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**Messrs. :** 一般共用

**Date :** 2018/08/17

# APPROVAL SHEET

**Product Name :** Medium Voltage Multilayer Ceramic Chip Capacitors

**Part No. :** FM Series

**Description :** Size 0402~2225, C0G/X7R/Y5V, 100Vdc~630Vdc

| PREPARED BY | APPROVED BY |
|-------------|-------------|
|             |             |

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# SPECIFICATION

FOR

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**SPEC. No. : FM-000-001-13**

**DATE : 2018/08/17**

| DRAWN BY        | CHECEKED BY       | APPROVED BY        |
|-----------------|-------------------|--------------------|
| <i>Tsu Chen</i> | <i>Yvens Chou</i> | <i>Joseph Ling</i> |

# PSA 信昌電子陶瓷股份有限公司

## Prosperity Dielectrics Co., Ltd.

### 1. INTRODUCTION

FM Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. Reliable performances are built-in through exact formulation of dielectric powders, preparation of conductive paste, advanced automatic manufacturing, and strict quality control to assure excellent control in dielectric thickness, electrode integrity, and electrode-to-termination continuity.

### 2. FEATURES

- a. Medium voltage in a given case size.
- b. High reliability and stability.
- c. RoHS compliant.

### 3. APPLICATIONS

- a. DC to DC converter.
- b. High voltage coupling/DC blocking.
- c. Back-lighting inverters.
- d. Snubbers in high frequency power converters.

### 4. HOW TO ORDER

| <b>FM</b>         | <b>31</b>   | <b>X</b>          | <b>471</b>         | <b>K</b>         | <b>251</b>           | <b>P</b>         | <b>X</b>         | <b>G</b>            |
|-------------------|-------------|-------------------|--------------------|------------------|----------------------|------------------|------------------|---------------------|
| <b>PDC Family</b> | <b>Size</b> | <b>Dielectric</b> | <b>Capacitance</b> | <b>Tolerance</b> | <b>Rated Voltage</b> | <b>Packaging</b> | <b>Thickness</b> | <b>Control Code</b> |
| Table 1           | Table 2     | Table 3           | Table 4            | Table 5          | Table 6              | Table 7          | Table 8          | Table 9             |

| Table 1 PDC Family |                                |
|--------------------|--------------------------------|
| Code               | Description                    |
| FM                 | 100V≤Rated Voltage≤630V series |

| Table 6 Rated Voltage |             |      |             |      |             |
|-----------------------|-------------|------|-------------|------|-------------|
| Code                  | Description | Code | Description | Code | Description |
| 101                   | 100Vdc      | 251  | 250Vdc      | 501  | 500Vdc      |
| 201                   | 200Vdc      | 401  | 400Vdc      | 631  | 630Vdc      |

| Table 2 Size |             |      |             |      |             |
|--------------|-------------|------|-------------|------|-------------|
| Code         | Description | Code | Description | Code | Description |
| 15           | 0402 (1005) | 32   | 1210 (3225) | 52   | 2211 (5728) |
| 18           | 0603 (1608) | 42   | 1808 (4520) | 55   | 2220 (5750) |
| 21           | 0805 (2012) | 43   | 1812 (4532) | 56   | 2225 (5763) |
| 31           | 1206 (3216) | 46   | 1825 (4563) |      |             |

| Table 7 Packaging Type |                                  |      |                               |
|------------------------|----------------------------------|------|-------------------------------|
| Code                   | Description                      | Code | Description                   |
| B                      | Bulk                             | T    | Tray package                  |
| E                      | Tape and 7" Reel, Embossed Tape  | P    | Tape and 7" Reel, Paper Tape  |
| K                      | Tape and 10" Reel, Embossed Tape | D    | Tape and 10" Reel, Paper Tape |
| L                      | Tape and 13" Reel, Embossed Tape | G    | Tape and 13" Reel, Paper Tape |

| Table 3 Dielectric Material Characteristics |             |      |             |
|---|-------------|------|-------------|
| Code  | Description | Code | Description |
| N   | C0G         | X    | X7R         |
| F   | Y5V         |      |             |

| Table 4 Capacitance Rule Code |                              |      |                                |
|-------------------------------|------------------------------|------|--------------------------------|
| Code                          | Description                  | Code | Description                    |
| R47                           | 0.47pF                       | 102  | 102=10x10 <sup>2</sup> =1000pF |
| 0R5                           | 0.5pF                        | 104  | 104=10x10 <sup>4</sup> =100nF  |
| 100                           | 100=10x10 <sup>0</sup> =10pF | 106  | 106=10x10 <sup>6</sup> =10μF   |

| Table 8 Thickness Description |                     |      |                    |      |                     |
|-------------------------------|---------------------|------|--------------------|------|---------------------|
| Code                          | Description         | Code | Description        | Code | Description         |
| A                             | 0.60 ± 0.10 mm      | I    | 1.25 ± 0.20 mm     | Q    | 0.50 +0.02/-0.05 mm |
| B                             | 0.8 + 0.15/-0.10 mm | J    | 1.15 ± 0.15 mm     | R    | 3.10 ± 0.30 mm      |
| C                             | 1.25 ± 0.10 mm      | K    | 0.50 ± 0.20 mm     | S    | 0.80 ± 0.07 mm      |
| D                             | 1.40 ± 0.15 mm      | L    | 0.30 ± 0.03 mm     | T    | 0.85 ± 0.10 mm      |
| E                             | 1.60 ± 0.20 mm      | M    | 0.95 ± 0.10 mm     | U    | 0.50 ± 0.10 mm      |
| F                             | 2.00 ± 0.20 mm      | N    | 0.50 ± 0.05 mm     | V    | 0.20 ± 0.02 mm      |
| G                             | 2.50 ± 0.30 mm      | O    | 3.50 ± 0.20 mm     | X    | 0.80 ± 0.10 mm      |
| H                             | 2.80 ± 0.30 mm      | P    | 1.60 +0.3/-0.10 mm | Z    | 0.25 ± 0.03 mm      |

| Table 5 Tolerance |             |      |             |      |             |
|-------------------|-------------|------|-------------|------|-------------|
| Code              | Description | Code | Description | Code | Description |
| A                 | ±0.05 pF    | J    | ±5 %        | X    | +10%~+20%   |
| B                 | ±0.10 pF    | K    | ±10 %       |      |             |
| C                 | ±0.25 pF    | L    | 0% ~ +10%   |      |             |
| D                 | ±0.50 pF    | M    | ±20 %       |      |             |
| F                 | ±1 %        | N    | -5% ~ +10%  |      |             |
| G                 | ±2 %        | P    | ±0.02 pF    |      |             |
| H                 | ±3 %        | Q    | ±0.03 pF    |      |             |
| I                 | -10% ~ 0%   | Z    | -20% ~ +80% |      |             |

| Table 9 Special Control Code |                                  |
|------------------------------|----------------------------------|
| Code                         | Description                      |
| G                            | RoHS Compliant                   |
| Q                            | Surface Coating (Size 1206~2225) |
| O                            | Gold plating (Size≥0603)         |

## 5. EXTERNAL DIMENSIONS

| Size Inch (mm) | L (mm)                                     | W (mm)                                     | Code / T (mm)              | M <sub>B</sub> (mm) |  |
|----------------|--|--|----------------------------|---------------------|---|
| 0402(1005)     | 1.00±0.10                                  | 0.50±0.10                                  | See No.4 Reference Table 8 | 0.25<br>+0.05/-0.10 |   |
| 0603(1608)     | 1.60±0.15                                  | 0.80±0.15                                  |                            | 0.40±0.15           |   |
| 0805(2012)     | 2.00±0.20                                  | 1.25±0.20                                  |                            | 0.50±0.20           |   |
| 1206(3216)     | 3.20±0.20<br>3.20 +0.30/-0.10 <sup>#</sup> | 1.60±0.20<br>1.60 +0.30/-0.10 <sup>#</sup> |                            | 0.60±0.20           |   |
| 1210(3225)     | 3.20±0.30                                  | 2.50±0.30                                  |                            | 0.75±0.35           |   |
| 1808(4520)     | 4.50±0.40                                  | 2.00±0.25                                  |                            | 0.75±0.35           |   |
| 1812(4532)     | 4.50±0.40                                  | 3.20±0.30                                  |                            | 0.75±0.35           |   |
| 1825(4563)     | 4.50±0.40                                  | 6.30±0.40                                  |                            | 0.75±0.35           |   |
| 2220(5750)     | 5.70±0.40                                  | 5.00±0.40                                  |                            | 0.85±0.35           |   |
| 2225(5763)     | 5.70±0.40                                  | 6.30±0.40                                  |                            | 0.85±0.35           |   |

Fig. 5.1 The outline of MLCC

<sup>#</sup>For 1206 size P thickness products.

