | D   | D    | D  | D  |     |
| 0.022μF (223)       | P             | P    | P  | P  | P  | K   | K    | K  | K  | K  | D   | D    | D  | D  |     |
| 0.027μF (273)       | P             | P    | P  | P  |    | K   | K    | K  | K  | K  | D   | D    | D  | D  |     |
| 0.033μF (333)       | P             | P    | P  | P  |    | K   | K    | K  | K  | K  | D   | D    | D  | D  |     |
| 0.039μF (393)       | P             | P    | P  | P  |    | K   | K    | K  | K  | K  | M   | M    | M  | M  |     |
| 0.047μF (473)       | J*            | J*   | J* | J* |    | K   | K    | K  | K  | K  | M   | M    | M  | M  |     |
| 0.056μF (563)       | J*            | J*   | J* | J* |    |     |      |    |    |    | M   | M    | M  | M  |     |
| 0.068μF (683)       | G*            | G*   | G* | G* |    |     |      |    |    |    | M   | M    | M  | M  |     |
| 0.082μF (823)       | G*            | G*   | G* | G* |    |     |      |    |    |    | M   | M    | M  | M  |     |
| 0.1μF (104)         | G*            | G*   | G* | G* |    |     |      |    |    |    | M   | M    | M  | M  |     |

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with " \* " mark is expressed capacitance tolerance "J" (±5%) only.
3. For more information about products with special capacitance or other data, please contact WTC local representative.

Multilayer Ceramic Capacitors

Approval Sheet

7-2. X7R Dielectric 0201, 0402, 0603, 0805 Sizes

| DIELECTRIC          |               | X7R  |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      |    |    |    |    |     |   |
|---------------------|---------------|------|----|----|----|----|------|----|----|----|----|-----|------|----|----|----|----|-----|------|----|----|----|----|-----|---|
| SIZE                |               | 0201 |    |    |    |    | 0402 |    |    |    |    |     | 0603 |    |    |    |    |     | 0805 |    |    |    |    |     |   |
| RATED VOLTAGE (VDC) |               | 6.3  | 10 | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 | 100 | 6.3  | 10 | 16 | 25 | 50 | 100 | 6.3  | 10 | 16 | 25 | 50 | 100 |   |
| Capacitance         | 100pF (101)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 120pF (121)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 150pF (151)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 180pF (181)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 220pF (221)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 270pF (271)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 330pF (331)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 390pF (391)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 470pF (471)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 560pF (561)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 680pF (681)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 820pF (821)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 1,000pF (102) | L    | L  | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 1,200pF (122) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 1,500pF (152) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 1,800pF (182) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 2,200pF (222) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 2,700pF (272) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 3,300pF (332) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 3,900pF (392) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 4,700pF (472) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 5,600pF (562) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 6,800pF (682) | L    | L  | L  |    |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 8,200pF (822) | L    | L  | L  |    |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 0.010μF (103) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  | B  | B   |   |
|                     | 0.012μF (123) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   |      | B  | B  | B  | B  | B   |   |
|                     | 0.015μF (153) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   |      | B  | B  | B  | B  | B   |   |
|                     | 0.018μF (183) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   |      | B  | B  | B  | B  | B   |   |
|                     | 0.022μF (223) |      | L  | L  |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   |      | B  | B  | B  | B  | B   |   |
|                     | 0.027μF (273) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   |      | B  | B  | B  | B  | D   |   |
|                     | 0.033μF (333) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  | B   | D |
|                     | 0.039μF (393) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  | B   | D |
|                     | 0.047μF (473) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  | B   | D |
|                     | 0.056μF (563) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  | B   | D |
|                     | 0.068μF (683) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  | B   | D |
|                     | 0.082μF (823) |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  | B   | D |
|                     | 0.10μF (104)  |      |    |    |    |    |      | N  | N  | N  | N  | E   |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  | B   | D |
|                     | 0.12μF (124)  |      |    |    |    |    |      |    |    |    |    |     |      | S  | S  | S  | X  |     |      |    | B  | B  | B  | D   | I |
|                     | 0.15μF (154)  |      |    |    |    |    |      |    |    |    |    |     |      | S  | S  | S  | X  |     |      |    | D  | D  | D  | D   | I |
|                     | 0.18μF (184)  |      |    |    |    |    |      |    |    |    |    |     |      | S  | S  | S  | X  |     |      |    | D  | D  | D  | D   | I |
| 0.22μF (224)        |               |      |    |    |    |    | N    | N  | N  | N  |    |     | S    | S  | S  | X  | X  |     |      | D  | D  | D  | D  | I   |   |
| 0.27μF (274)        |               |      |    |    |    |    |      |    |    |    |    |     | X    | X  | X  | X  |    |     |      | D  | D  | D  | I  |     |   |
| 0.33μF (334)        |               |      |    |    |    |    |      |    |    |    |    |     | X    | X  | X  | X  | X  |     |      | D  | D  | D  | I  |     |   |
| 0.39μF (394)        |               |      |    |    |    |    |      |    |    |    |    |     | X    | X  | X  | X  |    |     |      | D  | D  | D  | I  |     |   |
| 0.47μF (474)        |               |      |    |    |    |    | N    | N  |    |    |    |     | X    | X  | X  | X  | X  |     |      | D  | D  | D  | I  | I   |   |
| 0.56μF (564)        |               |      |    |    |    |    |      |    |    |    |    |     | X    | X  | X  |    |    |     |      | D  | D  | D  |    |     |   |
| 0.68μF (684)        |               |      |    |    |    |    |      |    |    |    |    |     | X    | X  | X  |    |    |     |      | D  | D  | D  |    |     |   |
| 0.82μF (824)        |               |      |    |    |    |    |      |    |    |    |    |     | X    | X  | X  |    |    |     |      | D  | D  | D  |    |     |   |
| 1.0μF (105)         |               |      |    |    |    |    | N    |    |    |    |    |     | X    | X  | X  | X  | X  |     |      | D  | D  | D  | I  |     |   |
| 1.5μF (155)         |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      | I  | I  | I  |    |     |   |
| 2.2μF (225)         |               |      |    |    |    |    |      |    |    |    |    |     | X    | X  | X  |    |    |     |      | I  | I  | I  | I  |     |   |
| 3.3μF (335)         |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      |    |    |    |    |     |   |
| 4.7μF (475)         |               |      |    |    |    |    |      |    |    |    |    |     | X    |    |    |    |    |     |      | I  | I  | I  | I  |     |   |
| 6.8μF (685)         |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      |    |    |    |    |     |   |
| 10μF (106)          |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      | I  | I  | I* |    |     |   |
| 22μF (226)          |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      |    |    |    |    |     |   |

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with " \* " mark is expressed product not in 10% (code "K") tolerance.

Multilayer Ceramic Capacitors

Approval Sheet

7-2. X7R Dielectric 1206, 1210, 1812 Sizes

| DIELECTRIC          |               | X7R  |    |    |    |    |    |      |     |    |    |    |    |      |    |    |    |    |     |
|---------------------|---------------|------|----|----|----|----|----|------|-----|----|----|----|----|------|----|----|----|----|-----|
| SIZE                |               | 1206 |    |    |    |    |    | 1210 |     |    |    |    |    | 1812 |    |    |    |    |     |
| RATED VOLTAGE (VDC) |               | 6.3  | 10 | 16 | 25 | 35 | 50 | 100  | 6.3 | 10 | 16 | 25 | 50 | 100  | 10 | 16 | 25 | 50 | 100 |
| Capacitance         | 100pF (101)   |      |    |    |    |    |    |      |     |    |    |    |    |      |    |    |    |    |     |
|                     | 120pF (121)   |      |    |    |    |    |    |      |     |    |    |    |    |      |    |    |    |    |     |
|                     | 150pF (151)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 180pF (181)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 220pF (221)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 270pF (271)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 330pF (331)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 390pF (391)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 470pF (471)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 560pF (561)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 680pF (681)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 820pF (821)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |    |    |    |    |     |
|                     | 1,000pF (102) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 1,200pF (122) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 1,500pF (152) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 1,800pF (182) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 2,200pF (222) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 2,700pF (272) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 3,300pF (332) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 3,900pF (392) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 4,700pF (472) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 5,600pF (562) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 6,800pF (682) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 8,200pF (822) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.010μF (103) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.012μF (123) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.015μF (153) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.018μF (183) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.022μF (223) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.027μF (273) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.033μF (333) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.039μF (393) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.047μF (473) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.056μF (563) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.068μF (683) |      | B  | B  | B  |    | B  | B    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.082μF (823) |      | B  | B  | B  |    | B  | D    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.10μF (104)  |      | B  | B  | B  |    | B  | D    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.12μF (124)  |      | B  | B  | B  |    | B  | D    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.15μF (154)  |      | C  | C  | C  |    | C  | G    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.18μF (184)  |      | C  | C  | C  |    | C  | G    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.22μF (224)  |      | C  | C  | C  |    | C  | G    |     | C  | C  | C  | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.27μF (274)  |      | C  | C  | C  |    | D  | G    |     | C  | C  | C  | C  | G    | D  | D  | D  | D  | D   |
|                     | 0.33μF (334)  |      | C  | C  | C  |    | D  | G    |     | C  | C  | C  | D  | G    | D  | D  | D  | D  | D   |
|                     | 0.39μF (394)  |      | C  | C  | J  |    | P  | G    |     | C  | C  | C  | D  | M    | D  | D  | D  | D  | D   |
|                     | 0.47μF (474)  |      | J  | J  | J  |    | P  | G    |     | C  | C  | C  | D  | M    | D  | D  | D  | D  | K   |
|                     | 0.56μF (564)  |      | J  | J  | J  |    | P  | P    |     | D  | D  | D  | D  | M    | D  | D  | D  | D  | K   |
| 0.68μF (684)        |               | J    | J  | J  |    | P  | P  |      | D   | D  | D  | D  | K  | D    | D  | D  | K  | K  |     |
| 0.82μF (824)        |               | J    | J  | J  |    | P  | P  |      | D   | D  | D  | D  | K  | D    | D  | D  | K  | K  |     |
| 1.0μF (105)         |               | J    | J  | J  |    | P  | P  |      | D   | D  | D  | D  | K  | D    | D  | D  | K  | K  |     |
| 1.5μF (155)         | J             | J    | J  | P  |    |    |    |      |     | K  | G  | M  | M  |      |    |    |    | K  |     |
| 2.2μF (225)         | J             | J    | J  | P  |    | P  | P  |      |     | K  | G  | M  | M  |      |    |    | M  | M  |     |
| 3.3μF (335)         |               | P    | P  | P  |    |    |    |      |     | K  | G  | M  |    |      |    |    |    |    |     |
| 4.7μF (475)         | P             | P    | P  | P  |    | P  |    |      | K   | K  | K  | M  | M  |      |    |    |    |    |     |
| 6.8μF (685)         |               |      |    |    |    |    |    |      |     |    |    |    |    |      |    |    |    |    |     |
| 10μF (106)          | P             | P    | P  | P  | P  |    |    |      | K   | K  | K  | M  |    |      |    |    |    |    |     |
| 22μF (226)          | P             | P    | P* |    |    |    |    |      | M   | M  | M  |    |    |      |    |    |    |    |     |
| 47μF (476)          |               |      |    |    |    |    |    | M    | M   |    |    |    |    |      |    |    |    |    |     |
| 100μF (107)         |               |      |    |    |    |    |    |      |     |    |    |    |    |      |    |    |    |    |     |

