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# 一般積層セラミックコンデンサ (温度補償用・Class 1) STANDARD MULTILAYER CERAMIC CAPACITORS (CLASS1: TEMPERATURE COMPENSATING DIELECTRIC TYPE)

OPERATING TEMP. -55~+125°C



リフロー／REFLOW

## 特長 FEATURES

- ・実装密度の向上が図れます
- ・モノリシックの構造のため、信頼性が高い
- ・同一形状、静電容量範囲が広い

- ・ Improve Higher Mounting Densities.
- ・ Multilayer block structure provides higher reliability
- ・ A wide range of capacitance values available in standard case sizes.

## 用途 APPLICATIONS

- ・一般電子機器用
- ・通信機器用(携帯電話、PHS、コードレス電話 etc.)

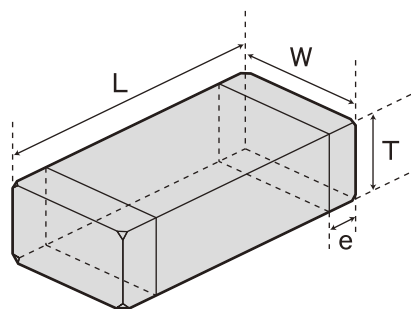
- ・ General electronic equipment
- ・ Communication equipment (cellular phone, PHS, other wireless applications, etc.)

## 形名表記法 ORDERING CODE

|                        |                                                                                                                                                                  |                                           |                                                              |                     |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------------------------------------------------------|---------------------|
| <b>1</b><br>定格電圧 [VDC] | <b>4</b><br>形状寸法 (EIA) L×W [mm]                                                                                                                                  | <b>6</b><br>公称静電容量 [pF]                   | <b>7</b><br>容量許容差                                            | <b>9</b><br>個別仕様    |
| E 16<br>T 25<br>U 50   | 042 (01005) 0.4×0.2<br>063 (0201) 0.6×0.3<br>105 (0402) 1.0×0.5                                                                                                  | 例<br>0R5 0.5<br>010 1<br>100 10<br>※R=小数点 | C ± 0.25 pF<br>D ± 0.5 pF<br>F ± 1 pF<br>J ± 5 %<br>K ± 10 % | — 標準                |
| <b>2</b><br>シリーズ名      | <b>5</b><br>温度特性 [ppm/°C]                                                                                                                                        | <b>8</b><br>製品厚み [mm]                     | <b>10</b><br>包装                                              | <b>11</b><br>当社管理記号 |
| M 積層コンデンサ              | C □ 0 : CG, CH, CJ, CK<br>R □ -220 : RH,<br>S □ -330 : SH, SJ, SK G ±30<br>T □ -470 : TJ, TK H ±60<br>U □ -750 : UJ, UK J ±120<br>S L +350~-1000 K ±250<br>□=許容差 | C 0.2<br>P 0.3<br>V 0.5<br>W 0.5          | F φ178mm テーピング<br>(2mmピッチ)                                   | △ 標準品<br>△=スペース     |
| <b>3</b><br>端子電極       |                                                                                                                                                                  |                                           |                                                              |                     |
| K メッキ品                 |                                                                                                                                                                  |                                           |                                                              |                     |

|   |   |   |   |   |   |   |   |   |    |    |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|----|----|---|---|---|---|---|
| U | M | K | 1 | 0 | 5 | C | H | 1 | 0  | 1  | J | V | - | F | △ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |   |   |   |   |   |

|                                 |                                                                                                                                                                        |                                                           |                                                              |                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------|--------------------------------------|
| <b>1</b><br>Rated voltage [VDC] | <b>4</b><br>Dimensions (case size) (EIA) L×W [mm]                                                                                                                      | <b>6</b><br>Nominal capacitance [pF]                      | <b>7</b><br>Capacitance tolerance                            | <b>9</b><br>Special code             |
| E 16<br>T 25<br>U 50            | 042 (01005) 0.4×0.2<br>063 (0201) 0.6×0.3<br>105 (0402) 1.0×0.5                                                                                                        | example<br>0R5 0.5<br>010 1<br>100 10<br>*R=decimal point | C ± 0.25 pF<br>D ± 0.5 pF<br>F ± 1 pF<br>J ± 5 %<br>K ± 10 % | — Standard Products                  |
| <b>2</b><br>Series name         | <b>5</b><br>Temperature characteristics [ppm/°C]                                                                                                                       | <b>8</b><br>Thickness [mm]                                | <b>10</b><br>Packaging                                       | <b>11</b><br>Internal code           |
| M Multilayer ceramic capacitor  | C □ 0 : CG, CH, CJ, CK<br>R □ -220 : RH,<br>S □ -330 : SH, SJ, SK G ±30<br>T □ -470 : TJ, TK H ±60<br>U □ -750 : UJ, UK J ±120<br>S L +350~-1000 K ±250<br>□=Tolerance | C 0.2<br>P 0.3<br>V 0.5<br>W 0.5                          | F φ178mm Taping<br>(2mm pitch)                               | △ Standard Products<br>△=Blank space |
| <b>3</b><br>End termination     |                                                                                                                                                                        |                                                           |                                                              |                                      |
| K Plated                        |                                                                                                                                                                        |                                                           |                                                              |                                      |



| Type (EIA)        | L                         | W                         | T                         | e                                  |
|-------------------|---------------------------|---------------------------|---------------------------|------------------------------------|
| □MK042<br>(01005) | 0.4±0.02<br>(0.016±0.001) | 0.2±0.02<br>(0.008±0.001) | 0.2±0.02<br>(0.008±0.001) | C<br>0.1±0.03<br>(0.004±0.001)     |
| □MK063<br>(0201)  | 0.6±0.03<br>(0.024±0.001) | 0.3±0.03<br>(0.012±0.001) | 0.3±0.03<br>(0.012±0.001) | P<br>0.15±0.05<br>(0.006±0.002)    |
| □MK105<br>(0402)  | 1.0±0.05<br>(0.039±0.002) | 0.5±0.05<br>(0.020±0.002) | 0.5±0.05<br>(0.020±0.002) | W, V<br>0.25±0.10<br>(0.010±0.004) |

Unit : mm (inch)

概略バリエーション AVAILABLE CAPACITANCE RANGE

| Cap<br>[pF] | Type                | 042 | 063 |     |    | 105 |    |    |    |    |
|-------------|---------------------|-----|-----|-----|----|-----|----|----|----|----|
|             | Temp.char.          | C□  | C□  | U□  | C□ | U□  | SL | R□ | S□ | T□ |
|             | VDC<br>[pF:3digits] | 16V | 25V | 50V |    |     |    |    |    |    |
| 0.5         | 0R5                 |     |     |     |    |     |    |    |    |    |
| 1           | 010                 |     |     |     |    |     |    |    |    |    |
| 1.5         | 1R5                 |     |     |     |    |     |    |    |    |    |
| 2           | 020                 |     |     |     |    |     |    |    |    |    |
| 3           | 030                 |     |     |     |    |     |    |    |    |    |
| 4           | 040                 |     |     |     | W  |     |    |    |    |    |
| 5           | 050                 |     |     | P   |    |     |    |    |    |    |
| 6           | 060                 |     |     |     | W  |     |    |    |    |    |
| 7           | 070                 |     |     |     |    |     |    |    |    |    |
| 8           | 080                 |     |     |     |    |     |    |    |    |    |
| 9           | 090                 |     |     |     |    |     |    |    |    |    |
| 10          | 100                 | C   | P   |     |    |     |    | W  |    |    |
| 12          | 120                 |     |     |     |    |     |    |    |    |    |
| 15          | 150                 |     |     |     |    |     |    |    |    |    |
| 18          | 180                 |     |     |     |    |     |    |    |    |    |
| 22          | 220                 |     |     |     |    |     |    |    |    |    |
| 27          | 270                 |     |     |     |    |     |    |    |    |    |
| 33          | 330                 |     |     |     |    |     |    |    |    |    |
| 39          | 390                 |     |     |     | V  |     |    |    |    |    |
| 47          | 470                 |     |     |     |    |     |    |    |    |    |
| 56          | 560                 |     |     |     |    |     |    |    |    |    |
| 68          | 680                 |     |     |     |    |     |    |    |    |    |
| 82          | 820                 |     |     |     | V  |     |    |    |    |    |
| 100         | 101                 |     |     |     |    |     |    |    |    |    |
| 120         | 121                 |     |     |     |    |     |    |    |    |    |
| 150         | 151                 |     |     |     |    |     |    |    |    |    |
| 180         | 181                 |     |     |     |    |     |    |    |    |    |
| 220         | 221                 |     |     |     |    |     | V  |    |    |    |
| 270         | 271                 |     |     |     |    |     |    |    |    |    |
| 330         | 331                 |     |     |     |    |     |    |    |    |    |
| 390         | 391                 |     |     |     |    |     |    |    |    |    |
| 470         | 471                 |     |     |     |    |     |    |    |    |    |
| 560         | 561                 |     |     |     |    |     |    |    |    |    |
| 680         | 681                 |     |     |     |    |     |    |    |    |    |
| 820         | 821                 |     |     |     |    |     |    |    |    |    |
| 1000        | 102                 |     |     |     |    |     |    |    |    |    |

注:グラフの記号は製品の厚み記号です。

Note: Letters in the table indicate thickness.

温度特性 Temperature Characteristics

| 温度特性<br>Temperature<br>char. (EIA) | 温度係数範囲<br>(ppm/°C) ※1<br>Temperature coefficient range | 使用温度範囲<br>Operating Temp. range |
|------------------------------------|--------------------------------------------------------|---------------------------------|
| C K (C0K)                          | 0±250                                                  | -55~+125°C                      |
| C J (C0J)                          | 0±120                                                  |                                 |
| C H (C0H)                          | 0±60                                                   |                                 |
| C G (C0G)                          | 0±30                                                   |                                 |
| R H (R2H)                          | -220±60                                                |                                 |
| S K (S2K)                          | -330±250                                               |                                 |
| S J (S2J)                          | -330±120                                               |                                 |
| S H (S2H)                          | -330±60                                                |                                 |
| T K (T2K)                          | -470±250                                               |                                 |
| T J (T2J)                          | -470±120                                               |                                 |
| U K (U2K)                          | -750±250                                               |                                 |
| U J (U2J)                          | -750±120                                               |                                 |
| S L                                | -1000~+350                                             |                                 |

※1: 20°Cにおける静電容量を基準。  
Based on the capacitance at 20°C

静電容量許容差 Capacitance Tolerance Symbol

| 記号<br>Symbol | 許容差<br>Tolerance | 区分<br>Item |
|--------------|------------------|------------|
| C            | ±0.25pF          | ~5pF       |
| D            | ±0.5 pF          | ~10pF      |
| F            | ±1pF             | 6~10 pF    |
| J            | ±5 %             | 11pF~      |
| K            | ±10 %            | 11pF~      |

Q

| Q※2<br>Symbol | 区分<br>Item |
|---------------|------------|
| ≥400+20・C※1   | ~27pF      |
| ≥1000         | 30pF~      |

※1: C=公称静電容量 Nominal capacitance [pF]

※2: 測定周波数 Measurement Frequency= 1±0.1MHz (C≤1000pF)  
1±0.1kHz (C>1000pF)

測定電圧 Measurement voltage = 0.5~5Vrms (C≤1000pF)  
1±0.2Vrms (C>1000pF)

