



信昌電子陶瓷股份有限公司  
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**Messrs. :** 一般共用

**Date :** \_\_\_\_\_

# APPROVAL SHEET

**Product Name :** High-Voltage Multilayer Ceramic Chip Capacitors

**Part No. :** FV Series

**Description :** Size 0805~2225, C0G/X7R, 1000Vdc to 4000Vdc

| PREPARED BY                              | APPROVED BY                              |
|--|--|
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# SPECIFICATION

FOR

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|   |
|---|
| <b>SPEC. No.</b> : <u>FV-000-001-06</u> |
| <b>DATE</b> :                           |

| DRAWN BY          | CHECEKED BY       | APPROVED BY      |
|-------------------|-------------------|------------------|
| <b>Yvens Chou</b> | <b>Yvens Chou</b> | <b>Ryan Chen</b> |



# 1. INTRODUCTION

PDC FV Series green type capacitors are manufactured by using environmental friendly material without lead or cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. This special design can distribute voltage gradients throughout the entire capacitor, so as to prevent short circuit failure. It is a safety design for LCD back-lighting inverter application.

## 2. FEATURES

- a. Special interior design offers high voltage rating 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. LAN/WLAN interface.
- e. Modem.
- f. Power supplies.

## 4. HOW TO ORDER

| <b>FV</b>  | <b>31</b> | <b>X</b>   | <b>103</b>  | <b>K</b>  | <b>102</b>    | <b>E</b>  | <b>C</b>  | <b>G</b>     |
|------------|-----------|------------|-------------|-----------|---------------|-----------|-----------|--------------|
| PDC Family | Size      | Dielectric | Capacitance | Tolerance | Rated Voltage | Packaging | Thickness | Control Code |
| Table 1    | Table 2   | Table 3    | Table 4     | Table 5   | Table 6       | Table 7   | Table 8   | Table 9      |

| Table 1 PDC Family |   |
|--------------------|---|
| Code               | Description                                       |
| FV                 | High voltage application with $\geq 1\text{KVdc}$ |

| 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 3 Dielectric Material Characteristics |             |      |             |
|---|-------------|------|-------------|
| Code  | Description | Code | Description |
| N   | C0G         | X    | X7R         |
| B   | X5R         | F    | Y5V         |

| Table 4 Capacitance Rule Code |                                  |      |                                    |
|-------------------------------|----------------------------------|------|------------------------------------|
| Code                          | Description                      | Code | Description                        |
| R47                           | 0.47pF                           | 102  | $102=10 \times 10^2=1000\text{pF}$ |
| 0R5                           | 0.5pF                            | 104  | $104=10 \times 10^4=100\text{nF}$  |
| 100                           | $100=10 \times 10^0=10\text{pF}$ | 106  | $106=10 \times 10^6=10\mu\text{F}$ |

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

| Table 6 Rated Voltage |             |      |             |      |             |
|-----------------------|-------------|------|-------------|------|-------------|
| Code                  | Description | Code | Description | Code | Description |
| 6R3                   | 6.3VDC      | 201  | 200VDC      | 152  | 1500VDC     |
| 100                   | 10VDC       | 251  | 250VDC      | 202  | 2000VDC     |
| 160                   | 16VDC       | 401  | 400VDC      | 302  | 3000VDC     |
| 250                   | 25VDC       | 501  | 500VDC      | 402  | 4000VDC     |
| 500                   | 50VDC       | 631  | 630VDC      | 502  | 5000VDC     |
| 101                   | 100VDC      | 102  | 1000VDC     | 602  | 6000VDC     |

| 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 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 9 Special Control Code |                                  |
|------------------------------|----------------------------------|
| Code                         | Description                      |
| G                            | RoHS Compliant                   |
| Q                            | Surface Coating (size 1206~2225) |

## 5. EXTERNAL DIMENSIONS

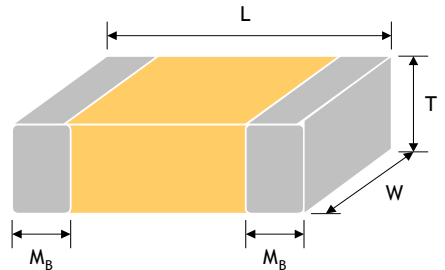
| Size Inch (mm) | L (mm)           | W (mm)    | Code / T (mm)              | M <sub>B</sub> (mm) |   |
|----------------|------------------|-----------|----------------------------|---------------------|---|
| 0805(2012)     | 2.10±0.20        | 1.25±0.20 | See No.4 Reference Table 8 | 0.50±0.20           |  |
| 1206(3216)     | 3.30±0.30        | 1.60±0.20 |                            | 0.60±0.20           |   |
| 1210(3225)     | 3.30±0.40        | 2.50±0.30 |                            | 0.75±0.35           |   |
| 1808(4520)     | 4.50 +0.50/-0.30 | 2.00±0.25 |                            | 0.75±0.35           |   |
| 1812(4532)     | 4.50 +0.50/-0.30 | 3.20±0.30 |                            | 0.75±0.35           |   |
| 1825(4563)     | 4.50 +0.50/-0.30 | 6.30±0.40 |                            | 0.75±0.35           |   |
| 2211(5728)     | 5.70±0.40        | 2.80±0.30 |                            | 0.85±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

## 6. GENERAL ELECTRICAL DATA

| Dielectric                              | C0G  | X7R  |                |             |                         |             |                         |  |
|---|--|--|----------------|-------------|-------------------------|-------------|-------------------------|--|
| Size                                    | 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225   | 0805, 1206, 1210, 1808, 1812, 1825, 2211, 2220, 2225   |                |             |                         |             |                         |  |
| Rated voltage (WVDC)                    | 1000V, 1500V, 2000V, 3000V, 4000V  | 1000V, 1500V, 2000V, 3000V, 4000V  |                |             |                         |             |                         |  |
| Capacitance range*                      | 1.5pF ~ 12nF   | 100pF ~ 390nF  |                |             |                         |             |                         |  |
| Capacitance tolerance                   | Reference to Table 5   | Reference to Table 5   |                |             |                         |             |                         |  |
| 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%  |
| Cap. Rang                               | Q Spec.  |  |                |             |                         |             |                         |  |
| Cap.<30pF                               | Q≥400+20C  |  |                |             |                         |             |                         |  |
| Cap.≥30pF                               | Q≥1000   |  |                |             |                         |             |                         |  |
| Capacitance & Tan δ Test condition      | Measured at the condition of 30~70% related humidity   |  |                |             |                         |             |                         |  |
|   | For 25°C at ambient temperature  | 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 |                |             |                         |             |                         |  |
|   | <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% | 1.0±0.2Vrms, 1.0kHz±10%, at 25°C ambient temperature |
| 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 U <sub>r</sub> | ≥100GΩ or RxC≥500Ω-F, whichever is smaller   | ≥10GΩ or RxC≥100Ω-F, whichever is smaller  |                |             |                         |             |                         |  |
| Operating temperature                   | -55°C to +125°C  |  |                |             |                         |             |                         |  |
| Capacitance characteristic              | ±30ppm/°C  | ±15%   |                |             |                         |             |                         |  |
| Termination                             | Cu(or Ag)/Ni/Sn (lead-free termination)  |  |                |             |                         |             |                         |  |