1. The letter in cell is expressed the symbol of product thickness.

2. The letter in cell with " \* " mark is expressed product not in 10% (code "K") tolerance.

Multilayer Ceramic Capacitors

Approval Sheet

7-3. Y5V Dielectric 0402, 0603, 0805 Sizes

| DIELECTRIC          |               | Y5V  |     |    |    |    |      |    |    |    |    |      |    |    |    |    |     |
|---------------------|---------------|------|-----|----|----|----|------|----|----|----|----|------|----|----|----|----|-----|
| SIZE                |               | 0402 |     |    |    |    | 0603 |    |    |    |    | 0805 |    |    |    |    |     |
| RATED VOLTAGE (VDC) |               | 6.3  | 10  | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 | 100 |
| Capacitance         | 0.010μF (103) |      | N   | N  | N  | N  |      | S  | S  | S  | S  |      | A  | A  | A  | A  | B   |
|                     | 0.015μF (153) |      | N   | N  | N  | N  |      | S  | S  | S  | S  |      | A  | A  | A  | A  | B   |
|                     | 0.022μF (223) |      | N   | N  | N  | N  |      | S  | S  | S  | S  |      | A  | A  | A  | A  | B   |
|                     | 0.033μF (333) |      | N   | N  | N  | N  |      | S  | S  | S  | S  |      | A  | A  | A  | A  | B   |
|                     | 0.047μF (473) |      | N   | N  | N  |    |      | S  | S  | S  | S  |      | A  | A  | A  | A  | B   |
|                     | 0.068μF (683) |      | N   | N  | N  |    |      | S  | S  | S  | S  |      | A  | A  | A  | A  | B   |
|                     | 0.10μF (104)  |      | N   | N  | N  |    |      | S  | S  | S  | S  |      | A  | A  | A  | A  | B   |
|                     | 0.15μF (154)  |      | N   | N  |    |    |      | S  | S  | S  | S  |      | A  | A  | A  | A  |     |
|                     | 0.22μF (224)  | N    | N   | N  |    |    |      | S  | S  | S  | S  |      | A  | A  | A  | A  |     |
|                     | 0.33μF (334)  | N    | N   | N  |    |    |      | S  | S  | S  | X  |      | B  | B  | B  | B  |     |
|                     | 0.47μF (474)  | N    | N   | N  |    |    |      | S  | S  | X  | X  |      | B  | B  | B  | B  |     |
|                     | 0.68μF (684)  | N    |     |    |    |    |      | S  | X  | X  |    |      | B  | B  | D  | D  |     |
|                     | 1.0μF (105)   | N/E  | N/E |    |    |    |      | S  | X  | X  |    |      | B  | B  | D  | D  |     |
|                     | 1.5μF (155)   |      |     |    |    |    |      | S  |    |    |    |      | D  | D  |    |    |     |
|                     | 2.2μF (225)   |      |     |    |    |    | S    | S  | X  |    |    |      | D  | D  | I  |    |     |
|                     | 3.3μF (335)   |      |     |    |    |    |      |    |    |    |    |      | D  | D  |    |    |     |
|                     | 4.7μF (475)   |      |     |    |    |    | X    | X  |    |    |    |      | D  | D  | I  |    |     |
|                     | 6.8μF (685)   |      |     |    |    |    |      |    |    |    |    |      | I  |    |    |    |     |
| 10μF (106)          |               |      |     |    |    |    |      |    |    |    |    | I    | I  | I  |    |    |     |
| 22μF (226)          |               |      |     |    |    |    |      |    |    |    |    | I    | I  |    |    |    |     |

1. The letter in cell is expressed the symbol of product thickness.
2. For more information about products with special capacitance or other data, please contact WTC local representative.

7-3. Y5V Dielectric 1206, 1210, 1812 Sizes

| DIELECTRIC          |               | Y5V  |    |    |    |    |     |      |    |    |    |    |    |      |    |    |    |    |     |
|---------------------|---------------|------|----|----|----|----|-----|------|----|----|----|----|----|------|----|----|----|----|-----|
| SIZE                |               | 1206 |    |    |    |    |     | 1210 |    |    |    |    |    | 1812 |    |    |    |    |     |
| RATED VOLTAGE (VDC) |               | 6.3  | 10 | 16 | 25 | 50 | 100 | 6.3  | 10 | 16 | 25 | 35 | 50 | 100  | 10 | 16 | 25 | 50 | 100 |
| Capacitance         | 0.010μF (103) |      | B  | B  | B  | B  | B   |      |    |    |    |    |    | C    |    |    |    |    | D   |
|                     | 0.015μF (153) |      | B  | B  | B  | B  | B   |      |    |    |    |    |    | C    |    |    |    |    | D   |
|                     | 0.022μF (223) |      | B  | B  | B  | B  | B   |      |    |    |    |    |    | C    |    |    |    |    | D   |
|                     | 0.033μF (333) |      | B  | B  | B  | B  | B   |      |    |    |    |    |    | C    |    |    |    |    | D   |
|                     | 0.047μF (473) |      | B  | B  | B  | B  | B   |      |    |    |    |    |    | C    |    |    |    |    | D   |
|                     | 0.068μF (683) |      | B  | B  | B  | B  | B   |      |    |    |    |    |    | C    |    |    |    |    | D   |
|                     | 0.10μF (104)  |      | B  | B  | B  | B  | B   |      | C  | C  | C  |    | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.15μF (154)  |      | B  | B  | B  | B  | C   |      | C  | C  | C  |    | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.22μF (224)  |      | B  | B  | B  | B  | C   |      | C  | C  | C  |    | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.33μF (334)  |      | B  | B  | B  | B  |     |      | C  | C  | C  |    | C  | C    | D  | D  | D  | D  | D   |
|                     | 0.47μF (474)  |      | B  | B  | B  | B  |     |      | C  | C  | C  |    | C  |      | D  | D  | D  | D  | D   |
|                     | 0.68μF (684)  |      | B  | B  | B  | B  |     |      | C  | C  | C  |    | C  |      | D  | D  | D  | D  | D   |
|                     | 1.0μF (105)   |      | C  | C  | C  | C  |     |      | C  | C  | C  |    | C  |      | D  | D  | D  | D  | D   |
|                     | 1.5μF (155)   |      | C  | C  | C  |    |     |      | C  | C  | C  |    |    |      | D  | D  | D  | D  |     |
|                     | 2.2μF (225)   |      | C  | C  | C  | J  |     |      | C  | C  | C  |    | G  |      | D  | D  | D  | D  |     |
|                     | 3.3μF (335)   |      | J  | J  | J  |    |     |      | C  | C  | C  |    |    |      | D  | D  | D  | D  |     |
|                     | 4.7μF (475)   |      | J  | J  | J  | P  |     |      | C  | C  | D  |    | G  |      | D  | D  | D  | D  |     |
|                     | 6.8μF (685)   |      | J  | J  |    |    |     |      | C  | C  | D  |    | K  |      | D  | D  | D  | D  |     |
|                     | 10μF (106)    |      | J  | J  | P  |    |     |      | D  | D  | G  | K  | K  |      | D  | D  | D  | K  |     |
|                     | 22μF (226)    |      | P  | P  |    |    |     |      |    | K  | K  |    |    |      |    |    |    |    |     |
| 47μF (476)          | P             |      |    |    |    |    |     | K    | K  |    |    |    |    |      | M  |    |    |    |     |
| 100μF (107)         |               |      |    |    |    |    |     | M    |    |    |    |    |    |      |    |    |    |    |     |

1. The letter in cell is expressed the symbol of product thickness.
2. For more information about products with special capacitance or other data, please contact WTC local representative.

7-4. X5R Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes

| Dielectric          |               | X5R  |    |    |    |    |      |     |     |     |     |    |      |     |    |    |    |    |
|---------------------|---------------|------|----|----|----|----|------|-----|-----|-----|-----|----|------|-----|----|----|----|----|
| Size                |               | 0201 |    |    |    |    | 0402 |     |     |     |     |    | 0603 |     |    |    |    |    |
| Rated Voltage (VDC) |               | 6.3  | 10 | 16 | 25 | 50 | 4    | 6.3 | 10  | 16  | 25  | 50 | 4    | 6.3 | 10 | 16 | 25 | 50 |
| Capacitance         | 100pF (101)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 120pF (121)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 150pF (151)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 180pF (181)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 220pF (221)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 270pF (271)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 330pF (331)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 390pF (391)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 470pF (471)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 560pF (561)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 680pF (681)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 820pF (821)   |      |    | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 1,000pF (102) |      | L  | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 1,500pF (152) |      | L  | L  | L  |    |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 2,200pF (222) |      | L  | L  | L  |    |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 2,700pF (272) |      | L  | L  | L  |    |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 3,300pF (332) |      | L  | L  | L  |    |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 4,700pF (472) |      | L  | L  | L  |    |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 6,800pF (682) |      | L  | L  | L  |    |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 0.010μF (103) | L    | L  | L  | L  | L  |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 0.015μF (153) | L    | L  |    |    |    |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 0.022μF (223) | L    | L  |    |    |    |      |     |     |     |     |    |      |     |    |    |    |    |
|                     | 0.027μF (273) | L    | L  |    |    |    |      |     |     | N   | N   |    |      |     |    |    |    |    |
|                     | 0.033μF (333) | L    | L  |    |    |    |      |     |     | N   | N   |    |      |     |    |    |    |    |
|                     | 0.039μF (393) | L    | L  |    |    |    |      |     |     | N   | N   |    |      |     |    |    |    |    |
|                     | 0.047μF (473) | L    | L  |    |    |    |      |     |     | N   | N   | N  |      |     |    |    |    |    |
|                     | 0.056μF (563) | L    | L  |    |    |    |      |     |     | N   | N   | N  |      |     |    |    |    |    |
|                     | 0.068μF (683) | L    | L  |    |    |    |      |     |     | N   | N   | N  |      |     |    |    |    |    |
|                     | 0.082μF (823) | L    | L  |    |    |    |      |     |     | N   | N   | N  |      |     |    |    |    |    |
|                     | 0.10μF (104)  | L    | L  | L  | L  |    |      |     |     | N   | N   | N  | N    | E   |    |    |    |    |
|                     | 0.15μF (154)  |      |    |    |    |    |      |     |     | N   | N   | N  | N    |     |    |    |    |    |
|                     | 0.22μF (224)  | L    | L  | L* |    |    |      |     |     | N   | N   | N  | N    | N   | X  | X  | X  | X  |
|                     | 0.27μF (274)  |      |    |    |    |    |      |     |     |     |     |    |      |     |    | X  | X  | X  |
|                     | 0.33μF (334)  | L*   |    |    |    |    |      |     |     | N   | N   |    |      |     | X  | X  | X  | X  |
|                     | 0.39μF (394)  |      |    |    |    |    |      |     |     |     |     |    |      |     |    | X  | X  | X  |
|                     | 0.47μF (474)  | L    |    |    |    |    |      |     |     | N   | N   | E  | E    | E   | X  | X  | X  | X  |
| 0.68μF (684)        |               |      |    |    |    |    |      |     | N   | N   |     |    |      | X   | X  | X  | X  |    |
| 0.82μF (824)        |               |      |    |    |    |    |      |     |     |     |     |    |      | X   | X  | X  | X  |    |
| 1.0μF (105)         | L*            | L*   | L* |    |    |    |      |     | N/E | N/E | N/E | N  | E    | X   | X  | X  | X  | X  |
| 1.5μF (155)         |               |      |    |    |    |    |      |     |     |     |     |    |      | X   |    |    |    |    |
| 2.2μF (225)         | L*            | L*   |    |    |    |    |      |     | N   | N   | E   | E  |      | X   | X  | X  | X  | X  |
| 3.3μF (335)         |               |      |    |    |    |    |      |     |     |     |     |    |      | X   | X  |    |    |    |
| 4.7μF (475)         |               |      |    |    |    |    |      |     | E   | E   | E*  |    |      | X   | X  | X  | X  |    |
| 6.8μF (685)         |               |      |    |    |    |    |      |     |     |     |     |    |      |     |    |    |    |    |
| 10μF (106)          |               |      |    |    |    |    | E*   | E*  | E*  |     |     |    |      | X   | X  | X  | X  | X* |
| 22μF (226)          |               |      |    |    |    |    |      |     |     |     |     |    |      | X*  | X* | X* |    |    |
| 47μF (476)          |               |      |    |    |    |    |      |     |     |     |     |    |      | X*  | X* |    |    |    |

| Dielectric          |             | X5R  |     |    |    |    |    |      |     |    |    |    |    |      |     |    |    |    |    |    |
|---------------------|-------------|------|-----|----|----|----|----|------|-----|----|----|----|----|------|-----|----|----|----|----|----|
| Size                |             | 0805 |     |    |    |    |    | 1206 |     |    |    |    |    | 1210 |     |    |    |    |    |    |
| Rated Voltage (VDC) |             | 4    | 6.3 | 10 | 16 | 25 | 50 | 4    | 6.3 | 10 | 16 | 25 | 50 | 4    | 6.3 | 10 | 16 | 25 | 35 | 50 |
| Capacitance         | 1.0μF (105) |      |     | D  | D  | D  | I  |      |     |    |    |    |    |      |     |    |    |    |    |    |
|                     | 1.5μF (155) |      | I   | I  | I  | I  |    |      |     | J  | J  |    |    |      |     | K  | K  |    |    |    |
|                     | 2.2μF (225) |      | I   | I  | I  | I  | I  |      |     | J  | J  | P  | P  |      |     | K  | K  |    |    |    |
|                     | 3.3μF (335) |      | I   | I  | I  | I  |    |      |     | P  | P  | P  | P  |      |     |    |    |    |    |    |
|                     | 4.7μF (475) |      | I   | I  | I  | I  | I  |      |     | P  | P  | P  | P  |      |     | K  | K  | K  |    |    |
|                     | 6.8μF (685) |      |     |    |    |    |    |      | P   | P  |    |    |    |      |     |    |    |    |    |    |
|                     | 10μF (106)  |      | I   | I  | I  | I  | I  |      | P   | P  | P  | P  | P  |      | K   | K  | K  | K  | M  | M  |
|                     | 22μF (226)  |      | I   | I* | I* | I* |    |      | P   | P  | P  | P  | P  |      | M   | M  | M  | M  | M  |    |
|                     | 47μF (476)  |      | I*  | I* |    |    |    |      | P   | P  | P* |    |    |      | M   | M  | M  | M* |    |    |
|                     | 100μF (107) | I*   | I*  |    |    |    |    |      | P   |    |    |    |    |      | M*  | M* | M* | M* |    |    |
|                     | 220μF (227) |      |     |    |    |    | P* |      |     |    |    |    | M* | M*   |     |    |    |    |    |    |

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with " \* " mark is expressed product not in 10% (code "K") tolerance.