セレクションガイド  
Selection Guide

アイテム一覧  
Part Numbers

特性図  
Electrical Characteristics

梱包  
Packaging

信頼性  
Reliability Data

使用上の注意  
Precautions



etc



042TYPE

Class 1

| 定格電圧<br>Rated<br>Voltage<br>(DC) | 形 名<br>Ordering code | EHS<br>(Environmental<br>Hazardous<br>Substances) | 温度特性<br>Temperature characteristics (EIA) |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 公称静電<br>容 量<br>Capacitance<br>[pF] | 静電容量<br>許 容 差<br>Capacitance<br>tolerance | 厚み<br>Thicknees<br>[mm]<br>(inch) |
|----------------------------------|----------------------|---------------------------------------------------|-------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------------------------|-------------------------------------------|-----------------------------------|
|                                  |                      |                                                   |                                           |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    |                                           |                                   |
|                                  |                      |                                                   | CK<br>(C0K)                               | CJ<br>(C0J) | CH<br>(C0H) | CG<br>(C0G) | PK<br>(P2K) | PJ<br>(P2J) | PH<br>(P2H) | RK<br>(R2K) | RJ<br>(R2J) | RH<br>(R2H) | SK<br>(S2K) | SJ<br>(S2J) | SH<br>(S2H) | TK<br>(T2K) | TJ<br>(T2J) | TH<br>(T2H) | UK<br>(U2K) | UJ<br>(U2J)                        | SL                                        |                                   |
| 16V                              | EMK042 △ 0R5□C       | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 0.5                                | ± 0.25pF<br>± 0.5pF                       | 0.2±0.02<br>(0.008±0.001)         |
|                                  | EMK042 △ 010□C       | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 1                                  |                                           |                                   |
|                                  | EMK042 △ 1R5□C       | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 1.5                                |                                           |                                   |
|                                  | EMK042 △ 020□C       | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 2                                  |                                           |                                   |
|                                  | EMK042 △ 030□C       | RoHS                                              |                                           | ●           |             | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 3                                  |                                           |                                   |
|                                  | EMK042 △ 040□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 4                                         |                                   |
|                                  | EMK042 △ 050□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 5                                         |                                   |
|                                  | EMK042 △ 060□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 6                                         |                                   |
|                                  | EMK042 △ 070□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 7                                         |                                   |
|                                  | EMK042 △ 080□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 8                                         |                                   |
|                                  | EMK042 △ 090□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 9                                         |                                   |
|                                  | EMK042 △ 100□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 10                                        |                                   |
|                                  | EMK042 △ 120□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 12                                        |                                   |
|                                  | EMK042 △ 150□C       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 15                                        |                                   |
|                                  | EMK042 △ 180□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 18                                        |                                   |
|                                  | EMK042 △ 220□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 22                                        |                                   |
|                                  | EMK042 △ 270□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 27                                        |                                   |
|                                  | EMK042 △ 330□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 33                                        |                                   |
|                                  | EMK042 △ 390□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 39                                        |                                   |
|                                  | EMK042 △ 470□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 47                                        |                                   |
|                                  | EMK042 △ 560□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 56                                        |                                   |
|                                  | EMK042 △ 680□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 68                                        |                                   |
|                                  | EMK042 △ 820□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 82                                        |                                   |
|                                  | EMK042 △ 101□P       | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    | 100                                       |                                   |

注:形名の△には温度特性、□には静電容量許容差記号が入ります。

△ Please specify the temperature characteristics code and □ the capacitance tolerance code.

063TYPE

Class 1

| 定格電圧<br>Rated<br>Voltage<br>(DC) | 形 名<br>Ordering code | EHS<br>(Environmental<br>Hazardous<br>Substances) | 温度特性<br>Temperature characteristics (EIA) |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 公称静電<br>容 量<br>Capacitance<br>[pF] | 静電容量<br>許 容 差<br>Capacitance<br>tolerance | 厚み<br>Thicknees<br>[mm]<br>(inch) |
|----------------------------------|----------------------|---------------------------------------------------|-------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------------------------|-------------------------------------------|-----------------------------------|
|                                  |                      |                                                   |                                           |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |                                    |                                           |                                   |
|                                  |                      |                                                   | CK<br>(C0K)                               | CJ<br>(C0J) | CH<br>(C0H) | CG<br>(C0G) | PK<br>(P2K) | PJ<br>(P2J) | PH<br>(P2H) | RK<br>(R2K) | RJ<br>(R2J) | RH<br>(R2H) | SK<br>(S2K) | SJ<br>(S2J) | SH<br>(S2H) | TK<br>(T2K) | TJ<br>(T2J) | TH<br>(T2H) | UK<br>(U2K) |                                    |                                           |                                   |
| 25V                              | TMK063 △0R5□P        | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 0.5                                | ±0.25pF<br>±0.5pF                         | 0.3±0.03<br>(0.012±0.001)         |
|                                  | TMK063 △010□P        | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 1                                  |                                           |                                   |
|                                  | TMK063 △1R5□P        | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 1.5                                |                                           |                                   |
|                                  | TMK063 △020□P        | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 2                                  |                                           |                                   |
|                                  | TMK063 △030□P        | RoHS                                              |                                           | ●           |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 3                                  |                                           |                                   |
|                                  | TMK063 △040□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 4                                  |                                           |                                   |
|                                  | TMK063 △050□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 5                                  |                                           |                                   |
|                                  | TMK063 △060□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 6                                  |                                           |                                   |
|                                  | TMK063 △070□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 7                                  |                                           |                                   |
|                                  | TMK063 △080□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 8                                  |                                           |                                   |
|                                  | TMK063 △090□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 9                                  |                                           |                                   |
|                                  | TMK063 △100□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 10                                 |                                           |                                   |
|                                  | TMK063 △120□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 12                                 |                                           |                                   |
|                                  | TMK063 △150□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             | 15                                 |                                           |                                   |
|                                  | TMK063 △180□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 18                                 |                                           |                                   |
|                                  | TMK063 △220□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 22                                 |                                           |                                   |
|                                  | TMK063 △270□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 27                                 |                                           |                                   |
|                                  | TMK063 △330□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 33                                 |                                           |                                   |
|                                  | TMK063 △390□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 39                                 |                                           |                                   |
|                                  | TMK063 △470□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 47                                 |                                           |                                   |
|                                  | TMK063 △560□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 56                                 |                                           |                                   |
|                                  | TMK063 △680□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 68                                 |                                           |                                   |
|                                  | TMK063 △820□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 82                                 |                                           |                                   |
|                                  | TMK063 △101□P        | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | 100                                |                                           |                                   |

注:形名の△には温度特性、□には静電容量許容差記号が入ります。

△ Please specify the temperature characteristics code and □ the capacitance tolerance code.

# 105TYPE

Class 1

| 定格電圧<br>Rated<br>Voltage<br>(DC) | 形 名<br>Ordering code |  | EHS<br>(Environmental<br>Hazardous<br>Substances) | 温度特性<br>Temperature characteristics (EIA) |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 公称静電<br>容 量<br>Capacitance<br>[pF] | 静電容量<br>許 容 差<br>Capacitance<br>tolerance | 厚み<br>Thickness<br>[mm]<br>(inch) |                           |                |             |
|----------------------------------|----------------------|--|---------------------------------------------------|-------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------------------------|-------------------------------------------|-----------------------------------|---------------------------|----------------|-------------|
|                                  |                      |  |                                                   | CK<br>(C0K)                               | CJ<br>(C0J) | CH<br>(C0H) | CG<br>(C0G) | PK<br>(P2K) | PJ<br>(P2J) | PH<br>(P2H) | RK<br>(R2K) | RJ<br>(R2J) | RH<br>(R2H) | SK<br>(S2K) | SJ<br>(S2J) | SH<br>(S2H) | TK<br>(T2K) | TJ<br>(T2J) | TH<br>(T2H) | UK<br>(U2K) | UJ<br>(U2J)                        | SL                                        |                                   |                           |                |             |
| 50V                              | UMK105 △ 0R5□W       |  | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             |                                    | 0.5                                       | ±0.25pF<br>±0.5pF                 | 0.5±0.05<br>(0.020±0.002) |                |             |
|                                  | UMK105 △ 010□W       |  | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             |                                    | 1                                         |                                   |                           |                |             |
|                                  | UMK105 △ 1R5□W       |  | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             |                                    | 1.5                                       |                                   |                           |                |             |
|                                  | UMK105 △ 020□W       |  | RoHS                                              | ●                                         |             |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             |                                    | 2                                         |                                   |                           |                |             |
|                                  | UMK105 △ 030□W       |  | RoHS                                              |                                           | ●           |             | ●           |             |             |             |             |             |             |             |             |             |             |             | ●           |             |                                    | 3                                         |                                   |                           |                |             |
|                                  | UMK105 △ 040□W       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             | ●           |                                    |                                           | 4                                 |                           | ±0.5pF<br>±1pF |             |
|                                  | UMK105 △ 050□W       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             | ●           |                                    |                                           | 5                                 |                           |                |             |
|                                  | UMK105 △ 060□W       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             | ●           |                                    |                                           | 6                                 |                           |                |             |
|                                  | UMK105 △ 070□W       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             | ●           |                                    |                                           | 7                                 |                           |                |             |
|                                  | UMK105 △ 080□○       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           |                | 8           |
|                                  | UMK105 △ 090□○       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 9              | ±5%<br>±10% |
|                                  | UMK105 △ 100□○       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 10             |             |
|                                  | UMK105 △ 120□○       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 12             |             |
|                                  | UMK105 △ 150□○       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 15             |             |
|                                  | UMK105 △ 180□○       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 18             |             |
|                                  | UMK105 △ 220□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 22             | ±5%<br>±10% |
|                                  | UMK105 △ 270□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 27             |             |
|                                  | UMK105 △ 330□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 33             |             |
|                                  | UMK105 △ 390□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 39             |             |
|                                  | UMK105 △ 470□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 47             |             |
|                                  | UMK105 △ 560□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 56             |             |
|                                  | UMK105 △ 680□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 68             |             |
|                                  | UMK105 △ 820□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 82             |             |
|                                  | UMK105 △ 101□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 100            |             |
|                                  | UMK105 △ 121□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 120            |             |
|                                  | UMK105 △ 151□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 150            |             |
|                                  | UMK105 △ 181□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 180            |             |
|                                  | UMK105 △ 221□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 220            |             |
|                                  | UMK105 △ 271□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 270            |             |
|                                  | UMK105 △ 331□V       |  | RoHS                                              |                                           |             | ●           | ●           |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 330            |             |
|                                  | UMK105 SL121□V       |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 120            |             |
|                                  | UMK105 SL151□V       |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 150            |             |
|                                  | UMK105 SL181□V       |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 180            |             |
|                                  | UMK105 SL221□V       |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 220            |             |
|                                  | UMK105 SL271□V       |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 270            |             |
|                                  | UMK105 SL331□V       |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | ●                                  |                                           |                                   |                           | 330            |             |

注:形名の△には温度特性、□には静電容量許容差記号、○にはCHの時には「V」、UJの時は「W」が入ります。

△ Please specify the temperature characteristics code. □ Please specify the capacitance tolerance code.

○ comes to "V" when △ is "CH" and "W" when △ is "UJ".

# 105TYPE

Class 1

| 定格電圧<br>Rated<br>Voltage<br>(DC) | 形 名<br>Ordering code |  | EHS<br>(Environmental<br>Hazardous<br>Substances) | 温度特性<br>Temperature characteristics (EIA) |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 公称静電<br>容 量<br>Capacitance | 静電容量<br>許 容 差<br>Capacitance<br>tolerance | 厚み<br>Thickness |                           |
|----------------------------------|----------------------|--|---------------------------------------------------|-------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|----------------------------|-------------------------------------------|-----------------|---------------------------|
|                                  |                      |  |                                                   | CK<br>(C0K)                               | CJ<br>(C0J) | CH<br>(C0H) | CG<br>(C0G) | PK<br>(P2K) | PJ<br>(P2J) | PH<br>(P2H) | RK<br>(R2K) | RJ<br>(R2J) | RH<br>(R2H) | SK<br>(S2K) | SJ<br>(S2J) | SH<br>(S2H) | TK<br>(T2K) | TJ<br>(T2J) | TH<br>(T2H) | UK<br>(U2K) | UJ<br>(U2J)                | SL                                        | [pF]            | [mm]<br>(inch)            |
| 50V                              | UMK105 △ 0R5BW       |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             |             |             |             |             |                            | 0.5                                       | ±0.1pF          | 0.5±0.05<br>(0.020±0.002) |
|                                  | UMK105 △ 010BW       |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             |             |             |             |             |                            | 1                                         |                 |                           |
|                                  | UMK105 △ 1R2BW       |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             |             |             |             |             |                            | 1.2                                       |                 |                           |
|                                  | UMK105 △ 1R5BW       |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             |             |             |             |             |                            | 1.5                                       |                 |                           |
|                                  | UMK105 △ 1R8BW       |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             |             |             |             |             |                            | 1.8                                       |                 |                           |
|                                  | UMK105 △ 2R2 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             |             |             |             |             |                            | 2.2                                       | ±5%             |                           |
|                                  | UMK105 △ 2R7 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             |             |             |             |             |                            | 2.7                                       |                 |                           |
|                                  | UMK105 △ 3R3 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             | ●           |             | ●           |             |             |             |             |             |                            | 3.3                                       |                 |                           |
|                                  | UMK105 △ 3R9 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             |             | ●           |             | ●           |             |             |             |             |                            | 3.9                                       |                 |                           |
|                                  | UMK105 △ 4R7 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             |             | ●           |             | ●           | ●           |             |             |             |                            | 4.7                                       |                 |                           |
|                                  | UMK105 △ 5R6 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             | ●           |             |             |             |                            | 5.6                                       |                 |                           |
|                                  | UMK105 △ 6R8 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             |             | ●           |             | ●           |             | ●           |             |             |             |                            | 6.8                                       |                 |                           |
|                                  | UMK105 △ 8R2 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             | ●           |             |             |             |                            | 8.2                                       |                 |                           |
|                                  | UMK105 △ 100 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             | ●           |             |             |             |                            | 10                                        |                 |                           |
|                                  | UMK105 △ 120 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             | ●           |             |             |             |                            | 12                                        |                 |                           |
|                                  | UMK105 △ 150 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             | ●           |             |             |             |                            | 15                                        |                 |                           |
|                                  | UMK105 △ 180 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             | ●           |             |             |             |                            | 18                                        |                 |                           |
|                                  | UMK105 △ 200 JW      |  | RoHS                                              |                                           |             |             |             |             |             |             |             | ●           |             |             | ●           |             | ●           |             |             |             |                            | 20                                        |                 |                           |

注:形名の△には温度特性が入ります。

△ Please specify the temperature characteristics code.