## 6. GENERAL ELECTRICAL DATA

| Dielectric   | C0G  | X7R  | Y5V  |  |           |                |             |                         |                |                         |
|--|--|--|--|--|-----------|----------------|-------------|-------------------------|----------------|-------------------------|
| Size   | 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225   | 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225 | 0805, 1206, 1210, 1812                               |  |           |                |             |                         |                |                         |
| Rated voltage (WVDC)                                 | 100V, 200V, 250V, 500V, 630V   | 100V, 200V, 250V, 500V, 630V                               | 100V, 200V, 250V                                     |  |           |                |             |                         |                |                         |
| Capacitance range                                    | 0.5pF ~ 100nF  | 100pF ~ 820nF  | 10nF to 680nF  |  |           |                |             |                         |                |                         |
| Capacitance tolerance                                | Reference to Table5  | Reference to Table5  | Reference to Table5                                  |  |           |                |             |                         |                |                         |
| Tan δ  | <table border="1"> <thead> <tr> <th>Cap. Rang</th> <th>Q Spec.</th> </tr> </thead> <tbody> <tr> <td>Cap.&lt;30pF</td> <td>Q≥400+20C</td> </tr> <tr> <td>Cap.≥30pF</td> <td>Q≥1000</td> </tr> </tbody> </table>   |  | Cap. Rang  | Q Spec.  | Cap.<30pF | Q≥400+20C      | Cap.≥30pF   | Q≥1000                  | ≤2.5% ~ ≤10.0% | ≤5.0%                   |
|  | Cap. Rang  | Q Spec.  |  |  |           |                |             |                         |                |                         |
|  | Cap.<30pF  | Q≥400+20C  |  |  |           |                |             |                         |                |                         |
| Cap.≥30pF  | Q≥1000   |  |  |  |           |                |             |                         |                |                         |
| Measured at the condition of 30~70% related humidity |  |  |  |  |           |                |             |                         |                |                         |
| For 25°C at ambient temperature                      |  |  |  |  |           |                |             |                         |                |                         |
| Capacitance & Tan δ Test condition                   | Preconditioning for Class II MLCC : Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition for 24±2 hours before measurement   |  | 1.0±0.2Vrms, 1.0KHz±10%, at 25°C ambient temperature | 1.0±0.2Vrms, 1.0KHz±10%, at 20°C ambient temperature |           |                |             |                         |                |                         |
|  | <table border="1"> <thead> <tr> <th>Cap. Rang</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>Cap.≤1000pF</td> <td>1.0±0.2Vrms, 1.0MHz±10%</td> </tr> <tr> <td>Cap.&gt;1000pF</td> <td>1.0±0.2Vrms, 1.0KHz±10%</td> </tr> </tbody> </table> |  |  |  | Cap. Rang | Test Condition | Cap.≤1000pF | 1.0±0.2Vrms, 1.0MHz±10% | Cap.>1000pF    | 1.0±0.2Vrms, 1.0KHz±10% |
|  | Cap. Rang  | Test Condition   |  |  |           |                |             |                         |                |                         |
| Cap.≤1000pF  | 1.0±0.2Vrms, 1.0MHz±10%  |  |  |  |           |                |             |                         |                |                         |
| Cap.>1000pF  | 1.0±0.2Vrms, 1.0KHz±10%  |  |  |  |           |                |             |                         |                |                         |
|  |  |  |  |  |           |                |             |                         |                |                         |
| Insulation resistance at Ur                          | ≥10GΩ or RxC≥500Ω-F, whichever is smaller  | ≥10GΩ or RxC≥100Ω-F, whichever is smaller                  |  |  |           |                |             |                         |                |                         |
| Operating temperature                                | -55 to +125°C  |  | -25 to +85°C   |  |           |                |             |                         |                |                         |
| Capacitance characteristic                           | ±30ppm/°C  | ±15%   | +30/-80%   |  |           |                |             |                         |                |                         |
| Termination  | Cu or Ag/Ni/Sn or Au (lead-free termination)   |  |  |  |           |                |             |                         |                |                         |

**7. CAPACITANCE RANGE**

**7-1. C0G**

| Dimension |      | 0402 |      |      | 0603 |      |      | 0805 |      |      |      |      | 1206 |      |      |      |      |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF)   | code | 100V | 200V | 250V | 100V | 200V | 250V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 0.5       | 0R5  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    |      |      |      |      |      |
| 1.0       | 1R0  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    |      |      |      |      |      |
| 1.2       | 1R2  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    |      |      | X    |      |
| 1.5       | 1R5  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 1.8       | 1R8  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 2.2       | 2R2  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 2.7       | 2R7  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 3.3       | 3R3  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 3.9       | 3R9  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 4.7       | 4R7  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 5.6       | 5R6  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 6.8       | 6R8  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 8.2       | 8R2  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 10        | 100  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 12        | 120  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 15        | 150  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 18        | 180  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 22        | 220  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 27        | 270  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 33        | 330  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 39        | 390  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 47        | 470  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 56        | 560  | N    | N    | N    | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 68        | 680  | N    | N    |      | S    | S    | S    | A    | A    | A    | A    | A    | X    | X    | X    | X    | X    |
| 82        | 820  | N    | N    |      | S    | S    | S    | A    | A    | A    | X    | X    | X    | X    | X    | X    | X    |
| 100       | 101  | N    | N    |      | S    | S    | S    | A    | A    | X    | X    | X    | X    | X    | X    | X    | X    |
| 120       | 121  | N    |      |      | S    | S    | S    | A    | A    | X    | C    | C    | X    | X    | X    | X    | X    |
| 150       | 151  | N    |      |      | S    | S    | S    | A    | X    | X    | C    | C    | X    | X    | X    | X    | X    |
| 180       | 181  | N    |      |      | S    | S    | S    | A    | X    | C    | C    | C    | X    | X    | X    | X    | X    |
| 220       | 221  | N    |      |      | S    | S    | S    | A    | C    | C    | C    | C    | X    | X    | X    | X    | X    |
| 270       | 271  |      |      |      | S    | B    | B    | A    | C    | C    | C    | C    | X    | X    | M    | M    | M    |
| 330       | 331  |      |      |      | S    | B    | B    | A    | C    | C    | C    | C    | X    | X    | M    | M    | M    |
| 390       | 391  |      |      |      | S    | B    | B    | X    | C    | C    | C    | C    | X    | X    | M    | M    | M    |
| 470       | 471  |      |      |      | S    | B    | B    | X    | C    | C    | I    | I    | X    | M    | M    | M    | M    |
| 560       | 561  |      |      |      | S    | B    | B    | X    | C    | C    | I    | I    | X    | M    | C    | C    | C    |
| 680       | 681  |      |      |      | S    |      |      | X    | C    | C    | I    | I    | X    | M    | C    | C    | C    |
| 820       | 821  |      |      |      | S    |      |      | X    | C    | C    | I    | I    | X    | M    | E    | E    | E    |
| 1000      | 102  |      |      |      | S    |      |      | X    | C    | C    | I    | I    | X    | M    | E    | E    | E    |
| 1200      | 122  |      |      |      | B    |      |      | X    | C    | C    |      |      | X    | M    | E    | E    | E    |
| 1500      | 152  |      |      |      | B    |      |      | X    | C    | C    |      |      | X    | C    | E    | E    | E    |
| 1800      | 182  |      |      |      |      |      |      | X    | C    | C    |      |      | X    | C    | E    | E    | E    |
| 2200      | 222  |      |      |      |      |      |      | X    | C    | C    |      |      | M    | C    | E    | E    | E    |
| 2700      | 272  |      |      |      |      |      |      | C    | C    | C    |      |      | M    | C    | E    | E    | E    |
| 3300      | 332  |      |      |      |      |      |      | C    |      |      |      |      | C    | C    | E    | E    | E    |
| 3900      | 392  |      |      |      |      |      |      | C    |      |      |      |      | C    | E    | E    | E    | E    |
| 4700      | 472  |      |      |      |      |      |      | C    |      |      |      |      | C    | E    | E    | E    | E    |
| 5600      | 562  |      |      |      |      |      |      | C    |      |      |      |      | E    | E    | E    | E    |      |
| 6800      | 682  |      |      |      |      |      |      | C    |      |      |      |      | E    | E    | E    | E    |      |
| 8200      | 822  |      |      |      |      |      |      |      |      |      |      |      | E    | E    | E    |      |      |
| 10000     | 103  |      |      |      |      |      |      |      |      |      |      |      | E    | E    | E    |      |      |
| 12000     | 123  |      |      |      |      |      |      |      |      |      |      |      | P    |      |      |      |      |
| 15000     | 153  |      |      |      |      |      |      |      |      |      |      |      | P    |      |      |      |      |
| 18000     | 183  |      |      |      |      |      |      |      |      |      |      |      | P    |      |      |      |      |
| 22000     | 223  |      |      |      |      |      |      |      |      |      |      |      | P    |      |      |      |      |
| 27000     | 273  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 33000     | 333  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