Multilayer Ceramic Capacitors

7-5. X6S Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes

| Dielectric          |              | X6S  |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|---------------------|--------------|------|----|----|----|------|----|----|----|------|-----|----|----|----|------|-----|----|----|----|----|------|----|----|----|----|------|----|----|----|----|
| Size                |              | 0201 |    |    |    | 0402 |    |    |    | 0603 |     |    |    |    | 0805 |     |    |    |    |    | 1206 |    |    |    |    | 1210 |    |    |    |    |
| Rated Voltage (VDC) |              | 6.3  | 10 | 16 | 25 | 6.3  | 10 | 16 | 25 | 4    | 6.3 | 10 | 16 | 25 | 4    | 6.3 | 10 | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 |
| Capacitance         | 0.10μF (104) | L    | L  | L  | L  |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 0.15μF (154) |      |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 0.22μF (224) | L    | L* |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 0.33μF (334) |      |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 0.47μF (474) |      |    |    |    | E    |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 0.68μF (684) |      |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 1.0μF (105)  | L*   |    |    |    | E    | E  | E  | E  |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 1.5μF (155)  |      |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 2.2μF (225)  |      |    |    |    | E    | E  | E  |    |      |     |    | X  | X  |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 3.3μF (335)  |      |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 4.7μF (475)  |      |    |    |    |      |    |    |    |      | X   | X  | X  | X  |      |     |    |    |    | I  | I    |    |    |    |    |      |    |    |    |    |
|                     | 6.8uF (685)  |      |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |
|                     | 10μF (106)   |      |    |    |    | E*   |    |    |    |      | X*  | X* | X* |    | I    | I   | I  | I  | I  |    |      |    |    | P  |    |      |    |    |    |    |
|                     | 22μF (226)   |      |    |    |    |      |    |    |    | X*   | X*  |    |    |    |      | I*  | I* | I* |    |    |      | P  | P* | P  |    |      |    |    | M  |    |
|                     | 47μF (476)   |      |    |    |    |      |    |    |    |      |     |    |    |    |      | I*  | I* |    |    |    | P    |    |    |    |    |      | M  | M  | M  |    |
| 100μF (107)         |              |      |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    | M*   | M* |    |    |    |

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with " \*" mark is expressed product not in 10% (code "K") tolerance.

7-6. X7S Dielectric 0402, 0603, 0805, 1206, 1210 Sizes

| Dielectric          |             | X7S  |    |    |    |      |    |    |    |      |    |    |    |     |     |      |    |    |    |     |      |    |    |    |     |    |    |    |    |  |  |
|---------------------|-------------|------|----|----|----|------|----|----|----|------|----|----|----|-----|-----|------|----|----|----|-----|------|----|----|----|-----|----|----|----|----|--|--|
| Size                |             | 0402 |    |    |    | 0603 |    |    |    | 0805 |    |    |    |     |     | 1206 |    |    |    |     | 1210 |    |    |    |     |    |    |    |    |  |  |
| Rated Voltage (VDC) |             | 6.3  | 10 | 16 | 25 | 6.3  | 10 | 16 | 25 | 10   | 16 | 25 | 50 | 100 | 6.3 | 10   | 16 | 25 | 50 | 6.3 | 10   | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 |  |  |
| Capacitance         | 1.0μF (105) |      | E  |    |    |      |    |    |    |      |    |    |    | I   |     |      |    |    |    |     |      |    |    |    |     |    |    |    |    |  |  |
|                     | 1.5μF (155) |      |    |    |    |      |    |    | I  |      |    |    |    |     |     |      |    |    |    |     |      |    |    |    |     |    |    |    |    |  |  |
|                     | 2.2μF (225) | E    | E  |    |    |      |    | X  | X  |      |    |    |    |     |     |      |    |    |    |     |      |    |    |    |     |    |    |    |    |  |  |
|                     | 3.3μF (335) |      |    |    |    |      |    |    |    |      |    |    |    |     |     |      |    |    |    |     |      |    |    |    |     |    |    |    |    |  |  |
|                     | 4.7μF (475) |      |    |    |    |      | X  | X  |    |      |    |    |    | I   |     |      |    |    |    |     |      |    |    |    |     |    |    |    |    |  |  |
|                     | 6.8uF (685) |      |    |    |    |      |    |    |    |      |    |    |    |     |     |      |    |    |    |     |      |    |    |    |     |    |    |    |    |  |  |
|                     | 10μF (106)  |      |    |    |    |      |    |    |    |      |    |    | I  | I   |     |      |    |    |    |     |      |    |    |    |     |    |    |    |    |  |  |
|                     | 22μF (226)  |      |    |    |    |      |    |    |    |      |    |    |    |     |     |      |    | P* |    |     |      |    |    |    |     |    |    |    |    |  |  |
|                     | 47μF (476)  |      |    |    |    |      |    |    |    |      |    |    |    |     |     |      |    | P* |    |     |      |    |    |    |     |    |    |    |    |  |  |
| 100μF (107)         |             |      |    |    |    |      |    |    |    |      |    |    |    |     |     |      |    |    | P* |     |      |    |    |    |     |    |    | M* |    |  |  |

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with " \*" mark is expressed product not in 10% (code "K") tolerance.

## 8. PACKAGING STYLE AND QUANTITY

| Size        | Thickness (mm)/Symbol |   | Paper tape |          | Plastic tape |          |
|-------------|-----------------------|---|------------|----------|--------------|----------|
|             |                       |   | 7" reel    | 13" reel | 7" reel      | 13" reel |
| 0201 (0603) | 0.30±0.03             | L | 15,000     | 70,000   | -            | -        |
|             | 0.30±0.05             | L | 15,000     | -        | -            | -        |
|             | 0.30±0.09             | L | 15,000     | -        | -            | -        |
| 0402 (1005) | 0.50±0.05             | N | 10,000     | 50,000   | -            | -        |
|             | 0.50±0.02/-0.05       | Q | 10,000     | 50,000   | -            | -        |
|             | 0.50±0.20             | E | 10,000     | -        | -            | -        |
| 0603 (1608) | 0.50±0.10             | H | 4,000      | -        | -            | -        |
|             | 0.80±0.07             | S | 4,000      | 15,000   | -            | -        |
|             | 0.80±0.15/-0.10       | X | 4,000      | 15,000   | -            | -        |
| 0805 (2012) | 0.50±0.10             | H | 4,000      | 15,000   | -            | -        |
|             | 0.60±0.10             | A | 4,000      | 15,000   | -            | -        |
|             | 0.80±0.10             | B | 4,000      | 15,000   | -            | -        |
|             | 0.85±0.10             | T | 4,000      | 15,000   | -            | -        |
|             | 1.25±0.10             | D | -          | -        | 3,000        | 10,000   |
|             | 1.25±0.20             | I | -          | -        | 3,000        | 10,000   |
| 1206 (3216) | 0.80±0.10             | B | 4,000      | 15,000   | -            | -        |
|             | 0.85±0.10             | T | 4,000      | 15,000   | -            | -        |
|             | 0.95±0.10             | C | -          | -        | 3,000        | 10,000   |
|             | 1.15±0.15             | J | -          | -        | 3,000        | 10,000   |
|             | 1.25±0.10             | D | -          | -        | 3,000        | 10,000   |
|             | 1.60±0.20             | G | -          | -        | 2,000        | 10,000   |
|             | 1.60±0.30/-0.10       | P | -          | -        | 2,000        | 9,000    |
| 1210 (3225) | 0.85±0.10             | T | -          | -        | 3,000        | 10,000   |
|             | 0.95±0.10             | C | -          | -        | 3,000        | 10,000   |
|             | 1.25±0.10             | D | -          | -        | 3,000        | 10,000   |
|             | 1.60±0.20             | G | -          | -        | 2,000        | -        |
|             | 2.00±0.20             | K | -          | -        | 1,000        | 6,000    |
|             | 2.50±0.30             | M | -          | -        | 1,000        | 6,000    |
| 1808 (4520) | 1.25±0.10             | D | -          | -        | 2,000        | 10,000   |
|             | 1.10±0.15             | F | -          | -        | 2,000        | 10,000   |
|             | 1.60±0.20             | G | -          | -        | 2,000        | 8,000    |
| 1812 (4532) | 2.00±0.20             | K | -          | -        | 1,000        | 6,000    |
|             | 1.25±0.10             | D | -          | -        | 1,000        | 5,000    |
|             | 1.60±0.20             | G | -          | -        | 1,000        | -        |
|             | 2.00±0.20             | K | -          | -        | 1,000        | -        |
|             | 2.50±0.30             | M | -          | -        | 500          | 3,000    |
|             | 2.80±0.30             | U | -          | -        | 500          | -        |