## 7. CAPACITANCE RANGE

### 7-1. C0G

| Dimension |      | 0805  | 1206  |       |       |       | 1210  |       |       |       |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Cap.(pF)  | code | 1000V | 1000V | 1500V | 2000V | 3000V | 1000V | 1500V | 2000V | 3000V |
| 1.5       | 1R5  | C     | X     | X     | X     |       |       |       |       |       |
| 1.8       | 1R8  | C     | X     | X     | X     |       |       |       |       |       |
| 2.2       | 2R2  | C     | X     | X     | X     |       |       |       |       |       |
| 2.7       | 2R7  | C     | X     | X     | X     |       |       |       |       |       |
| 3.3       | 3R3  | C     | X     | X     | X     |       |       |       |       |       |
| 3.9       | 3R9  | C     | X     | X     | X     |       |       |       |       |       |
| 4.7       | 4R7  | C     | X     | X     | X     |       |       |       |       |       |
| 5.0       | 5R0  | C     | X     | X     | X     |       |       |       |       |       |
| 5.6       | 5R6  | C     | X     | X     | X     |       |       |       |       |       |
| 6.8       | 6R8  | C     | X     | X     | X     |       |       |       |       |       |
| 8.2       | 8R2  | C     | X     | X     | X     |       |       |       |       |       |
| 10        | 100  | C     | X     | X     | X     | E     | M     | M     | M     | F     |
| 12        | 120  | C     | X     | X     | X     | E     | M     | M     | M     | F     |
| 15        | 150  | C     | X     | X     | X     | E     | M     | M     | M     | F     |
| 18        | 180  | C     | X     | X     | X     | E     | M     | M     | M     | F     |
| 22        | 220  | C     | X     | X     | X     | E     | M     | M     | M     | F     |
| 27        | 270  | C     | X     | X     | X     | E     | M     | M     | M     | F     |
| 33        | 330  | C     | X     | M     | M     | E     | M     | M     | M     | F     |
| 39        | 390  | C     | X     | M     | M     | E     | M     | M     | M     | F     |
| 47        | 470  | C     | M     | M     | M     | E     | M     | M     | M     | F     |
| 56        | 560  | C     | M     | C     | C     | E     | M     | C     | C     | F     |
| 68        | 680  | C     | M     | C     | C     | E     | M     | C     | C     | F     |
| 82        | 820  | C     | C     | C     | C     | E     | M     | C     | C     | F     |
| 100       | 101  | C     | C     | C     | C     |       | C     | C     | C     | F     |
| 120       | 121  | C     | C     | E     | E     |       | C     | C     | C     | F     |
| 150       | 151  | C     | C     | E     | E     |       | C     | E     | E     | F     |
| 180       | 181  | C     | E     | E     | E     |       | C     | E     | E     | F     |
| 220       | 221  | C     | E     | E     | E     |       | E     | E     | E     | F     |
| 270       | 271  | C     | E     | E     | E     |       | E     | E     | E     | G     |
| 330       | 331  | C     | E     | E     | E     |       | E     | E     | E     |       |
| 390       | 391  |       | E     | E     | E     |       | E     | E     | E     |       |
| 470       | 471  |       | E     | E     | E     |       | E     | E     | E     |       |
| 560       | 561  |       | E     |       |       |       | E     | E     | E     |       |
| 680       | 681  |       | E     |       |       |       | E     | E     | E     |       |
| 820       | 821  |       | E     |       |       |       | E     | E     | E     |       |
| 1000      | 102  |       | E     |       |       |       | E     | F     | F     |       |
| 1200      | 122  |       | E     |       |       |       | E     | F     | F     |       |
| 1500      | 152  |       |       |       |       |       | F     | G     | G     |       |
| 1800      | 182  |       |       |       |       |       | G     | G     | G     |       |
| 2200      | 222  |       |       |       |       |       | G     |       |       |       |
| 2700      | 272  |       |       |       |       |       | G     |       |       |       |
| 3300      | 332  |       |       |       |       |       | G     |       |       |       |
| 3900      | 392  |       |       |       |       |       | G     |       |       |       |

## 7. CAPACITANCE RANGE(Con.)

### 7-1. C0G

| Dimension |      | 1808  |       |       |       | 1812  |       |       |       | 1825  |       |       |       |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Cap.(pF)  | code | 1000V | 1500V | 2000V | 3000V | 1000V | 1500V | 2000V | 3000V | 1000V | 1500V | 2000V | 3000V |
| 1.5       | 1R5  |       |       |       |       |       |       |       |       |       |       |       |       |
| 1.8       | 1R8  |       |       |       |       |       |       |       |       |       |       |       |       |
| 2.2       | 2R2  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 2.7       | 2R7  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 3.3       | 3R3  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 3.9       | 3R9  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 4.7       | 4R7  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 5.0       | 5R0  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 5.6       | 5R6  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 6.8       | 6R8  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 8.2       | 8R2  | C     | C     | C     | C     |       |       |       |       |       |       |       |       |
| 10        | 100  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 12        | 120  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 15        | 150  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 18        | 180  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 22        | 220  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 27        | 270  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 33        | 330  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 39        | 390  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 47        | 470  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 56        | 560  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 68        | 680  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 82        | 820  | C     | C     | C     | C     | C     | C     | C     | C     | F     | F     | F     | F     |
| 100       | 101  | C     | C     | C     | F     | C     | C     | C     | C     | F     | F     | F     | F     |
| 120       | 121  | C     | C     | C     | F     | C     | C     | C     | C     | F     | F     | F     | F     |
| 150       | 151  | C     | F     | F     | F     | C     | C     | C     | C     | F     | F     | F     | F     |
| 180       | 181  | C     | F     | F     | F     | C     | C     | C     | F     | F     | F     | F     | F     |
| 220       | 221  | C     | F     | F     | F     | C     | C     | C     | F     | F     | F     | F     | F     |
| 270       | 271  | F     | F     | F     | F     | C     | F     | F     | F     | F     | F     | F     | F     |
| 330       | 331  | F     | F     | F     | F     | C     | F     | F     | F     | F     | F     | F     | F     |
| 390       | 391  | F     | F     | F     | F     | C     | F     | F     | F     | F     | F     | F     | F     |
| 470       | 471  | 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     |
| 680       | 681  | F     | F     | F     |       | F     | F     | F     | F     | F     | F     | F     | G     |
| 820       | 821  | F     | F     | F     |       | F     | F     | F     | G     | F     | F     | F     | G     |
| 1000      | 102  | F     | F     | F     |       | F     | F     | F     | G     | F     | F     | F     | G     |
| 1200      | 122  | F     | F     | F     |       | F     | F     | F     |       | F     | F     | F     | G     |
| 1500      | 152  | F     | F     | F     |       | F     | F     | F     |       | F     | G     | G     | G     |
| 1800      | 182  | F     | F     | F     |       | F     | F     | F     |       | F     | G     | G     | G     |
| 2200      | 222  | F     |       |       |       | F     | F     | F     |       | F     | G     | G     | G     |
| 2700      | 272  | F     |       |       |       | F     | G     | G     |       | F     | G     | G     | G     |
| 3300      | 332  | F     |       |       |       | F     | G     | G     |       | F     | G     | G     |       |
| 3900      | 392  |       |       |       |       | G     |       |       |       | G     | G     | G     |       |
| 4700      | 472  |       |       |       |       | G     |       |       |       | G     | G     | G     |       |
| 5600      | 562  |       |       |       |       | G     |       |       |       | G     | G     | G     |       |
| 6800      | 682  |       |       |       |       |       |       |       |       | G     | G     | G     |       |
| 8200      | 822  |       |       |       |       |       |       |       |       | G     | G     | G     |       |
| 10000     | 103  |       |       |       |       |       |       |       |       | G     |       |       |       |
| 12000     | 123  |       |       |       |       |       |       |       |       | G     |       |       |       |