**7. CAPACITANCE RANGE**

**7-1. C0G**

| Dimension |      | 1210 |      |      |      |      | 1808 |      |      |      |      | 1812 |      |      |      |      |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF)   | code | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 2.2       | 2R2  |      |      |      |      |      | C    | C    | C    | C    | C    |      |      |      |      |      |
| 2.7       | 2R7  |      |      |      |      |      | C    | C    | C    | C    | C    |      |      |      |      |      |
| 3.3       | 3R3  |      |      |      |      |      | C    | C    | C    | C    | C    |      |      |      |      |      |
| 3.9       | 3R9  |      |      |      |      |      | C    | C    | C    | C    | C    |      |      |      |      |      |
| 4.7       | 4R7  |      |      |      |      |      | C    | C    | C    | C    | C    |      |      |      |      |      |
| 5.6       | 5R6  |      |      |      |      |      | C    | C    | C    | C    | C    |      |      |      |      |      |
| 6.8       | 6R8  |      |      |      |      |      | C    | C    | C    | C    | C    |      |      |      |      |      |
| 8.2       | 8R2  |      |      |      |      |      | C    | C    | C    | C    | C    |      |      |      |      |      |
| 10        | 100  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 12        | 120  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 15        | 150  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 18        | 180  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 22        | 220  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 27        | 270  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 33        | 330  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 39        | 390  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 47        | 470  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 56        | 560  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 68        | 680  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 82        | 820  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 100       | 101  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 120       | 121  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 150       | 151  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 180       | 181  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 220       | 221  | M    | M    | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 270       | 271  | M    | M    | M    | M    | M    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 330       | 331  | M    | M    | M    | M    | M    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 390       | 391  | M    | M    | M    | M    | M    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 470       | 471  | M    | M    | M    | M    | M    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 560       | 561  | M    | M    | M    | M    | M    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 680       | 681  | M    | M    | M    | M    | M    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 820       | 821  | M    | M    | M    | M    | M    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 1000      | 102  | M    | C    | C    | C    | C    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 1200      | 122  | M    | C    | C    | C    | C    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 1500      | 152  | M    | C    | C    | C    | C    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 1800      | 182  | M    | C    | C    | C    | C    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 2200      | 222  | M    | C    | C    | C    | C    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 2700      | 272  | M    | C    | C    | C    | C    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 3300      | 332  | M    | C    | C    | C    | C    | C    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 3900      | 392  | M    | C    | C    | C    | C    | C    | C    | C    |      |      | C    | C    | C    | C    | C    |
| 4700      | 472  | M    | E    | E    | C    | C    | C    | C    | C    |      |      | C    | C    | C    | C    | C    |
| 5600      | 562  | C    | E    | E    | C    | C    | C    | E    | E    |      |      | C    | C    | C    | C    | C    |
| 6800      | 682  | C    | E    | E    | E    | E    | C    | E    | E    |      |      | C    | C    | C    | C    | C    |
| 8200      | 822  | C    | E    | E    | E    | E    | E    | F    | F    |      |      | C    | C    | C    | C    | C    |
| 10000     | 103  | E    | F    | F    | F    | F    | E    | F    | F    |      |      | C    | C    | C    | C    | C    |
| 12000     | 123  | E    | F    |      |      |      |      |      |      |      |      | C    | E    | E    | E    | E    |
| 15000     | 153  | F    | G    |      |      |      |      |      |      |      |      | C    | E    | E    | E    | E    |
| 18000     | 183  | G    | G    |      |      |      |      |      |      |      |      | E    | F    | F    | F    | F    |
| 22000     | 223  | G    | G    |      |      |      |      |      |      |      |      | E    | F    | F    | F    | F    |
| 27000     | 273  | G    |      |      |      |      |      |      |      |      |      | F    | G    | G    |      |      |
| 33000     | 333  | G    |      |      |      |      |      |      |      |      |      | F    |      |      |      |      |
| 39000     | 393  | G    |      |      |      |      |      |      |      |      |      | G    |      |      |      |      |
| 47000     | 473  | G    |      |      |      |      |      |      |      |      |      | G    |      |      |      |      |
| 56000     | 563  |      |      |      |      |      |      |      |      |      |      | G    |      |      |      |      |
| 68000     | 683  |      |      |      |      |      |      |      |      |      |      | G    |      |      |      |      |
| 82000     | 823  |      |      |      |      |      |      |      |      |      |      | G    |      |      |      |      |
| 100000    | 104  |      |      |      |      |      |      |      |      |      |      | G    |      |      |      |      |



**7. CAPACITANCE RANGE**

**7-1. C0G**

| Dimension |      | 1825 |      |      |      |      | 2220 |      |      |      |      | 2225 |      |      |      |      |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF)   | code | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 10        | 100  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 12        | 120  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 15        | 150  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 18        | 180  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 22        | 220  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 27        | 270  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 33        | 330  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 39        | 390  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 47        | 470  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 56        | 560  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 68        | 680  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 82        | 820  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 100       | 101  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 120       | 121  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 150       | 151  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 180       | 181  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 220       | 221  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 270       | 271  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 330       | 331  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 390       | 391  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 470       | 471  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 560       | 561  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 680       | 681  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 820       | 821  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 1000      | 102  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 1200      | 122  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 1500      | 152  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 1800      | 182  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 2200      | 222  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 2700      | 272  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 3300      | 332  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 3900      | 392  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 4700      | 472  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 5600      | 562  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 6800      | 682  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 8200      | 822  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 10000     | 103  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 12000     | 123  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 15000     | 153  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 18000     | 183  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 22000     | 223  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 27000     | 273  | F    | F    | F    | F    |      | F    | F    | F    | F    |      | F    | F    | F    | F    | F    |
| 33000     | 333  | F    | F    | F    | F    |      | F    | F    | F    | F    |      | F    | F    | F    | F    | F    |
| 39000     | 393  | F    | F    | F    | F    |      | F    | F    | F    | G    |      | F    | F    | F    | F    | F    |
| 47000     | 473  | F    | F    | F    | F    |      | F    | G    | G    | G    |      | F    | F    | F    | F    | F    |
| 56000     | 563  | F    | G    | G    |      |      | F    | G    | G    |      |      | F    | G    | G    | G    | G    |
| 68000     | 683  | F    | G    | G    |      |      | F    | G    | G    |      |      | F    | G    | G    | G    | G    |
| 82000     | 823  | G    |      |      |      |      | G    |      |      |      |      | F    | G    | G    | G    |      |
| 100000    | 104  | G    |      |      |      |      | G    |      |      |      |      | G    | G    | G    |      |      |
| 120000    | 124  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 150000    | 154  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 180000    | 184  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 220000    | 224  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

**7. CAPACITANCE RANGE**

**7-2. X7R**

| Dimension |      | 0402 |      | 0603 |      | 0805 |      |      |      |      | 1206 |      |      |      |      |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF)   | code | 100V | 100V | 200V | 250V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 100       | 101  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 120       | 121  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 150       | 151  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 180       | 181  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 220       | 221  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 270       | 271  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 330       | 331  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 390       | 391  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 470       | 471  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 560       | 561  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 680       | 681  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 820       | 821  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 1000      | 102  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 1200      | 122  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 1500      | 152  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 1800      | 182  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 2200      | 222  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 2700      | 272  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 3300      | 332  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 3900      | 392  | N    | S    | B    | B    | X    | X    | X    | X    | X    | X    | C    | C    | C    | C    |
| 4700      | 472  | N    | S    | B    | B    | X    | X    | X    | C    | C    | X    | C    | C    | C    | C    |
| 5600      | 562  |      | S    | B    | B    | X    | X    | X    | C    | C    | X    | C    | C    | C    | C    |
| 6800      | 682  |      | S    | B    | B    | X    | X    | X    | C    | C    | X    | C    | C    | C    | C    |
| 8200      | 822  |      | S    | B    | B    | X    | X    | X    | C    | C    | X    | C    | C    | C    | C    |
| 10000     | 103  |      | S    | B    | B    | X    | C    | C    | C    | C    | X    | C    | C    | C    | C    |
| 12000     | 123  |      | B    |      |      | X    | C    | C    | C    | C    | X    | C    | C    | C    | C    |
| 15000     | 153  |      | B    |      |      | X    | C    | C    | C    | C    | X    | C    | C    | C    | C    |
| 18000     | 183  |      | B    |      |      | X    | C    | C    | C    | C    | X    | C    | C    | C    | C    |
| 22000     | 223  |      | B    |      |      | X    | C    | C    | C    | C    | X    | C    | C    | E    | E    |
| 27000     | 273  |      | B    |      |      | C    | C    | C    | C    | C    | X    | C    | C    | E    | E    |
| 33000     | 333  |      | B    |      |      | C    | C    | C    | C    | C    | X    | E    | E    | E    | E    |
| 39000     | 393  |      | B    |      |      | C    | C    | C    |      |      | X    | E    | E    | E    | E    |
| 47000     | 473  |      | B    |      |      | C    | C    | C    |      |      | X    | E    | E    | E    | E    |
| 56000     | 563  |      | B    |      |      | C    | C    | C    |      |      | X    | E    | E    | E    | E    |
| 68000     | 683  |      | B    |      |      | C    | C    | C    |      |      | X    | E    | E    |      |      |
| 82000     | 823  |      | B    |      |      | C    | C    |      |      |      | C    | E    | E    |      |      |
| 100000    | 104  |      | B    |      |      | C    | C    |      |      |      | C    | E    | E    |      |      |
| 120000    | 124  |      |      |      |      | I    |      |      |      |      | C    | E    | E    |      |      |
| 150000    | 154  |      |      |      |      | I    |      |      |      |      | E    | E    | E    |      |      |
| 180000    | 184  |      |      |      |      | I    |      |      |      |      | E    | E    | E    |      |      |
| 220000    | 224  |      |      |      |      | I    |      |      |      |      | E    | E    | E    |      |      |
| 270000    | 274  |      |      |      |      | I    |      |      |      |      | E    |      |      |      |      |
| 330000    | 334  |      |      |      |      | I    |      |      |      |      | E    |      |      |      |      |
| 390000    | 394  |      |      |      |      | I    |      |      |      |      | E    |      |      |      |      |
| 470000    | 474  |      |      |      |      | I    |      |      |      |      | E    |      |      |      |      |
| 560000    | 564  |      |      |      |      |      |      |      |      |      | P    |      |      |      |      |
| 680000    | 684  |      |      |      |      |      |      |      |      |      | P    |      |      |      |      |
| 820000    | 824  |      |      |      |      |      |      |      |      |      | P    |      |      |      |      |



