

# APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

Safety Certified X1/Y2, S2 Series

1808 to 2220 Sizes

NP0 & X7R Dielectrics

Halogen Free & RoHS Compliance

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

## 1. DESCRIPTION

WTC's SAFETY CERTIFIED CAPACITORS are designed for surge or lightning immunity in modem facsimile and other equipments. The capacitors of series S2 are class X1/Y2 compliant respectively.

The green type capacitors in S2 and S3 series are manufactured by using environmentally friendly materials without lead or cadmium.

The terminations are composed of plated nickel and pure tin to feature the superior leaching resistance during soldering.

## 2. FEATURES

- High reliability and stability.
- Small size and high capacitance
- RoHS compliant
- Safety standard approval by  
EN 60384-14 : 2013  
IEC 60384-14 : 2013  
UL 60384-14 (Ed 2.0)
- Certificate number:  
TUV: R50381780  
UL: E182369
- HALOGEN compliant.

## 3. APPLICATIONS

- Modem.
- Facsimile.
- Telephone.
- Other electronic equipment for lightning or surge protection and isolation



Type Approved  
Safety  
Regular Production  
Surveillance  
  
www.tuv.com  
ID 1419048358



SA  
SYSTEM ALLIANCE

## 4. HOW TO ORDER

| <u>S2</u>                       | <u>42</u>                                                            | <u>N</u>          | <u>100</u>                                                                                                                                                 | <u>J</u>                                                                          | <u>502</u>                                                                                                                                                     | <u>K</u>                                                                                                                                   | <u>I</u>                    |
|---------------------------------|----------------------------------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| <u>Series</u>                   | <u>Size</u>                                                          | <u>Dielectric</u> | <u>Capacitance</u>                                                                                                                                         | <u>Tolerance</u>                                                                  | <u>Impulse voltage</u>                                                                                                                                         | <u>Termination</u>                                                                                                                         | <u>Packaging</u>            |
| S2=X1/Y2<br>Safety<br>Certified | 42=1808 (4520)<br>43=1812 (4532)<br>52=2211 (5728)<br>55=2220 (5750) | N=NP0<br>B=X7R    | Two significant digits followed by no. of zeros. And R is in place of decimal point.<br><br>eg.:<br>0R5=0.5pF<br>1R0=1.0pF<br>100=10x10 <sup>0</sup> =10pF | C= ±0.25pF<br>D= ±0.5pF<br>F= ±1.0%<br>G= ±2.0%<br>J= ±5.0%<br>K= ±10%<br>M= ±20% | Two significant digits followed by no. of zeros. And R is in place of decimal point.<br><br>502: 5000V<br>Impulse Voltage<br><br>602: 6000V<br>Impulse Voltage | E= Soft termination<br>Z= Soft termination + Surface Coating<br>M= Surface Coating (Specific product)<br>K= Non Coating (Specific product) | T=7" reeled<br>G=13" reeled |

## 5. EXTERNAL DIMENSIONS & STRUCTURE

### 5-1 Safety certified Caps.

| Size<br>Inch (mm) | L (mm)         | W (mm)    | T (mm)        | M <sub>B</sub> (mm) |
|-------------------|----------------|-----------|---------------|---------------------|
| 1808 (4520)       | 4.50 +0.8/-0.3 | 2.00±0.25 | 1.25±0.10 (D) | 0.50±0.25           |
| 1812 (4532)       | 4.50 +0.8/-0.3 | 3.20±0.40 | 1.40±0.15 (F) | 0.50±0.25           |
| 2211 (5728)       | 5.70±0.40      | 2.80±0.30 | 1.60±0.20 (G) | 0.60±0.30           |
| 2220 (5750)       | 5.70±0.40      | 5.00±0.40 | 2.00±0.20 (K) | 0.60±0.30           |
|                   |                |           | 2.50±0.30 (M) | 0.60±0.30           |
|                   |                |           | 2.80±0.30 (U) | 0.60±0.30           |