## 梱包 PACKAGING

### ①最小受注単位数 Minimum Quantity

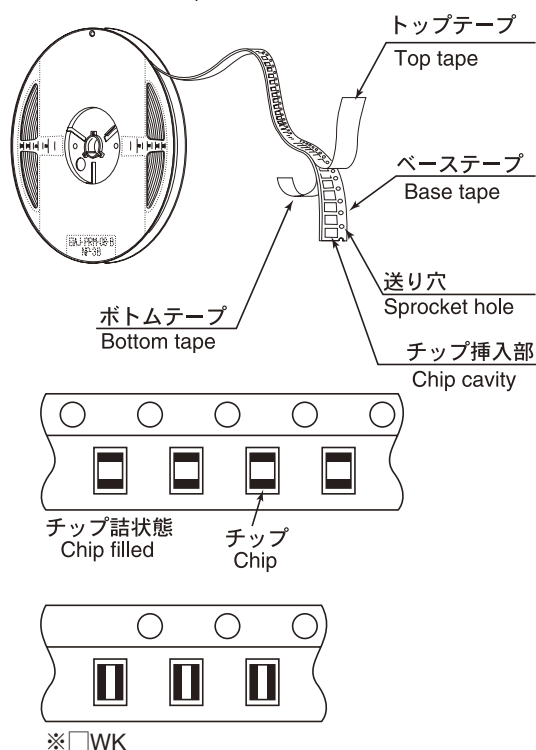
#### ■テーピング梱包 Taped packaging

| 形式 (EIA)<br>Type               | 製品厚み<br>Thickness |      | 標準数量<br>Standard quantity<br>[ pcs ] |                          |
|--------------------------------|-------------------|------|--------------------------------------|--------------------------|
|                                | mm (inch)         | code | 紙テープ<br>paper                        | エンボステープ<br>Embossed tape |
| □MK042 (01005)                 | 0.2 (0.008)       | C    | 15000                                | —                        |
| □MK063 (0201)                  | 0.3 (0.012)       | P    | 15000                                | —                        |
| □2K096 (0302)                  | 0.3 (0.012)       | P    | 10000                                | —                        |
|                                | 0.45 (0.018)      | K    |                                      |                          |
| □WK105 (0204)                  | 0.3 (0.012)       | P    | 10000                                | —                        |
| □MK105 (0402)                  | 0.5 (0.020)       | V, W | 10000                                | —                        |
| □VK105 (0402)                  |                   | W    |                                      |                          |
| □MK107 (0603)<br>□WK107 (0306) | 0.45 (0.018)      | K    | 4000                                 | —                        |
|                                | 0.5 (0.020)       | V    | —                                    | 4000                     |
|                                | 0.8 (0.031)       | A    | 4000                                 | —                        |
| □2K110 (0504)                  | 0.5 (0.020)       | V    | 4000                                 | —                        |
|                                | 0.8 (0.031)       | A    | 4000                                 | —                        |
|                                | 0.6 (0.024)       | B    | 4000                                 | —                        |
| □MK212 (0805)<br>□WK212 (0508) | 0.45 (0.018)      | K    | 4000                                 | —                        |
|                                | 0.85 (0.033)      | D    | 4000                                 | —                        |
|                                | 1.25 (0.049)      | G    | —                                    | 3000                     |
| □4K212 (0805)<br>□2K212 (0805) | 0.85 (0.033)      | D    | 4000                                 | —                        |
|                                | 0.85 (0.033)      | D    | 4000                                 | —                        |
|                                | 0.85 (0.033)      | D    | 4000                                 | —                        |
| □MK316 (1206)                  | 1.15 (0.045)      | F    | —                                    | 3000                     |
|                                | 1.25 (0.049)      | G    | —                                    | 3000                     |
|                                | 1.6 (0.063)       | L    | —                                    | 2000                     |
| □MK325 (1210)                  | 0.85 (0.033)      | D    | —                                    | 2000                     |
|                                | 1.15 (0.045)      | F    |                                      |                          |
|                                | 1.5 (0.059)       | H    |                                      |                          |
|                                | 1.9 (0.075)       | N    |                                      |                          |
|                                | 2.0max (0.079)    | Y    | —                                    | 2000                     |
| □MK432 (1812)                  | 2.5 (0.098)       | M    | —                                    | 500 (T),<br>1000 (P)     |
|                                | 2.5 (0.098)       | M    | —                                    | 500                      |

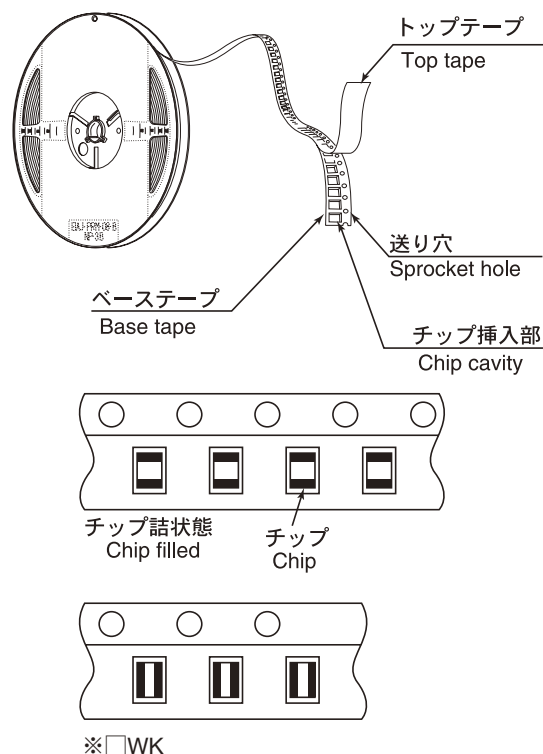
### ②テーピング材質 Taping material

紙テープ  
Card board carrier tape

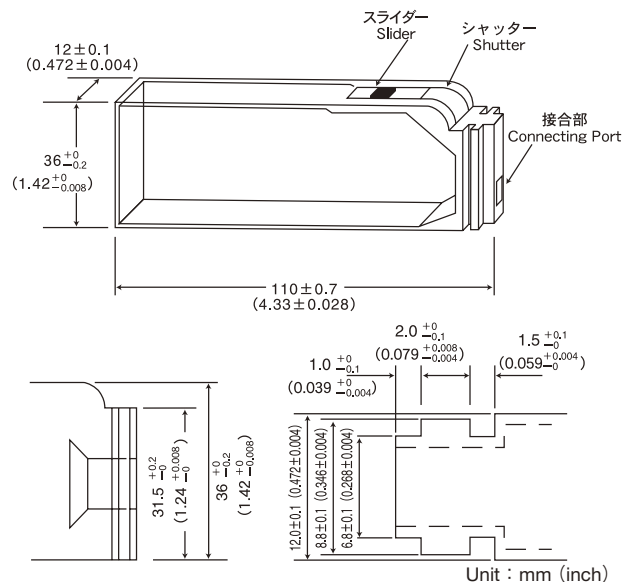
※プレスポケットタイプは、  
ボトムテープ無し。



### エンボステープ Embossed Tape

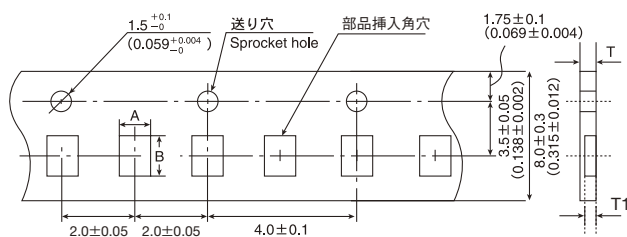


### ③バルクカセット Bulk Cassette



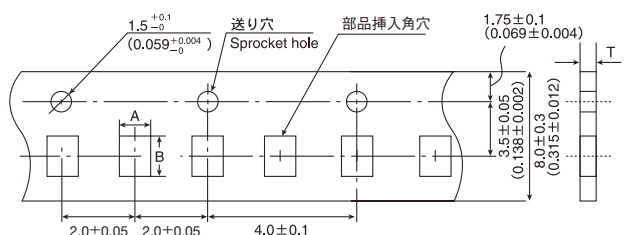
105, 107, 212形状で個別対応致しますのでお問い合わせ下さい。  
Please contact any of our offices for accepting your requirement according to dimensions 0402, 0603, 0805 (inch)

## ③テーピング寸法 Taping dimensions 紙テープ Paper Tape (8mm幅) (0.315inches wide)



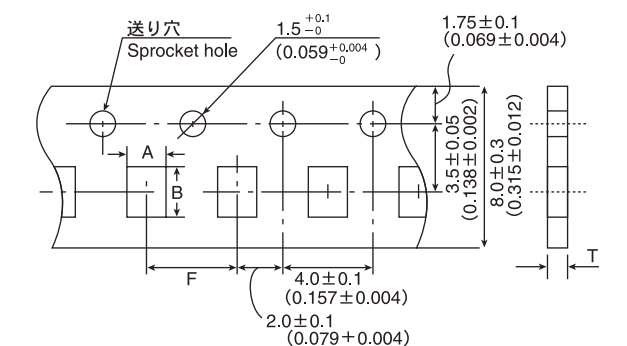
| Type<br>(EIA)  | チップ挿入部<br>Chip Cavity |                 | 挿入ピッチ<br>Insertion Pitch      | テープ厚み<br>Tape Thickness |                        |
|----------------|-----------------------|-----------------|-------------------------------|-------------------------|------------------------|
|                | A                     | B               |                               | T                       | T1                     |
| □MK042 (01005) | 0.25<br>(0.010)       | 0.45<br>(0.018) | 2.0 ± 0.05<br>(0.079 ± 0.002) | 0.36max.<br>(0.014)     | 0.27max.<br>(0.011)    |
| □MK063 (0201)  | 0.37<br>(0.016)       | 0.67<br>(0.027) | 2.0 ± 0.05<br>(0.079 ± 0.002) | 0.45max.<br>(0.018)     | 0.42max.<br>(0.017)    |
| □WK105 (0204)  | 0.65<br>(0.026)       | 1.15<br>(0.045) | 2.0 ± 0.05<br>(0.079 ± 0.002) | 0.45max.<br>(0.018max)  | 0.42max.<br>(0.017max) |

Unit : mm (inch)



| Type<br>(EIA) | チップ挿入部<br>Chip Cavity |                 | 挿入ピッチ<br>Insertion Pitch      | テープ厚み<br>Tape Thickness                 |  |
|---------------|-----------------------|-----------------|-------------------------------|-----------------------------------------|--|
|               | A                     | B               |                               | T                                       |  |
| □2K096 (0302) | 0.72<br>(0.028)       | 1.02<br>(0.040) | 2.0 ± 0.05<br>(0.079 ± 0.002) | 0.45max.(0.018max)<br>0.6max.(0.024max) |  |
| □MK105 (0402) | 0.65<br>(0.026)       | 1.15<br>(0.045) | 2.0 ± 0.05<br>(0.079 ± 0.002) | 0.8max.<br>(0.031max.)                  |  |
| □VK105 (0402) |                       |                 |                               |                                         |  |