**7. CAPACITANCE RANGE**

**7-2. X7R**

| Dimension |      | 1210 |      |      |      |      | 1808 |      | 1812 |      |      |      |      |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF)   | code | 100V | 200V | 250V | 500V | 630V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 100       | 101  |      |      |      |      |      |      |      |      |      |      |      |      |
| 120       | 121  |      |      |      |      |      |      |      |      |      |      |      |      |
| 150       | 151  |      |      |      |      |      | C    | C    |      |      |      |      |      |
| 180       | 181  |      |      |      |      |      | C    | C    |      |      |      |      |      |
| 220       | 221  | M    | M    | M    | C    | C    | C    | C    |      |      |      |      |      |
| 270       | 271  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 330       | 331  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 390       | 391  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 470       | 471  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 560       | 561  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 680       | 681  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 820       | 821  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 1000      | 102  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 1200      | 122  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 1500      | 152  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 1800      | 182  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 2200      | 222  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 2700      | 272  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 3300      | 332  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 3900      | 392  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 4700      | 472  | M    | M    | M    | C    | C    | C    | C    | C    | C    | C    | C    | C    |
| 5600      | 562  | M    | M    | M    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 6800      | 682  | M    | M    | M    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 8200      | 822  | M    | M    | M    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 10000     | 103  | M    | M    | M    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 12000     | 123  | M    | M    | M    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 15000     | 153  | M    | M    | M    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 18000     | 183  | M    | M    | M    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 22000     | 223  | M    | M    | M    | C    | C    | F    | F    | C    | C    | C    | C    | C    |
| 27000     | 273  | M    | M    | M    | E    | E    | F    | F    | C    | C    | C    | C    | C    |
| 33000     | 333  | M    | M    | M    | E    | E    | F    | F    | C    | C    | C    | C    | C    |
| 39000     | 393  | M    | M    | M    | E    | E    | F    | F    | C    | C    | C    | C    | C    |
| 47000     | 473  | M    | C    | C    | E    | E    | F    | F    | C    | C    | C    | C    | C    |
| 56000     | 563  | M    | C    | E    | E    | E    | F    | F    | C    | C    | C    | F    | F    |
| 68000     | 683  | M    | E    | E    | F    | F    | F    | F    | C    | C    | C    | F    | F    |
| 82000     | 823  | M    | E    | E    | F    | F    | F    | F    | C    | C    | C    | F    | F    |
| 100000    | 104  | M    | E    | E    | F    | F    |      |      | C    | C    | C    | F    | F    |
| 120000    | 124  | M    | E    | E    |      |      |      |      | C    | C    | C    | G    | G    |
| 150000    | 154  | C    | G    | G    |      |      |      |      | C    | F    | F    | G    | G    |
| 180000    | 184  | C    | G    | G    |      |      |      |      | C    | F    | F    | G    | G    |
| 220000    | 224  | C    | G    | G    |      |      |      |      | C    | F    | F    | G    | G    |
| 270000    | 274  | E    | G    | G    |      |      |      |      | C    | F    | F    | G    |      |
| 330000    | 334  | E    | G    | G    |      |      |      |      | C    | F    | F    | G    |      |
| 390000    | 394  | G    | G    | G    |      |      |      |      | C    | F    | F    | G    |      |
| 470000    | 474  | G    | G    | G    |      |      |      |      | F    | F    | F    | G    |      |
| 560000    | 564  | G    | G    | G    |      |      |      |      | F    | G    | G    |      |      |
| 680000    | 684  | G    | G    | G    |      |      |      |      | F    | G    | G    |      |      |
| 820000    | 824  | G    |      |      |      |      |      |      | F    | G    | G    |      |      |

**7. CAPACITANCE RANGE**

**7-2. X7R**

| Dimension |      | 1825 |      |      |      |      | 2220 |      |      |      |      | 2225 |      |      |      |      |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF)   | code | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 1000      | 102  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 1200      | 122  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 1500      | 152  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 1800      | 182  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 2200      | 222  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 2700      | 272  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 3300      | 332  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 3900      | 392  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 4700      | 472  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 5600      | 562  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 6800      | 682  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 8200      | 822  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 10000     | 103  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 12000     | 123  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 15000     | 153  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 18000     | 183  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 22000     | 223  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 27000     | 273  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 33000     | 333  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 39000     | 393  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 47000     | 473  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 56000     | 563  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 68000     | 683  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 82000     | 823  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 100000    | 104  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 120000    | 124  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 150000    | 154  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 180000    | 184  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 220000    | 224  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 270000    | 274  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 330000    | 334  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 390000    | 394  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 470000    | 474  | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    | F    |
| 560000    | 564  | F    | F    | F    | G    | G    | F    | F    | F    |      |      | F    | F    | F    | F    | F    |
| 680000    | 684  | F    | F    | F    |      |      | F    | F    | F    |      |      | F    | F    | F    |      |      |
| 820000    | 824  | F    | F    | F    |      |      | F    | F    | F    |      |      | F    | F    | F    |      |      |

**7. CAPACITANCE RANGE**

**7-3. Y5V**

| Dimension |      | 0805 |      |      | 1206 |      |      | 1210 |      |      | 1812 |      |      |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(μF)   | code | 100V | 200V | 250V | 100V | 200V | 250V | 100V | 200V | 250V | 100V | 200V | 250V |
| 0.010     | 103  | B    | B    | B    | B    | B    | B    | C    | C    | C    | D    | D    | D    |
| 0.015     | 153  | B    | B    | B    | B    | B    | B    | C    | C    | C    | D    | D    | D    |
| 0.022     | 223  | B    | B    | B    | B    | B    | B    | C    | C    | C    | D    | D    | D    |
| 0.033     | 333  | B    | B    | B    | B    | B    | B    | C    | C    | C    | D    | D    | D    |
| 0.047     | 473  | B    | B    | B    | B    | B    | B    | C    | C    | C    | D    | D    | D    |
| 0.068     | 683  | B    | B    | B    | B    | B    | B    | C    | C    | C    | D    | D    | D    |
| 0.10      | 104  | B    |      |      | B    | B    | B    | C    | C    | C    | D    | D    | D    |
| 0.15      | 154  |      |      |      | C    | C    | C    | C    | C    | C    | D    | D    | D    |
| 0.22      | 224  |      |      |      | C    |      |      | C    |      |      | D    | D    | D    |
| 0.33      | 334  |      |      |      |      |      |      | C    |      |      | D    | D    | D    |
| 0.47      | 474  |      |      |      |      |      |      |      |      |      | D    | D    | D    |
| 0.68      | 684  |      |      |      |      |      |      |      |      |      | D    | D    | D    |