## 7. CAPACITANCE RANGE(Con.)

### 7-1. C0G

| Dimension |      | 2220  |       |       |       |       | 2225  |       |       |       |       |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Cap.(pF)  | code | 1000V | 1500V | 2000V | 3000V | 4000V | 1000V | 1500V | 2000V | 3000V | 4000V |
| 1.5       | 1R5  |       |       |       |       |       |       |       |       |       |       |
| 1.8       | 1R8  |       |       |       |       |       |       |       |       |       |       |
| 2.2       | 2R2  |       |       |       |       |       |       |       |       |       |       |
| 2.7       | 2R7  |       |       |       |       |       |       |       |       |       |       |
| 3.3       | 3R3  |       |       |       |       |       |       |       |       |       |       |
| 3.9       | 3R9  |       |       |       |       |       |       |       |       |       |       |
| 4.7       | 4R7  |       |       |       |       |       |       |       |       |       |       |
| 5.0       | 5R0  |       |       |       |       |       |       |       |       |       |       |
| 5.6       | 5R6  |       |       |       |       |       |       |       |       |       |       |
| 6.8       | 6R8  |       |       |       |       |       |       |       |       |       |       |
| 8.2       | 8R2  |       |       |       |       |       |       |       |       |       |       |
| 10        | 100  | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 12        | 120  | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 15        | 150  | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 18        | 180  | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 22        | 220  | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 27        | 270  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 33        | 330  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 39        | 390  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 47        | 470  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 56        | 560  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 68        | 680  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 82        | 820  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 100       | 101  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 120       | 121  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 150       | 151  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 180       | 181  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 220       | 221  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 270       | 271  | F     | F     | F     | F     | G     | F     | F     | F     | F     | G     |
| 330       | 331  | F     | F     | F     | G     | G     | F     | F     | F     | F     |       |
| 390       | 391  | F     | F     | F     | G     |       | F     | F     | F     | F     |       |
| 470       | 471  | F     | F     | F     | G     |       | F     | F     | F     | F     |       |
| 560       | 561  | F     | F     | F     | G     |       | F     | F     | F     | F     |       |
| 680       | 681  | F     | F     | F     | G     |       | F     | F     | F     | F     |       |
| 820       | 821  | F     | F     | F     | G     |       | F     | G     | G     | G     |       |
| 1000      | 102  | F     | F     | F     | G     |       | F     | G     | G     | G     |       |
| 1200      | 122  | G     | G     | G     | G     |       | F     | G     | G     | G     |       |
| 1500      | 152  | G     | G     | G     | G     |       | F     | G     | G     | G     |       |
| 1800      | 182  | G     | G     | G     | G     |       | F     | G     | G     | G     |       |
| 2200      | 222  | G     | G     | G     | G     |       | F     | G     | G     | G     |       |
| 2700      | 272  | G     | G     | G     | G     |       | F     | G     | G     | G     |       |
| 3300      | 332  | G     | G     | G     |       |       | F     | G     | G     | G     |       |
| 3900      | 392  | G     | G     | G     |       |       | F     | G     | G     |       |       |
| 4700      | 472  | G     | G     | G     |       |       | F     | G     | G     |       |       |
| 5600      | 562  | G     | G     | G     |       |       | G     | G     | G     |       |       |
| 6800      | 682  | G     | G     | G     |       |       | G     | G     | G     |       |       |
| 8200      | 822  | G     | G     | G     |       |       | G     | G     | G     |       |       |
| 10000     | 103  | G     |       |       |       |       | G     | G     | G     |       |       |
| 12000     | 123  | G     |       |       |       |       | G     |       |       |       |       |

## 7. CAPACITANCE RANGE(Con.)

### 7-2. X7R

| Dimension |      | 0805  |       |       |       | 1206  |       |       |       | 1210  |       |       | 1808  |       |       |       |  |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| Cap.(pF)  | code | 1000V | 1000V | 1500V | 2000V | 1000V | 1500V | 2000V | 1000V | 1500V | 2000V | 1000V | 1500V | 2000V | 3000V | 4000V |  |
| 100       | 101  | X     | C     | C     | C     |       |       |       |       |       |       |       |       |       |       |       |  |
| 120       | 121  | X     | C     | C     | C     |       |       |       |       |       |       |       |       |       |       |       |  |
| 150       | 151  | X     | C     | C     | C     |       |       |       |       |       |       | C     | C     | C     | C     | F     |  |
| 180       | 181  | X     | C     | C     | C     |       |       |       |       |       |       | C     | C     | C     | C     | F     |  |
| 220       | 221  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | C     | F     |  |
| 270       | 271  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | C     | F     |  |
| 330       | 331  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | F     | F     |  |
| 390       | 391  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | F     | F     |  |
| 470       | 471  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | F     | F     |  |
| 560       | 561  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | F     | F     |  |
| 680       | 681  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | F     | F     |  |
| 820       | 821  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | F     | F     |  |
| 1000      | 102  | X     | C     | C     | C     | C     | E     | E     | C     | C     | C     | C     | C     | C     | F     | F     |  |
| 1200      | 122  | X     | C     | E     | E     | C     | F     | F     | C     | F     | F     | F     | F     | F     | F     |       |  |
| 1500      | 152  | C     | C     | E     | E     | C     | F     | F     | C     | F     | F     | F     | F     | F     | F     |       |  |
| 1800      | 182  | C     | C     | E     | E     | C     | F     | F     | C     | F     | F     | F     | F     | F     | F     |       |  |
| 2200      | 222  | C     | C     | E     | E     | C     | F     | F     | C     | F     | F     | F     | F     | F     | F     |       |  |
| 2700      | 272  | C     | C     | E     | E     | C     | G     | G     | C     | F     | F     | F     | F     | F     | F     |       |  |
| 3300      | 332  | C     | C     | E     | E     | C     | G     | G     | C     | F     | F     | F     | F     | F     | F     |       |  |
| 3900      | 392  | C     | C     | E     |       | E     | G     | G     | C     | F     | F     | F     | F     | F     | F     |       |  |
| 4700      | 472  | C     | C     | E     |       | E     | G     | G     | C     | F     | F     | F     | F     | F     | F     |       |  |
| 5600      | 562  | C     | C     |       |       | E     | G     | G     | F     | F     | F     | F     | F     | F     | F     |       |  |
| 6800      | 682  | C     | C     |       |       | E     | G     | G     | F     | F     | F     | F     | F     | F     | F     |       |  |
| 8200      | 822  | C     | C     |       |       | E     | G     | G     | F     | F     | F     | F     | F     | F     | F     |       |  |
| 10000     | 103  |       | C     |       |       | E     |       |       | F     |       |       |       |       |       |       |       |  |
| 12000     | 123  |       | E     |       |       | E     |       |       | F     |       |       |       |       |       |       |       |  |
| 15000     | 153  |       | E     |       |       | E     |       |       | F     |       |       |       |       |       |       |       |  |
| 18000     | 183  |       | E     |       |       | E     |       |       | F     |       |       |       |       |       |       |       |  |
| 22000     | 223  |       | E     |       |       | E     |       |       | F     |       |       |       |       |       |       |       |  |
| 27000     | 273  |       |       |       |       | E     |       |       | F     |       |       |       |       |       |       |       |  |
| 33000     | 333  |       |       |       |       | E     |       |       | F     |       |       |       |       |       |       |       |  |
| 39000     | 393  |       |       |       |       | F     |       |       | F     |       |       |       |       |       |       |       |  |
| 47000     | 473  |       |       |       |       | G     |       |       | F     |       |       |       |       |       |       |       |  |
| 56000     | 563  |       |       |       |       | G     |       |       | F     |       |       |       |       |       |       |       |  |
| 68000     | 683  |       |       |       |       | G     |       |       |       |       |       |       |       |       |       |       |  |



## 7. CAPACITANCE RANGE(Con.)

### 7-2. X7R

| Dimension |      | 1812  |       |       |       |       | 1825  |       |       |       |       |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Cap.(pF)  | code | 1000V | 1500V | 2000V | 3000V | 4000V | 1000V | 1500V | 2000V | 3000V | 4000V |
| 270       | 271  | C     | C     | C     | E     | F     |       |       |       |       | F     |
| 330       | 331  | C     | C     | C     | E     | F     |       |       |       |       | F     |
| 390       | 391  | C     | C     | C     | E     | F     |       |       |       |       | F     |
| 470       | 471  | C     | C     | C     | E     | F     |       |       |       |       | F     |
| 560       | 561  | C     | C     | C     | E     | F     |       |       |       |       | F     |
| 680       | 681  | C     | C     | C     | F     | F     |       |       |       |       | F     |
| 820       | 821  | C     | C     | C     | F     | F     |       |       |       |       | F     |
| 1000      | 102  | C     | C     | C     | F     | F     | F     | F     | F     | F     | F     |
| 1200      | 122  | C     | C     | C     | F     | G     | F     | F     | F     | F     | G     |
| 1500      | 152  | C     | C     | C     | F     | G     | F     | F     | F     | F     | G     |
| 1800      | 182  | C     | E     | E     | G     | G     | F     | F     | F     | F     | G     |
| 2200      | 222  | C     | E     | E     | G     |       | F     | F     | F     | F     |       |
| 2700      | 272  | C     | E     | E     | G     |       | F     | F     | F     | F     |       |
| 3300      | 332  | C     | F     | F     | G     |       | F     | F     | F     | F     |       |
| 3900      | 392  | C     | F     | F     | G     |       | F     | F     | F     | F     |       |
| 4700      | 472  | C     | F     | F     | G     |       | F     | F     | F     | F     |       |
| 5600      | 562  | C     | G     | G     |       |       | F     | F     | F     | G     |       |
| 6800      | 682  | C     | G     | G     |       |       | F     | F     | F     | G     |       |
| 8200      | 822  | C     | G     | G     |       |       | F     | F     | F     | G     |       |
| 10000     | 103  | E     | G     | G     |       |       | F     | F     | F     | G     |       |
| 12000     | 123  | F     |       |       |       |       | F     | G     | G     | H     |       |
| 15000     | 153  | F     |       |       |       |       | F     | G     | G     | H     |       |
| 18000     | 183  | G     |       |       |       |       | F     | G     | G     | H     |       |
| 22000     | 223  | G     |       |       |       |       | F     | G     | G     |       |       |
| 27000     | 273  | G     |       |       |       |       | F     | H     | H     |       |       |
| 33000     | 333  | G     |       |       |       |       | F     | H     | H     |       |       |
| 39000     | 393  | G     |       |       |       |       | F     | H     | H     |       |       |
| 47000     | 473  | G     |       |       |       |       | F     | H     | H     |       |       |
| 56000     | 563  | G     |       |       |       |       | F     | H     | H     |       |       |
| 68000     | 683  | G     |       |       |       |       | F     |       |       |       |       |
| 82000     | 823  | G     |       |       |       |       | G     |       |       |       |       |
| 100000    | 104  | G     |       |       |       |       | G     |       |       |       |       |
| 120000    | 124  |       |       |       |       |       | H     |       |       |       |       |
| 150000    | 154  |       |       |       |       |       | H     |       |       |       |       |
| 180000    | 184  |       |       |       |       |       | H     |       |       |       |       |
| 220000    | 224  |       |       |       |       |       | H     |       |       |       |       |
| 270000    | 274  |       |       |       |       |       | H     |       |       |       |       |
| 330000    | 334  |       |       |       |       |       | H     |       |       |       |       |