Unit: pieces

## 9. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.                                                           | Item                            | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Requirements                                                                                                               |                                             |                                                                                                                            |                 |        |                                                                                     |
|---------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------------|--------|-------------------------------------------------------------------------------------|
| 1.                                                            | Visual and Mechanical           | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | * No remarkable defect.<br>* Dimensions to conform to individual specification sheet.                                      |                                             |                                                                                                                            |                 |        |                                                                                     |
| 2.                                                            | Capacitance                     | Class I: (NP0)<br>≤1000pF, 1.0±0.2Vrms · 1MHz±10%<br>>1000pF, 1.0±0.2Vrms · 1KHz±10%<br>Class II: (X7R, X7E, X6S, X5R,X7S,Y5V)<br>C ≤10μF, 1.0±0.2Vrms · 1KHz±10% **<br>C >10μF, 0.5±0.2Vrms · 120Hz±20%                                                                                                                                                                                                                                                                                                                                                                                                               | * Shall not exceed the limits given in the detailed spec.<br>NP0: Cap≥30pF, Q≥1000; Cap<30pF,Q≥400+20C<br>X7R,X5R,X6S,X7S: |                                             |                                                                                                                            |                 |        |                                                                                     |
| 3.                                                            | Q/ D.F.<br>(Dissipation Factor) | ** Test condition: 0.5±0.2Vrms · 1KHz±10%<br>X7R:<br>0805=106(6.3V), 0603/475(6.3V)<br>X5R:<br>0201 ≥ 224 (6.3V,10V,16V) <sup>#1</sup> ,<br>0402 ≥ 475 (6.3V,16V), 0402 ≥ 225(10V),<br>0603=106 (6.3V,10V),<br>TT18X ≥ 475(10V) , TT15X series<br>X6S:<br>0201 ≥ 104 (6.3V,10V) <sup>#1</sup> ,<br>0402 ≥ 225 (6.3V),<br>0402/475 (10V), 0603/106 (6.3V),<br>X7S:<br>0402/225(6.3V)<br><br>#1 Excluding<br>X5R/0201/105(6.3V);225(10V),<br>X6S/0201/104(10V)<br>(1.0±0.2Vrms · 1KHz±10%)<br><br>*Before initial measurement (Class II only):<br>To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. | Rated vol.                                                                                                                 | D.F. ≤                                      | Exception of D.F. ≤                                                                                                        |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ≥ 100V                                                                                                                     | ≤ 2.5%                                      | ≤ 3% 1206 ≥ 0.47μF<br>≤ 5% 0805 > 0.1μF;0603 ≥ 0.068μF;1206>1μF;1210 ≥ 2.2μF;TT series<br>≤ 10% 0805 > 0.22μF;1210 ≥ 3.3μF |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 50V                                                                                                                        | ≤ 2.5%                                      | ≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF;1206 ≥ 0.47μF                                                                |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             | ≤ 5% 0201 ≥ 0.01uF; 1210 ≥ 4.7μF                                                                                           |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             | ≤ 10% 0402 ≥ 0.012μF;0603>0.1μF; 0805 ≥ 1μF;1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series                                           |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 35V                                                                                                                        | ≤ 3.5%                                      | ≤ 10% 0603 ≥ 1μF;0805≥2.2μF; 1206 ≥ 2.2μF;1210 ≥ 10μF                                                                      |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 25V                                                                                                                        | ≤ 3.5%                                      | ≤ 5% 0201 ≥ 0.01μF;0805 ≥ 1μF; 1210 ≥ 10μF                                                                                 |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             | ≤ 7% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF                                                                                           |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             | ≤ 10% 0201 ≥ 0.1μF;0402 ≥ 0.10μF&(0402/X7R ≥ 0.056μF); TT series                                                           |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             | ≤ 12.5% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF;1206 ≥ 6.8μF; 1210 ≥ 22μF                                                              |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 16V                                                                                                                        | ≤ 3.5%                                      | ≤ 5% 0201 ≥ 0.01μF;0402 ≥ 0.033μF;0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF;1210 ≥ 4.7μF                                  |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             | ≤ 10% 0201 ≥ 0.1uF(0201/X7R ≥ 0.022μF); 0402 ≥ 0.22uF; 0603 ≥ 0.68μF;0805 ≥ 2.2μF;1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series     |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 10V                                                                                                                        | ≤ 5%                                        | ≤ 10% 0201 ≥ 0.012μF;0402 ≥ 0.33μF(0402/X7R ≥ 0.22μF); TT series                                                           |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6.3V                                                                                                                       | ≤ 10%                                       | ≤ 15% 0603 ≥ 0.33μF; 0805 ≥ 2.2μF;1206 ≥ 2.2μF;1210 ≥ 22μF;01R5                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             | 0201 ≥ 0.1μF; 0402 ≥ 1μF                                                                                                   |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4V                                                                                                                         | ≤ 15%                                       | ≤ 15% 0201 ≥ 0.1μF;0402 ≥ 1μF;0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF ;1210 ≥ 100μF; TT series                              |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             | 0402 ≥ 2.2μF                                                                                                               |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Y5V:                                                                                                                       |                                             |                                                                                                                            | Rated vol.      | D.F. ≤ | Exception of D.F. ≤                                                                 |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | ≥ 50V           | ≤ 5%   | ≤ 7% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF; TT series                           |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            |                 |        | ≤ 12.5% 1210 ≥ 6.8μF                                                                |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | 35V             | ≤ 7%   | ---                                                                                 |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | 25V             | ≤ 5%   | ≤ 7% 0402 ≥ 0.047μF;0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF           |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            |                 |        | ≤ 9% 0402 ≥ 0.068μF;0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series             |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | 16V (C<1.0μF)   | ≤ 7%   | ≤ 9% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF                                                  |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            |                 |        | ≤ 12.5% 0402 ≥ 0.22μF                                                               |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | 16V (C ≥ 1.0μF) | ≤ 9%   | ≤ 12.5% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF;1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF; TT series |
| 10V                                                           | ≤ 12.5%                         | ≤ 20% 0402 ≥ 0.47μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                            |                                             |                                                                                                                            |                 |        |                                                                                     |
| 6.3V                                                          | ≤ 20%                           | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                            |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | ---             |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | ---             |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | ---             |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            | ---             |        |                                                                                     |
| 4.                                                            | Dielectric Strength             | * To apply voltage (≤100V) 250%.<br>* Duration: 1 to 5 sec.<br>* Charge and discharge current less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | * No evidence of damage or flash over during test.                                                                         |                                             |                                                                                                                            |                 |        |                                                                                     |
| 5.                                                            | Insulation Resistance           | To apply rated voltage for MAX. 120sec.<br><br>*Before initial measurement (Class II only):<br>To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 10GΩ or RxC ≥ 500Ω·F whichever is smaller.<br>Class II (X7R, X7E, X5R,X6S,X7S,Y5V:)                                        |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Rated voltage                                                                                                              | Insulation Resistance                       |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 100V: All X7R                                                                                                              | 10GΩ or RxC ≥ 100 Ω·F whichever is smaller. |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 50V:0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF                                                                    |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 35V:0805≥2.2μF;1206 ≥ 2.2μF; 1210 ≥ 10μF                                                                                   |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 25V:0402≥1μF;0603≥2.2μF;0805≥2.2μF;1206≥10μF;1210≥10μF                                                                     |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 16V: 0201≥0.1μF;0402≥0.22μF;0603≥1μF; 0805≥2.2μF;1206≥10μF;1210≥47μF                                                       |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 10V:0201≥47nF;0402≥0.47μF;0603≥0.47μF;0805≥2.2μF; 1206≥4.7μF;1210≥47μF                                                     |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6.3V ; 4V ; TT series; Size≥1812                                                                                           |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Rated voltage                                                                                                              | Insulation Resistance                       |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | All X6S items, All X7S items                                                                                               | RxC ≥ 50 Ω·F.                               |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 100V: 1210≥3.3μF                                                                                                           |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 50V: 0402≥0.1μF; 0603≥2.2μF; 0805≥10μF;1206≥10μF                                                                           |                                             |                                                                                                                            |                 |        |                                                                                     |
|                                                               |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 35V: 0603≥1μF;                                                                                                             |                                             |                                                                                                                            |                 |        |                                                                                     |
| 25V: 0201≥0.1μF; 0402≥2.2μF;0603≥10μF; 0805≥10μF;1206≥22μF    |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            |                 |        |                                                                                     |
| 16V: 0603≥10μF; 0402≥1μF; 0201≥0.22μF                         |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            |                 |        |                                                                                     |
| 10V: 0201>0.1μF; 0402≥1μF; 0603≥10μF; 0805≥47μF; TT21>4.7μF   |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            |                 |        |                                                                                     |
| 6.3V: 0201≥0.1μF; 0603>4.7μF; 0805≥47μF;1206≥10μF; TT15>1.0μF |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            |                 |        |                                                                                     |
| 4V:0603≥22μF; 0805≥47μF; 1206≥100μF                           |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                                             |                                                                                                                            |                 |        |                                                                                     |

Multilayer Ceramic Capacitors

Approval Sheet

| No.                | Item                             | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Requirements                                                                                                                                                                                                                                                                                                        |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
|--------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------|-----------------|----------------------------|-----------------|-----|-------------------|-----|-----------------|----------------------------|-----------------|-----|-----------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------|------------------|---------------------|--|---------------|------|------|-------------|-------------|---------------|---------------------|--------------------|-----------------|----------------|--|------|-----------|--------------|--------------|----------------|----------------------|----------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|-----|-----------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|------------------|
| 6.                 | Temperature Coefficient          | <div>With no electrical load.</div> <table><tr><th>T.C.</th><th>Operating Temp</th></tr><tr><td>NPO</td><td>-55~125℃ at 25℃</td></tr><tr><td>X7R</td><td>-55~125℃ at 25℃</td></tr><tr><td>X7S</td><td>-55 ~ 125℃ at 25℃</td></tr><tr><td>X5R</td><td>-55~ 85℃ at 25℃</td></tr><tr><td>X6S</td><td>-55~105℃ at 25℃</td></tr><tr><td>Y5V</td><td>-25~ 85℃ at 20℃</td></tr></table> <div>*Before initial measurement (Class II only):<br/>To apply de-aging at 150℃ for 1hr then set for 24± 2 hrs at room temp.<br/>* Measurement voltage for Class II:</div> <table><tr><th>01005</th><th>0201</th></tr><tr><td>Cap≤0.01μF: 0.5V</td><td>Cap&lt;0.1μF:1V</td></tr><tr><td>Cap&gt;0.01μF: 0.2V</td><td>0.1μF≤Cap&lt;1μF: 0.2V</td></tr><tr><td></td><td>Cap≥1μF: 0.1V</td></tr><tr><th>0402</th><th>0603</th></tr><tr><td>Cap&lt;1μF: 1V</td><td>Cap≤1μF: 1V</td></tr><tr><td>Cap=1μF: 0.5V</td><td>1μF&lt;Cap≤4.7μF: 0.5V</td></tr><tr><td>1μF&lt;Cap&lt;10μF: 0.2V</td><td>Cap&gt;4.7μF: 0.2V</td></tr><tr><td>Cap≥10μF: 0.1V</td><td></td></tr><tr><th>0805</th><th>1206/1210</th></tr><tr><td>Cap&lt;10μF: 1V</td><td>Cap≤10μF: 1V</td></tr><tr><td>Cap=10μF: 0.5V</td><td>10μF&lt;Cap≤100μF: 0.5V</td></tr><tr><td>Cap&gt;10μF: 0.2V</td><td>Cap&gt;100μF: 0.2V</td></tr></table> | T.C.                                                                                                                                                                                                                                                                                                                | Operating Temp | NPO         | -55~125℃ at 25℃ | X7R                        | -55~125℃ at 25℃ | X7S | -55 ~ 125℃ at 25℃ | X5R | -55~ 85℃ at 25℃ | X6S                        | -55~105℃ at 25℃ | Y5V | -25~ 85℃ at 20℃ | 01005 | 0201                                                                                                                                                                                                                                          | Cap≤0.01μF: 0.5V | Cap<0.1μF:1V | Cap>0.01μF: 0.2V | 0.1μF≤Cap<1μF: 0.2V |  | Cap≥1μF: 0.1V | 0402 | 0603 | Cap<1μF: 1V | Cap≤1μF: 1V | Cap=1μF: 0.5V | 1μF<Cap≤4.7μF: 0.5V | 1μF<Cap<10μF: 0.2V | Cap>4.7μF: 0.2V | Cap≥10μF: 0.1V |  | 0805 | 1206/1210 | Cap<10μF: 1V | Cap≤10μF: 1V | Cap=10μF: 0.5V | 10μF<Cap≤100μF: 0.5V | Cap>10μF: 0.2V | Cap>100μF: 0.2V | <table><tr><th>T.C.</th><th>Capacitance Change</th></tr><tr><td>NPO</td><td>Within ±30ppm/℃</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>X7S</td><td>Within ±22%</td></tr><tr><td>X5R</td><td>Within ±15%</td></tr><tr><td>X6S</td><td>Within ±22%</td></tr><tr><td>Y5V</td><td>Within +30%/-80%</td></tr></table> | T.C. | Capacitance Change | NPO | Within ±30ppm/℃ | X7R | Within ±15% | X7S | Within ±22% | X5R | Within ±15% | X6S | Within ±22% | Y5V | Within +30%/-80% |
| T.C.               | Operating Temp                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| NPO                | -55~125℃ at 25℃                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| X7R                | -55~125℃ at 25℃                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| X7S                | -55 ~ 125℃ at 25℃                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| X5R                | -55~ 85℃ at 25℃                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| X6S                | -55~105℃ at 25℃                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Y5V                | -25~ 85℃ at 20℃                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 01005              | 0201                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Cap≤0.01μF: 0.5V   | Cap<0.1μF:1V                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Cap>0.01μF: 0.2V   | 0.1μF≤Cap<1μF: 0.2V              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
|                    | Cap≥1μF: 0.1V                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 0402               | 0603                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Cap<1μF: 1V        | Cap≤1μF: 1V                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Cap=1μF: 0.5V      | 1μF<Cap≤4.7μF: 0.5V              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 1μF<Cap<10μF: 0.2V | Cap>4.7μF: 0.2V                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Cap≥10μF: 0.1V     |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 0805               | 1206/1210                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Cap<10μF: 1V       | Cap≤10μF: 1V                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Cap=10μF: 0.5V     | 10μF<Cap≤100μF: 0.5V             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Cap>10μF: 0.2V     | Cap>100μF: 0.2V                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| T.C.               | Capacitance Change               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| NPO                | Within ±30ppm/℃                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| X7R                | Within ±15%                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| X7S                | Within ±22%                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| X5R                | Within ±15%                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| X6S                | Within ±22%                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Y5V                | Within +30%/-80%                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 7.                 | Adhesive Strength of Termination | <div>* Pressurizing force :<br/>2N (0201) and 5N (≤0603) and 10N (&gt;0603)<br/>* Test time: 10±1 sec.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <div>* No remarkable damage or removal of the terminations.</div>                                                                                                                                                                                                                                                   |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 8.                 | Vibration Resistance             | <div>* Vibration frequency: 10~55 Hz/min.<br/>* Total amplitude: 1.5mm<br/>* Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)<br/>*Before initial measurement (Class II only):<br/>To apply de-aging at 150℃ for 1hr then set for 24± 2 hrs at room temp.<br/>*Cap./DF(Q) Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <div>* No remarkable damage.<br/>* Cap change and Q/D.F.: To meet initial spec.</div>                                                                                                                                                                                                                               |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 9.                 | Solderability                    | <div>* Solder temperature: 235±5℃<br/>* Dipping time: 2±0.5 sec.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <div>95% min. coverage of all metalized area.</div>                                                                                                                                                                                                                                                                 |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 10.                | Bending Test                     | <div>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec.<br/>*Before initial measurement (Class II only):<br/>To apply de-aging at 150℃ for 1hr then set for 24± 2 hrs at room temp.<br/>* Measurement to be made after keeping at room temp. for 24±2 hrs.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <div>* No remarkable damage.<br/>* Cap change :<br/>NPO: within ±5% or 0.5pF whichever is larger<br/>X7R, X5R, X6S, X7S: within ±12.5%<br/>Y5V: within ±30%<br/>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</div> |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 11.                | Resistance to Soldering Heat     | <div>* Solder temperature: 260±5℃<br/>* Dipping time: 10±1 sec<br/>* Preheating: 120 to 150℃ for 1 minute before immerse the capacitor in a eutectic solder.<br/>*Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.<br/>*Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <div>* No remarkable damage.<br/>* Cap change:<br/>NPO: within ±2.5% or 0.25pF whichever is larger<br/>X7R, X5R, X6S, X7S: within ±7.5%<br/>Y5V: within ±20%<br/>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.<br/>* 25% max. leaching on each edge.</div>                                  |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 12.                | Temperature Cycle                | <div>* Conduct the five cycles according to the temperatures and time.</div> <table><tr><th>Step</th><th>Temp. (℃)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. operating temp. +0/-3</td><td>30±3</td></tr><tr><td>2</td><td>Room temp.</td><td>2~3</td></tr><tr><td>3</td><td>Max. operating temp. +3/-0</td><td>30±3</td></tr><tr><td>4</td><td>Room temp.</td><td>2~3</td></tr></table> <div>*Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.<br/>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Step                                                                                                                                                                                                                                                                                                                | Temp. (℃)      | Time (min.) | 1               | Min. operating temp. +0/-3 | 30±3            | 2   | Room temp.        | 2~3 | 3               | Max. operating temp. +3/-0 | 30±3            | 4   | Room temp.      | 2~3   | <div>* No remarkable damage.<br/>* Cap change :<br/>NPO: within ±2.5% or 0.25pF whichever is larger<br/>X7R, X5R, X6S, X7S: within ±7.5%<br/>Y5V: within ±20%<br/>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</div> |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| Step               | Temp. (℃)                        | Time (min.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 1                  | Min. operating temp. +0/-3       | 30±3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 2                  | Room temp.                       | 2~3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 3                  | Max. operating temp. +3/-0       | 30±3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |
| 4                  | Room temp.                       | 2~3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                     |                |             |                 |                            |                 |     |                   |     |                 |                            |                 |     |                 |       |                                                                                                                                                                                                                                               |                  |              |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |                                                                                                                                                                                                                                                                                                                                 |      |                    |     |                 |     |             |     |             |     |             |     |             |     |                  |