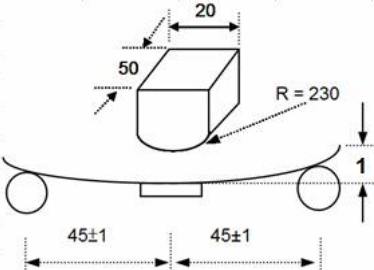
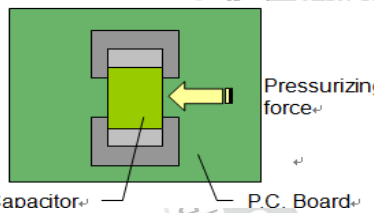
8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.  | Item  | Test Condition  | Requirements  |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|--|---|---|---|-----------------|----------------|-----------------------------|----------------------------|-----------------------------|-----------|-----------------------------|---|-----------------------------|---|-----------|---|---|--------------|---|---|-----------------|---|
| 1.   | Visual and Dimensions                         | ---   | * No remarkable defect.<br>* Dimensions to confirm to individual specification sheet.   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 2.   | Capacitance                                   |   | * Shall not exceed the limits given in the detailed spec.   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 3.   | Q/ D.F. (Dissipation Factor)                  | * Class I : C0G<br>Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%.<br>Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%.<br>* Class II : (X7R, Y5V)<br>1.0±0.2Vrms, 1KHz±10%.  | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Q/D.F.</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I (C0G)</td> <td>Q≥1000</td> <td>Cap.≥30pF</td> </tr> <tr> <td>Q≥400+20C</td> <td>Cap.&lt;30pF</td> </tr> <tr> <td rowspan="4">Class II</td> <td>D.F.≤2.5%</td> <td>X7R items</td> </tr> <tr> <td>D.F.≤3.5%</td> <td>X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF</td> </tr> <tr> <td>D.F.≤5.0%</td> <td>X7R 0603≥0.068μF, 0805&gt;0.1μF<br/>All Y5V items</td> </tr> <tr> <td>D.F.≤10.0%</td> <td>X7R 0805&gt;0.22μF</td> </tr> </tbody> </table> | Dielectric      | Q/D.F.         | Remark                      | Class I (C0G)              | Q≥1000                      | Cap.≥30pF | Q≥400+20C                   | Cap.<30pF   | Class II                    | D.F.≤2.5%   | X7R items | D.F.≤3.5%   | X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF | D.F.≤5.0%    | X7R 0603≥0.068μF, 0805>0.1μF<br>All Y5V items   | D.F.≤10.0%                                | X7R 0805>0.22μF |   |
|  |   |   | Dielectric  | Q/D.F.          | Remark         |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|  |   |   | Class I (C0G)   | Q≥1000          | Cap.≥30pF      |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|  |   |   |   | Q≥400+20C       | Cap.<30pF      |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|  |   |   | Class II  | D.F.≤2.5%       | X7R items      |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| D.F.≤3.5%  | X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF     |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| D.F.≤5.0%  | X7R 0603≥0.068μF, 0805>0.1μF<br>All Y5V items |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| D.F.≤10.0%   | X7R 0805>0.22μF                               |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 4.   | Temperature Coefficient                       | * With no electrical load. <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp.</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>Y5V</td> <td>-25~85°C at 20°C</td> </tr> </tbody> </table>  | T.C.  | Operating Temp. | C0G            | -55~125°C at 25°C           | X7R                        | -55~125°C at 25°C           | Y5V       | -25~85°C at 20°C            | <table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>Within ±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> <tr> <td>Y5V</td> <td>Within +30%/-80%</td> </tr> </tbody> </table> | T.C.                        | Capacitance Change                                | C0G       | Within ±30ppm/°C  | X7R                                       | Within ±15%  | Y5V   | Within +30%/-80%                          |                 |   |
| T.C.   | Operating Temp.                               |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| C0G  | -55~125°C at 25°C                             |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| X7R  | -55~125°C at 25°C                             |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| Y5V  | -25~85°C at 20°C                              |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| T.C.   | Capacitance Change                            |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| C0G  | Within ±30ppm/°C                              |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| X7R  | Within ±15%                                   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| Y5V  | Within +30%/-80%                              |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 5.   | Insulation Resistance                         | <table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>=100</td> <td>1 times of U<sub>R</sub></td> <td>Max. 120 sec.</td> </tr> <tr> <td>100&lt;V≤500</td> <td>1 times of U<sub>R</sub></td> <td>60 sec.</td> </tr> <tr> <td>&gt;500</td> <td>500Vdc</td> <td>60 sec.</td> </tr> </tbody> </table>   | Rated Vol.(V)   | Apply Voltage   | Test Condition | =100                        | 1 times of U <sub>R</sub>  | Max. 120 sec.               | 100<V≤500 | 1 times of U <sub>R</sub>   | 60 sec.   | >500                        | 500Vdc  | 60 sec.   | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Requirements</th> </tr> </thead> <tbody> <tr> <td>Class I</td> <td>≥10GΩ or RxC≥500Ω-F, whichever is smaller</td> </tr> <tr> <td>Class II</td> <td>≥10GΩ or RxC≥100Ω-F, whichever is smaller</td> </tr> </tbody> </table> | Dielectric                                | Requirements | Class I   | ≥10GΩ or RxC≥500Ω-F, whichever is smaller | Class II        | ≥10GΩ or RxC≥100Ω-F, whichever is smaller |
| Rated Vol.(V)  | Apply Voltage                                 | Test Condition  |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| =100   | 1 times of U <sub>R</sub>                     | Max. 120 sec.   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 100<V≤500  | 1 times of U <sub>R</sub>                     | 60 sec.   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| >500   | 500Vdc  | 60 sec.   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| Dielectric   | Requirements                                  |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| Class I  | ≥10GΩ or RxC≥500Ω-F, whichever is smaller     |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| Class II   | ≥10GΩ or RxC≥100Ω-F, whichever is smaller     |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 6.   | Solderability                                 | * Solder temperature : 235±5°C for (0402~1210).<br>* Solder temperature : 245±5°C for (1808~2225).<br>* Dipping time : 2±0.5 sec.   | * 75% min. coverage of all metalized area.  |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 7.   | Dielectric Strength                           | <table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤100</td> <td>2.5 times of U<sub>R</sub></td> </tr> <tr> <td>100&lt;V≤250</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>250&lt;V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>=630</td> <td>1.2 times of U<sub>R</sub></td> </tr> </tbody> </table>  | Rated Vol.(V)   | Condition       | ≤100           | 2.5 times of U <sub>R</sub> | 100<V≤250                  | 2.0 times of U <sub>R</sub> | 250<V≤500 | 1.5 times of U <sub>R</sub> | =630  | 1.2 times of U <sub>R</sub> | * No evidence of damage or flashover during test. |           |   |   |              |   |   |                 |   |
|  |   | Rated Vol.(V)   | Condition   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| ≤100   | 2.5 times of U <sub>R</sub>                   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 100<V≤250  | 2.0 times of U <sub>R</sub>                   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 250<V≤500  | 1.5 times of U <sub>R</sub>                   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| =630   | 1.2 times of U <sub>R</sub>                   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| * Duration : 1 to 5 sec.<br>* Charge and discharge current less than 50mA.   |   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 8.   | Resistance to Soldering Heat                  | * Solder temperature : 260±5°C.<br>* Dipping time : 10±1 sec.<br>* Preheating : 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.<br>* Before initial measurement (Class II only) : Perform 150 +0/-10°C for 1 hr and then set for 48±4 hrs at room temp.<br>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).   | * No remarkable damage.<br>* Cap. Change :<br>C0G : Within ±2.5% or ±0.25pF, whichever is larger.<br>X7R : Within ±7.5%.<br>Y5V : Within ±20%.<br>* Q/D.F. & I.R. : To meet the initial requirement.<br>* 25% max. leaching on each edge.   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 9.   | Temperature Cycle                             | * Conduct the five cycles according to the temperatures and time. <table border="1"> <thead> <tr> <th>Step</th> <th>Temp.(°C)</th> <th>Time(min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> | Step  | Temp.(°C)       | Time(min.)     | 1                           | Min. operating temp. +0/-3 | 30±3                        | 2         | Room temp.                  | 2~3   | 3                           | Max. operating temp. +3/-0                        | 30±3      | 4   | Room temp.                                | 2~3          | * No remarkable damage.<br>* Cap. change :<br>C0G : Within ±2.5% or ±0.25pF, whichever is larger.<br>X7R : Within ±7.5%.<br>Y5V : Within ±20%.<br>* Q/D.F. :<br>C0G : To meet the initial requirement.<br>X7R, Y5V : D.F.≤150% of initial requirement.<br>* I.R. : To meet the initial requirement. |   |                 |   |
|  |   | Step  | Temp.(°C)   | Time(min.)      |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|  |   | 1   | Min. operating temp. +0/-3  | 30±3            |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|  |   | 2   | Room temp.  | 2~3             |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|  |   | 3   | Max. operating temp. +3/-0  | 30±3            |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| 4  | Room temp.                                    | 2~3   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| * Before initial measurement (Class II only) : Perform 150 +0/-10°C for 1 hr and then set for 48±4 hrs at room temp. |   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
| * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).                  |   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|  |   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |
|  |   |   |   |                 |                |                             |                            |                             |           |                             |   |                             |   |           |   |   |              |   |   |                 |   |

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.           | Item                                       | Test Condition   | Requirements  |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
|---------------|--|--|---|---------------|---------------|-----|------|-----------------------------|-----|-----------|-----------------------------|-----|------|-----------------------------|---------------|------|------------|---------------|-----|------|----------|-----------------------------|------|---------|-----------|------|----------|------|---------|---|
| 10.           | Humidity<br>(Damp Heat)<br>Steady State    | * Test temp. : 40±2°C.<br>* Humidity : 90~95%RH.<br>* Test time : 500 +24/-0 hrs.<br>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).   | * No remarkable damage.<br>* Cap. change :<br>C0G : Within ±5.0% or ±0.5pF, whichever is larger.<br>X7R : Within ±12.5%.<br>Y5V : Within ±30%.<br>* Q/D.F. :<br>C0G : Cap.>30pF, Q≥350; 10pF≤Cap.≤30pF, Q≥275+2.5C; Cap.<10pF, Q≥200+10C.<br>X7R, Y5V : D.F.≤200% of initial requirement.<br>* I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller.<br>X7R 100V : ≥1GΩ or RxC≥10Ω-F, whichever is smaller. |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
| 11.           | Humidity<br>(Damp Heat)<br>Load            | * Test temp. : 40±2°C.<br>* Humidity : 90~95% RH.<br>* Test time : 500 +24/-0hrs.<br>* To apply voltage : Rated voltage (Max. 500Vdc).<br>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).  | * No remarkable damage.<br>* Cap. change :<br>C0G : Within ±7.5% or ±0.75pF, whichever is larger.<br>X7R : Within ±12.5%.<br>Y5V : Within ±30%.<br>* Q/D.F. :<br>C0G : Cap.≥30pF, Q≥200; Cap.<30pF, Q≥100+10/3C.<br>X7R, Y5V : D.F.≤200% of initial requirement.<br>* I.R. : ≥500MΩ or RxC≥25Ω-F, whichever is smaller.<br>X7R 100V : ≥500MΩ or RxC≥5Ω-F, whichever is smaller.                       |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
| 12.           | High<br>Temperature<br>Load<br>(Endurance) | * Test temp. :<br>C0G, X7R : 125±3°C.<br>Y5V : 85±3°C.<br><table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Dielectric</th> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>≤250</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>X7R</td> <td>250&lt;V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>Y5V</td> <td>=630</td> <td>1.2 times of U<sub>R</sub></td> </tr> </tbody> </table> * Exception items :<br><table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Size</th> <th>Cap. Range</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="2">100</td> <td>0603</td> <td>≥0.082μF</td> <td rowspan="4">1.5 times of U<sub>R</sub></td> </tr> <tr> <td>0805</td> <td>≥0.12μF</td> </tr> <tr> <td rowspan="2">200 &amp; 250</td> <td>0603</td> <td>≥0.082μF</td> </tr> <tr> <td>1812</td> <td>≥0.47μF</td> </tr> </tbody> </table> * Test time : 1000 +24/-0 hrs.<br>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II). | Dielectric  | Rated Vol.(V) | Apply Voltage | C0G | ≤250 | 2.0 times of U <sub>R</sub> | X7R | 250<V≤500 | 1.5 times of U <sub>R</sub> | Y5V | =630 | 1.2 times of U <sub>R</sub> | Rated Vol.(V) | Size | Cap. Range | Apply Voltage | 100 | 0603 | ≥0.082μF | 1.5 times of U <sub>R</sub> | 0805 | ≥0.12μF | 200 & 250 | 0603 | ≥0.082μF | 1812 | ≥0.47μF | * No remarkable damage.<br>* Cap. change :<br>C0G : Within ±3.0% or ±0.3pF, whichever is larger.<br>X7R : Within ±12.5%.<br>Y5V : Within ±30%.<br>* Q/D.F. :<br>C0G : Cap.>30pF, Q≥350; 10pF≤Cap.≤30pF, Q≥275+2.5C; Cap.<10pF, Q≥200+10C.<br>X7R, Y5V : D.F.≤200% of initial requirement.<br>* I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller.<br>X7R 100V : ≥1GΩ or RxC≥10Ω-F, whichever is smaller. |
| Dielectric    | Rated Vol.(V)                              | Apply Voltage  |   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
| C0G           | ≤250                                       | 2.0 times of U <sub>R</sub>  |   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
| X7R           | 250<V≤500                                  | 1.5 times of U <sub>R</sub>  |   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
| Y5V           | =630                                       | 1.2 times of U <sub>R</sub>  |   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
| Rated Vol.(V) | Size                                       | Cap. Range   | Apply Voltage   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
| 100           | 0603                                       | ≥0.082μF   | 1.5 times of U <sub>R</sub>   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
|               | 0805                                       | ≥0.12μF  |   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
| 200 & 250     | 0603                                       | ≥0.082μF   |   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |
|               | 1812                                       | ≥0.47μF  |   |               |               |     |      |                             |     |           |                             |     |      |                             |               |      |            |               |     |      |          |                             |      |         |           |      |          |      |         |   |