## 7. CAPACITANCE RANGE(Con.)

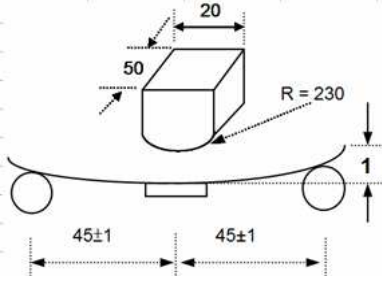
### 7-2. X7R

| Dimension |      | 2211  |       | 2220  |       |       |       |       | 2225  |       |       |       |       |
|-----------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Cap.(pF)  | code | 3000V | 4000V | 1000V | 1500V | 2000V | 3000V | 4000V | 1000V | 1500V | 2000V | 3000V | 4000V |
| 270       | 271  | F     | F     |       |       |       |       | F     |       |       |       |       | F     |
| 330       | 331  | F     | F     |       |       |       |       | F     |       |       |       |       | F     |
| 390       | 391  | F     | F     |       |       |       |       | F     |       |       |       |       | F     |
| 470       | 471  | F     | F     |       |       |       |       | F     |       |       |       |       | F     |
| 560       | 561  | F     | F     |       |       |       |       | F     |       |       |       |       | F     |
| 680       | 681  | F     | F     |       |       |       |       | F     |       |       |       |       | F     |
| 820       | 821  | F     | F     |       |       |       |       | F     |       |       |       |       | F     |
| 1000      | 102  | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     | F     |
| 1200      | 122  | G     | G     | F     | F     | F     | F     | G     | F     | F     | F     | F     | G     |
| 1500      | 152  | G     | G     | F     | F     | F     | F     | G     | F     | F     | F     | F     | G     |
| 1800      | 182  | G     | G     | F     | F     | F     | F     | G     | F     | F     | F     | F     | G     |
| 2200      | 222  | G     |       | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 2700      | 272  | G     |       | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 3300      | 332  | G     |       | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 3900      | 392  |       |       | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 4700      | 472  |       |       | F     | F     | F     | F     |       | F     | F     | F     | F     |       |
| 5600      | 562  |       |       | F     | F     | F     | F     |       | F     | F     | F     | G     |       |
| 6800      | 682  |       |       | F     | F     | F     | G     |       | F     | F     | F     | G     |       |
| 8200      | 822  |       |       | F     | G     | G     | G     |       | F     | F     | F     | G     |       |
| 10000     | 103  |       |       | F     | G     | G     | G     |       | F     | F     | F     | G     |       |
| 12000     | 123  |       |       | F     | G     | G     | H     |       | F     | G     | G     | G     |       |
| 15000     | 153  |       |       | F     | G     | G     | H     |       | F     | G     | G     | G     |       |
| 18000     | 183  |       |       | F     | H     | H     | H     |       | F     | G     | G     | H     |       |
| 22000     | 223  |       |       | F     | H     | H     |       |       | F     | G     | G     |       |       |
| 27000     | 273  |       |       | F     | H     | H     |       |       | F     | G     | G     |       |       |
| 33000     | 333  |       |       | F     | H     | H     |       |       | F     | G     | G     |       |       |
| 39000     | 393  |       |       | F     | H     | H     |       |       | F     | G     | H     |       |       |
| 47000     | 473  |       |       | F     | H     | H     |       |       | F     | G     | H     |       |       |
| 56000     | 563  |       |       | F     | H     | H     |       |       | F     | G     | H     |       |       |
| 68000     | 683  |       |       | G     |       |       |       |       | F     | G     |       |       |       |
| 82000     | 823  |       |       | G     |       |       |       |       | F     | G     |       |       |       |
| 100000    | 104  |       |       | G     |       |       |       |       | G     | G     |       |       |       |
| 120000    | 124  |       |       | G     |       |       |       |       | H     |       |       |       |       |
| 150000    | 154  |       |       | H     |       |       |       |       | H     |       |       |       |       |
| 180000    | 184  |       |       | H     |       |       |       |       | H     |       |       |       |       |
| 220000    | 224  |       |       | H     |       |       |       |       | H     |       |       |       |       |
| 270000    | 274  |       |       | H     |       |       |       |       | H     |       |       |       |       |
| 330000    | 334  |       |       | H     |       |       |       |       | H     |       |       |       |       |
| 390000    | 394  |       |       | H     |       |       |       |       | H     |       |       |       |       |