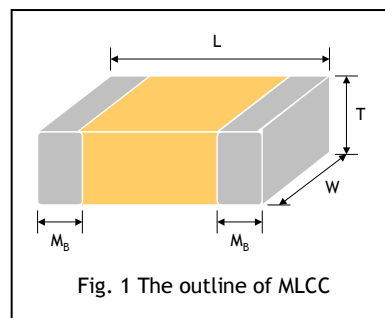


Fig. 1 The outline of MLCC

### 5-2 Safety certified Caps. with soft termination

| Size<br>Inch (mm) | L (mm)         | W (mm)    | T (mm)        | M <sub>B</sub> (mm) |
|-------------------|----------------|-----------|---------------|---------------------|
| 1808 (4520)       | 4.50 +0.9/-0.3 | 2.00±0.30 | 1.25±0.10 (D) | 0.50±0.25           |
| 1812 (4532)       | 4.50 +0.9/-0.3 | 3.20±0.40 | 1.40±0.15 (F) | 0.50±0.25           |
| 2211 (5728)       | 5.70±0.50      | 2.80±0.40 | 1.60±0.20 (G) | 0.60±0.30           |
| 2220 (5750)       | 5.70±0.50      | 5.00±0.50 | 2.00±0.20 (K) | 0.60±0.30           |
|                   |                |           | 2.50±0.30 (M) | 0.60±0.30           |
|                   |                |           | 2.80±0.30 (U) | 0.60±0.30           |

# Reflow soldering only is recommended

## 6. GENERAL ELECTRICAL DATA

| Dielectric                  | NP0                                                                                               | X7R                         |
|-----------------------------|---------------------------------------------------------------------------------------------------|-----------------------------|
| Size                        | 1808, 1812, 2211                                                                                  | 1808, 1812, 2211, 2220      |
| Capacitance                 | 3pF to 680pF                                                                                      | 100pF to 4700pF             |
| Capacitance tolerance       | Cap.<10pF: C (±0.25pF), D (±0.5pF)<br>Cap.≥10pF: F (±1%), G (±2%), J (±5%),<br>K (±10%), M (±20%) | J (±5%), K (±10%), M (±20%) |
| Rated voltage (WVAC)        | 250Vac                                                                                            |                             |
| Q/ DF(Tan δ)                | Cap<30pF: Q≥400+20C <sub>NCE</sub><br>Cap≥30pF: Q≥1000                                            | DF≤2.5%                     |
| Insulation resistance at Ur | ≥10GΩ                                                                                             |                             |
| Peak impulse voltage        | 5000V ~ 6000V                                                                                     |                             |
| Operating temperature       | -55 to +125℃                                                                                      |                             |
| Capacitance characteristic  | ±30ppm/℃                                                                                          | ±15%                        |
| Termination                 | Ni/Sn (lead-free termination)                                                                     |                             |
| Certified number            | TUV: R50195920, TUV: R50381780, UL: E182369                                                       |                             |
| Test standard               | EN 60384-14 : 2013, IEC 60384-14 : 2013, UL 60384-14 (Ed 2.0)                                     |                             |

\* NP0: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, at 25℃ ambient temperature.

\* X7R: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25℃ ambient temperature.

## 7. PACKAGE DIMENSION AND QUANTITY

| Size        | Thickness (mm)/Symbol |   | Plastic tape |          |
|-------------|-----------------------|---|--------------|----------|
|             |                       |   | 7" reel      | 13" reel |
| 1808 (4520) | 1.40±0.15             | F | 2k           | 10k      |
|             | 1.60±0.20             | G | 2k           | 8k       |
|             | 2.00±0.20             | K | 1k           | 6k       |
| 1812 (4532) | 1.25±0.10             | D | 1k           | 5k       |
|             | 1.60±0.20             | G | 1k           | 4k       |
|             | 2.00±0.20             | K | 1k           | 3k       |
|             | 2.50±0.30             | M | 0.5k         | 3k       |
| 2211 (5728) | 1.60±0.20             | G | 1k           | 4k       |
|             | 2.00±0.20             | K | 1k           | 3k       |
|             | 2.50±0.30             | M | 0.5k         | 3k       |
|             | 2.80±0.30             | U | 0.5k         | -        |
| 2220 (5750) | 2.00±0.20             | K | 1k           | 3k       |
|             | 2.50±0.30             | M | 0.5k         | 2k       |

Unit: pieces

Multilayer Ceramic Capacitors

## 8. CAPACITANCE RANGE

- ☐ "+" mark: Surface coating is the standard product.
- ☐ "-" mark: Non-surface coating is the standard product.