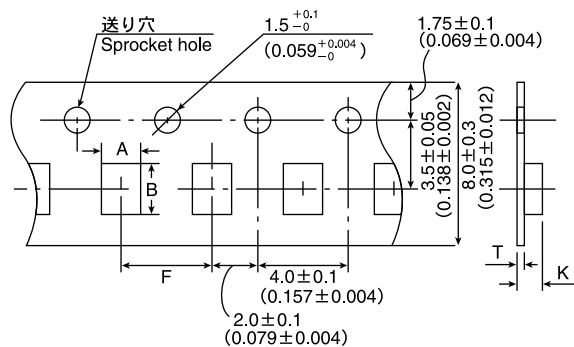
Unit : mm (inch)



| Type<br>(EIA) | チップ挿入部<br>Chip Cavity |                 | 挿入ピッチ<br>Insertion Pitch     | テープ厚み<br>Tape Thickness |  |
|---------------|-----------------------|-----------------|------------------------------|-------------------------|--|
|               | A                     | B               |                              | T                       |  |
| □MK107 (0603) | 1.0<br>(0.039)        | 1.8<br>(0.071)  | 4.0 ± 0.1<br>(0.157 ± 0.004) | 1.1max.<br>(0.043max.)  |  |
| □WK107 (0306) |                       |                 |                              |                         |  |
| □2K110 (0504) | 1.15<br>(0.045)       | 1.55<br>(0.061) | 4.0 ± 0.1<br>(0.157 ± 0.004) | 1.0max.<br>(0.039max.)  |  |
| □MK212 (0805) | 1.65<br>(0.065)       | 2.4<br>(0.094)  | 4.0 ± 0.1<br>(0.157 ± 0.004) | 1.1max.<br>(0.043max.)  |  |
| □WK212 (0508) |                       |                 |                              |                         |  |
| □4K212 (0805) |                       |                 |                              |                         |  |
| □2K212 (0805) |                       |                 |                              |                         |  |
| □MK316 (1206) | 2.0<br>(0.079)        | 3.6<br>(0.142)  |                              |                         |  |

Unit : mm (inch)

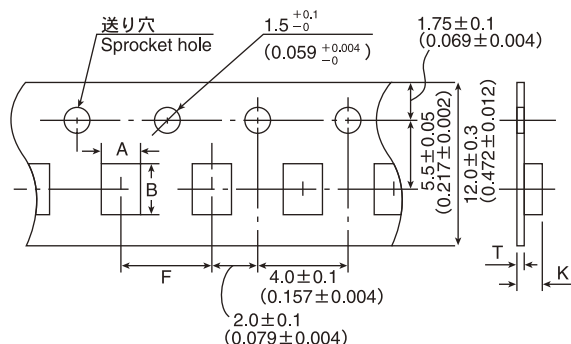
## エンボステープ Embossed tape (8mm幅) (0.315inches wide)



| Type<br>(EIA) | チップ挿入部<br>Chip cavity |                | 挿入ピッチ<br>Insertion Pitch     | テープ厚み<br>Tape Thickness |                              |
|---------------|-----------------------|----------------|------------------------------|-------------------------|------------------------------|
|               | A                     | B              |                              | K                       | T                            |
| □WK107 (0306) | 1.0<br>(0.039)        | 1.8<br>(0.071) | 4.0 ± 0.1<br>(0.157 ± 0.004) | 1.3max.<br>(0.051max.)  | 0.25 ± 0.1<br>(0.01 ± 0.004) |
| □MK212 (0805) | 1.65<br>(0.065)       | 2.4<br>(0.094) |                              |                         |                              |
| □MK316 (1206) | 2.0<br>(0.079)        | 3.6<br>(0.142) |                              | 3.4max.<br>(0.134max.)  | 0.6max.<br>(0.024max.)       |
| □MK325 (1210) | 2.8<br>(0.110)        | 3.6<br>(0.142) |                              |                         |                              |

Unit : mm (inch)

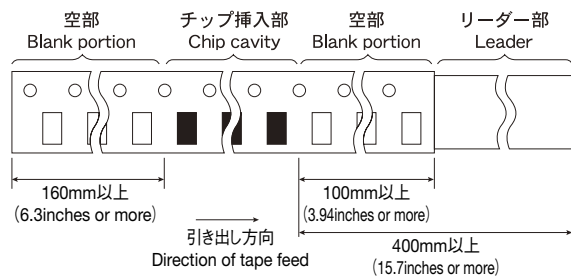
## エンボステープ Embossed tape (12mm幅) (0.472inches wide)



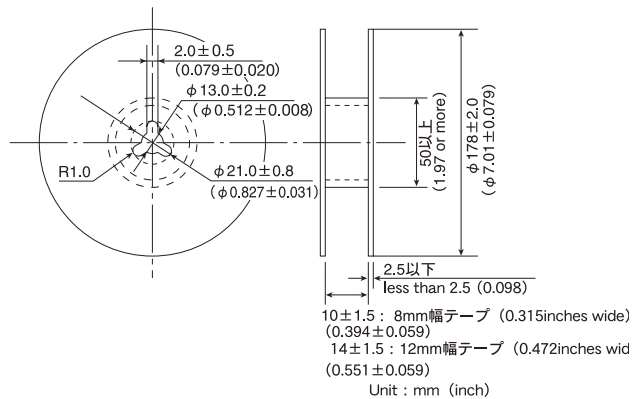
| Type<br>(EIA) | チップ挿入部<br>Chip cavity |                | 挿入ピッチ<br>Insertion Pitch     | テープ厚み<br>Tape Thickness |                        |
|---------------|-----------------------|----------------|------------------------------|-------------------------|------------------------|
|               | A                     | B              |                              | K                       | T                      |
| □MK432 (1812) | 3.7<br>(0.146)        | 4.9<br>(0.193) | 8.0 ± 0.1<br>(0.315 ± 0.004) | 4.0max.<br>(0.157max.)  | 0.6max.<br>(0.024max.) |

Unit : mm (inch)

## ④ リーダー部／空部 Leader and Blank portion

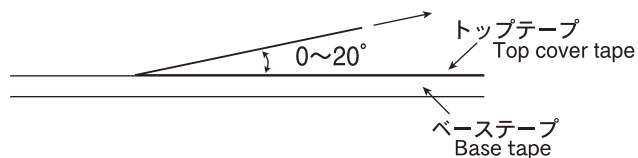


## ⑤ リール寸法 Reel size

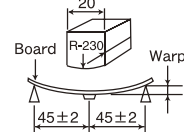


## ⑥ トップテープ強度 Top Tape Strength

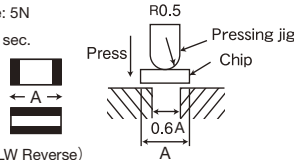
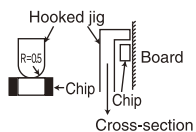
トップテープのはがし力とは図矢印方向にて0.1～0.7Nとなります。  
The top tape requires a peel-off force of 0.1～0.7N in the direction of the arrow as illustrated below.



## Multilayer Ceramic Capacitor Chips

| Item                                        |                               | Specified Value                                                                                                                                                                                                        |                                                                       |                                                                                               | Test Methods and Remarks                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                             |                               | Temperature Compensating (Class 1)                                                                                                                                                                                     |                                                                       | High Permittivity (Class 2)                                                                   |                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                             |                               | Standard                                                                                                                                                                                                               | High Frequency Type                                                   | Standard Note1                                                                                |                                                                                                            | High Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1.Operating Temperature Range               |                               | -55 to +125℃                                                                                                                                                                                                           |                                                                       | BJ : -55 to +125℃<br>F : -25 to +85℃                                                          | -25 to +85℃                                                                                                | High Capacitance Type BJ (X7R) : -55~+125℃, BJ (X5R) : -55~+85℃<br>E (Y5U) : -30~+85℃, F (Y5V) : -30~+85℃                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 2.Storage Temperature Range                 |                               | -55 to +125℃                                                                                                                                                                                                           |                                                                       | BJ : -55 to +125℃<br>F : -25 to +85℃                                                          | -25 to +85℃                                                                                                | High Capacitance Type BJ (X7R) : -55~+125℃, BJ (X5R) : -55~+85℃<br>E (Y5U) : -30~+85℃, F (Y5V) : -30~+85℃                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 3.Rated Voltage                             |                               | 50VDC,25VDC, 16VDC                                                                                                                                                                                                     | 16VDC<br>50VDC                                                        | 50VDC,25VDC                                                                                   | 50VDC,35VDC,25VDC<br>16VDC,10VDC,6.3VDC<br>4DVC, 2.5VDC                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4.Withstanding Voltage Between terminals    |                               | No breakdown or damage                                                                                                                                                                                                 | No abnormality                                                        | No breakdown or damage                                                                        |                                                                                                            | Applied voltage: Rated voltage×3 (Class 1)<br>Rated voltage×2.5 (Class 2)<br>Duration: 1 to 5 sec.<br>Charge/discharge current: 50mA max. (Class 1,2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 5.Insulation Resistance                     |                               | 10000 MΩ min.                                                                                                                                                                                                          |                                                                       | 500 MΩ μF. or 10000 MΩ., whichever is the smaller.<br>Note 5                                  |                                                                                                            | Applied voltage: Rated voltage<br>Duration: 60±5 sec.<br>Charge/discharge current: 50mA max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 6.Capacitance (Tolerance)                   |                               | 0.5 to 5 pF: ±0.25 pF<br>1 to 10pF: ±0.5 pF<br>5 to 10 pF: ±1 pF<br>11 pF or over: ± 5%<br>± 10%<br>105TYPER△,S△,T△,U△ only<br>0.5~2pF: ±0.1pF<br>2.2~20pF: ±5%                                                        | 0.5 to 2 pF : ±0.1 pF<br>2.2 to 5.1 pF : ±5%                          | BJ: ±10%, ±20%<br>F : +80%<br>-20%                                                            | BJ : ±10%、 ±20%<br>F : -20%／+80%                                                                           | Measuring frequency :<br>Class1 : 1MHz±10% (C≤1000pF)<br>1 k Hz±10% (C>1000pF)<br>Class2 : 1 k Hz±10% (C≤10 μF)<br>120Hz±10Hz (C>10 μF)<br>Measuring voltage :<br>Note 4 Class1 : 0.5~5Vrms (C≤1000pF)<br>1±0.2Vrms (C>1000pF)<br>Class2 : 1±0.2Vrms (C≤10 μF)<br>0.5±0.1Vrms (C>10 μF)<br>Bias application: None                                                                                                                                                                                                                                                                                                                                                     |
| 7.Q or Tangent of Loss Angle (tan δ)        |                               | Under 30 pF<br>: Q≥400 + 20C<br>30 pF or over : Q≥1000<br>C= Nominal capacitance                                                                                                                                       | Refer to detailed specification                                       | BJ: 2.5% max. (50V, 25V)<br>F: 5.0% max. (50V, 25V)<br>Note 4                                 | BJ : 2.5% max.<br>F : 7% max.<br>Note 4                                                                    | Multilayer:<br>Measuring frequency :<br>Class1 : 1MHz±10% (C≤1000pF)<br>1 k Hz±10% (C>1000pF)<br>Class2 : 1 k Hz±10% (C≤10 μF)<br>120Hz±10Hz (C>10 μF)<br>Measuring voltage :<br>Note 4 Class1 : 0.5~5Vrms (C≤1000pF)<br>1±0.2Vrms (C>1000pF)<br>Class2 : 1±0.2Vrms (C≤10 μF)<br>0.5±0.1Vrms (C>10 μF)<br>Bias application: None<br>High—Frequency—Multilayer:<br>Measuring frequency: 1GHz<br>Measuring equipment: HP4291A<br>Measuring jig: HP16192A                                                                                                                                                                                                                |
| 8.Temperature Characteristic of Capacitance | (Without voltage application) | CK : 0±250<br>CJ : 0±120<br>CH : 0±60<br>CG : 0±30<br>RH : -220±60<br>SK : -330±250<br>SJ : -330±120<br>SH : -330±60<br>TK : -470±250<br>TJ : -470±120<br>UK : -750±250<br>UJ : -750±120<br>SL : +350 to -1000 (ppm/℃) | CH : 0±60<br>RH : -220±60 (ppm/℃)                                     | BJ : ±10% (-25~85℃)<br>F : +30% (-25~85℃)<br>-80<br>BJ (X7R) : ±15%<br>F (Y5V) : +22%<br>-82  | BJ : ±10%<br>(-25~+85℃)<br>F : +30%／-80%<br>(-25~+85℃)<br>BJ (X7R、X5R) :<br>±15%<br>F (Y5V) :<br>+22%／-82% | According to JIS C 5102 clause 7.12.<br>Temperature compensating:<br>Measurement of capacitance at 20℃ and 85℃ shall be made to calculate temperature characteristic by the following equation.<br>$\frac{(C_{85}-C_{20})}{C_{20} \times \Delta T} \times 10^6 \text{ (ppm/℃)}$<br>High permittivity:<br>Change of maximum capacitance deviation in step 1 to 5<br>Temperature at step 1: +20℃<br>Temperature at step 2: minimum operating temperature<br>Temperature at step 3: +20℃ (Reference temperature)<br>Temperature at step 4: maximum operating temperature<br>Temperature at step 5: +20℃<br>Reference temperature for X7R, X5R, Y5U and Y5V shall be +25℃ |
| 9.Resistance to Flexure of Substrate        |                               | Appearance:<br>No abnormality<br>Capacitance change:<br>Within ±5% or ±0.5 pF, whichever is larger.                                                                                                                    | Appearance:<br>No abnormality<br>Capacitance change:<br>Within±0.5 pF | Appearance:<br>No abnormality<br>Capacitance change:<br>BJ : Within ±12.5%<br>F : Within ±30% |                                                                                                            | Warp: 1mm<br>Testing board: glass epoxy—resin substrate<br>Thickness: 1.6mm (063 TYPE : 0.8mm)<br>The measurement shall be made with board in the bent position.<br><br>(Unit: mm)                                                                                                                                                                                                                                                                                                                                                                                               |