| No.       | Item                                                                                                                                                                 | Test Condition                                                                                                            | Requirements                                                                                                                                                       |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13.       | Humidity (Damp Heat) Steady State                                                                                                                                    | *Test temp.: 40±2℃                                                                                                        | * No remarkable damage.                                                                                                                                            |
|           |                                                                                                                                                                      | *Humidity: 90~95%RH                                                                                                       | * Cap change:                                                                                                                                                      |
|           |                                                                                                                                                                      | *Test time: 500+24/-0hrs.                                                                                                 | NP0: within ±5% or 0.5pF whichever is larger                                                                                                                       |
|           |                                                                                                                                                                      | *Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.        | X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤6.3V within ±25%;<br>TT series & C≥ 1uF, within ±25%                                                                   |
|           |                                                                                                                                                                      | * Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.           | **10V: 0603≥4.7μF; 0402≥1μF; 0201≥0.1μF, within ±25%;<br>Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40%                                                            |
|           |                                                                                                                                                                      | * Q/D.F. value:                                                                                                           | NP0: More than 30pF Q≥350, 10pF≤C≤30pF, Q≥275+2.5C<br>Less than 10pF Q≥200+10C                                                                                     |
|           |                                                                                                                                                                      | X7R, X5R, X6S, X7S:                                                                                                       |                                                                                                                                                                    |
|           |                                                                                                                                                                      | Rated vol. D.F.≤ Exception of D.F.≤                                                                                       |                                                                                                                                                                    |
|           |                                                                                                                                                                      | ≥100V ≤3%                                                                                                                 | ≤6% 1206≥0.47μF<br>≤7.5% 0805>0.1μF, 0603≥0.068μF, 1206>1μF; 1210≥2.2μF; TT series<br>≤20% 0805>0.22μF; 1210≥3.3μF                                                 |
|           |                                                                                                                                                                      | 50V ≤3%                                                                                                                   | ≤6% 0201(50V); 0603≥0.047μF; 0805≥0.18μF; 1206≥0.47μF<br>≤10% 0201≥0.01uF; 1210≥4.7μF<br>≤20% 0402≥0.012μF; 0603>0.1μF; 0805≥1μF; 1206≥2.2μF; 1210≥10μF; TT series |
| 35V ≤5%   | ≤20% 0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF<br>≤10% 0201≥0.01μF; 0805≥1μF; 1210≥10μF<br>≤14% 0603≥0.33μF; 1206≥4.7μF                                            |                                                                                                                           |                                                                                                                                                                    |
| 25V ≤5%   | ≤10% 0201≥0.1μF; 0402≥0.10μF&(0402/X7R≥0.056μF); TT series<br>≤15% 0603≥0.47μF; 0805≥2.2μF; 1206≥6.8μF; 1210≥22μF<br>≤20% 0402≥0.47μF                                |                                                                                                                           |                                                                                                                                                                    |
| 16V ≤5%   | ≤10% 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF; 1210≥4.7μF<br>≤15% 0201≥0.01μF(0201/X7R≥0.022μF); 0402≥0.033μF; 0603≥0.68μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥22μF; TT series |                                                                                                                           |                                                                                                                                                                    |
| 10V ≤7.5% | ≤15% 0201≥0.012μF; 0402≥0.33μF(0402/X7R≥0.22μF); 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥22μF<br>≤20% 0201≥0.1μF ;0402≥1μF; TT series; 01R5                        |                                                                                                                           |                                                                                                                                                                    |
| 6.3V ≤15% | ≤30% 0201≥0.1μF; 0402≥1μF; 0603≥10μF; 0805≥4.7μF; 1206≥47μF; 1210≥100μF; TT series                                                                                   |                                                                                                                           |                                                                                                                                                                    |
| 4V ≤20%   | ---                                                                                                                                                                  |                                                                                                                           |                                                                                                                                                                    |
|           | Y5V:                                                                                                                                                                 |                                                                                                                           |                                                                                                                                                                    |
|           | Rated vol. D.F.≤ Exception of D.F.≤                                                                                                                                  |                                                                                                                           |                                                                                                                                                                    |
|           | ≥50V ≤7.5%                                                                                                                                                           | ≤10% 0603≥0.1μF; 0805≥0.47μF; 1206≥4.7μF<br>≤20% 1210≥6.8μF                                                               |                                                                                                                                                                    |
|           | 35V ≤10%                                                                                                                                                             | ---                                                                                                                       |                                                                                                                                                                    |
|           | 25V ≤7.5%                                                                                                                                                            | ≤10% 0402≥0.047μF; 0603≥0.1μF; 0805≥0.33μF; 1206≥1μF; 1210≥4.7μF<br>≤15% 0402≥0.068μF; 0603≥0.47μF; 1206≥4.7μF; 1210≥22μF |                                                                                                                                                                    |
|           | 16V (C<1.0μF) ≤10%                                                                                                                                                   | ≤12.5% 0402≥0.068μF; 0603≥0.68μF<br>≤20% 0402≥0.22μF                                                                      |                                                                                                                                                                    |
|           | 16V (C≥1.0μF) ≤12.5%                                                                                                                                                 | ≤20% 0603≥2.2μF; 0805≥3.3μF; 1206≥10μF; 1210≥22μF; 1812≥47μF;                                                             |                                                                                                                                                                    |
|           | 10V ≤20%                                                                                                                                                             | ≤30% 0402≥0.47μF                                                                                                          |                                                                                                                                                                    |
|           | 6.3V ≤30%                                                                                                                                                            | ---                                                                                                                       |                                                                                                                                                                    |
|           |                                                                                                                                                                      | *I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller.                                                                          |                                                                                                                                                                    |
|           |                                                                                                                                                                      | Class II (X7R, X5R, X6S, X7S, Y5V)                                                                                        |                                                                                                                                                                    |
|           |                                                                                                                                                                      | Rated voltage Insulation Resistance                                                                                       |                                                                                                                                                                    |
|           |                                                                                                                                                                      | 100V: All X7R; 1210≥3.3μF                                                                                                 | 1GΩ or RxC≥10 Ω-F whichever is smaller.                                                                                                                            |
|           |                                                                                                                                                                      | 50V: 0402>0.01μF; 0603≥1μF; 0805≥1μF; 1206≥4.7μF; 1210≥4.7μF                                                              |                                                                                                                                                                    |
|           |                                                                                                                                                                      | 35V: 0603≥1μF; 0805≥2.2μF; 1206≥2.2μF; 1210≥10μF                                                                          |                                                                                                                                                                    |
|           |                                                                                                                                                                      | 25V: 0201≥0.1uF; 0402≥0.22μF; 0603≥2.2μF; 0805≥2.2μF; 1206≥10μF; 1210≥10μF                                                |                                                                                                                                                                    |
|           |                                                                                                                                                                      | 16V: 0201≥0.1uF; 0402≥0.22μF; 0603≥1μF; 0805≥2.2μF; 1206≥10μF; 1210≥47μF                                                  |                                                                                                                                                                    |
|           |                                                                                                                                                                      | 10V: 0201≥47nF; 0402≥0.47μF; 0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF; 1210≥47μF                                               |                                                                                                                                                                    |
|           |                                                                                                                                                                      | 6.3V ; 4V ; TT series ; All X6S/X7S items; Size≥1812                                                                      |                                                                                                                                                                    |