| DIELECTRIC           |             | NP0                |                |                    |                |                    |                |                    |                |
|----------------------|-------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|
| SIZE                 |             | 1808               |                | 1812               |                | 2211               |                | 2211               |                |
| PEAK IMPULSE VOLTAGE |             | 5000               |                |                    |                |                    |                | 6000               |                |
| Certificated         |             | TUV<br>IEC60384-14 | UL<br>60384    | TUV<br>IEC60384-14 | UL<br>60384    | TUV<br>IEC60384-14 | UL<br>60384    | TUV<br>IEC60384-14 | UL<br>60384    |
| Capacitance          | 3.0pF (3R0) | F <sup>-</sup>     | F <sup>-</sup> |                    |                |                    |                |                    |                |
|                      | 3.3pF (3R3) | F <sup>-</sup>     | F <sup>-</sup> |                    |                |                    |                |                    |                |
|                      | 3.9pF (3R9) | F <sup>-</sup>     | F <sup>-</sup> |                    |                |                    |                |                    |                |
|                      | 4.0pF (4R0) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 4.7pF (4R7) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 5.0pF (5R0) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 5.6pF (5R6) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 6.0pF (6R0) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 6.8pF (6R8) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 7.0pF (7R0) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 8.0pF (8R0) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 8.2pF (8R2) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 9.0pF (9R0) | F <sup>-</sup>     | F <sup>-</sup> |                    |                | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 10pF (100)  | F <sup>-</sup>     | F <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 12pF (120)  | F <sup>-</sup>     | F <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 15pF (150)  | F <sup>-</sup>     | F <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 18pF (180)  | F <sup>-</sup>     | F <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 22pF (220)  | F <sup>-</sup>     | F <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 27pF (270)  | F <sup>-</sup>     | F <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 33pF (330)  | F <sup>-</sup>     | F <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 39pF (390)  | G <sup>-</sup>     | G <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 47pF (470)  | G <sup>-</sup>     | G <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 56pF (560)  | G <sup>-</sup>     | G <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> |
|                      | 68pF (680)  | G <sup>-</sup>     | G <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |
|                      | 82pF (820)  | G <sup>-</sup>     | G <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |
|                      | 100pF (101) | K <sup>-</sup>     | K <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | U <sup>-</sup>     | U <sup>-</sup> |
|                      | 120pF (121) | K <sup>-</sup>     | K <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 130pF (131) | K <sup>-</sup>     | K <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 150pF (151) | K <sup>-</sup>     | K <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 160pF (161) | K <sup>-</sup>     | K <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 180pF (181) | K <sup>-</sup>     | K <sup>-</sup> | D <sup>-</sup>     | D <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 220pF (221) | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 270pF (271) | K <sup>-</sup>     | K <sup>-</sup> | K <sup>-</sup>     | K <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 300pF (301) |                    |                | K <sup>-</sup>     | K <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 330pF (331) |                    |                | K <sup>-</sup>     | K <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
|                      | 390pF (391) |                    |                | K <sup>-</sup>     | K <sup>-</sup> | M <sup>-</sup>     | M <sup>-</sup> |                    |                |
| 470pF (471)          |             |                    | K <sup>-</sup> | K <sup>-</sup>     | M <sup>-</sup> | M <sup>-</sup>     |                |                    |                |
| 560pF (561)          |             |                    |                |                    | M <sup>-</sup> | M <sup>-</sup>     |                |                    |                |
| 680pF (681)          |             |                    |                |                    | M <sup>-</sup> | M <sup>-</sup>     |                |                    |                |
| 720pF (721)          |             |                    |                |                    |                |                    |                |                    |                |

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

- ☐ “+” mark: Surface coating is the standard product.  
☐ “-” mark: Non-surface coating is the standard product.