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.            | Item  | Test Condition  | Requirements  |            |             |               |   |                |               |                |             |
|----------------|---|---|---|------------|-------------|---------------|---|----------------|---------------|----------------|-------------|
| 13             | Resistance to Flexure of Substrate          | <p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 1mm.</p>  <p>Unit : mm</p>  | <p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Change</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td>Within ±3.0% or ±2.0pF, whichever is larger</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±12.5%</td> </tr> <tr> <td>Class II (Y5V)</td> <td>Within ±30%</td> </tr> </tbody> </table> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)</p> | Dielectric | Cap. Change | Class I (C0G) | Within ±3.0% or ±2.0pF, whichever is larger | Class II (X7R) | Within ±12.5% | Class II (Y5V) | Within ±30% |
| Dielectric     | Cap. Change                                 |   |   |            |             |               |   |                |               |                |             |
| Class I (C0G)  | Within ±3.0% or ±2.0pF, whichever is larger |   |   |            |             |               |   |                |               |                |             |
| Class II (X7R) | Within ±12.5%                               |   |   |            |             |               |   |                |               |                |             |
| Class II (Y5V) | Within ±30%                                 |   |   |            |             |               |   |                |               |                |             |
| 14.            | Adhesive Strength of Termination            | <p>* Capacitors mounted on a substrate. A force of 5N(≤0603) or 10N(&gt;0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.</p>  <p>Capacitor, P.C. Board, Pressurizing force</p> | <p>* No remarkable damage or removal of the terminations.</p>   |            |             |               |   |                |               |                |             |
| 15.            | Vibration Resistance                        | <p>* Vibration frequency : 10~55 Hz/min.<br/>                     * Total amplitude : 1.5mm.<br/>                     * Test time : 6 hrs. (Two hrs each in three mutually perpendicular directions)<br/>                     * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</p>           | <p>* No remarkable damage.<br/>                     * Cap. change and Q/D.F. : To meet the initial spec.</p>  |            |             |               |   |                |               |                |             |



**9. PACKAGE DIMENSION AND QUANTITY**

| Size       | Thickness (mm)   | Paper tape |          | Plastic tape |          |
|------------|------------------|------------|----------|--------------|----------|
|            |                  | 7" reel    | 13" reel | 7" reel      | 13" reel |
| 0201(0603) | 0.30±0.03        | 15k        | 70k      | -            | -        |
|            | 0.30±0.05        | 15k        | -        | -            | -        |
|            | 0.30±0.09        | 15k        | -        | -            | -        |
| 0402(1005) | 0.50±0.05        | 10k        | 50k      | -            | -        |
|            | 0.50 +0.02/-0.05 | 10k        | 50k      | -            | -        |
| 0603(1608) | 0.50±0.20        | 10k        | -        | -            | -        |
|            | 0.50±0.10        | 4k         | -        | -            | -        |
|            | 0.80±0.07        | 4k         | 15k      | -            | -        |
| 0805(2012) | 0.80 +0.15/-0.10 | 4k         | 15k      | -            | -        |
|            | 0.50±0.10        | 4k         | 15k      | -            | -        |
|            | 0.60±0.10        | 4k         | 15k      | -            | -        |
| 1206(3216) | 0.80±0.10        | 4k         | 15k      | -            | -        |
|            | 0.85±0.10        | 4k         | 15k      | -            | -        |
|            | 0.95±0.10        | -          | -        | 3k           | 10k      |
|            | 1.15±0.15        | -          | -        | 3k           | 10k      |
|            | 1.25±0.10        | -          | -        | 3k           | 10k      |
|            | 1.60±0.20        | -          | -        | 2k           | 10k      |
| 1210(3225) | 1.60 +0.30/-0.10 | -          | -        | 2k           | 9k       |
|            | 0.85±0.10        | -          | -        | 3k           | 10k      |
|            | 0.95±0.10        | -          | -        | 3k           | 10k      |
|            | 1.25±0.10        | -          | -        | 3k           | 10k      |
|            | 1.60±0.20        | -          | -        | 2k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | 6k       |
| 1808(4520) | 2.50±0.30        | -          | -        | 1k           | 6k       |
|            | 1.25±0.10        | -          | -        | 2k           | 10k      |
|            | 1.60±0.20        | -          | -        | 2k           | 8k       |
| 1812(4532) | 2.00±0.20        | -          | -        | 1k           | 6k       |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
|            | 2.50±0.30        | -          | -        | 0.5k         | 3k       |
|            | 2.80±0.30        | -          | -        | 0.5k         | -        |
| 1825(4563) | 1.60±0.20        | -          | -        | 1k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
|            | 2.50±0.30        | -          | -        | 0.5k         | -        |
| 2220(5750) | 2.80±0.30        | -          | -        | 0.5k         | -        |
|            | 1.60±0.20        | -          | -        | 1k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
|            | 2.50±0.30        | -          | -        | 0.5k         | -        |
| 2225(5763) | 2.80±0.30        | -          | -        | 0.5k         | -        |
|            | 1.60±0.20        | -          | -        | 1k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |

Unit : pcs

## 9. PACKAGE DIMENSION AND QUANTITY

### 9.1. EMBOSSED TAPE DIMENSIONS

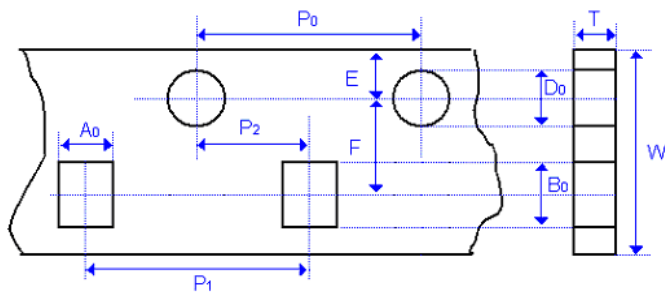


Fig. 9.1 The dimension of paper tape

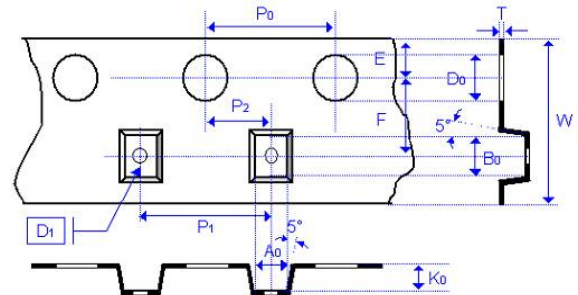


Fig. 9.2 The dimension of plastic tape

| Size              | 0201       | 0402                   | 0603             |                  | 0805       |                        |
|-------------------|------------|------------------------|------------------|------------------|------------|------------------------|
| Chip Thickness    | 0.30±0.03  | 0.50±0.05<br>0.50±0.10 | 0.80±0.07        | 0.80 +0.15/-0.1  | 0.80±0.10  | 1.25±0.10<br>1.25±0.20 |
| A <sub>0</sub>    | 0.39±0.07  | 0.70±0.20              | 1.00 +0.05/-0.10 | 1.02 +0.05/-0.10 | 1.50±0.10  | <1.65                  |
| B <sub>0</sub>    | 0.69±0.07  | 1.20±0.20              | 1.80±0.10        | 1.80±0.10        | 2.30±0.10  | <2.40                  |
| T                 | ≤0.50      | ≤0.80                  | 0.95±0.05        | 0.97±0.05        | 0.95±0.05  | 0.23±0.05              |
| K <sub>0</sub>    | -          | -                      | -                | -                | -          | <2.50                  |
| W                 | 8.00±0.10  | 8.00±0.10              | 8.00±0.10        | 8.00±0.10        | 8.00±0.10  | 8.00±0.10              |
| P <sub>0</sub>    | 4.00±0.10  | 4.00±0.10              | 4.00±0.10        | 4.00±0.10        | 4.00±0.10  | 4.00±0.10              |
| 10xP <sub>0</sub> | 40.00±0.10 | 40.00±0.10             | 40.00±0.20       | 40.00±0.20       | 40.00±0.20 | 40.00±0.20             |
| P <sub>1</sub>    | 2.00±0.05  | 2.00±0.05              | 4.00±0.10        | 4.00±0.10        | 4.00±0.10  | 4.00±0.10              |
| P <sub>2</sub>    | 2.00±0.05  | 2.00±0.05              | 2.00±0.05        | 2.00±0.05        | 2.00±0.05  | 2.00±0.05              |
| D <sub>0</sub>    | 1.55±0.05  | 1.55±0.05              | 1.55±0.05        | 1.55±0.05        | 1.55±0.05  | 1.50 +0.10/-0          |
| D <sub>1</sub>    | -          | -                      | -                | -                | -          | 1.00±0.10              |
| E                 | 1.75±0.05  | 1.75±0.05              | 1.75±0.05        | 1.75±0.05        | 1.75±0.05  | 1.75±0.10              |
| F                 | 3.50±0.05  | 3.50±0.05              | 3.50±0.05        | 3.50±0.05        | 3.50±0.05  | 3.50±0.05              |
| Unit :            | mm         | mm                     | mm               | mm               | mm         | mm                     |