| No                                                                                      | Item                                        | Test Condition                                                                                                                                                                                                                                                                                                                                                                                      | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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                                              |                                    |               |      |                      |               |        |                                                                         |     |      |                    |      |      |     |               |                       |                             |                                             |                                                                        |                                                          |                                                                                        |                                                                                      |                                                                                         |                                                        |
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----------------------|-----|-----|--------------------------------------------------------------------|-------------------------------------------------------------|--------------------|-----|-----|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----|-------|------------------------------------------------|---------------------------------------------------------|------|------|------------------------------------------------------------------------------------------------|----|------|-----|------------|--------|---------------------|------|-------|------------------------------------------------|-------------------|-----|------|-----|-----|-------|----------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------------|---------------|------|----------------------|---------------|--------|-------------------------------------------------------------------------|-----|------|--------------------|------|------|-----|---------------|-----------------------|-----------------------------|---------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------|
| 14                                                                                      | Humidity (Damp Heat) Load                   | <p>*Test temp. : 40±2℃</p> <p>*Humidity : 90~95%RH</p> <p>*Test time : 500+24/-0 hrs.</p> <p>*To apply voltage :<br/>Rated voltage (MAX. 500V)</p> <p>*Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.</p> | <p>* No remarkable damage.</p> <p>Cap change:<br/>NP0: ±7.5% or 0.75pF whichever is larger.<br/>X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤6.3V within ±25%;<br/>TT series &amp; C≥1uF, within ±25%</p> <p>**10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%;<br/>Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40%</p> <p>Q/D.F. value:<br/>NP0: C≥30pF, Q≥200; C&lt;30pF, Q≥100+10/3C<br/>X7R, X5R, X6S, X7S:</p> <table><tr><th>Rated V</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td rowspan="3">≥100V</td><td rowspan="3">≤3%</td><td>≤6% 1206 ≥ 0.47μF</td></tr><tr><td>≤7.5% 0805 &gt; 0.1μF; 0603 ≥ 0.068μF; 1206 &gt; 1μF; 1210 ≥ 2.2μF; TT series</td></tr><tr><td>≤20% 0805 &gt; 0.22μF; 1210 ≥ 3.3μF</td></tr><tr><td rowspan="3">50V</td><td rowspan="3">≤3%</td><td>≤6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td></tr><tr><td>≤10% 0201 ≥ 0.01uF; 1210 ≥ 4.7μF</td></tr><tr><td>≤20% 0402 ≥ 0.012μF; 0603 &gt; 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td></tr><tr><td rowspan="3">35V</td><td rowspan="3">≤5%</td><td>≤20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td>≤10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td></tr><tr><td>≤14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td></tr><tr><td rowspan="3">25V</td><td rowspan="3">≤5%</td><td>≤10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF &amp; (0402/X7R ≥ 0.056μF); TT series</td></tr><tr><td>≤15% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td></tr><tr><td>≤20% 0402 ≥ 0.47μF</td></tr><tr><td rowspan="3">16V</td><td rowspan="3">≤5%</td><td>≤10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td></tr><tr><td>≤15% 0201 ≥ 0.01μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td></tr><tr><td>≤20% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td></tr><tr><td rowspan="2">10V</td><td rowspan="2">≤7.5%</td><td>≤15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5</td></tr><tr><td>≤20% 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td></tr><tr><td>6.3V</td><td>≤15%</td><td>≤30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td></tr><tr><td>4V</td><td>≤20%</td><td>---</td></tr></table> <p>Y5V:</p> <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td rowspan="2">≥50V</td><td rowspan="2">≤7.5%</td><td>≤10% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td></tr><tr><td>≤20% 1210 ≥ 6.8μF</td></tr><tr><td>35V</td><td>≤10%</td><td>---</td></tr><tr><td rowspan="3">25V</td><td rowspan="3">≤7.5%</td><td>≤10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td></tr><tr><td>≤15% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr><tr><td>≤20% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td></tr><tr><td>16V (C&lt;1.0μF)</td><td>≤10%</td><td>≤12.5% 0402 ≥ 0.22μF</td></tr><tr><td>16V (C≥1.0μF)</td><td>≤12.5%</td><td>≤20% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;</td></tr><tr><td>10V</td><td>≤20%</td><td>≤30% 0402 ≥ 0.47μF</td></tr><tr><td>6.3V</td><td>≤30%</td><td>---</td></tr></table> <p>*I.R.: ≥10V, 500MΩ or 25 Ω-F whichever is smaller.<br/>Class II (X7R, X5R, X6S, X7S, Y5V)</p> <table><tr><th>Rated voltage</th><th>Insulation Resistance</th></tr><tr><td>100V: All X7R; 1210 ≥ 3.3μF</td><td rowspan="7">500MΩ or Rx C ≥ 5 Ω-F whichever is smaller.</td></tr><tr><td>50V: 0402 &gt; 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td></tr><tr><td>35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td>25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF</td></tr><tr><td>16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF</td></tr><tr><td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF</td></tr><tr><td>6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812</td></tr></table> | Rated V | D.F. ≤ | Exception of D.F. ≤ | ≥100V | ≤3% | ≤6% 1206 ≥ 0.47μF | ≤7.5% 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series | ≤20% 0805 > 0.22μF; 1210 ≥ 3.3μF | 50V | ≤3% | ≤6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF | ≤10% 0201 ≥ 0.01uF; 1210 ≥ 4.7μF | ≤20% 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series | 35V | ≤5% | ≤20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | ≤10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF | ≤14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF | 25V | ≤5% | ≤10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series | ≤15% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF | ≤20% 0402 ≥ 0.47μF | 16V | ≤5% | ≤10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF | ≤15% 0201 ≥ 0.01μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series | ≤20% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF | 10V | ≤7.5% | ≤15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5 | ≤20% 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series | 6.3V | ≤15% | ≤30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series | 4V | ≤20% | --- | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | ≥50V | ≤7.5% | ≤10% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF | ≤20% 1210 ≥ 6.8μF | 35V | ≤10% | --- | 25V | ≤7.5% | ≤10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF | ≤15% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF | ≤20% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF | 16V (C<1.0μF) | ≤10% | ≤12.5% 0402 ≥ 0.22μF | 16V (C≥1.0μF) | ≤12.5% | ≤20% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF; | 10V | ≤20% | ≤30% 0402 ≥ 0.47μF | 6.3V | ≤30% | --- | Rated voltage | Insulation Resistance | 100V: All X7R; 1210 ≥ 3.3μF | 500MΩ or Rx C ≥ 5 Ω-F whichever is smaller. | 50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF | 35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | 25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF | 16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF | 10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF | 6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812 |
| Rated V                                                                                 | D.F. ≤                                      | Exception of D.F. ≤                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| ≥100V                                                                                   | ≤3%                                         | ≤6% 1206 ≥ 0.47μF                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|                                                                                         |                                             | ≤7.5% 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|                                                                                         |                                             | ≤20% 0805 > 0.22μF; 1210 ≥ 3.3μF                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 50V                                                                                     | ≤3%                                         | ≤6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|                                                                                         |                                             | ≤10% 0201 ≥ 0.01uF; 1210 ≥ 4.7μF                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|                                                                                         |                                             | ≤20% 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 35V                                                                                     | ≤5%                                         | ≤20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|                                                                                         |                                             | ≤10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|                                                                                         |                                             | ≤14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 25V                                                                                     | ≤5%                                         | ≤10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|                                                                                         |                                             | ≤15% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 16V                                                                                     | ≤5%                                         | ≤10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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|                                                                                         |                                             | ≤15% 0201 ≥ 0.01μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 6.3V                                                                                    | ≤15%                                        | ≤30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 25V                                                                                     | ≤7.5%                                       | ≤10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 16V (C<1.0μF)                                                                           | ≤10%                                        | ≤12.5% 0402 ≥ 0.22μF                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 16V (C≥1.0μF)                                                                           | ≤12.5%                                      | ≤20% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 6.3V                                                                                    | ≤30%                                        | ---                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| Rated voltage                                                                           | Insulation Resistance                       |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 100V: All X7R; 1210 ≥ 3.3μF                                                             | 500MΩ or Rx C ≥ 5 Ω-F whichever is smaller. |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF                  |                                             |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                |                                             |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 25V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF  |                                             |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 16V: 0201 ≥ 0.1uF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF    |                                             |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF |                                             |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| 6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812                                  |                                             |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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## Multilayer Ceramic Capacitors