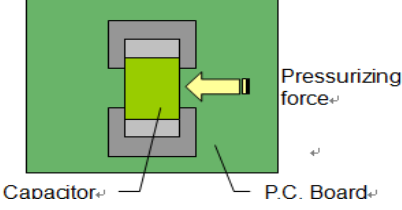
## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.            | Item   | Test Condition  | Requirements   |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
|----------------|--|---|--|-----------------|----------------|-------------------|----------------------------|--|--|----------------|--------------------|-----------|--|----------------|---|------------|-----|---|------------|------|-------------|--------|---------------|-----------------------------|--|-------------------------------|----------------|--------------|----------------------------------|
| 1.             | Visual and Dimensions                        | ---   | * No remarkable defect.<br>* Dimensions to conform 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<br>1.0±0.2Vrms, 1KHz±10%.   | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Rated Vol.(V)</th> <th>Q/D.F.</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I (C0G)</td> <td rowspan="2">All</td> <td>Q≥1000</td> <td>Cap.≥30pF</td> </tr> <tr> <td>Q≥400+20C</td> <td>Cap.&lt;30pF</td> </tr> <tr> <td>Class II (X7R)</td> <td>All</td> <td>D.F.≤2.5%</td> <td></td> </tr> </tbody> </table>                 | Dielectric      | Rated Vol.(V)  | Q/D.F.            | Remark                     | Class I (C0G)                                | All  | Q≥1000         | Cap.≥30pF          | Q≥400+20C | Cap.<30pF                                  | Class II (X7R) | All                                       | D.F.≤2.5%  |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Dielectric     | Rated Vol.(V)                                | Q/D.F.  | Remark   |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Class I (C0G)  | All  | Q≥1000  | Cap.≥30pF  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
|                |  | Q≥400+20C   | Cap.<30pF  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Class II (X7R) | All  | D.F.≤2.5%   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| 4.             | Temperature Coefficient                      | * With no electrical load.<br><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> </tbody> </table>   | T.C.   | Operating Temp. | C0G            | -55~125°C at 25°C | X7R                        | -55~125°C at 25°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> </tbody> </table>  | T.C.           | Capacitance Change | C0G       | Within ±30ppm/°C                           | X7R            | Within ±15%                               |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| T.C.           | Operating Temp.                              |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| C0G            | -55~125°C at 25°C                            |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| X7R            | -55~125°C at 25°C                            |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| T.C.           | Capacitance Change                           |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| C0G            | Within ±30ppm/°C                             |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| X7R            | Within ±15%                                  |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| 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>&gt;500</td> <td>500Vdc</td> <td>60 sec.</td> </tr> </tbody> </table>   | Rated Vol.(V)  | Apply Voltage   | Test Condition | >500              | 500Vdc                     | 60 sec.                                      | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Requirements</th> </tr> </thead> <tbody> <tr> <td>Class I</td> <td>≥100GΩ 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   | ≥100GΩ or RxC≥500Ω-F, whichever is smaller | Class II       | ≥10GΩ or RxC≥100Ω-F, whichever is smaller |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Rated Vol.(V)  | Apply Voltage                                | Test Condition  |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| >500           | 500Vdc                                       | 60 sec.   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Dielectric     | Requirements                                 |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Class I        | ≥100GΩ 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 (0603~1210).<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>630≤V≤3000V</td> <td>1.2 times of UR</td> </tr> <tr> <td>3000&lt;V≤5000V</td> <td>1.1 times of UR</td> </tr> </tbody> </table><br>* Duration : 1 to 5 sec.<br>* Charge and discharge current less than 50mA.  | Rated Vol.(V)  | Condition       | 630≤V≤3000V    | 1.2 times of UR   | 3000<V≤5000V               | 1.1 times of UR                              | * No evidence of damage or flashover during test.  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Rated Vol.(V)  | Condition                                    |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| 630≤V≤3000V    | 1.2 times of UR                              |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| 3000<V≤5000V   | 1.1 times of UR                              |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| 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><table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Change</th> <th>Q/D.F. &amp; I.R.</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td>Within ±2.5% or ±0.25pF, whichever is larger</td> <td rowspan="2">To meet initial requirement</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±7.5%</td> </tr> </tbody> </table><br>* 25% max. leaching on each edge. | Dielectric      | Cap. Change    | Q/D.F. & I.R.     | Class I (C0G)              | Within ±2.5% or ±0.25pF, whichever is larger | To meet initial requirement  | Class II (X7R) | Within ±7.5%       |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Dielectric     | Cap. Change                                  | Q/D.F. & I.R.   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Class I (C0G)  | Within ±2.5% or ±0.25pF, whichever is larger | To meet initial requirement   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Class II (X7R) | Within ±7.5%                                 |   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| 9.             | Temperature Cycle                            | * Conduct the five cycles according to the temperatures and time.<br><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><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). | 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><table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R.</th> <th>Cap. Change</th> <th>Q/D.F.</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td rowspan="2">To meet initial requirement</td> <td>Within ±2.5% or ±0.25pF, whichever is larger</td> <td>≤1.0(Q) × initial requirement</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±7.5%</td> <td>≤1.5(D.F.) × initial requirement</td> </tr> </tbody> </table> | Dielectric | I.R. | Cap. Change | Q/D.F. | Class I (C0G) | To meet initial requirement | Within ±2.5% or ±0.25pF, whichever is larger | ≤1.0(Q) × initial requirement | Class II (X7R) | Within ±7.5% | ≤1.5(D.F.) × 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   |  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Dielectric     | I.R.   | Cap. Change   | Q/D.F.   |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Class I (C0G)  | To meet initial requirement                  | Within ±2.5% or ±0.25pF, whichever is larger  | ≤1.0(Q) × initial requirement  |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |
| Class II (X7R) |  | Within ±7.5%  | ≤1.5(D.F.) × initial requirement   |                 |                |                   |                            |  |  |                |                    |           |  |                |   |            |     |   |            |      |             |        |               |                             |  |                               |                |              |                                  |

## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.            | Item  | Test Condition  | Requirements  |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
|----------------|---|---|---|------------|-------------|---------------|---|----------------|---|---|--|----------------|-------|----------------|------------|----------------|--|---------------|-----------|-----------|--|--|--|----------------------------------|--|
| 10.            | <b>Humidity (Damp Heat) Steady State</b>    | <ul style="list-style-type: none"> <li>* Test temp. : 40±2°C.</li> <li>* Humidity : 90~95%RH.</li> <li>* Test time : 500 +24/-0 hrs.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</li> </ul>  | <p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R.</th> <th>Cap. Change</th> <th colspan="2">Q/D.F.</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I (C0G)</td> <td rowspan="2">≥1G or RxC≥50Ω-F, whichever is smaller</td> <td rowspan="2">Within ±5.0% or ±0.5pF, whichever is larger</td> <td>Cap.≥30pF</td> <td>Q≥350</td> </tr> <tr> <td>10pF≤Cap.&lt;30pF</td> <td>Q≥275+2.5C</td> </tr> <tr> <td>Class II (X7R)</td> <td></td> <td>Within ±12.5%</td> <td>Cap.&lt;10pF</td> <td>Q≥200+10C</td> </tr> <tr> <td colspan="3"></td> <td colspan="2">D.F.≤200% of initial requirement</td> </tr> </tbody> </table>   | Dielectric | I.R.        | Cap. Change   | Q/D.F.                                      |                | Class I (C0G)                           | ≥1G or RxC≥50Ω-F, whichever is smaller      | Within ±5.0% or ±0.5pF, whichever is larger  | Cap.≥30pF      | Q≥350 | 10pF≤Cap.<30pF | Q≥275+2.5C | Class II (X7R) |  | Within ±12.5% | Cap.<10pF | Q≥200+10C |  |  |  | D.F.≤200% of initial requirement |  |
| Dielectric     | I.R.  | Cap. Change   | Q/D.F.  |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Class I (C0G)  | ≥1G or RxC≥50Ω-F, whichever is smaller      | Within ±5.0% or ±0.5pF, whichever is larger   | Cap.≥30pF   | Q≥350      |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
|                |   |   | 10pF≤Cap.<30pF  | Q≥275+2.5C |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Class II (X7R) |   | Within ±12.5%   | Cap.<10pF   | Q≥200+10C  |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
|                |   |   | D.F.≤200% of initial requirement  |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| 11.            | <b>Humidity (Damp Heat) Load</b>            | <ul style="list-style-type: none"> <li>* Reflow solder the capacitors on a P.C. Board before test.</li> <li>* Test temp. : 40±2°C.</li> <li>* Humidity : 90~95% RH.</li> <li>* Test time : 500 +24/-0hrs.</li> <li>* To apply voltage : 500Vdc.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</li> </ul> | <p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R.</th> <th>Cap. Change</th> <th colspan="2">Q/D.F.</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I (C0G)</td> <td rowspan="2">≥1GΩ or RxC≥50Ω-F, whichever is smaller</td> <td rowspan="2">Within ±7.5% or ±0.75pF, whichever is larger</td> <td>Cap.≥30pF</td> <td>Q≥350</td> </tr> <tr> <td>10pF≤Cap.&lt;30pF</td> <td>Q≥275+2.5C</td> </tr> <tr> <td>Class II (X7R)</td> <td></td> <td>Within ±12.5%</td> <td>Cap.&lt;10pF</td> <td>Q≥200+10C</td> </tr> <tr> <td colspan="3"></td> <td colspan="2">D.F.≤200% of initial requirement</td> </tr> </tbody> </table> | Dielectric | I.R.        | Cap. Change   | Q/D.F.                                      |                | Class I (C0G)                           | ≥1GΩ or RxC≥50Ω-F, whichever is smaller     | Within ±7.5% or ±0.75pF, whichever is larger | Cap.≥30pF      | Q≥350 | 10pF≤Cap.<30pF | Q≥275+2.5C | Class II (X7R) |  | Within ±12.5% | Cap.<10pF | Q≥200+10C |  |  |  | D.F.≤200% of initial requirement |  |
| Dielectric     | I.R.  | Cap. Change   | Q/D.F.  |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Class I (C0G)  | ≥1GΩ or RxC≥50Ω-F, whichever is smaller     | Within ±7.5% or ±0.75pF, whichever is larger  | Cap.≥30pF   | Q≥350      |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
|                |   |   | 10pF≤Cap.<30pF  | Q≥275+2.5C |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Class II (X7R) |   | Within ±12.5%   | Cap.<10pF   | Q≥200+10C  |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
|                |   |   | D.F.≤200% of initial requirement  |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| 12.            | <b>High Temperature Load (Endurance)</b>    | <ul style="list-style-type: none"> <li>* Test temp. : 125±3°C.</li> <li>* Apply voltage : 110% of rated voltage.</li> <li>* Test time : 1000 +24/-0 hrs.</li> <li>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</li> </ul>  | <p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R.</th> <th>Cap. Change</th> <th>Q/D.F.</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td>≥1GΩ or RxC≥50Ω-F, whichever is smaller</td> <td>Within ±3.0% or ±0.3pF, whichever is larger</td> <td rowspan="2">D.F.≤200% of initial requirement</td> </tr> <tr> <td>Class II (X7R)</td> <td></td> <td>Within ±12.5%</td> </tr> </tbody> </table>  | Dielectric | I.R.        | Cap. Change   | Q/D.F.                                      | Class I (C0G)  | ≥1GΩ or RxC≥50Ω-F, whichever is smaller | Within ±3.0% or ±0.3pF, whichever is larger | D.F.≤200% of initial requirement             | Class II (X7R) |       | Within ±12.5%  |            |                |  |               |           |           |  |  |  |                                  |  |
| Dielectric     | I.R.  | Cap. Change   | Q/D.F.  |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Class I (C0G)  | ≥1GΩ or RxC≥50Ω-F, whichever is smaller     | Within ±3.0% or ±0.3pF, whichever is larger   | D.F.≤200% of initial requirement  |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Class II (X7R) |   | Within ±12.5%   |   |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| 13             | <b>Resistance to Flexure of Substrate</b>   | <ul style="list-style-type: none"> <li>* 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.</li> </ul>  <p style="text-align: center;">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 ±0.3pF, whichever is larger</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±12.5%</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 ±0.3pF, whichever is larger | Class II (X7R) | Within ±12.5%                           |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Dielectric     | Cap. Change                                 |   |   |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Class I (C0G)  | Within ±3.0% or ±0.3pF, whichever is larger |   |   |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |
| Class II (X7R) | Within ±12.5%                               |   |   |            |             |               |   |                |   |   |  |                |       |                |            |                |  |               |           |           |  |  |  |                                  |  |

## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

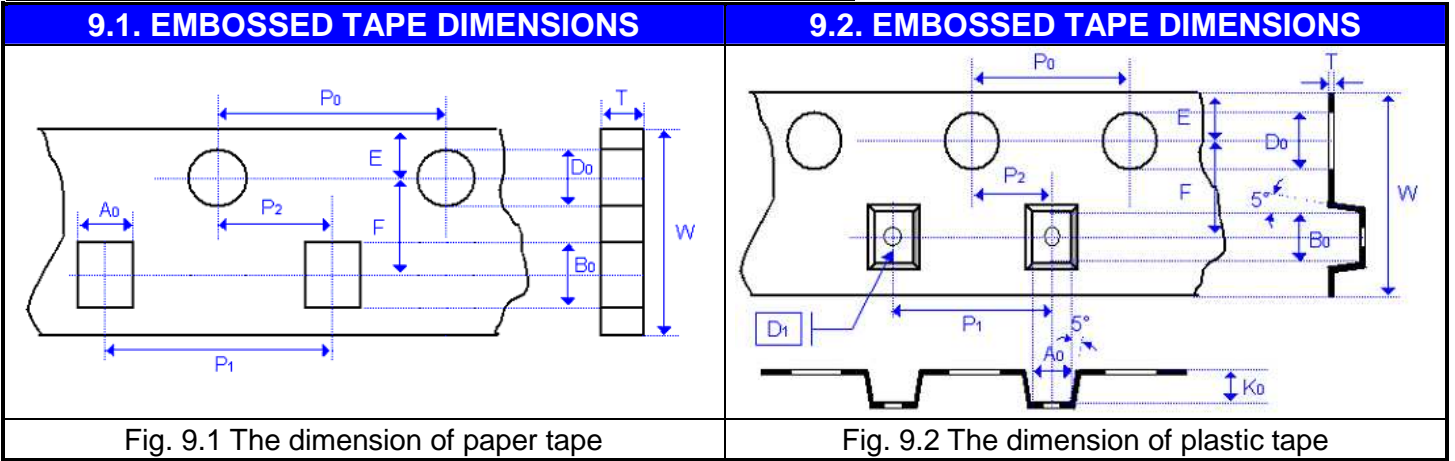
| No. | Item                                    | Test Condition  | Requirements   |
|-----|---|---|--|
| 14. | <b>Adhesive Strength of Termination</b> | <p>* Capacitors mounted on a substrate. A force of 5N(<math>\leq 0603</math>) or 10N(<math>&gt; 0603</math>) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for <math>10 \pm 1</math> second.</p>  <p>The diagram shows a green rectangular P.C. Board with a yellow capacitor mounted on it. A grey rectangular frame surrounds the capacitor. A yellow arrow labeled 'Pressurizing force' points to the right, indicating the direction of the applied force. Labels 'Capacitor' and 'P.C. Board' are present with leader lines pointing to their respective components.</p> | <p>* No remarkable damage or removal of the terminations.</p>                                  |
| 15. | <b>Vibration Resistance</b>             | <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.)</p>  | <p>* No remarkable damage.<br/>           * Cap. change and Q/D.F. : To meet initial spec.</p> |

## 9. PACKAGE DIMENSION AND QUANTITY

| Size       | Thickness (mm)   | Paper tape |          | Plastic tape |          |
|------------|------------------|------------|----------|--------------|----------|
|            |                  | 7" reel    | 13" reel | 7" reel      | 13" reel |
| 0402(1005) | 0.50±0.05        | 10k        | 50K      | -            | -        |
| 0603(1608) | 0.80±0.07        | 4k         | 15k      | -            | -        |
|            | 0.80 +0.15/-0.10 | 4k         | 15k      |              |          |
| 0805(2012) | 0.60±0.10        | 4k         | 15k      | -            | -        |
|            | 0.80±0.10        | 4k         | 15k      | -            | -        |
|            | 1.25±0.10        | -          | -        | 3k           | 10k      |
|            | 1.25±0.20        | -          | -        | 3k           | -        |
| 1206(3216) | 0.80±0.10        | 4k         | 15k      | -            | -        |
|            | 0.95±0.10        | -          | -        | 3k           | 10k      |
|            | 1.25±0.10        | -          | -        | 3k           | 10k      |
|            | 1.60±0.20        | -          | -        | 2k           | -        |
| 1210(3225) | 0.95±0.10        | -          | -        | 3k           | 10k      |
|            | 1.25±0.10        | -          | -        | 3k           | 10k      |
|            | 1.60±0.20        | -          | -        | 2k           | -        |
|            | 2.50±0.30        | -          | -        | 1k           | -        |
| 1808(4520) | 1.25±0.10        | -          | -        | 2k           | -        |
|            | 1.60±0.20        | -          | -        | 2k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
| 1812(4532) | 1.25±0.10        | -          | -        | 1k           | -        |
|            | 1.60±0.20        | -          | -        | 1k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
|            | 2.50±0.30        | -          | -        | 0.5k         | -        |
| 1825(4563) | 1.60±0.20        | -          | -        | 1k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
|            | 2.50±0.30        | -          | -        | 0.5k         | -        |
|            | 2.80±0.30        | -          | -        | 0.5k         | -        |
| 2211(5728) | 1.60±0.20        | -          | -        | 1k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
|            | 2.50±0.30        | -          | -        | 0.5k         | -        |
|            | 2.80±0.30        | -          | -        | 0.5k         | -        |
| 2220(5750) | 1.60±0.20        | -          | -        | 1k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
|            | 2.50±0.30        | -          | -        | 0.5k         | -        |
|            | 2.80±0.30        | -          | -        | 0.5k         | -        |
| 2225(5763) | 1.60±0.20        | -          | -        | 1k           | -        |
|            | 2.00±0.20        | -          | -        | 1k           | -        |
|            | 2.50±0.30        | -          | -        | 0.5k         | -        |
|            | 2.80±0.30        | -          | -        | 0.5k         | -        |