| Size              | 1206       |                        |                            | 1210                                |               | 1812                                |               |
|-------------------|------------|------------------------|----------------------------|-------------------------------------|---------------|-------------------------------------|---------------|
| Chip Thickness    | 0.80±0.10  | 0.95±0.10<br>1.25±0.10 | 1.60±0.20<br>1.60±0.3/-0/1 | 0.95±0.10<br>1.25±0.10<br>1.60±0.20 | 2.50±0.30     | 1.25±0.10<br>1.60±0.20<br>2.00±0.20 | 2.50±0.30     |
| A <sub>0</sub>    | 2.00±0.10  | <2.00                  | <2.00                      | <3.05                               | <3.10         | <3.90                               | <3.90         |
| B <sub>0</sub>    | 3.50±0.10  | <3.60                  | <3.70                      | <3.80                               | <4.00         | <5.30                               | <5.30         |
| T                 | 0.95±0.05  | 0.23±0.05              | 0.23±0.05                  | 0.23±0.05                           | 0.23±0.05     | 0.25±0.05                           | 0.25±0.05     |
| K <sub>0</sub>    | -          | <2.50                  | <2.50                      | <2.50                               | <3.50         | <2.50                               | <3.00         |
| W                 | 8.00±0.10  | 8.00±0.10              | 8.00±0.10                  | 8.00±0.10                           | 8.00±0.10     | 12.00±0.20                          | 12.00±0.20    |
| P <sub>0</sub>    | 4.00±0.10  | 4.00±0.10              | 4.00±0.10                  | 4.00±0.10                           | 4.00±0.10     | 4.00±0.10                           | 4.00±0.10     |
| 10xP <sub>0</sub> | 40.00±0.20 | 40.00±0.20             | 40.00±0.20                 | 40.00±0.20                          | 40.0±0.20     | 40.00±0.20                          | 40.00±0.20    |
| P <sub>1</sub>    | 4.00±0.10  | 4.00±0.10              | 4.00±0.10                  | 4.00±0.10                           | 4.00±0.10     | 8.00±0.10                           | 8.00±0.10     |
| P <sub>2</sub>    | 2.00±0.05  | 2.00±0.05              | 2.00±0.05                  | 2.00±0.05                           | 2.00±0.05     | 2.00±0.05                           | 2.00±0.05     |
| D <sub>0</sub>    | 1.55±0.05  | 1.50 +0.10/-0          | 1.50 +0.10/-0              | 1.50 +0.10/-0                       | 1.50 +0.10/-0 | 1.50 +0.10/-0                       | 1.50 +0.10/-0 |
| D <sub>1</sub>    | -          | 1.00±0.10              | 1.00±0.10                  | 1.00±0.10                           | 1.00±0.10     | 1.50±0.10                           | 1.50±0.10     |
| E                 | 1.75±0.10  | 1.75±0.10              | 1.75±0.10                  | 1.75±0.10                           | 1.75±0.10     | 1.75±0.10                           | 1.75±0.10     |
| F                 | 3.50±0.05  | 3.50±0.05              | 3.50±0.05                  | 3.50±0.05                           | 3.50±0.05     | 5.50±0.05                           | 5.50±0.05     |
| Unit :            | mm         | mm                     | mm                         | mm                                  | mm            | mm                                  | mm            |

### 9. PACKAGE DIMENSION AND QUANTITY

| Size              | 1825                   |               | 2220                                |               | 2225                   |               |
|-------------------|------------------------|---------------|-------------------------------------|---------------|------------------------|---------------|
| Chip Thickness    | 1.60±0.20<br>2.00±0.20 | 2.50±0.30     | 1.40±0.15<br>1.60±0.20<br>2.00±0.20 | 2.50±0.30     | 1.60±0.20<br>2.00±0.20 | 2.50±0.30     |
| A <sub>0</sub>    | <6.80                  | <6.80         | <5.80                               | <5.80         | <6.80                  | <6.80         |
| B <sub>0</sub>    | <5.30                  | <5.30         | <6.50                               | <6.50         | <6.50                  | <6.50         |
| T                 | 0.30±0.10              | 0.30±0.10     | 0.30±0.10                           | 0.30±0.10     | 0.30±0.10              | 0.30±0.10     |
| K <sub>0</sub>    | <2.50                  | <3.10         | <2.50                               | <3.10         | <2.50                  | <3.10         |
| W                 | 12.00±0.20             | 12.00±0.20    | 12.00±0.20                          | 12.00±0.20    | 12.00±0.20             | 12.00±0.20    |
| P <sub>0</sub>    | 4.00±0.10              | 4.00±0.10     | 4.00±0.10                           | 4.00±0.10     | 4.00±0.10              | 4.00±0.10     |
| 10xP <sub>0</sub> | 40.00±0.20             | 40.00±0.20    | 40.00±0.20                          | 40.00±0.20    | 40.00±0.20             | 40.00±0.20    |
| P <sub>1</sub>    | 8.00±0.10              | 8.00±0.10     | 8.00±0.10                           | 8.00±0.10     | 8.00±0.10              | 8.00±0.10     |
| P <sub>2</sub>    | 2.00±0.05              | 2.00±0.05     | 2.00±0.05                           | 2.00±0.05     | 2.00±0.05              | 2.00±0.05     |
| D <sub>0</sub>    | 1.50 +0.10/-0          | 1.50 +0.10/-0 | 1.50 +0.10/-0                       | 1.50 +0.10/-0 | 1.50 +0.10/-0          | 1.50 +0.10/-0 |
| D <sub>1</sub>    | 1.50±0.10              | 1.50±0.10     | 1.50±0.10                           | 1.50±0.10     | 1.50±0.10              | 1.50±0.10     |
| E                 | 1.75±0.10              | 1.75±0.10     | 1.75±0.10                           | 1.75±0.10     | 1.75±0.10              | 1.75±0.10     |
| F                 | 5.50±0.05              | 5.50±0.05     | 5.50±0.05                           | 5.50±0.05     | 5.50±0.05              | 5.50±0.05     |
| Unit :            | mm                     | mm            | mm                                  | mm            | mm                     | mm            |

### 9.2. REEL DIMENSIONS

| Size           | 0201, 0402, 0603,<br>0805, 1206, 1210 |                   |                   | 1808, 1812, 1825,<br>2220, 2225 |
|----------------|---------------------------------------|-------------------|-------------------|---------------------------------|
| Reel size      | 7"                                    | 7"                | 13"               | 7"                              |
| C              | 13.0<br>+0.5/-0.2                     | 13.0<br>+0.5/-0.2 | 13.0<br>+0.5/-0.2 | 13.0<br>+0.5/-0.2               |
| W <sub>1</sub> | 8.4<br>+1.5/-0                        | 12.4<br>+2.0/-0   | 8.4<br>+1.5/-0    | 8.4<br>+1.5/-0                  |
| A              | 178.0<br>±0.10                        | 178.0<br>±0.10    | 330.0<br>±1.0     | 178.0<br>±0.10                  |
| N              | 60.0<br>+1.0/-0                       | 80.0<br>±1.0      | 100<br>±1.0       | 60.0<br>+1.0/-0                 |

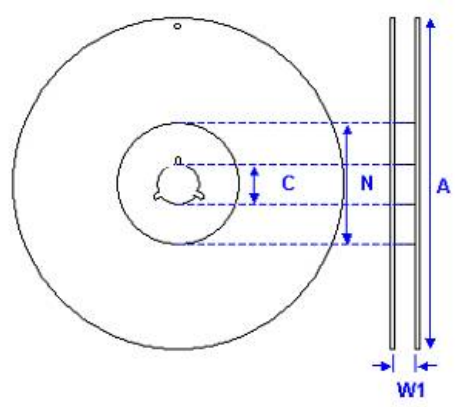


Fig. 9.3 The dimension of reel

**10. APPLICATION NOTES**

**STORAGE**

To prevent the damage of solderability of terminations, the following storage conditions are recommended :  
 Indoors under 5 ~ 40°C and 20% ~ 70% RH.

No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.

Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The product is recommended to be used within 12 months after shipment and checked the solderability before use.