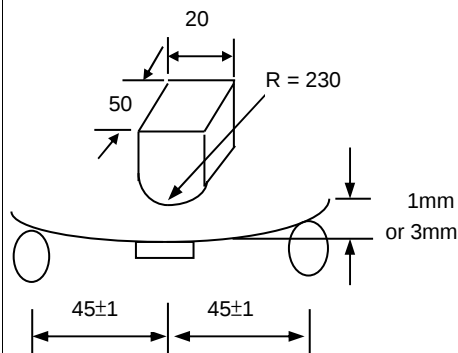
| DIELECTRIC           |               | X7R                |                |                    |                |                    |                |                    |                |
|----------------------|---------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|
| SIZE                 |               | 1808               |                | 1812               |                | 2211               |                | 2220               |                |
| PEAK IMPULSE VOLTAGE |               | 5000               |                |                    |                |                    |                |                    |                |
| Certificated         |               | TUV<br>IEC60384-14 | UL<br>60384    | TUV<br>IEC60384-14 | UL<br>60384    | TUV<br>IEC60384-14 | UL<br>60384    | TUV<br>IEC60384-14 | UL<br>60384    |
| Capacitance          | 100pF (101)   | G <sup>-</sup>     | G <sup>-</sup> |                    |                | G <sup>-</sup>     | G <sup>-</sup> |                    |                |
|                      | 120pF (121)   | G <sup>+</sup>     | G <sup>+</sup> |                    |                | G <sup>+</sup>     | G <sup>+</sup> |                    |                |
|                      | 130pF (131)   | G <sup>+</sup>     | G <sup>+</sup> |                    |                | G <sup>+</sup>     | G <sup>+</sup> |                    |                |
|                      | 150pF (151)   | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> |                    |                |
|                      | 160pF (161)   | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 180pF (181)   | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 220pF (221)   | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 270pF (271)   | K <sup>+</sup>     | K <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 300pF (301)   | K <sup>+</sup>     | K <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 330pF (331)   | K <sup>+</sup>     | K <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 390pF (391)   | K <sup>+</sup>     | K <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 470pF (471)   | K <sup>+</sup>     | K <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 560pF (561)   | K <sup>+</sup>     | K <sup>+</sup> | G <sup>+</sup>     | G <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 680pF (681)   | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 720pF (721)   | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 820pF (821)   | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 1,000pF (102) | K <sup>+</sup>     | K <sup>+</sup> | M <sup>+</sup>     | M <sup>+</sup> | M <sup>+</sup>     | M <sup>+</sup> | K <sup>+</sup>     | K <sup>+</sup> |
|                      | 1,200pF (122) |                    |                |                    |                | M <sup>+</sup>     | M <sup>+</sup> | M <sup>+</sup>     | M <sup>+</sup> |
|                      | 1,500pF (152) |                    |                |                    |                | M <sup>+</sup>     | M <sup>+</sup> | M <sup>+</sup>     | M <sup>+</sup> |
|                      | 1,800pF (182) |                    |                |                    |                | M <sup>+</sup>     | M <sup>+</sup> | M <sup>+</sup>     | M <sup>+</sup> |
|                      | 2,200pF (222) |                    |                |                    |                | M <sup>+</sup>     | M <sup>+</sup> | M <sup>+</sup>     | M <sup>+</sup> |
|                      | 2,700pF (272) |                    |                |                    |                | U <sup>+</sup>     | U <sup>+</sup> | M <sup>+</sup>     | M <sup>+</sup> |
|                      | 3,300pF (332) |                    |                |                    |                |                    |                | M <sup>+</sup>     | M <sup>+</sup> |
|                      | 3,900pF (392) |                    |                |                    |                |                    |                | M <sup>+</sup>     | M <sup>+</sup> |
|                      | 4,700pF (472) |                    |                |                    |                |                    |                | M <sup>+</sup>     | M <sup>+</sup> |