## Multilayer Ceramic Capacitor Chips

| Item                        | Specified Value                                                                                                                                                                                                                                                                         |                                                                                                                                                                                          |                                                                                                                                                                                                                           |                                                                                                                                                                                                              | Test Methods and Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | Temperature Compensating (Class 1)                                                                                                                                                                                                                                                      |                                                                                                                                                                                          | High Permittivity (Class 2)                                                                                                                                                                                               |                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                             | Standard                                                                                                                                                                                                                                                                                | High Frequency Type                                                                                                                                                                      | Standard Note1                                                                                                                                                                                                            | High Value                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 10.Body Strength            | —                                                                                                                                                                                                                                                                                       | No mechanical damage.                                                                                                                                                                    | —                                                                                                                                                                                                                         | —                                                                                                                                                                                                            | High Frequency Multilayer:<br>Applied force: 5N<br>Duration: 10 sec.<br>                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 11.Adhesion of Electrode    | No separation or indication of separation of electrode.                                                                                                                                                                                                                                 |                                                                                                                                                                                          |                                                                                                                                                                                                                           |                                                                                                                                                                                                              | Applied force: 5N (01005, 0201, 0302 TYPE 2N)<br>Duration: 30±5 sec.<br>                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 12.Solderability            | At least 95% of terminal electrode is covered by new solder.                                                                                                                                                                                                                            |                                                                                                                                                                                          |                                                                                                                                                                                                                           |                                                                                                                                                                                                              | Solder temperature: 230±5°C<br>Duration: 4±1 sec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 13.Resistance to soldering  | Appearance: No abnormality<br>Capacitance change: Within ±2.5% or ±0.25pF, whichever is larger.<br>Q: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality                                                                 | Appearance: No abnormality<br>Capacitance change: Within ±2.5%<br>Q: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality   | Appearance: No abnormality<br>Capacitance change: Within ±7.5% (BJ)<br>Within ±20% (F)<br>tan δ: Initial value Note 4<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality |                                                                                                                                                                                                              | Preconditioning: Thermal treatment (at 150°C for 1 hr)<br>(Applicable to Class 2.)<br>Solder temperature: 270±5°C<br>Duration: 3±0.5 sec.<br>Preheating conditions: 80 to 100°C, 2 to 5 min. or 5 to 10 min.<br>150 to 200°C, 2 to 5 min. or 5 to 10 min.<br>Recovery: Recovery for the following period under the standard condition after the test.<br>6~24 hrs (Class 1)<br>24±2 hrs (Class 2)                                                                                                                                                                                                      |
| 14.Thermal shock            | Appearance: No abnormality<br>Capacitance change: Within ±2.5% or ±0.25pF, whichever is larger.<br>Q: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality                                                                 | Appearance: No abnormality<br>Capacitance change: Within ±0.25pF<br>Q: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality | Appearance: No abnormality<br>Capacitance change: Within ±7.5% (BJ)<br>Within ±20% (F)<br>tan δ: Initial value Note 4<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality |                                                                                                                                                                                                              | Preconditioning: Thermal treatment (at 150°C for 1 hr)<br>(Applicable to Class 2.)<br>Conditions for 1 cycle:<br>Step 1: Minimum operating temperature $+0_{-3}^{\circ}\text{C}$ 30±3 min.<br>Step 2: Room temperature 2 to 3 min.<br>Step 3: Maximum operating temperature $+0_{+3}^{-\circ}\text{C}$ 30±3 min.<br>Step 4: Room temperature 2 to 3 min.<br>Number of cycles: 5 times<br>Recovery after the test: 6~24 hrs (Class 1)<br>24±2 hrs (Class 2)                                                                                                                                             |
| 15.Damp Heat (steady state) | Appearance: No abnormality<br>Capacitance change: Within ±5% or ±0.5pF, whichever is larger.<br>Q:<br>$C\geq 30\text{ pF} : Q\geq 350$<br>$10\leq C<30\text{ pF} : Q\geq 275+2.5C$<br>$C<10\text{ pF} : Q\geq 200+10C$<br>C: Nominal capacitance<br>Insulation resistance: 1000 MΩ min. | Appearance: No abnormality<br>Capacitance change: Within ±0.5pF,<br>Insulation resistance: 1000 MΩ min.                                                                                  | Appearance: No abnormality<br>Capacitance change: BJ: Within ±12.5%<br>F: Within ±30%<br>tan δ: BJ: 5.0% max.<br>F: 7.5% max.<br>Note 4<br>Insulation resistance: 50 MΩ μF or 1000 MΩ whichever is smaller.<br>Note 5     | Appearance: No abnormality<br>Capacitance change: BJ: Within ±12.5%<br>Note 4<br>tan δ: BJ: 5.0% max. Note 4.<br>F: 11.0% max.<br>Insulation resistance: 50 MΩ μF or 1000 MΩ whichever is smaller.<br>Note 5 | Multilayer :<br>Preconditioning: Thermal treatment (at 150°C for 1 hr)<br>(Applicable to Class 2.)<br>Temperature: 40±2°C<br>Humidity: 90 to 95% RH<br>Duration: 500 $+24_{-0}$ hrs<br>Recovery: Recovery for the following period under the standard condition after the removal from test chamber.<br>6~24 hrs (Class 1)<br>24±2 hrs (Class 2)<br>High-Frequency Multilayer:<br>Temperature: 60±2°C<br>Humidity: 90 to 95% RH<br>Duration: 500 $+24_{-0}$ hrs<br>Recovery: Recovery for the following period under the standard condition after the removal from test chamber.<br>6~24 hrs (Class 1) |

## Multilayer Ceramic Capacitor Chips

| Item                           | Specified Value                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                | Test Methods and Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                | Temperature Compensating (Class 1)                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                      | High Permittivity (Class 2)                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                | Standard                                                                                                                                                                                                                                                                                                                         | High Frequency Type                                                                                                                                                                                                  | Standard Note1                                                                                                                                                                                                                                           | High Value                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 16.Loading under Damp Heat     | Appearance: No abnormality<br>Capacitance change: Within $\pm 7.5\%$ or $\pm 0.75\text{pF}$ , whichever is larger.<br>Q: $C\geq 30\text{ pF}$ : $Q\geq 200$<br>$C<30\text{ pF}$ : $Q\geq 100 + 10\text{C}/3$<br>C : Nominal capacitance<br>Insulation resistance: 500 MΩ min.                                                    | Appearance: No abnormality<br>Capacitance change: $C\leq 2\text{ pF}$ : Within $\pm 0.4\text{ pF}$<br>$C>2\text{ pF}$ : Within $\pm 0.75\text{ pF}$<br>C : Nominal capacitance<br>Insulation resistance: 500 MΩ min. | Appearance: No abnormality<br>Capacitance change: BJ: Within $\pm 12.5\%$<br>F: Within $\pm 30\%$<br>Note 4<br>$\tan \delta$ : BJ: 5.0% max.<br>F: 7.5% max.<br>Note 4<br>Insulation resistance: 25 MΩ μF or 500 MΩ, whichever is the smaller.<br>Note 5 | Appearance: No abnormality<br>Capacitance change: BJ : Within $\pm 12.5\%$<br>F : Within $\pm 30\%$<br>Note 4<br>$\tan \delta$ : BJ : 5.0% max.<br>F : 11% max.<br>Note 4<br>Insulation resistance: 25 MΩ μF or 500 MΩ, whichever is the smaller.<br>Note 5                                                                    | According to JIS C 5102 Clause 9. 9.<br>Multilayer:<br>Preconditioning: Voltage treatment (Class 2)<br>Temperature: $40\pm 2^{\circ}\text{C}$<br>Humidity: 90 to 95% RH<br>Duration: $500\begin{smallmatrix} +24\\ -0 \end{smallmatrix}\text{hrs}$<br>Applied voltage: Rated voltage<br>Charge and discharge current: 50mA max. (Class 1,2)<br>Recovery: Recovery for the following period under the standard condition after the removal from test chamber.<br>$6\sim 24\text{ hrs}$ (Class 1)<br>$24\pm 2\text{ hrs}$ (Class 2)<br>High—Frequency Multilayer:<br>Temperature: $60\pm 2^{\circ}\text{C}$<br>Humidity: 90 to 95% RH<br>Duration: $500\begin{smallmatrix} +24\\ -0 \end{smallmatrix}\text{hrs}$<br>Applied voltage: Rated voltage<br>Charge and discharge current: 50mA max.<br>Recovery: $6\sim 24\text{ hrs}$ of recovery under the standard condition after the removal from test chamber. |
| 17.Loading at High Temperature | Appearance: No abnormality<br>Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$ , whichever is larger.<br>Q: $C\geq 30\text{ pF}$ : $Q\geq 350$<br>$10\leq C<30\text{ pF}$ : $Q\geq 275 + 2.5\text{C}$<br>$C<10\text{ pF}$ : $Q\geq 200 + 10\text{C}$<br>C : Nominal capacitance<br>Insulation resistance: 1000 MΩ min. | Appearance: No abnormality<br>Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$ , whichever is larger.<br>Insulation resistance: 1000 MΩ min.                                                               | Appearance: No abnormality<br>Capacitance change: BJ: Within $\pm 12.5\%$<br>F: Within $\pm 30\%$<br>Note 4<br>$\tan \delta$ : BJ: 4.0% max.<br>F: 7.5% max.<br>Note 4<br>Insulation resistance: 50 MΩ μF or 1000 MΩ, whichever is smaller.<br>Note 5    | Appearance: No abnormality<br>Capacitance change: BJ : Within $\pm 12.5\%$<br>Within $\pm 20\% \times \times$<br>Within $\pm 25\% \times \times$<br>F : Within $\pm 30\%$<br>Note 4<br>$\tan \delta$ : BJ : 5.0% max.<br>F : 11% max.<br>Note 4<br>Insulation resistance: 50 MΩ μF or 1000 MΩ, whichever is smaller.<br>Note 5 | According to JIS C 5102 clause 9.10.<br>Multilayer:<br>Preconditioning: Voltage treatment (Class 2)<br>Temperature: $125\pm 3^{\circ}\text{C}$ (Class 1, Class 2: B, BJ (X7R))<br>$85\pm 2^{\circ}\text{C}$ (Class 2: BJ,F)<br>Duration: $1000\begin{smallmatrix} +48\\ -0 \end{smallmatrix}\text{hrs}$<br>Applied voltage: Rated voltage $\times 2$ Note 6<br>Recovery: Recovery for the following period under the standard condition after the removal from test chamber.<br>$6\sim 24\text{ hrs}$ (Class 1)<br>$24\pm 2\text{ hrs}$ (Class 2)<br>High—Frequency Multilayer:<br>Temperature: $125\pm 3^{\circ}\text{C}$ (Class 1)<br>Duration: $1000\begin{smallmatrix} +48\\ -0 \end{smallmatrix}\text{hrs}$<br>Applied voltage: Rated voltage $\times 2$<br>Recovery: $6\sim 24\text{ hrs}$ of recovery under the standard condition after the removal from test chamber.                               |

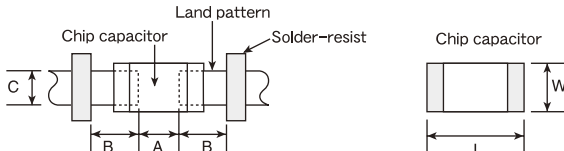
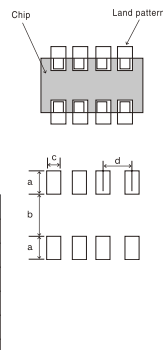
Note 1 :For 105 type, specified in "High value".