Unit : pcs

## 9. PACKAGE DIMENSION AND QUANTITY



| Size              | 0603                |                     | 0805       |                        | 1206       |                        |                            |
|-------------------|---------------------|---------------------|------------|------------------------|------------|------------------------|----------------------------|
| Chip Thickness    | 0.80±0.07           | 0.80<br>+0.15/-0.1  | 0.80±0.10  | 1.25±0.10<br>1.25±0.20 | 0.80±0.10  | 0.95±0.10<br>1.25±0.10 | 1.60±0.20<br>1.60+0.3/-0.1 |
| A <sub>0</sub>    | 1.00<br>+0.05/-0.10 | 1.02<br>+0.05/-0.10 | 1.50±0.10  | <1.65                  | 2.00±0.10  | <2.00                  | <2.00                      |
| B <sub>0</sub>    | 1.80±0.10           | 1.80±0.10           | 2.30±0.10  | <2.40                  | 3.50±0.10  | <3.60                  | <3.70                      |
| T                 | 0.95±0.05           | 0.97±0.05           | 0.95±0.05  | 0.23±0.05              | 0.95±0.05  | 0.23±0.05              | 0.23±0.05                  |
| K <sub>0</sub>    | -                   | -                   | -          | <2.50                  | -          | <2.50                  | <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              | 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              | 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             | 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  | 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              | 2.00±0.05                  |
| D <sub>0</sub>    | 1.55±0.05           | 1.55±0.05           | 1.55±0.05  | 1.50 +0.10/-0          | 1.55±0.05  | 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                  |
| E                 | 1.75±0.05           | 1.75±0.05           | 1.75±0.05  | 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  | 3.50±0.05              | 3.50±0.05                  |
| Unit :            | mm                  | mm                  | mm         | mm                     | mm         | mm                     | mm                         |

| Size              | 1210                                |               | 1808                   |               | 1812                                |               |
|-------------------|-------------------------------------|---------------|------------------------|---------------|-------------------------------------|---------------|
| Chip Thickness    | 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 | 2.00±0.20     | 1.25±0.10<br>1.60±0.20<br>2.00±0.20 | 2.50±0.30     |
| A <sub>0</sub>    | <3.05                               | <3.10         | <2.50                  | <2.50         | <3.90                               | <3.90         |
| B <sub>0</sub>    | <3.80                               | <4.00         | <5.30                  | <5.30         | <5.30                               | <5.30         |
| T                 | 0.23±0.05                           | 0.23±0.05     | 0.25±0.05              | 0.25±0.05     | 0.25±0.05                           | 0.25±0.05     |
| K <sub>0</sub>    | <2.50                               | <3.50         | <2.50                  | <2.50         | <2.50                               | <3.00         |
| W                 | 8.00±0.10                           | 8.00±0.10     | 12.0±0.20              | 12.0±0.20     | 12.0±0.20                           | 12.0±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                          | 40.0±0.10     | 40.0±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     | 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>    | 1.00±0.10                           | 1.00±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                 | 3.50±0.05                           | 3.50±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. PACKAGE DIMENSION AND QUANTITY

| Size              | 1825                   |                  | 2211                   |                  | 2220                                |                  | 2225                   |                  |
|-------------------|------------------------|------------------|------------------------|------------------|-------------------------------------|------------------|------------------------|------------------|
| Chip Thickness    | 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        | 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            | <3.30                  | <3.30            | <5.80                               | <5.80            | <6.80                  | <6.80            |
| B <sub>0</sub>    | <5.30                  | <5.30            | <6.50                  | <6.50            | <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        | 0.30±0.10              | 0.30±0.10        |
| K <sub>0</sub>    | <2.50                  | <3.10            | <2.50                  | <3.10            | <2.50                               | <3.10            | <2.50                  | <3.10            |
| W                 | 12.0±0.20              | 12.0±0.20        | 12.0±0.20              | 12.0±0.20        | 12.0±0.20                           | 12.0±0.20        | 12.0±0.20              | 12.0±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              | 4.00±0.10        |
| 10xP <sub>0</sub> | 40.00±0.20             | 40.00±0.20       | 40.0±0.20              | 40.0±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        | 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              | 2.00±0.05        |
| D <sub>0</sub>    | 1.50<br>+0.10/-0       | 1.50<br>+0.10/-0 | 1.50<br>+0.10/-0       | 1.50<br>+0.10/-0 | 1.50<br>+0.10/-0                    | 1.50<br>+0.10/-0 | 1.50<br>+0.10/-0       | 1.50<br>+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        | 1.50±0.10              | 1.50±0.10        |
| E                 | 1.75±0.1               | 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                 | 5.50±0.05              | 5.50±0.05        | 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               | mm                     | mm               |

### 9.3. REEL DIMENSIONS

| Size           | 0603, 0805, 1206, 1210 |                   |                   | 1808, 1812, 1825,<br>2211, 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                       |

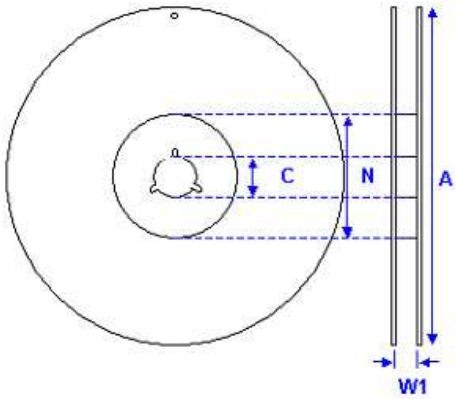


Fig. 9.3 The dimension of reel



## 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.

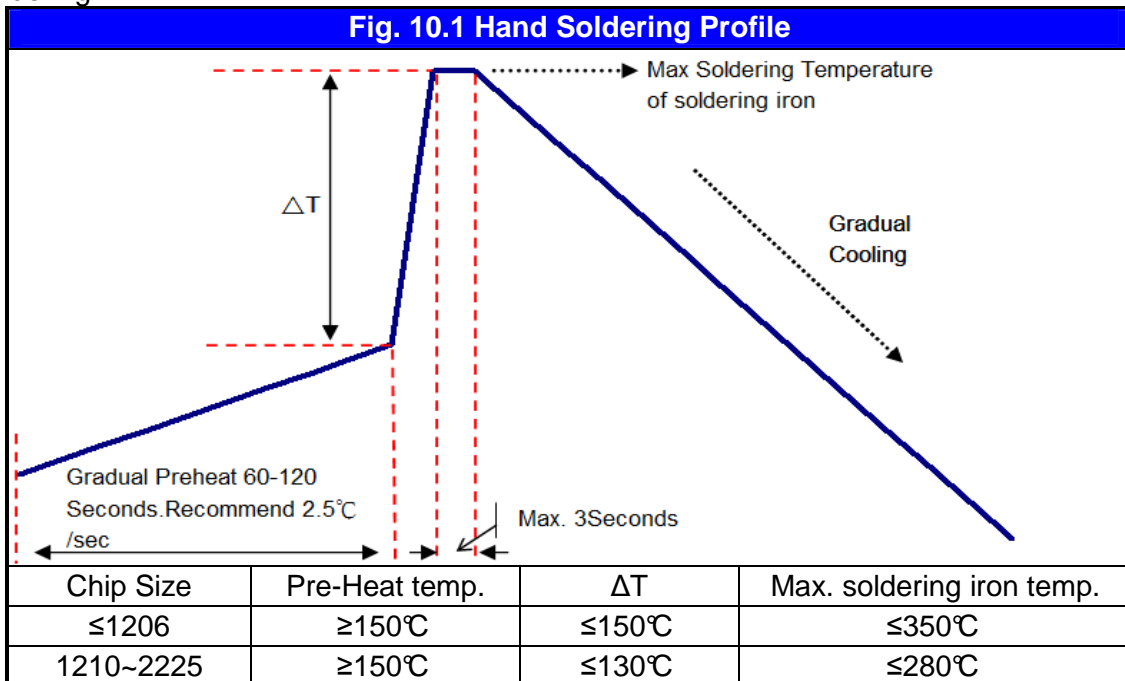
### PREHEAT

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 mildly 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.