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

## 9. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

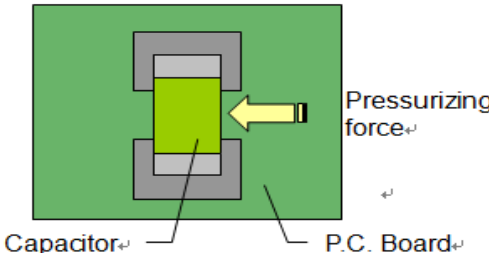
| No.            | Item                                            | Standard Method                              | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Requirements                                                                                                                                                                                                                                                                                                    |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
|----------------|-------------------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|-------------------|----------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------|---------------|---------------------------------------------|----------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------|-------------|--------|---------------|-----------------------------|----------------------------------------------|-------------------------------|----------------|--------------|----------------------------------|
| 1.             | Visual examination and Dimensions               | IEC 60384-1 4.1                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | * No remarkable defect.<br>* Dimensions to confirm to individual specification sheet.                                                                                                                                                                                                                           |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| 2.             | Capacitance                                     | IEC 60384-1 4.2.2                            | * Test temp.: Room Temperature.<br>* Class I : (C0G)<br>Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%.<br>Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%.                                                                                                                                                                                                                                                                                                                                   | * Capacitance is within specified tolerance.<br>* C <sub>R</sub> means rated capacitance for conform to the E6 series of preferred values given in IEC 60063.                                                                                                                                                   |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| 3.             | D.F. (Dissipation Factor) Tangent of loss angle | IEC 60384-1 4.2.3                            | * Class II : (X7R)<br>1.0±0.2Vrms, 1KHz±10%.                                                                                                                                                                                                                                                                                                                                                                                                                         | <table><tr><th>Dielectric</th><th>Q/D.F.</th><th>Remark</th></tr><tr><td rowspan="2">Class I (C0G)</td><td>Q≥1000</td><td>Cap.≥30pF</td></tr><tr><td>Q≥400+20C</td><td>Cap.&lt;30pF</td></tr><tr><td>Class II (X7R)</td><td>D.F.≤2.5%</td><td></td></tr></table>                                                | Dielectric     | Q/D.F.         | Remark            | Class I (C0G)              | Q≥1000            | Cap.≥30pF                                                                                                                                                    | Q≥400+20C                                    | Cap.<30pF                                                                                                                                                                                                                             | Class II (X7R) | D.F.≤2.5%                 |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Dielectric     | Q/D.F.                                          | Remark                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Class I (C0G)  | Q≥1000                                          | Cap.≥30pF                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
|                | Q≥400+20C                                       | Cap.<30pF                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Class II (X7R) | D.F.≤2.5%                                       |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| 4.             | Temperature Coefficient                         | IEC 60384-21/22 4.6                          | With no electrical load.<br><table><tr><th>T.C.</th><th>Operating Temp</th></tr><tr><td>C0G(NP0)</td><td>-55~125°C at 25°C</td></tr><tr><td>X7R</td><td>-55~125°C at 25°C</td></tr></table>                                                                                                                                                                                                                                                                          | T.C.                                                                                                                                                                                                                                                                                                            | Operating Temp | C0G(NP0)       | -55~125°C at 25°C | X7R                        | -55~125°C at 25°C | <table><tr><th>T.C.</th><th>Capacitance Change</th></tr><tr><td>C0G(NP0)</td><td>Within ±30ppm/°C</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr></table> | T.C.                                         | Capacitance Change                                                                                                                                                                                                                    | C0G(NP0)       | Within ±30ppm/°C          | X7R           | Within ±15%                                 |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| T.C.           | Operating Temp                                  |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| C0G(NP0)       | -55~125°C at 25°C                               |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| X7R            | -55~125°C at 25°C                               |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| T.C.           | Capacitance Change                              |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| C0G(NP0)       | Within ±30ppm/°C                                |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| X7R            | Within ±15%                                     |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| 5.             | Voltage proof (Dielectric Strength)             | IEC 60384-14 4.2.1                           | * To apply voltage :<br>X Capacitor : 1075Vdc (4.3U <sub>R</sub> ).<br>Y Capacitor : 1500Vac.<br>* Duration : 60 sec.<br>* The charge current shall not exceed 0.05A.<br>* The voltage shall be raised from the near zero to the test voltage a rate not exceeding 150V(r.m.s.)/sec.                                                                                                                                                                                 | * No evidence of damage or flash over during test.                                                                                                                                                                                                                                                              |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| 6.             | Insulation Resistance                           | IEC 60384-21/22 4.5.3                        | <table><tr><th>Rated Vol.(V)</th><th>Apply Voltage</th><th>Charge Current</th><th>Charge Time</th></tr><tr><td>&gt;500</td><td>500Vdc</td><td>≤50mA</td><td>60 sec.</td></tr></table><br>*Test temp.: Room Temperature.                                                                                                                                                                                                                                              | Rated Vol.(V)                                                                                                                                                                                                                                                                                                   | Apply Voltage  | Charge Current | Charge Time       | >500                       | 500Vdc            | ≤50mA                                                                                                                                                        | 60 sec.                                      | <table><tr><th>Dielectric</th><th>Requirements</th></tr><tr><td>Class I (C0G)</td><td>≥100GΩ or RxC≥1000Ω-F, whichever is smaller</td></tr><tr><td>Class II (X7R)</td><td>≥10GΩ or RxC≥500Ω-F, whichever is smaller</td></tr></table> | Dielectric     | Requirements              | Class I (C0G) | ≥100GΩ or RxC≥1000Ω-F, whichever is smaller | Class II (X7R) | ≥10GΩ or RxC≥500Ω-F, whichever is smaller |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Rated Vol.(V)  | Apply Voltage                                   | Charge Current                               | Charge Time                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| >500           | 500Vdc                                          | ≤50mA                                        | 60 sec.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Dielectric     | Requirements                                    |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Class I (C0G)  | ≥100GΩ or RxC≥1000Ω-F, whichever is smaller     |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Class II (X7R) | ≥10GΩ or RxC≥500Ω-F, whichever is smaller       |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| 7.             | Solderability                                   | IEC 60384-21/22 4.10                         | * Solder temperature: 235±5°C(0201~1210).<br>* Solder temperature: 245±5°C(1808~2225).<br>* Dipping time : 2±0.5 sec.                                                                                                                                                                                                                                                                                                                                                | * 75% min. coverage of all metalized area.                                                                                                                                                                                                                                                                      |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| 8.             | Resistance to Soldering Heat                    | IEC 60384-14 4.4<br>IEC 60384-21/22 4.9      | * 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>* Measurement to be made after keeping at room temperature for 24±2 hrs.                                                                                                                                                                                                                             | <table><tr><th>Dielectric</th><th>I.R.</th><th>Cap. Change</th><th>Q/D.F.</th></tr><tr><td>Class I (C0G)</td><td>≥1GΩ</td><td>Within ±2.5% or ±0.25pF, whichever is larger</td><td rowspan="2">≤100% of initial requirement</td></tr><tr><td>Class II (X7R)</td><td>≥1GΩ</td><td>Within ±7.5%</td></tr></table> | Dielectric     | I.R.           | Cap. Change       | Q/D.F.                     | Class I (C0G)     | ≥1GΩ                                                                                                                                                         | Within ±2.5% or ±0.25pF, whichever is larger | ≤100% of initial requirement                                                                                                                                                                                                          | Class II (X7R) | ≥1GΩ                      | Within ±7.5%  |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Dielectric     | I.R.                                            | Cap. Change                                  | Q/D.F.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Class I (C0G)  | ≥1GΩ                                            | Within ±2.5% or ±0.25pF, whichever is larger | ≤100% of initial requirement                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| Class II (X7R) | ≥1GΩ                                            | Within ±7.5%                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |
| 9.             | Temperature Cycle                               | IEC 60384-21/22 4.11                         | * Conduct the five cycles according to the temperatures and time.<br><table><tr><th>Step</th><th>Temp.(°C)</th><th>Time(min.)</th></tr><tr><td>1</td><td>Min. operating temp. +0/-3</td><td>30±3</td></tr><tr><td>2</td><td>Room temp.</td><td>2~3</td></tr><tr><td>3</td><td>Max.operating temp. +3/-0</td><td>30±3</td></tr><tr><td>4</td><td>Room temp.</td><td>2~3</td></tr></table><br>* Measurement to be made after keeping at room temperature for 24±2 hrs. | 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                                       | <table><tr><th>Dielectric</th><th>I.R.</th><th>Cap. Change</th><th>Q/D.F.</th></tr><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></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                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                 |                |                |                   |                            |                   |                                                                                                                                                              |                                              |                                                                                                                                                                                                                                       |                |                           |               |                                             |                |                                           |                                                                                                                                                                                                                                                                                                                                                                     |            |      |             |        |               |                             |                                              |                               |                |              |                                  |

\* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

| No.            | Item                                      | Standard Method                           | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Requirements                                                                                                                                                                                                                                                                                                                                                                                               |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
|----------------|-------------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|---------------|-------------------------------------------|----------------|-----------------------------------------|-------------------------------------------|--------|----------------|------------|-------------|-----------------------------------|
| 10.            | Humidity (Damp Heat) Steady State         | IEC 60384-14 4.12                         | <ul style="list-style-type: none"><li>* Test temp. : 40±2℃.</li><li>* Humidity : 90~95% RH.</li><li>* Test time : 500 +24/-0hrs.</li><li>* Applied voltage : 250Vac.</li><li>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II).</li></ul>                                                                                                                                                                                                                                                                                                                       | <div><div>* No remarkable damage.</div><table><tr><th>Dielectr ic</th><th>I.R.</th><th>Cap. Change</th><th>Q/D.F.</th></tr><tr><td>Class I (C0G)</td><td>≥1GΩ or RxC≥ 25Ω-F, whichever is larger</td><td>Within ±3.0% or ±2pF, whichever is larger</td><td>≤0.25%</td></tr><tr><td>Class II (X7R)</td><td>is smaller</td><td>Within ±15%</td><td>≤2.0(D.F.) × initial requireme nt</td></tr></table></div> | Dielectr ic | I.R.        | Cap. Change   | Q/D.F.                                    | Class I (C0G)  | ≥1GΩ or RxC≥ 25Ω-F, whichever is larger | Within ±3.0% or ±2pF, whichever is larger | ≤0.25% | Class II (X7R) | is smaller | Within ±15% | ≤2.0(D.F.) × initial requireme nt |
| Dielectr ic    | I.R.                                      | Cap. Change                               | Q/D.F.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                            |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
| Class I (C0G)  | ≥1GΩ or RxC≥ 25Ω-F, whichever is larger   | Within ±3.0% or ±2pF, whichever is larger | ≤0.25%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                            |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
| Class II (X7R) | is smaller                                | Within ±15%                               | ≤2.0(D.F.) × initial requireme nt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                            |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
| 11.            | Passive Flammability                      | IEC 60384-14 4.17<br>IEC 60384-1 4.38     | <ul style="list-style-type: none"><li>* Volume sample: 21.56 mm<sup>3</sup></li><li>* Flame exposure time: 5 sec Max.</li><li>* Category of flammability : C.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                           | <div><div>* Capacitor didn't burn at all.</div></div>                                                                                                                                                                                                                                                                                                                                                      |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
| 12.            | Active Flammability                       | IEC 60384-21/22 4.18                      | <ul style="list-style-type: none"><li>* The capacitors applied UR (250Vac). Then each sample shall be subjected to 20 discharges from a tank capacitor, charge to a voltage that, when discharged, plase Ui 2500V for X1Y2 across the capacitor under test. The interval between successive discharges shall be 5 sec.</li></ul>                                                                                                                                                                                                                                                                                  | <div><div>* The cheese cloth shall not burn with a flame.</div></div>                                                                                                                                                                                                                                                                                                                                      |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
| 13.            | High Temperature Load (Endurance)         | IEC 60384-14 4.14                         | <ul style="list-style-type: none"><li>* Impulse Voltage : Each individual capacitor shall be subjected to a Vp = 5.0KV (X1Y2 Class Impulse 5KV) &amp; Vp = 6.0KV (X1Y2 Class Impulse 6KV) impulse for three times before applied to endurance test.</li><li>* Test temp. : 125±3℃.</li><li>* Test time: 1000 +48/-0 hrs.</li><li>* Applied voltage : X capacitor: 1.25UR (312.5Vac). Y capacitor: 1.70UR (425Vac). Once every hour the voltage shall be increased to 1000Vrms for 0.1 sec.</li><li>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II).</li></ul> | <div><div>* Appearance : No mechanical damage.</div><div>* Cap. change : C0G within ±5% or ±0.5pF, whichever is larger. X7R within ±20%.</div><div>* D.F. value : C0G≤0.25%. X7R≤5.0%.</div><div>* I.R.≥1GΩ.</div><div>* Dielectric strength satisfies the specified initial value.</div></div>                                                                                                            |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
| 14.            | Resistance to Flexure of Substrate        | IEC 60384-21/22 4.8                       | <div><div><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 for standard termination product, 3mm for soft termination product.</li></ul></div><div></div></div>                                                                                                                                                                                                                  | <div><div>* No remarkable damage.</div><table><tr><th>Dielectric</th><th>Cap. Change</th></tr><tr><td>Class I (C0G)</td><td>Within ±3.0% or ±2pF, whichever is larger</td></tr><tr><td>Class II (X7R)</td><td>Within ±12.5%</td></tr></table><div>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)</div></div> | Dielectric  | Cap. Change | Class I (C0G) | Within ±3.0% or ±2pF, whichever is larger | Class II (X7R) | Within ±12.5%                           |                                           |        |                |            |             |                                   |
| Dielectric     | Cap. Change                               |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                            |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
| Class I (C0G)  | Within ±3.0% or ±2pF, whichever is larger |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                            |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |
| Class II (X7R) | Within ±12.5%                             |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                            |             |             |               |                                           |                |                                         |                                           |        |                |            |             |                                   |