Note 2 :Thermal treatment (Multilayer): 1 hr of thermal treatment at  $150 \pm 0 / -10^\circ\text{C}$  followed by  $24 \pm 2$  hrs of recovery under the standard condition shall be performed before the measurement.Note 3 :Voltage treatment (Multilayer): 1 hr of voltage treatment under the specified temperature and voltage for testing followed by  $24 \pm 2$  hrs of recovery under the standard condition shall be performed before the measurement.

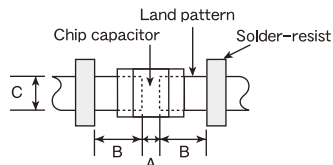
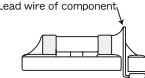
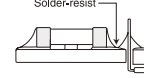
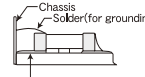
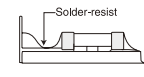
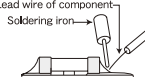
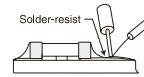
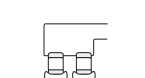
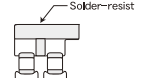
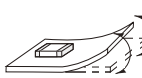
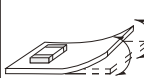
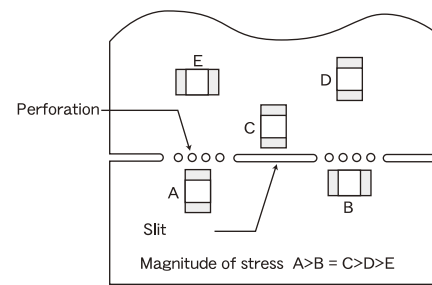
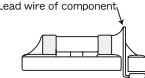
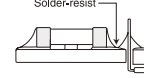
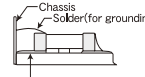
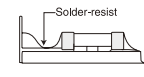
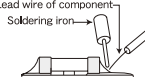
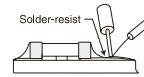
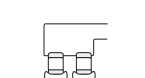
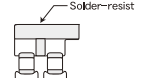
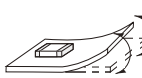
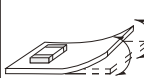
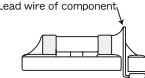
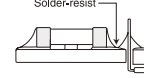
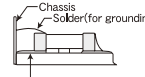
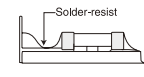
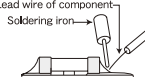
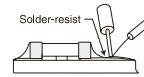
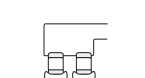
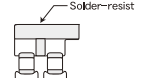
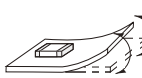
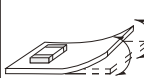
Note 4, 5 :The figure indicates typical inspection. Please refer to individual specifications.

Note 6 :Some of the parts are applicable in rated voltage  $\times 1.5$ . Please refer to individual specifications.Note on standard condition: "standard condition" referred to herein is defined as follows: 5 to  $35^\circ\text{C}$  of temperature, 45 to 85% relative humidity, and 86 to 106kPa of air pressure.When there are questions concerning measurement results: In order to provide correlation data, the test shall be conducted under condition of  $20 \pm 2^\circ\text{C}$  of temperature, 60 to 70% relative humidity, and 86 to 106kPa of air pressure. Unless otherwise specified, all the tests are conducted under the "standard condition."

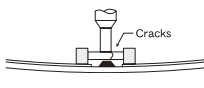
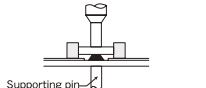
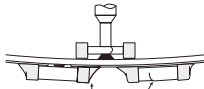
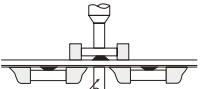
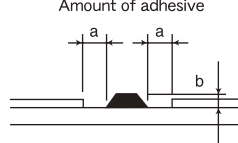
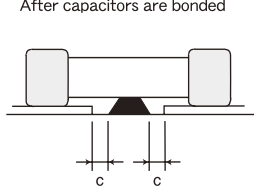
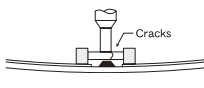
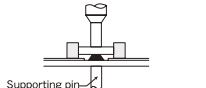
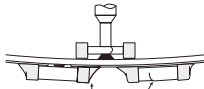
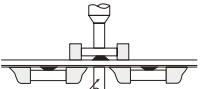
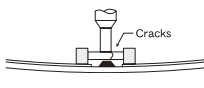
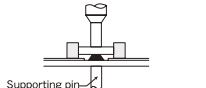
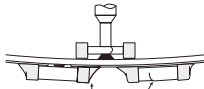
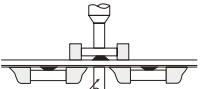
## Precautions on the use of Multilayer Ceramic Capacitors

| Stages           | Precautions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Technical considerations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
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-|-----|---|------|-----|-----|---|---------|-----------|-----------|---|---------|-----------|-----------|---|---------|---------|-----------|---|-----|------|------|
| 1.Circuit Design | <p>Verification of operating environment, electrical rating and performance</p> <p>1. A malfunction in medical equipment, spacecraft, nuclear reactors, etc. may cause serious harm to human life or have severe social ramifications. As such, any capacitors to be used in such equipment may require higher safety and/or reliability considerations and should be clearly differentiated from components used in general purpose applications.</p> <p>Operating Voltage (Verification of Rated voltage)</p> <p>1. The operating voltage for capacitors must always be lower than their rated values.</p> <p>If an AC voltage is loaded on a DC voltage, the sum of the two peak voltages should be lower than the rated value of the capacitor chosen. For a circuit where both an AC and a pulse voltage may be present, the sum of their peak voltages should also be lower than the capacitor's rated voltage.</p> <p>2. Even if the applied voltage is lower than the rated value, the reliability of capacitors might be reduced if either a high frequency AC voltage or a pulse voltage having rapid rise time is present in the circuit.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |         |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| 2.PCB Design     | <p>Pattern configurations<br/>(Design of Land-patterns)</p> <p>1. When capacitors are mounted on a PCB, the amount of solder used (size of fillet) can directly affect capacitor performance. Therefore, the following items must be carefully considered in the design of solder land patterns:</p> <p>(1) The amount of solder applied can affect the ability of chips to withstand mechanical stresses which may lead to breaking or cracking. Therefore, when designing land-patterns it is necessary to consider the appropriate size and configuration of the solder pads which in turn determines the amount of solder necessary to form the fillets.</p> <p>(2) When more than one part is jointly soldered onto the same land or pad, the pad must be designed so that each component's soldering point is separated by solder-resist.</p>                                                                                                                                                                                                                                                                                                      | <p>1.The following diagrams and tables show some examples of recommended patterns to prevent excessive solder amounts. (larger fillets which extend above the component end terminations)</p> <p>Examples of improper pattern designs are also shown.</p> <p>(1) Recommended land dimensions for a typical chip capacitor land patterns for PCBs</p> <div></div> <p>Recommended land dimensions for wave-soldering (unit: mm)</p> <table><tr><th>Type</th><th>107</th><th>212</th><th>316</th><th>325</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>1.6</td><td>2.0</td><td>3.2</td><td>3.2</td></tr><tr><td>W</td><td>0.8</td><td>1.25</td><td>1.6</td><td>2.5</td></tr><tr><td>A</td><td>0.8~1.0</td><td>1.0~1.4</td><td>1.8~2.5</td><td>1.8~2.5</td></tr><tr><td>B</td><td>0.5~0.8</td><td>0.8~1.5</td><td>0.8~1.7</td><td>0.8~1.7</td></tr><tr><td>C</td><td>0.6~0.8</td><td>0.9~1.2</td><td>1.2~1.6</td><td>1.8~2.5</td></tr></table> <p>Recommended land dimensions for reflow-soldering (unit: mm)</p> <table><tr><th>Type</th><th>042</th><th>063</th><th>105</th><th>107</th><th>212</th><th>316</th><th>325</th><th>432</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>0.4</td><td>0.6</td><td>1.0</td><td>1.6</td><td>2.0</td><td>3.2</td><td>3.2</td><td>4.5</td></tr><tr><td>W</td><td>0.2</td><td>0.3</td><td>0.5</td><td>0.8</td><td>1.25</td><td>1.6</td><td>2.5</td><td>3.2</td></tr><tr><td>A</td><td>0.15~0.25</td><td>0.20~0.30</td><td>0.45~0.55</td><td>0.8~1.0</td><td>0.8~1.2</td><td>1.8~2.5</td><td>1.8~2.5</td><td>2.5~3.5</td></tr><tr><td>B</td><td>0.10~0.20</td><td>0.20~0.30</td><td>0.40~0.50</td><td>0.6~0.8</td><td>0.8~1.2</td><td>1.0~1.5</td><td>1.0~1.5</td><td>1.5~1.8</td></tr><tr><td>C</td><td>0.15~0.30</td><td>0.25~0.40</td><td>0.45~0.55</td><td>0.6~0.8</td><td>0.9~1.6</td><td>1.2~2.0</td><td>1.8~3.2</td><td>2.3~3.5</td></tr></table> <p>Excess solder can affect the ability of chips to withstand mechanical stresses. Therefore, please take proper precautions when designing land-patterns.</p> <div></div> <table><tr><th>Type</th><th>212 (4 circuits)</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>2.0</td></tr><tr><td>W</td><td>1.25</td></tr><tr><td>a</td><td>0.5~0.6</td></tr><tr><td>b</td><td>0.5~0.6</td></tr><tr><td>c</td><td>0.2~0.3</td></tr><tr><td>d</td><td>0.5</td></tr></table> <table><tr><th>Type</th><th>212 (2 circuits)</th><th>110 (2 circuits)</th><th>096 (2 circuits)</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>2.0</td><td>1.37</td><td>0.9</td></tr><tr><td>W</td><td>1.25</td><td>1.0</td><td>0.6</td></tr><tr><td>a</td><td>0.5~0.6</td><td>0.35~0.45</td><td>0.25~0.35</td></tr><tr><td>b</td><td>0.5~0.6</td><td>0.55~0.65</td><td>0.15~0.25</td></tr><tr><td>c</td><td>0.5~0.6</td><td>0.3~0.4</td><td>0.15~0.25</td></tr><tr><td>d</td><td>1.0</td><td>0.64</td><td>0.45</td></tr></table> | Type             | 107     | 212     | 316     | 325     | Size    | L   | 1.6 | 2.0 | 3.2 | 3.2 | W | 0.8 | 1.25 | 1.6 | 2.5 | A | 0.8~1.0 | 1.0~1.4 | 1.8~2.5 | 1.8~2.5 | B | 0.5~0.8 | 0.8~1.5 | 0.8~1.7 | 0.8~1.7 | C | 0.6~0.8 | 0.9~1.2 | 1.2~1.6 | 1.8~2.5 | Type | 042 | 063 | 105 | 107 | 212 | 316 | 325 | 432 | Size | L | 0.4 | 0.6 | 1.0 | 1.6 | 2.0 | 3.2 | 3.2 | 4.5 | W | 0.2 | 0.3 | 0.5 | 0.8 | 1.25 | 1.6 | 2.5 | 3.2 | A | 0.15~0.25 | 0.20~0.30 | 0.45~0.55 | 0.8~1.0 | 0.8~1.2 | 1.8~2.5 | 1.8~2.5 | 2.5~3.5 | B | 0.10~0.20 | 0.20~0.30 | 0.40~0.50 | 0.6~0.8 | 0.8~1.2 | 1.0~1.5 | 1.0~1.5 | 1.5~1.8 | C | 0.15~0.30 | 0.25~0.40 | 0.45~0.55 | 0.6~0.8 | 0.9~1.6 | 1.2~2.0 | 1.8~3.2 | 2.3~3.5 | Type | 212 (4 circuits) | Size | L | 2.0 | W | 1.25 | a | 0.5~0.6 | b | 0.5~0.6 | c | 0.2~0.3 | d | 0.5 | Type | 212 (2 circuits) | 110 (2 circuits) | 096 (2 circuits) | Size | L | 2.0 | 1.37 | 0.9 | W | 1.25 | 1.0 | 0.6 | a | 0.5~0.6 | 0.35~0.45 | 0.25~0.35 | b | 0.5~0.6 | 0.55~0.65 | 0.15~0.25 | c | 0.5~0.6 | 0.3~0.4 | 0.15~0.25 | d | 1.0 | 0.64 | 0.45 |
| Type             | 107                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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| Size             | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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                                                                                                          | 2.0              | 3.2     | 3.2     |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
|                  | W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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                                                                                                          | 1.25             | 1.6     | 2.5     |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| A                | 0.8~1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1.0~1.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.8~2.5          | 1.8~2.5 |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| B                | 0.5~0.8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.8~1.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.8~1.7          | 0.8~1.7 |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| C                | 0.6~0.8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.9~1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.2~1.6          | 1.8~2.5 |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| Type             | 042                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| Size             | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.6              | 1.0     | 1.6     | 2.0     | 3.2     | 3.2     | 4.5 |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
|                  | W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.3              | 0.5     | 0.8     | 1.25    | 1.6     | 2.5     | 3.2 |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| A                | 0.15~0.25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.20~0.30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.45~0.55        | 0.8~1.0 | 0.8~1.2 | 1.8~2.5 | 1.8~2.5 | 2.5~3.5 |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| B                | 0.10~0.20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.20~0.30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.40~0.50        | 0.6~0.8 | 0.8~1.2 | 1.0~1.5 | 1.0~1.5 | 1.5~1.8 |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| C                | 0.15~0.30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.25~0.40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.45~0.55        | 0.6~0.8 | 0.9~1.6 | 1.2~2.0 | 1.8~3.2 | 2.3~3.5 |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| Type             | 212 (4 circuits)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| Size             | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
|                  | W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| a                | 0.5~0.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| b                | 0.5~0.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| c                | 0.2~0.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| d                | 0.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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  |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| Type             | 212 (2 circuits)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 110 (2 circuits)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 096 (2 circuits) |         |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| Size             | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1.37             | 0.9     |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
|                  | W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1.0              | 0.6     |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| a                | 0.5~0.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.35~0.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.25~0.35        |         |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| b                | 0.5~0.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.55~0.65                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.15~0.25        |         |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| c                | 0.5~0.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.3~0.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.15~0.25        |         |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |
| d                | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.64                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.45             |         |         |         |         |         |     |     |     |     |     |   |     |      |     |     |   |         |         |         |         |   |         |         |         |         |   |         |         |         |         |      |     |     |     |     |     |     |     |     |      |   |     |     |     |     |     |     |     |     |   |     |     |     |     |      |     |     |     |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |   |           |           |           |         |         |         |         |         |      |                  |      |   |     |   |      |   |         |   |         |   |         |   |     |      |                  |                  |                  |      |   |     |      |     |   |      |     |     |   |         |           |           |   |         |           |           |   |         |         |           |   |     |      |      |