| No                                                                                       | Item                                                                                                                       | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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-----------------------|--|----------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------|------------|--------------------------------------------------------------------------------------------------|----------|-----|------------|--------|---------------------|-------|--------|-------------------------------------------------|--|-------|--------------|-----|-------|-----|-----|--------|-----------------------------------------------------------------------------|----------------------------------------------------------------|---------------------------------------|-----------------|-------|---------------------|-----------------|---------|--------------------------------------------------------------------------|-----|-------|---------------------|------|-------|-----|---------------|-----------------------|-----------------------------|-------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------|--|
| 15.                                                                                      | High Temperature Load (Endurance)                                                                                          | <p>Test temp. :<br/>NP0, X7R/X7E/X7S: 125±3°C<br/>X6S: 105±3°C<br/>X5R, Y5V: 85±3°C<br/>Test time: 1000+24/-0 hrs.<br/>To apply voltage:<br/>(1) ≤ 6.3V or C ≥ 10μF or TT series: 150% of rated voltage.<br/>(2) 10V ≤ Ur&lt;500V: 200% of rated voltage.<br/>(3) 500V: 150% of rated voltage.<br/>(4) Ur ≥ 630V: 120% of rated voltage.<br/>(5) 100% of rated voltage for below range.</p> <table><tr><th>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capacitance range</th></tr><tr><td>0201</td><td>X5R/X7R/X6S</td><td>≤ 10V<br/>≥ 16V</td><td>C ≥ 0.1μF<br/>C &gt; 0.1μF</td></tr><tr><td rowspan="3">0402</td><td rowspan="2">X5R</td><td>≤ 16V</td><td>C &gt; 1.0μF</td></tr><tr><td>25V, 50V</td><td>C ≥ 1.0μF</td></tr><tr><td>X6S</td><td>6.3V<br/>10V~25V</td><td>C &gt; 1.0μF<br/>C ≥ 1.0μF</td></tr><tr><td></td><td>X7R/X7S/Y5V</td><td>6.3V, 10V</td><td>C ≥ 1.0μF</td></tr><tr><td rowspan="3">0603</td><td rowspan="3">X5R/X7R/X6S/X7S</td><td>4V</td><td>C ≥ 22μF</td></tr><tr><td>6.3V, 10V</td><td>C ≥ 4.7μF</td></tr><tr><td>25V, 35V</td><td>C ≥ 1.0μF</td></tr><tr><td rowspan="3">0805</td><td rowspan="3">X5R/X7R/X6S/X7S</td><td>4V</td><td>C ≥ 47μF</td></tr><tr><td>6.3V</td><td>C ≥ 22μF</td></tr><tr><td>10V~50V</td><td>C ≥ 10μF</td></tr><tr><td>1206</td><td>X5R/X7R/X6S</td><td>≤ 6.3V</td><td>C ≥ 47μF</td></tr><tr><td></td><td>NP0</td><td>3000V</td><td>C ≥ 1.5pF</td></tr><tr><td>1210</td><td>X5R/X7R/X6S</td><td>16V</td><td>C ≥ 47μF</td></tr><tr><td></td><td>X7R</td><td>100V</td><td>C ≥ 3.3μF</td></tr><tr><td>TT15</td><td>X5R</td><td>6.3V</td><td>C &gt; 1.0μF</td></tr><tr><td>TT18</td><td>Y5V</td><td>6.3V, 10V</td><td>C ≥ 2.2μF</td></tr><tr><td>TT21</td><td>Y5V</td><td>6.3V</td><td>C ≥ 10μF</td></tr><tr><td></td><td>X5R/X7R/X6S</td><td>≤ 10V</td><td>C ≥ 10μF</td></tr><tr><td>TT31</td><td>Y5V</td><td>6.3V</td><td>C ≥ 22μF</td></tr></table> <p>**1WV items must follow de-rating conditions.</p> <p>(6) 150% of rated voltage for below range.</p> <table><tr><th>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capacitance range</th></tr><tr><td rowspan="2">0201</td><td>X5R/X6S</td><td>16V, 25V</td><td>C=0.1μF</td></tr><tr><td>X7R</td><td>16V</td><td>C ≥ 0.022μF</td></tr><tr><td rowspan="3">0402</td><td>X7R/X5R/X6S</td><td>50V</td><td>C ≥ 0.1μF</td></tr><tr><td></td><td>10~25V</td><td>C ≥ 0.22μF</td></tr><tr><td>Y5V</td><td>16V</td><td>C ≥ 0.47μF</td></tr><tr><td rowspan="5">0603</td><td>X7S</td><td>50V~100V</td><td>C &gt; 0.22μF</td></tr><tr><td>X7R</td><td>50V</td><td>C &gt; 0.1μF</td></tr><tr><td>X5R</td><td>50V</td><td>C ≥ 1.0μF</td></tr><tr><td>X5R/X7R/X6S/X7S</td><td>10V, 16V,</td><td>C ≥ 1.0μF</td></tr><tr><td>Y5V</td><td>16V</td><td>C ≥ 2.2μF</td></tr><tr><td rowspan="4">0805</td><td rowspan="3">X5R/X7R/X6S/X7S</td><td>100V</td><td>C ≥ 0.47μF</td></tr><tr><td>50V</td><td>C ≥ 1.0μF</td></tr><tr><td>35V</td><td>C ≥ 2.2μF</td></tr><tr><td></td><td>10~25V</td><td>C ≥ 4.7μF</td></tr><tr><td></td><td>Y5V</td><td>16V</td><td>C ≥ 4.7μF</td></tr><tr><td>1206</td><td>X5R/X7R/X6S/X7S</td><td>100V</td><td>C &gt; 1.0μF</td></tr><tr><td></td><td></td><td>50V</td><td>C = 4.7μF</td></tr><tr><td>1210</td><td>X5R/X7R/X6S/X7S</td><td>50V~100V</td><td>C ≥ 2.2μF</td></tr><tr><td>1825<br/>2220<br/>2225</td><td>X7R</td><td>100V~250V</td><td>C ≥ 1.0μF</td></tr></table> <p>* Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.<br/>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.<br/>* De-rating conditions:</p> <p>Ratio (Operating Voltage/Rated Voltage (%))</p> <p>Temperature at Product (°C)</p> <p>Product for 125°C<br/>Product for 105°C<br/>Product for 85°C</p> | Size                   | Dielectric | Rated voltage | Capacitance range | 0201 | X5R/X7R/X6S | ≤ 10V<br>≥ 16V | C ≥ 0.1μF<br>C > 0.1μF | 0402 | X5R | ≤ 16V | C > 1.0μF | 25V, 50V | C ≥ 1.0μF | X6S | 6.3V<br>10V~25V | C > 1.0μF<br>C ≥ 1.0μF |  | X7R/X7S/Y5V | 6.3V, 10V | C ≥ 1.0μF | 0603 | X5R/X7R/X6S/X7S | 4V | C ≥ 22μF | 6.3V, 10V | C ≥ 4.7μF | 25V, 35V | C ≥ 1.0μF | 0805 | X5R/X7R/X6S/X7S | 4V | C ≥ 47μF | 6.3V | C ≥ 22μF | 10V~50V | C ≥ 10μF | 1206 | X5R/X7R/X6S | ≤ 6.3V | C ≥ 47μF |  | NP0 | 3000V | C ≥ 1.5pF | 1210 | X5R/X7R/X6S | 16V | C ≥ 47μF |  | X7R | 100V | C ≥ 3.3μF | TT15 | X5R | 6.3V | C > 1.0μF | TT18 | Y5V | 6.3V, 10V | C ≥ 2.2μF | TT21 | Y5V | 6.3V | C ≥ 10μF |  | X5R/X7R/X6S | ≤ 10V | C ≥ 10μF | TT31 | Y5V | 6.3V | C ≥ 22μF | Size | Dielectric | Rated voltage | Capacitance range | 0201 | X5R/X6S | 16V, 25V | C=0.1μF | X7R | 16V | C ≥ 0.022μF | 0402 | X7R/X5R/X6S | 50V | C ≥ 0.1μF |  | 10~25V | C ≥ 0.22μF | Y5V | 16V | C ≥ 0.47μF | 0603 | X7S | 50V~100V | C > 0.22μF | X7R | 50V | C > 0.1μF | X5R | 50V | C ≥ 1.0μF | X5R/X7R/X6S/X7S | 10V, 16V, | C ≥ 1.0μF | Y5V | 16V | C ≥ 2.2μF | 0805 | X5R/X7R/X6S/X7S | 100V | C ≥ 0.47μF | 50V | C ≥ 1.0μF | 35V | C ≥ 2.2μF |  | 10~25V | C ≥ 4.7μF |  | Y5V | 16V | C ≥ 4.7μF | 1206 | X5R/X7R/X6S/X7S | 100V | C > 1.0μF |  |  | 50V | C = 4.7μF | 1210 | X5R/X7R/X6S/X7S | 50V~100V | C ≥ 2.2μF | 1825<br>2220<br>2225 | X7R | 100V~250V | C ≥ 1.0μF | <p>* No remarkable damage.</p> <p>Cap change:</p> <p>NP0: ±3.0% or ±0.3pF whichever is larger<br/>X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤ 6.3V within ±25%;<br/>TT series &amp; C ≥ 1μF, within ±25%</p> <p>**10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%;<br/>Y5V: ≥10V, within ±30%; ≤ 6.3V, within +30/-40%</p> <p>Q/D.F. value:</p> <p>NP0: More than 30pF, Q ≥ 350<br/>10pF ≤ C &lt; 30pF, Q ≥ 275+2.5C<br/>Less than 10pF, Q ≥ 200+10C</p> <p>X7R, X5R, X6S, X7S:</p> <table><tr><th>Rated V.D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td>≥ 100V ≤ 3%</td><td>≤ 6% 1206 ≥ 0.47μF</td></tr><tr><td></td><td>≤ 7.5% 0805 &gt; 0.1μF, 0603 ≥ 0.068μF, 1206 &gt; 1μF; 1210 ≥ 2.2μF; TT series</td></tr><tr><td></td><td>≤ 20% 0805 &gt; 0.22μF; 1210 ≥ 3.3μF</td></tr><tr><td>50V ≤ 3%</td><td>≤ 6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td></tr><tr><td></td><td>≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF</td></tr><tr><td></td><td>≤ 20% 0402 ≥ 0.012μF; 0603 &gt; 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td></tr><tr><td>35V ≤ 5%</td><td>≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td></td><td>≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td></tr><tr><td></td><td>≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td></tr><tr><td>25V ≤ 5%</td><td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF &amp; (0402/X7R ≥ 0.056μF); TT series</td></tr><tr><td></td><td>≤ 20% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td></tr><tr><td></td><td>≤ 20% 0402 ≥ 0.47μF</td></tr><tr><td>16V ≤ 5%</td><td>≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td></tr><tr><td></td><td>≤ 15% 0201 ≥ 0.01μF; 0201/X7R ≥ 0.022μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td></tr><tr><td>10V ≤ 7.5%</td><td>≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF; 0402/X7R ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td></tr><tr><td></td><td>≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5</td></tr><tr><td>6.3V ≤ 15%</td><td>≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 4.7μF; 1210 ≥ 100μF; TT series</td></tr><tr><td>4V ≤ 20%</td><td>---</td></tr></table> <p>Y5V:</p> <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td>≥ 50V</td><td>≤ 7.5%</td><td>≤ 10% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF</td></tr><tr><td></td><td>≤ 20%</td><td>1210 ≥ 6.8μF</td></tr><tr><td>35V</td><td>≤ 10%</td><td>---</td></tr><tr><td rowspan="3">25V</td><td rowspan="3">≤ 7.5%</td><td>≤ 10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF</td></tr><tr><td>≤ 15% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr><tr><td>≤ 12.5% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF</td></tr><tr><td>16V (C &lt; 1.0μF)</td><td>≤ 10%</td><td>≤ 20% 0402 ≥ 0.22μF</td></tr><tr><td>16V (C ≥ 1.0μF)</td><td>≤ 12.5%</td><td>≤ 20% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;</td></tr><tr><td>10V</td><td>≤ 20%</td><td>≤ 30% 0402 ≥ 0.47μF</td></tr><tr><td>6.3V</td><td>≤ 30%</td><td>---</td></tr></table> <p>* I.R.: ≥10V, 1GΩ or 50 Ω·F whichever is smaller.</p> <p>Class II (X7R, X5R, X6S, X7S, Y5V)</p> <table><tr><th>Rated voltage</th><th>Insulation Resistance</th></tr><tr><td>100V: All X7R; 1210 ≥ 3.3μF</td><td rowspan="6">1GΩ or RxC ≥ 10 Ω·F whichever is smaller.</td></tr><tr><td>50V: 0402 &gt; 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td></tr><tr><td>35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td>25V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF</td></tr><tr><td>16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 4.7μF</td></tr><tr><td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td></tr><tr><td>6.3V; 4V; TT series; All X6S/X7S items; Size ≥ 1812</td><td></td></tr></table> | Rated V.D.F. ≤ | Exception of D.F. ≤ | ≥ 100V ≤ 3% | ≤ 6% 1206 ≥ 0.47μF |  | ≤ 7.5% 0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; 1210 ≥ 2.2μF; TT series |  | ≤ 20% 0805 > 0.22μF; 1210 ≥ 3.3μF | 50V ≤ 3% | ≤ 6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF |  | ≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF |  | ≤ 20% 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series | 35V ≤ 5% | ≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF |  | ≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF |  | ≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF | 25V ≤ 5% | ≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series |  | ≤ 20% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF |  | ≤ 20% 0402 ≥ 0.47μF | 16V ≤ 5% | ≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF |  | ≤ 15% 0201 ≥ 0.01μF; 0201/X7R ≥ 0.022μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series | 10V ≤ 7.5% | ≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF; 0402/X7R ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF |  | ≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5 | 6.3V ≤ 15% | ≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 4.7μF; 1210 ≥ 100μF; TT series | 4V ≤ 20% | --- | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | ≥ 50V | ≤ 7.5% | ≤ 10% 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF |  | ≤ 20% | 1210 ≥ 6.8μF | 35V | ≤ 10% | --- | 25V | ≤ 7.5% | ≤ 10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF | ≤ 15% 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF | ≤ 12.5% 0402 ≥ 0.068μF; 0603 ≥ 0.68μF | 16V (C < 1.0μF) | ≤ 10% | ≤ 20% 0402 ≥ 0.22μF | 16V (C ≥ 1.0μF) | ≤ 12.5% | ≤ 20% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF; | 10V | ≤ 20% | ≤ 30% 0402 ≥ 0.47μF | 6.3V | ≤ 30% | --- | Rated voltage | Insulation Resistance | 100V: All X7R; 1210 ≥ 3.3μF | 1GΩ or RxC ≥ 10 Ω·F whichever is smaller. | 50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF | 35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | 25V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF | 16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 4.7μF | 10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF | 6.3V; 4V; TT series; All X6S/X7S items; Size ≥ 1812 |  |
| Size                                                                                     | Dielectric                                                                                                                 | Rated voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Capacitance range      |            |               |                   |      |             |                |                        |      |     |       |           |          |           |     |                 |                        |  |             |           |           |      |                 |    |          |           |           |          |           |      |                 |    |          |      |          |         |          |      |             |        |          |  |     |       |           |      |             |     |          |  |     |      |           |      |     |      |           |      |     |           |           |      |     |      |          |  |             |       |          |      |     |      |          |      |            |               |                   |      |         |          |         |     |     |             |      |             |     |           |  |        |            |     |     |            |      |     |          |            |     |     |           |     |     |           |                 |           |           |     |     |           |      |                 |      |            |     |           |     |           |  |        |           |  |     |     |           |      |                 |      |           |  |  |     |           |      |                 |          |           |                      |     |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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             |  |                                                                                                                            |            |                                                                                                                |  |                                                 |            |                                                                                                  |          |     |            |        |                     |       |        |                                                 |  |       |              |     |       |     |     |        |                                                                             |                                                                |                                       |                 |       |                     |                 |         |                                                                          |     |       |                     |      |       |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 0201                                                                                     | X5R/X7R/X6S                                                                                                                | ≤ 10V<br>≥ 16V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | C ≥ 0.1μF<br>C > 0.1μF |            |               |                   |      |             |                |                        |      |     |       |           |          |           |     |                 |                        |  |             |           |           |      |                 |    |          |           |           |          |           |      |                 |    |          |      |          |         |          |      |             |        |          |  |     |       |           |      |             |     |          |  |     |      |           |      |     |      |           |      |     |           |           |      |     |      |          |  |             |       |          |      |     |      |          |      |            |               |                   |      |         |          |         |     |     |             |      |             |     |           |  |        |            |     |     |            |      |     |          |            |     |     |           |     |     |           |                 |           |           |     |     |           |      |                 |      |            |     |           |     |           |  |        |           |  |     |     |           |      |                 |      |           |  |  |     |           |      |                 |          |           |                      |     |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
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| 1206                                                                                     | X5R/X7R/X6S                                                                                                                | ≤ 6.3V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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| 1210                                                                                     | X5R/X7R/X6S                                                                                                                | 16V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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| TT15                                                                                     | X5R                                                                                                                        | 6.3V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| TT18                                                                                     | Y5V                                                                                                                        | 6.3V, 10V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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    |             |                |                        |      |     |       |           |          |           |     |                 |                        |  |             |           |           |      |                 |    |          |           |           |          |           |      |                 |    |          |      |          |         |          |      |             |        |          |  |     |       |           |      |             |     |          |  |     |      |           |      |     |      |           |      |     |           |           |      |     |      |          |  |             |       |          |      |     |      |          |      |            |               |                   |      |         |          |         |     |     |             |      |             |     |           |  |        |            |     |     |            |      |     |          |            |     |     |           |     |     |           |                 |           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| TT21                                                                                     | Y5V                                                                                                                        | 6.3V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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|                                                                                          | X5R/X7R/X6S                                                                                                                | ≤ 10V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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| TT31                                                                                     | Y5V                                                                                                                        | 6.3V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| 35V ≤ 5%                                                                                 | ≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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|                                                                                          | ≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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|                                                                                          | ≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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| 25V ≤ 5%                                                                                 | ≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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|                                                                                          | ≤ 20% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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|                                                                                          | ≤ 20% 0402 ≥ 0.47μF                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 16V ≤ 5%                                                                                 | ≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
|                                                                                          | ≤ 15% 0201 ≥ 0.01μF; 0201/X7R ≥ 0.022μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 10V ≤ 7.5%                                                                               | ≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF; 0402/X7R ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
|                                                                                          | ≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series; 01R5                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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| 25V                                                                                      | ≤ 7.5%                                                                                                                     | ≤ 10% 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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| 16V (C < 1.0μF)                                                                          | ≤ 10%                                                                                                                      | ≤ 20% 0402 ≥ 0.22μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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| 16V (C ≥ 1.0μF)                                                                          | ≤ 12.5%                                                                                                                    | ≤ 20% 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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| 10V                                                                                      | ≤ 20%                                                                                                                      | ≤ 30% 0402 ≥ 0.47μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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| 6.3V                                                                                     | ≤ 30%                                                                                                                      | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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| 100V: All X7R; 1210 ≥ 3.3μF                                                              | 1GΩ or RxC ≥ 10 Ω·F whichever is smaller.                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF                   |                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                 |                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 25V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF   |                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 4.7μF    |                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF |                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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     |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |
| 6.3V; 4V; TT series; All X6S/X7S items; Size ≥ 1812                                      |                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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             |  |                                                                                                                            |            |                                                                                                                |  |                                                 |            |                                                                                                  |          |     |            |        |                     |       |        |                                                 |  |       |              |     |       |     |     |        |                                                                             |                                                                |                                       |                 |       |                     |                 |         |                                                                          |     |       |                     |      |       |     |               |                       |                             |                                           |                                                                        |                                                          |                                                                                        |                                                                                       |                                                                                          |                                                     |  |