**HANDLING**

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

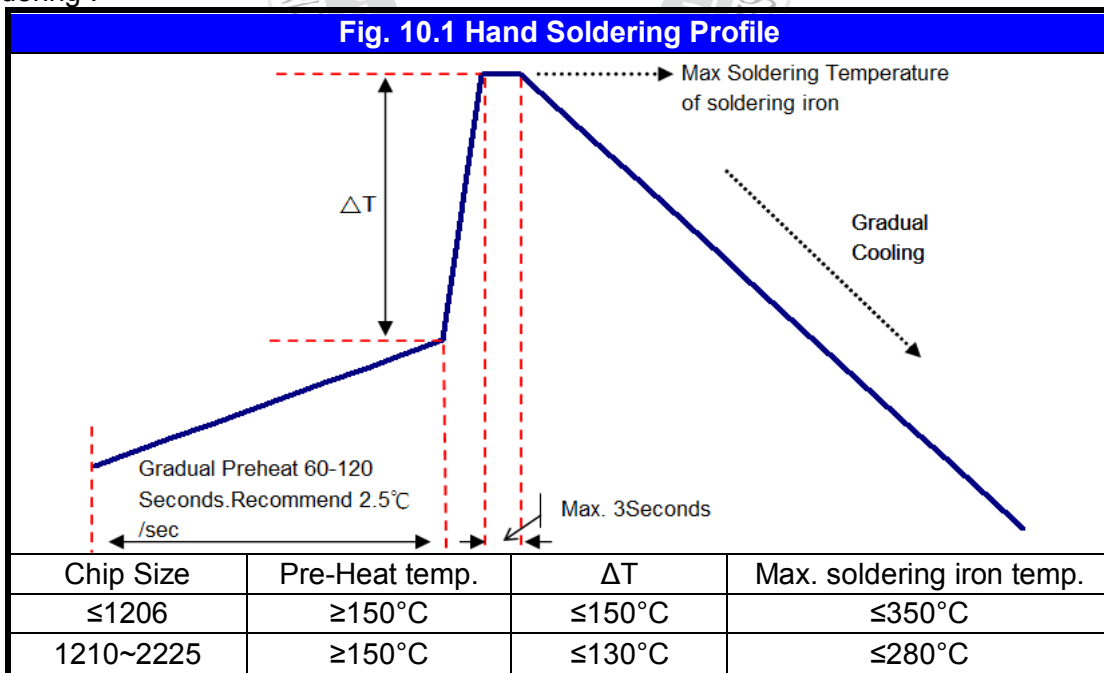
**PREHEAT**

In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

**SOLDERING**

Use middy activated rosin RA and RMA fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

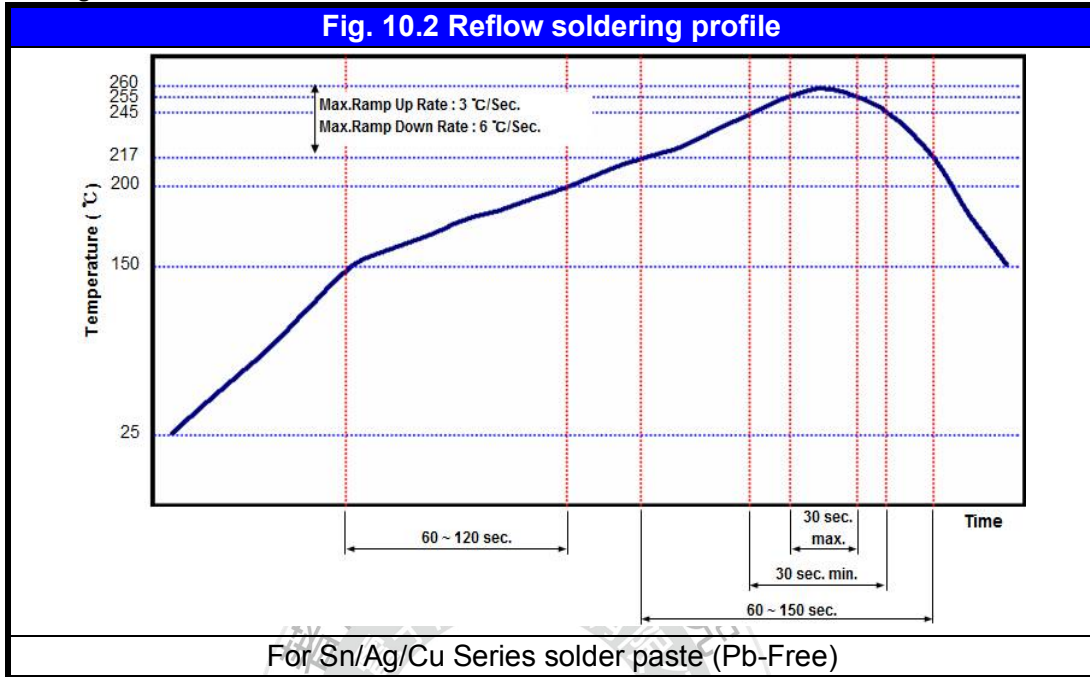
a.) Hand soldering :



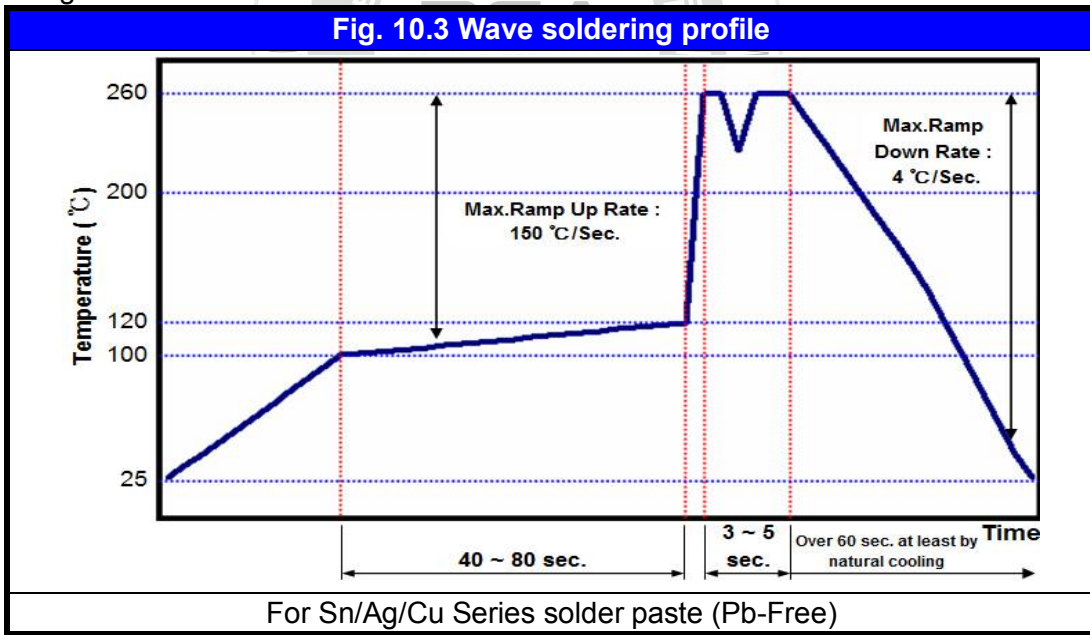
- \* Soldering iron tip diameter  $\leq 1.0$  mm and wattage max. 20W.
- \* The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.
- \* The required amount of solder shall be melted on the soldering tip.
- \* The tip of iron should not contact the ceramic body directly.
- \* The Capacitors shall be cooled gradually at room temperature after soldering.
- \* Forced air cooling is not allowed.

**10. APPLICATION NOTES**

b.) Reflow soldering :



c.) Wave soldering :



Soldering conditions :

Class I :

| Size Inch (mm) | Temper. Char. | Capacitance | Condition |        |
|----------------|---------------|-------------|-----------|--------|
|                |               |             | Wave      | Reflow |
| ≤0402 (1005)   | All Class I   | All         | X         | O      |
| 0603 (1608)    | All Class I   | All         | O         | O      |
| 0805 (2012)    | All Class I   | All         | O         | O      |
| 1206 (3216)    | All Class I   | All         | O         | O      |
| ≥1210 (3225)   | All Class I   | All         | X         | O      |



## 10. APPLICATION NOTES

Soldering conditions :  
 Class II :

| Size Inch (mm) | Temper. Cher. | Capacitance | Condition |        |
|----------------|---------------|-------------|-----------|--------|
|                |               |             | Wave      | Reflow |
| ≤0402 (1005)   | All Class II  | All         | X         | O      |
| 0603 (1608)    | All Class II  | Cap. <2.2μF | O         | O      |
|                |               | Cap. ≥2.2μF | X         | O      |
| 0805 (2012)    | All Class II  | Cap. <4.7μF | O         | O      |
|                |               | Cap. ≥4.7μF | X         | O      |
| 1206 (3216)    | All Class II  | Cap. <4.7μF | O         | O      |
|                |               | Cap. ≥4.7μF | X         | O      |
| ≥1210 (3225)   | All Class II  | All         | X         | O      |

Soldering height :

The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less.  
 (Reference from IPC-610E)

The diagram illustrates a cross-section of a chip on a substrate. The chip is shown in yellow and grey. A vertical double-headed arrow on the left indicates the 'Chip Thickness'. A horizontal double-headed arrow on the right indicates the 'Soldering Height', which is the height of the solder joint between the chip and the substrate.

### COOLING

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint.

### CLEANING

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.



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[KHC201E225M76N0T00](#) [LRC-LRF1206LF-01R025FTR1K](#) [1812J1K00222JCT](#) [1812J2K00102KXT](#) [1812J2K00222KXT](#)  
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[CGA2B2C0G1H040C](#) [CGA2B2C0G1H050C](#) [CGA2B2C0G1H060D](#) [CGA2B2C0G1H070D](#) [CGA2B2C0G1H151J](#) [CGA2B2C0G1H1R5C](#)  
[CGA2B2C0G1H2R2C](#) [CGA2B2C0G1H3R3C](#) [CGA2B2C0G1H680J](#) [CGA2B2C0G1H6R8D](#) [CGA2B2X8R1H221K](#) [CGA2B2X8R1H472K](#)  
[CGA3E1X7R1C474K](#)