## Precautions on the use of Multilayer Ceramic Capacitors

| Stages                                                      | Precautions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Technical considerations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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| 2.PCB Design                                                | <p>Pattern configurations</p> <p>(Capacitor layout on panelized [breakaway] PC boards)</p> <p>1. After capacitors have been mounted on the boards, chips can be subjected to mechanical stresses in subsequent manufacturing processes (PCB cutting, board inspection, mounting of additional parts, assembly into the chassis, wave soldering the reflow soldered boards etc.) For this reason, planning pattern configurations and the position of SMD capacitors should be carefully performed to minimize stress.</p> | <p>LWDC Recommended land dimensions for reflow-soldering</p> <div></div> <table><tr><th>Type</th><th>105</th><th>107</th><th>212</th></tr><tr><td rowspan="2">Size</td><td>L</td><td>0.52</td><td>0.8</td><td>1.25</td></tr><tr><td>W</td><td>1.0</td><td>1.6</td><td>2.0</td></tr><tr><td>A</td><td>0.18~0.22</td><td>0.25~0.3</td><td>0.5~0.7</td></tr><tr><td>B</td><td>0.2~0.25</td><td>0.3~0.4</td><td>0.4~0.5</td></tr><tr><td>C</td><td>0.9~1.1</td><td>1.5~1.7</td><td>1.9~2.1</td></tr></table> <p>(unit: mm)</p> <p>(2) Examples of good and bad solder application</p> <table><tr><th>Items</th><th>Not recommended</th><th>Recommended</th></tr><tr><td>Mixed mounting of SMD and leaded components</td><td></td><td></td></tr><tr><td>Component placement close to the chassis</td><td></td><td></td></tr><tr><td>Hand-soldering of leaded components near mounted components</td><td></td><td></td></tr><tr><td>Horizontal component placement</td><td></td><td></td></tr></table> <p>1-1. The following are examples of good and bad capacitor layout; SMD capacitors should be located to minimize any possible mechanical stresses from board warp or deflection.</p> <table><tr><th></th><th>Not recommended</th><th>Recommended</th></tr><tr><td>Deflection of the board</td><td></td><td><br/>Position the component at a right angle to the direction of the mechanical stresses that are anticipated.</td></tr></table> <p>1-2. To layout the capacitors for the breakaway PC board, it should be noted that the amount of mechanical stresses given will vary depending on capacitor layout. The example below shows recommendations for better design.</p> <div></div> <p>Magnitude of stress <math>A &gt; B = C &gt; D &gt; E</math></p> <p>1-3. When breaking PC boards along their perforations, the amount of mechanical stress on the capacitors can vary according to the method used. The following methods are listed in order from least stressful to most stressful: push-back, slit, V-grooving, and perforation. Thus, any ideal SMD capacitor layout must also consider the PCB splitting procedure.</p> | Type    | 105  | 107 | 212 | Size | L | 0.52 | 0.8 | 1.25 | W | 1.0 | 1.6 | 2.0 | A | 0.18~0.22 | 0.25~0.3 | 0.5~0.7 | B | 0.2~0.25 | 0.3~0.4 | 0.4~0.5 | C | 0.9~1.1 | 1.5~1.7 | 1.9~2.1 | Items | Not recommended | Recommended | Mixed mounting of SMD and leaded components |  |  | Component placement close to the chassis |  |  | Hand-soldering of leaded components near mounted components |  |  | Horizontal component placement |  |  |  | Not recommended | Recommended | Deflection of the board |  | <br>Position the component at a right angle to the direction of the mechanical stresses that are anticipated. |
|                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Type                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                                                                     |
| Size                                                        | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.52                                                                                                                                                                                                                                                                                                                                                                                                                                         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|                                                             | W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                          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| A                                                           | 0.18~0.22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.25~0.3                                                                                                                                                                                                                                                                                                                                                                                                                                     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| B                                                           | 0.2~0.25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.3~0.4                                                                                                                                                                                                                                                                                                                                                                                                                                      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| C                                                           | 0.9~1.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1.5~1.7                                                                                                                                                                                                                                                                                                                                                                                                                                      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| Items                                                       | Not recommended                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Recommended                                                                                                                                                                                                                                                                                                                                                                                                                                  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| Mixed mounting of SMD and leaded components                 |                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |         |      |     |     |      |   |      |     |      |   |     |     |     |   |           |          |         |   |          |         |         |   |         |         |         |       |                 |             |                                             |                                                                                     |                                                                                     |                                          |                                                                                     |                                                                                     |                                                             |                                                                                      |                                                                                      |                                |                                                                                       |                                                                                       |  |                 |             |                         |                                                                                      |                                                                                                                                                                                                    |
| Component placement close to the chassis                    |                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |         |      |     |     |      |   |      |     |      |   |     |     |     |   |           |          |         |   |          |         |         |   |         |         |         |       |                 |             |                                             |                                                                                     |                                                                                     |                                          |                                                                                     |                                                                                     |                                                             |                                                                                      |                                                                                      |                                |                                                                                       |                                                                                       |  |                 |             |                         |                                                                                      |                                                                                                                                                                                                    |
| Hand-soldering of leaded components near mounted components |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         |      |     |     |      |   |      |     |      |   |     |     |     |   |           |          |         |   |          |         |         |   |         |         |         |       |                 |             |                                             |                                                                                     |                                                                                     |                                          |                                                                                     |                                                                                     |                                                             |                                                                                      |                                                                                      |                                |                                                                                       |                                                                                       |  |                 |             |                         |                                                                                      |                                                                                                                                                                                                    |
| Horizontal component placement                              |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         |      |     |     |      |   |      |     |      |   |     |     |     |   |           |          |         |   |          |         |         |   |         |         |         |       |                 |             |                                             |                                                                                     |                                                                                     |                                          |                                                                                     |                                                                                     |                                                             |                                                                                      |                                                                                      |                                |                                                                                       |                                                                                       |  |                 |             |                         |                                                                                      |                                                                                                                                                                                                    |
|                                                             | Not recommended                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Recommended                                                                                                                                                                                                                                                                                                                                                                                                                                  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                                                                                     |
| Deflection of the board                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                       | <br>Position the component at a right angle to the direction of the mechanical stresses that are anticipated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |         |      |     |     |      |   |      |     |      |   |     |     |     |   |           |          |         |   |          |         |         |   |         |         |         |       |                 |             |                                             |                                                                                     |                                                                                     |                                          |                                                                                     |                                                                                     |                                                             |                                                                                      |                                                                                      |                                |                                                                                       |                                                                                       |  |                 |             |                         |                                                                                      |                                                                                                                                                                                                    |

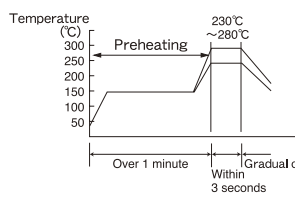
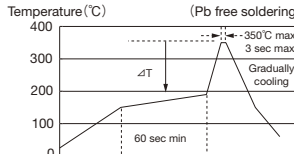
## Precautions on the use of Multilayer Ceramic Capacitors