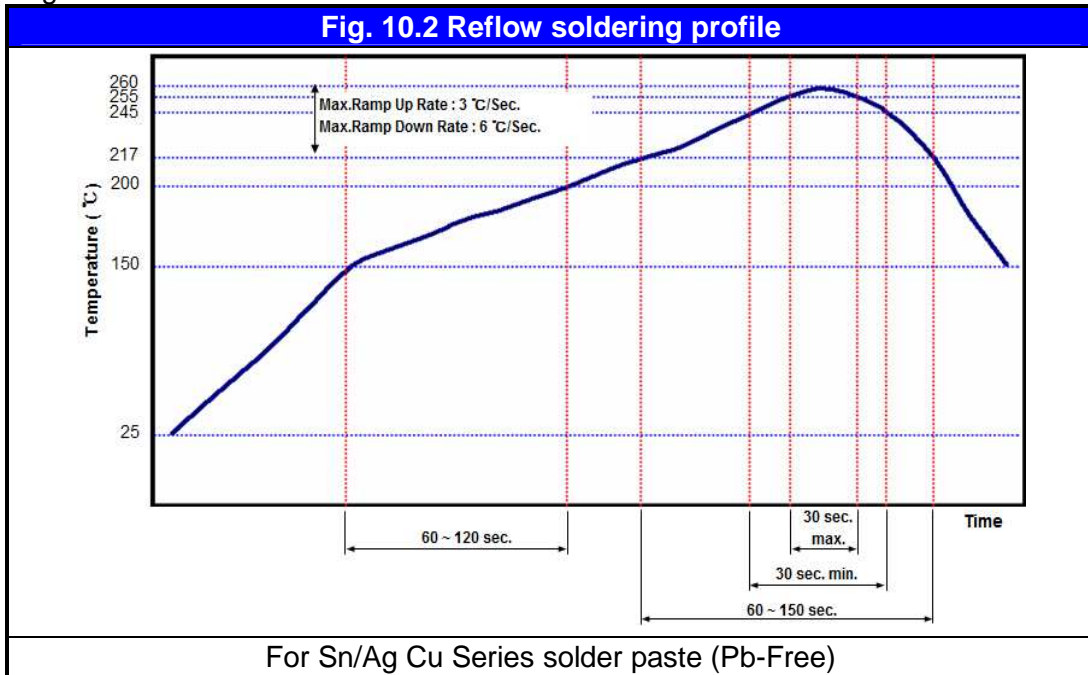
\* The tip of iron should not contact the ceramic body directly.

\* The Capacitors shall be cooled gradually at room temperature after soldering.

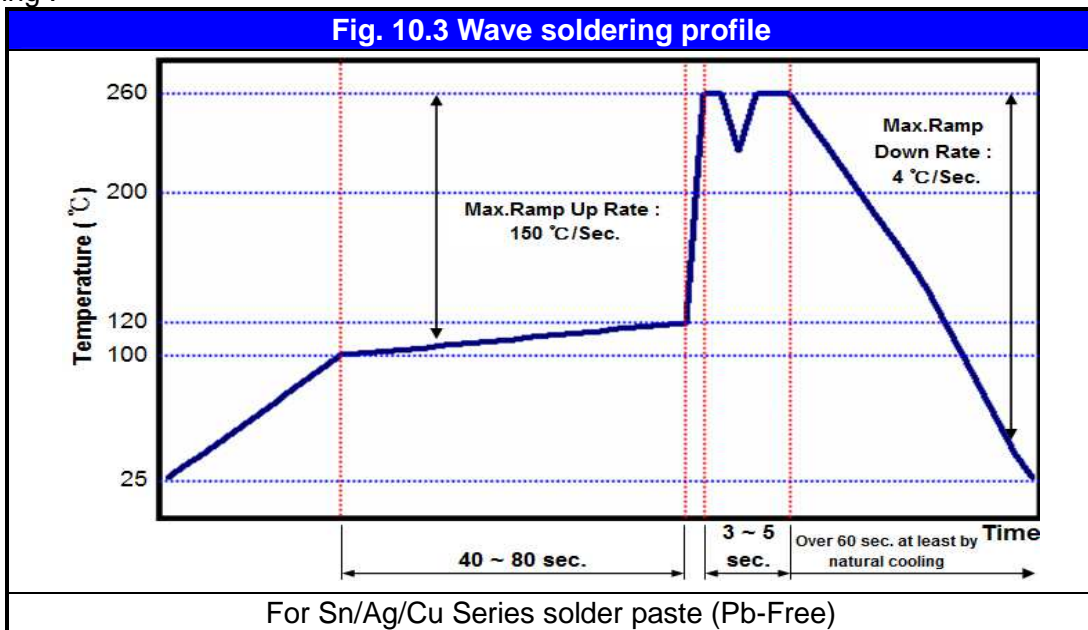
\* Forced air cooling is not allowed.

## 10. APPLICATION NOTES

b.) Reflow soldering :



c.) Wave soldering :



Soldering conditions :

Class I :

| Size Inch (mm) | Temper. Cher. | Capacitance | Condition |        |
|----------------|---------------|-------------|-----------|--------|
|                |               |             | Wave      | Reflow |
| ≤0402(1005)    | Class I - C0G | All         | X         | O      |
| 0603(1608)     | Class I - C0G | All         | O         | O      |
| 0805(2012)     | Class I - C0G | All         | O         | O      |
| 1206(3216)     | Class I - C0G | All         | O         | O      |
| ≥1210(3225)    | Class I - C0G | All         | X         | O      |

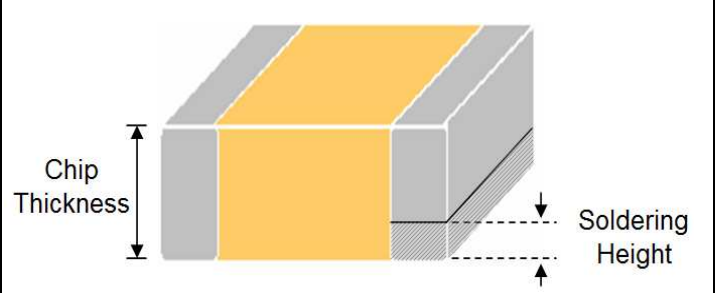
## 10. APPLICATION NOTES

Soldering conditions :

Class II :

| Size Inch (mm) | Temper. Cher.  | Capacitance | Condition |        |
|----------------|----------------|-------------|-----------|--------|
|                |                |             | Wave      | Reflow |
| ≤0402(1005)    | Class II - X7R | All         | X         | O      |
| 0603 (1608)    | Class II - X7R | Cap. <2.2μF | O         | O      |
|                |                | Cap. ≥2.2μF | X         | O      |
| 0805 (2012)    | Class II - X7R | Cap. <4.7μF | O         | O      |
|                |                | Cap. ≥4.7μF | X         | O      |
| 1206 (3216)    | Class II - X7R | Cap. <4.7μF | O         | O      |
|                |                | Cap. ≥4.7μF | X         | O      |
| ≥1210 (3225)   | Class II - X7R | All         | X         | O      |

Soldering height :

|  |  |
|--|--|
| <p>The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less.<br/>(Reference from IPC-610E)</p> |  <p>The diagram illustrates a cross-section of a chip on a substrate. A yellow rectangular chip is mounted on a grey substrate. A vertical double-headed arrow on the left indicates the 'Chip Thickness'. A horizontal dashed line with a vertical arrow pointing down from the top surface of the chip to the substrate surface indicates the 'Soldering Height'.</p> |
|--|--|

### 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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[C1608C0G2A221J](#) [C1608X7R1E334K](#) [C2012C0G2A472J](#) [2220J2K00562KXT](#) [CCR06CG153FSV](#) [CDR04BX104AKSR](#)  
[CDR33BX104AKUR](#) [CDR33BX683AKUS](#) [CGA3E1X7R1C684K](#) [CL10C0R8BB8ANNC](#) [M55342H06B20G0R-T/R](#) [C1005X5R0G225M](#)  
[C2012X7R2E223K](#) [C3216C0G2J272J](#) [D55342E07B35E7R-T/R](#) [CDR34BX563BKUS](#) [CDR34BX563BKWS](#) [NMC0402NPO220F50TRPF](#)  
[NMC0402X7R562J25TRPF](#) [NMC0603NPO102J25TRPF](#) [NMC1206X7R332K50TRPF](#) [NMC-P1206X7R104K250TRPLPF](#) [726632-1](#)  
[CGA6M3X7R1H225K](#) [CGA5L2X7R2A105K](#) [CGA3E2X8R1H223K](#) [CDR33BX823AKUR\M500](#) [CDR33BP132BJUR](#)