Multilayer Ceramic Capacitors

APPENDIXES

■ Tape & reel dimensions

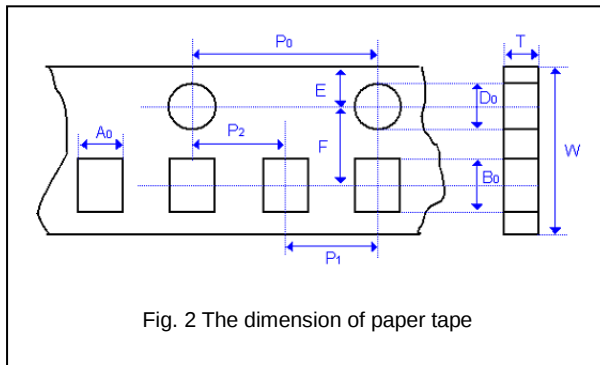


Fig. 2 The dimension of paper tape

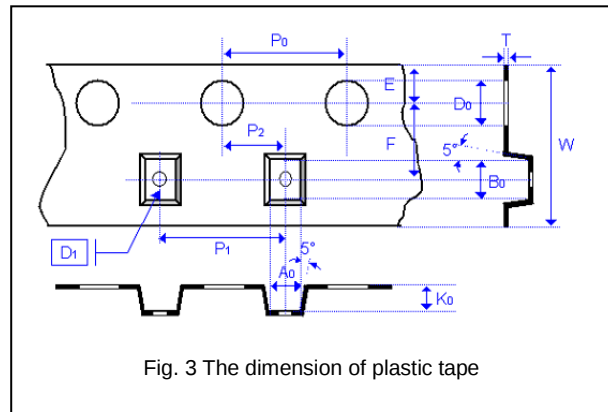


Fig. 3 The dimension of plastic tape

| Size              | 0201              | 0402              | 0603              | 0805              |                   |                   | 1206              |                   |                   | 1210              |                   |                   | 1808              | 1812              |                   |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Thickness         | L                 | N,E               | S,H,X             | A,H               | B,T               | D,I               | B,T               | C,J,D             | G,P               | T                 | C,D,G,K           | M                 | D,F,G,K           | D,F,G,K           | M,U               |
| A <sub>0</sub>    | 0.40<br>+/-0.10   | 0.70<br>+/-0.20   | 1.05<br>+/-0.30   | 1.50<br>+/-0.20   | 1.50<br>+/-0.20   | < 1.80            | 1.90<br>+/-0.50   | < 2.00            | < 2.30            | < 3.05            | < 3.05            | < 3.20            | < 2.50            | < 3.90            | < 3.90            |
| B <sub>0</sub>    | 0.70<br>+/-0.10   | 1.20<br>+/-0.20   | 1.80<br>+/-0.30   | 2.30<br>+/-0.20   | 2.30<br>+/-0.20   | < 2.70            | 3.50<br>+/-0.50   | < 3.70            | < 4.00            | < 3.80            | < 3.80            | < 4.00            | < 5.30            | < 5.30            | < 5.30            |
| T                 | ≤ 0.55            | ≤ 0.80            | ≤ 1.20            | ≤ 1.15            | ≤ 1.20            | 0.23<br>+/-0.1    | ≤ 1.20            | 0.23<br>+/-0.1    | 0.23<br>+/-0.1    | 0.23<br>+/-0.1    | 0.23<br>+/-0.1    | 0.23<br>+/-0.1    | 0.25<br>+/-0.1    | 0.25<br>+/-0.1    | 0.25<br>+/-0.1    |
| K <sub>0</sub>    | -                 | -                 | -                 | -                 | -                 | < 2.50            | -                 | < 2.50            | < 2.50            | < 1.50            | < 2.50            | < 3.20            | < 2.50            | < 2.50            | < 3.50            |
| W                 | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 8.00<br>+/-0.30   | 12.00<br>+/-0.30  | 12.00<br>+/-0.30  | 12.00<br>+/-0.30  |
| P <sub>0</sub>    | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   |
| 10xP <sub>0</sub> | 40.00<br>+/-0.10  | 40.00<br>+/-0.10  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  | 40.00<br>+/-0.20  |
| P <sub>1</sub>    | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 4.00<br>+/-0.10   | 8.00<br>+/-0.10   | 8.00<br>+/-0.10   |
| P <sub>2</sub>    | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.05   | 2.00<br>+/-0.10   | 2.00<br>+/-0.10   |
| D <sub>0</sub>    | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 | 1.50<br>+/-0.1/-0 |
| D <sub>1</sub>    | -                 | -                 | -                 | -                 | -                 | 1.00<br>+/-0.10   | -                 | 1.00<br>+/-0.10   | 1.00<br>+/-0.10   | 1.00<br>+/-0.10   | 1.00<br>+/-0.10   | 1.00<br>+/-0.10   | 1.00<br>+/-0.10   | 1.50<br>+/-0.10   | 1.50<br>+/-0.10   |
| E                 | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   | 1.75<br>+/-0.10   |
| F                 | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 3.50<br>+/-0.05   | 5.50<br>+/-0.10   | 5.50<br>+/-0.10   | 5.50<br>+/-0.10   |

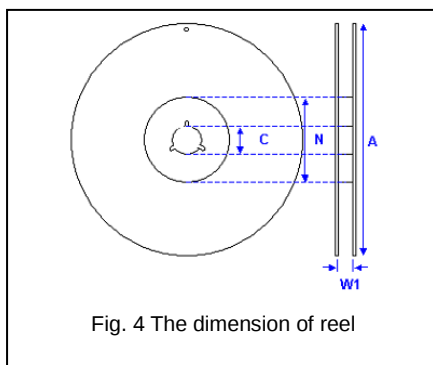
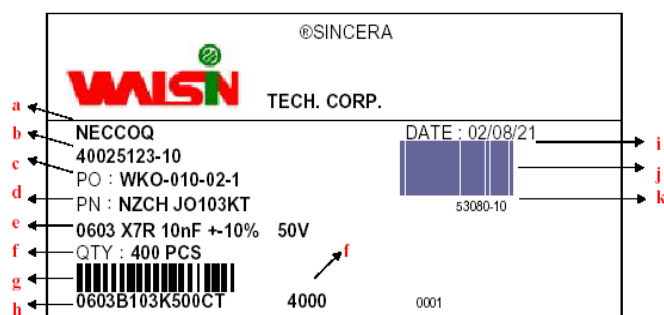


Fig. 4 The dimension of reel

| Size           | 0201, 0402, 0603, 0805, 1206, 1210 |               |               | 1812          |
|----------------|------------------------------------|---------------|---------------|---------------|
| Reel size      | 7"                                 | 10"           | 13"           | 7"            |
| C              | 13.0+0.5/-0.2                      | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 |
| W <sub>1</sub> | 8.4+1.5/-0                         | 8.4+1.5/-0    | 8.4+1.5/-0    | 12.4+2.0/-0   |
| A              | 178.0±1.0                          | 250.0±1.0     | 330.0±1.0     | 178.0±1.0     |
| N              | 60.0+1.0/-0                        | 100.0±1.0     | 100±1.0       | 60.0+1.0/-0   |

## Multilayer Ceramic Capacitors

### Description of customer label



- a. Customer name
- b. WTC order series and item number
- c. Customer P/O
- d. Customer P/N
- e. Description of product
- f. Quantity
- g. Bar code including quantity & WTC P/N or customer
- h. WTC P/N
- i. Shipping date
- j. Order bar code including series and item numbers
- k. Serial number of label

### Constructions

| No. | Name             | NPO                      | X7R, X5R, X6S, X7S, Y5V  |
|-----|------------------|--------------------------|--------------------------|
| ①   | Ceramic material | CaZrO <sub>3</sub> based | BaTiO <sub>3</sub> based |
| ②   | Inner electrode  |                          | Ni                       |
| ③   | Termination      | Inner layer              | Cu                       |
| ④   |                  | Middle layer             | Ni                       |
| ⑤   |                  | Outer layer              | Sn                       |

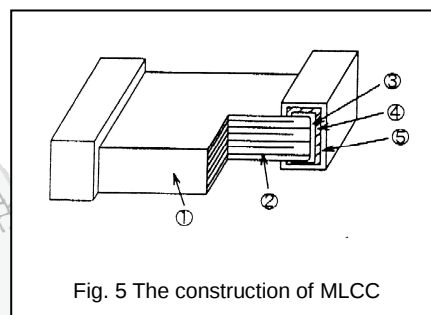


Fig. 5 The construction of MLCC

### Storage and handling conditions

- (1) To store products at 5 to 40°C ambient temperature and 20 to 70% related humidity conditions.
- (2) The product is recommended to be used within one year after shipment. Check solderability in case of shelf life extension is needed.

#### Cautions:

- a. The corrosive gas reacts on the terminal electrodes of capacitors, and results in the poor solderability. Do not store the capacitors in the ambience of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)
- b. In corrosive atmosphere, solderability might be degraded, and silver migration might occur to cause low reliability.
- c. Due to the dewing by rapid humidity change, or the photochemical change of the terminal electrode by direct sunlight, the solderability and electrical performance may deteriorate. Do not store capacitors under direct sunlight or dewing condition. To store products on the shelf and avoid exposure to moisture.

## Recommended soldering conditions

The lead-free termination MLCCs are not only to be used on SMT against lead-free solder paste, but also suitable against lead-containing solder paste. If the optimized solder joint is requested, increasing soldering time, temperature and concentration of  $N_2$  within oven are recommended.