| Stages                                    | Precautions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Technical considerations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                 |             |                       |                                                                                    |                                                                                     |                       |                                                                                    |                                                                                     |        |                                |   |           |   |              |   |                                      |
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| 3.Considerations for auto-matic placement | <p>Adjustment of mounting machine</p> <p>1. Excessive impact load should not be imposed on the capacitors when mounting onto the PC boards.</p> <p>2. The maintenance and inspection of the mounters should be conducted periodically.</p> <p>Selection of Adhesives</p> <p>1. Mounting capacitors with adhesives in preliminary assembly, before the soldering stage, may lead to degraded capacitor characteristics unless the following factors are appropriately checked; the size of land patterns, type of adhesive, amount applied, hardening temperature and hardening period. Therefore, it is imperative to consult the manufacturer of the adhesives on proper usage and amounts of adhesive to use.</p> | <p>1. If the lower limit of the pick-up nozzle is low, too much force may be imposed on the capacitors, causing damage. To avoid this, the following points should be considered before lowering the pick-up nozzle:</p> <p>(1) The lower limit of the pick-up nozzle should be adjusted to the surface level of the PC board after correcting for deflection of the board.</p> <p>(2) The pick-up pressure should be adjusted between 1 and 3 N static loads.</p> <p>(3) To reduce the amount of deflection of the board caused by impact of the pick-up nozzle, supporting pins or back-up pins should be used under the PC board. The following diagrams show some typical examples of good pick-up nozzle placement:</p> <table><tr><th></th><th>Not recommended</th><th>Recommended</th></tr><tr><td>Single-sided mounting</td><td></td><td></td></tr><tr><td>Double-sided mounting</td><td></td><td></td></tr></table> <p>2. As the alignment pin wears out, adjustment of the nozzle height can cause chipping or cracking of the capacitors because of mechanical impact on the capacitors. To avoid this, the monitoring of the width between the alignment pin in the stopped position, and maintenance, inspection and replacement of the pin should be conducted periodically.</p> <p>5. Some adhesives may cause reduced insulation resistance. The difference between the shrinkage percentage of the adhesive and that of the capacitors may result in stresses on the capacitors and lead to cracking. Moreover, too little or too much adhesive applied to the board may adversely affect component placement, so the following precautions should be noted in the application of adhesives.</p> <p>(1) Required adhesive characteristics</p> <p>a. The adhesive should be strong enough to hold parts on the board during the mounting &amp; solder process.</p> <p>b. The adhesive should have sufficient strength at high temperatures.</p> <p>c. The adhesive should have good coating and thickness consistency.</p> <p>d. The adhesive should be used during its prescribed shelf life.</p> <p>e. The adhesive should harden rapidly</p> <p>f. The adhesive must not be contaminated.</p> <p>g. The adhesive should have excellent insulation characteristics.</p> <p>h. The adhesive should not be toxic and have no emission of toxic gasses.</p> <p>(2) The recommended amount of adhesives is as follows;</p> <table><tr><th>Figure</th><th>212/316 case sizes as examples</th></tr><tr><td>a</td><td>0.3mm min</td></tr><tr><td>b</td><td>100 ~120 μ m</td></tr><tr><td>c</td><td>Adhesives should not contact the pad</td></tr></table> <p>Amount of adhesive</p>  <p>After capacitors are bonded</p>  |  | Not recommended | Recommended | Single-sided mounting |  |  | Double-sided mounting |  |  | Figure | 212/316 case sizes as examples | a | 0.3mm min | b | 100 ~120 μ m | c | Adhesives should not contact the pad |
|                                           | Not recommended                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Recommended                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |                 |             |                       |                                                                                    |                                                                                     |                       |                                                                                    |                                                                                     |        |                                |   |           |   |              |   |                                      |
| Single-sided mounting                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                 |             |                       |                                                                                    |                                                                                     |                       |                                                                                    |                                                                                     |        |                                |   |           |   |              |   |                                      |
| Double-sided mounting                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                 |             |                       |                                                                                    |                                                                                     |                       |                                                                                    |                                                                                     |        |                                |   |           |   |              |   |                                      |
| Figure                                    | 212/316 case sizes as examples                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                 |             |                       |                                                                                    |                                                                                     |                       |                                                                                    |                                                                                     |        |                                |   |           |   |              |   |                                      |
| a                                         | 0.3mm min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                 |             |                       |                                                                                    |                                                                                     |                       |                                                                                    |                                                                                     |        |                                |   |           |   |              |   |                                      |
| b                                         | 100 ~120 μ m                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                 |             |                       |                                                                                    |                                                                                     |                       |                                                                                    |                                                                                     |        |                                |   |           |   |              |   |                                      |
| c                                         | Adhesives should not contact the pad                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                 |             |                       |                                                                                    |                                                                                     |                       |                                                                                    |                                                                                     |        |                                |   |           |   |              |   |                                      |

## Precautions on the use of Multilayer Ceramic Capacitors

| Stages       | Precautions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Technical considerations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| 4. Soldering | <p><b>Selection of Flux</b></p> <p>1. Since flux may have a significant effect on the performance of capacitors, it is necessary to verify the following conditions prior to use;</p> <p>(1) Flux used should be with less than or equal to 0.1 wt% (equivalent to chlorine) of halogenated content. Flux having a strong acidity content should not be applied.</p> <p>(2) When soldering capacitors on the board, the amount of flux applied should be controlled at the optimum level.</p> <p>(3) When using water-soluble flux, special care should be taken to properly clean the boards.</p> <p><b>Soldering</b></p> <p>Temperature, time, amount of solder, etc. are specified in accordance with the following recommended conditions.</p> <p><b>Sn-Zn solder paste can affect MLCC reliability performance. Please contact us prior to usage.</b></p> | <p>1-1. When too much halogenated substance (Chlorine, etc.) content is used to activate the flux, or highly acidic flux is used, an excessive amount of residue after soldering may lead to corrosion of the terminal electrodes or degradation of insulation resistance on the surface of the capacitors.</p> <p>1-2. Flux is used to increase solderability in flow soldering, but if too much is applied, a large amount of flux gas may be emitted and may detrimentally affect solderability. To minimize the amount of flux applied, it is recommended to use a flux-bubbling system.</p> <p>1-3. Since the residue of water-soluble flux is easily dissolved by water content in the air, the residue on the surface of capacitors in high humidity conditions may cause a degradation of insulation resistance and therefore affect the reliability of the components. The cleaning methods and the capability of the machines used should also be considered carefully when selecting water-soluble flux.</p> <p><b>1-1. Preheating when soldering</b></p> <p>Heating: Ceramic chip components should be preheated to within 100 to 130°C of the soldering.</p> <p>Cooling: The temperature difference between the components and cleaning process should not be greater than 100°C.</p> <p>Ceramic chip capacitors are susceptible to thermal shock when exposed to rapid or concentrated heating or rapid cooling. Therefore, the soldering process must be conducted with great care so as to prevent malfunction of the components due to excessive thermal shock.</p> <p><b>Recommended conditions for soldering</b></p> <p><b>[Reflow soldering]</b></p> <p><b>Temperature profile</b></p> <p>Temperature (°C) (Pb free soldering)</p> <p>Peak 260°C max 10 sec max</p> <p>Preheating 150°C 60 sec min</p> <p>Heating above 230°C 40 sec max</p> <p>Gradually cooling</p> <p>※ Ceramic chip components should be preheated to within 100 to 130°C of the soldering.</p> <p>※ Assured to be reflow soldering for 2 times.</p> <p><b>Caution</b></p> <p>1. The ideal condition is to have solder mass (fillet) controlled to 1/2 to 1/3 of the thickness of the capacitor, as shown below:</p> <p>Capacitor</p> <p>Solder</p> <p>PC board</p> <p><math>\frac{1}{2}T \sim \frac{1}{3}T</math></p> <p>2. Because excessive dwell times can detrimentally affect solderability, soldering duration should be kept as close to recommended times as possible.</p> <p><b>[Wave soldering]</b></p> <p><b>Temperature profile</b></p> <p>Temperature (°C) (Pb free soldering)</p> <p>Peak 260°C max 10 sec max</p> <p>Preheating 150°C 120 sec min</p> <p>Gradually cooling</p> <p>※ Ceramic chip components should be preheated to within 100 to 130°C of the soldering.</p> <p>※ Assured to be wave soldering for 1 time.</p> <p>※ Except for reflow soldering type.</p> <p><b>Caution</b></p> <p>1. Make sure the capacitors are preheated sufficiently.</p> <p>2. The temperature difference between the capacitor and melted solder should not be greater than 100 to 130°C</p> <p>3. Cooling after soldering should be as gradual as possible.</p> <p>4. Wave soldering must not be applied to the capacitors designated as for reflow soldering only.</p> |

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| Stages                    | Precautions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Technical considerations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |               |                      |              |                           |                |
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| 4. Soldering              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>[Hand soldering]</p> <p>Temperature profile</p> <div></div> <div></div> <p>(Pb free soldering)</p> <p>※ <math>\Delta T \leq 190^{\circ}\text{C}</math> (3216Type max), <math>\Delta T \leq 130^{\circ}\text{C}</math> (3225Type min)<br/>※ It is recommended to use 20W soldering iron and the tip is 1φ or less.<br/>※ The soldering iron should not directly touch the components.<br/>※ Assured to be soldering iron for 1 time.</p> <p>Note: The above profiles are the maximum allowable soldering condition, therefore these profiles are not always recommended.</p> <p>Caution</p> <ol style="list-style-type: none"><li>1. Use a 20W soldering iron with a maximum tip diameter of 1.0 mm.</li><li>2. The soldering iron should not directly touch the capacitor.</li></ol>                                                |                   |               |                      |              |                           |                |
| 5.Cleaning                | <p>Cleaning conditions</p> <ol style="list-style-type: none"><li>1. When cleaning the PC board after the capacitors are all mounted, select the appropriate cleaning solution according to the type of flux used and purpose of the cleaning (e.g. to remove soldering flux or other materials from the production process.)</li><li>2. Cleaning conditions should be determined after verifying, through a test run, that the cleaning process does not affect the capacitor's characteristics.</li></ol>                                                                                                                                                                                                                                                                                                                                              | <ol style="list-style-type: none"><li>1. The use of inappropriate solutions can cause foreign substances such as flux residue to adhere to the capacitor or deteriorate the capacitor's outer coating, resulting in a degradation of the capacitor's electrical properties (especially insulation resistance).</li><li>2. Inappropriate cleaning conditions (insufficient or excessive cleaning) may detrimentally affect the performance of the capacitors.</li></ol> <p>(1)Excessive cleaning</p> <p>In the case of ultrasonic cleaning, too much power output can cause excessive vibration of the PC board which may lead to the cracking of the capacitor or the soldered portion, or decrease the terminal electrodes' strength. Thus the following conditions should be carefully checked;</p> <table><tr><td>Ultrasonic output</td><td>Below 20 W/ ℓ</td></tr><tr><td>Ultrasonic frequency</td><td>Below 40 kHz</td></tr><tr><td>Ultrasonic washing period</td><td>5 min. or less</td></tr></table> | Ultrasonic output | Below 20 W/ ℓ | Ultrasonic frequency | Below 40 kHz | Ultrasonic washing period | 5 min. or less |
| Ultrasonic output         | Below 20 W/ ℓ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |               |                      |              |                           |                |
| Ultrasonic frequency      | Below 40 kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |               |                      |              |                           |                |
| Ultrasonic washing period | 5 min. or less                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |               |                      |              |                           |                |
| 6.Post cleaning processes | <ol style="list-style-type: none"><li>1. With some type of resins a decomposition gas or chemical reaction vapor may remain inside the resin during the hardening period or while left under normal storage conditions resulting in the deterioration of the capacitor's performance.</li><li>2. When a resin's hardening temperature is higher than the capacitor's operating temperature, the stresses generated by the excess heat may lead to capacitor damage or destruction. The use of such resins, molding materials etc. is not recommended.</li></ol>                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |               |                      |              |                           |                |
| 7.Handling                | <p>Breakaway PC boards (splitting along perforations)</p> <ol style="list-style-type: none"><li>1. When splitting the PC board after mounting capacitors and other components, care is required so as not to give any stresses of deflection or twisting to the board.</li><li>2. Board separation should not be done manually, but by using the appropriate devices.</li></ol> <p>Mechanical considerations</p> <ol style="list-style-type: none"><li>1. Be careful not to subject the capacitors to excessive mechanical shocks.<ol style="list-style-type: none"><li>(1)If ceramic capacitors are dropped onto the floor or a hard surface, they should not be used.</li><li>(2)When handling the mounted boards, be careful that the mounted components do not come in contact with or bump against other boards or components.</li></ol></li></ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |               |                      |              |                           |                |

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| Stages               | Precautions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Technical considerations |           |          |              |                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| 8.Storage conditions | <p>Storage</p> <p>1. To maintain the solderability of terminal electrodes and to keep the packaging material in good condition, care must be taken to control temperature and humidity in the storage area. Humidity should especially be kept as low as possible.</p> <p>• Recommended conditions</p> <table><tr><td>Ambient temperature</td><td>Below 30℃</td></tr><tr><td>Humidity</td><td>Below 70% RH</td></tr></table> <p>The ambient temperature must be kept below 40℃. Even under ideal storage conditions capacitor electrode solderability decreases as time passes, so should be used within 6 months from the time of delivery.</p> <p>• Ceramic chip capacitors should be kept where no chlorine or sulfur exists in the air.</p> <p>2. The capacitance value of high dielectric constant capacitors (type 2 &amp;3) will gradually decrease with the passage of time, so this should be taken into consideration in the circuit design. If such a capacitance reduction occurs, a heat treatment of 150℃ for 1hour will return the capacitance to its initial level.</p> | Ambient temperature      | Below 30℃ | Humidity | Below 70% RH | <p>1. If the parts are stored in a high temperature and humidity environment, problems such as reduced solderability caused by oxidation of terminal electrodes and deterioration of taping/packageging materials may take place. For this reason, components should be used within 6 months from the time of delivery. If exceeding the above period, please check solderability before using the capacitors.</p> |
| Ambient temperature  | Below 30℃                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                          |           |          |              |                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Humidity             | Below 70% RH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                          |           |          |              |                                                                                                                                                                                                                                                                                                                                                                                                                    |