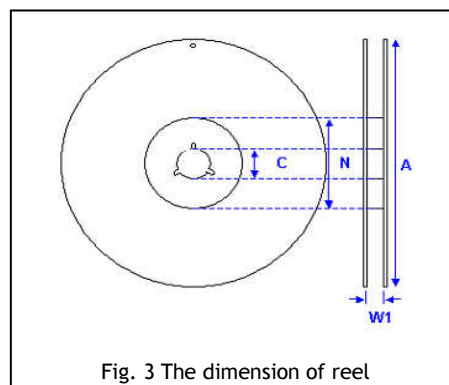
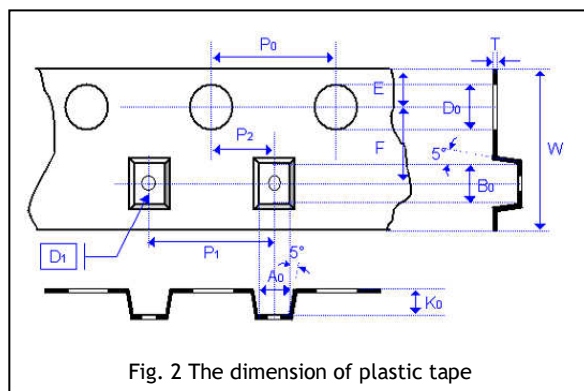
\* "Room condition" Temperature: 15 to  $35^{\circ}\text{C}$ , Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

Multilayer Ceramic Capacitors

| No. | Item                             | Standard Method                          | Test Condition                                                                                                                                                                                                                                                      | Requirements                                                                           |
|-----|----------------------------------|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 15. | Adhesive Strength of Termination | IEC 60384-21/22 4.15<br>IEC 60384-1 4.13 | <p>* Capacitors mounted on a substrate. A force of 10N applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 sec.</p>  | * No remarkable damage or removal of the terminations.                                 |
| 16. | Vibration                        | IEC 60384-1 4.17                         | <p>* Reflow solder the capacitors on P. C. Board before test.</p> <p>* Vibration frequency : 10~55 Hz/min.</p> <p>* Total amplitude : 1.5mm.</p> <p>* Repeat the conditions for 2 hours each in 3 perpendicular directions.</p>                                     | <p>* No remarkable damage.</p> <p>* Cap. change and Q/D.F. : To meet initial spec.</p> |
| 17. | Impulse Voltage                  | IEC 60384-14 4.13                        | <p>* X1 : 4.0KV</p> <p>* Y2 : 5.0KV.</p> <p>* Number of impulse : 24 max.</p>                                                                                                                                                                                       | * There shall be no permanent breakdown or flashover.                                  |

\* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

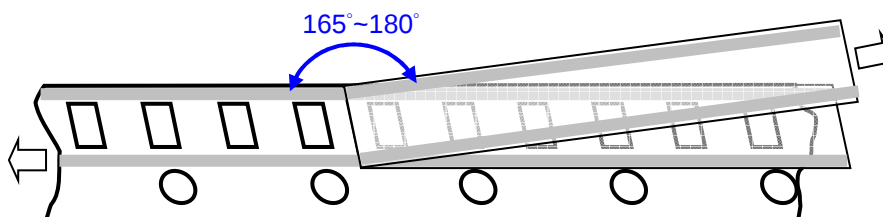
## EMBOSSSED TAPE DIMENSIONS

[illegible]

| Size           | 1808, 1812, 2211, 2220 |               |
|----------------|------------------------|---------------|
| Reel size      | 7"                     | 13"           |
| C              | 13.0+0.5/-0.2          | 13.0+0.5/-0.2 |
| W <sub>1</sub> | 12.4+2.0/-0            | 12.4+2.0/-0   |
| A              | 178.0±1.0              | 330.0±1.0     |
| N              | 60.0+1.0/-0            | 100+1.0       |

■ **Peeling force (EIA-481)**

Peel-off force should be in the range of 10 grams to 100 grams at a peel-off speed of  $300 \pm 10$  mm/min.



## 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; MSL Level 1.

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

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

### Handling

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

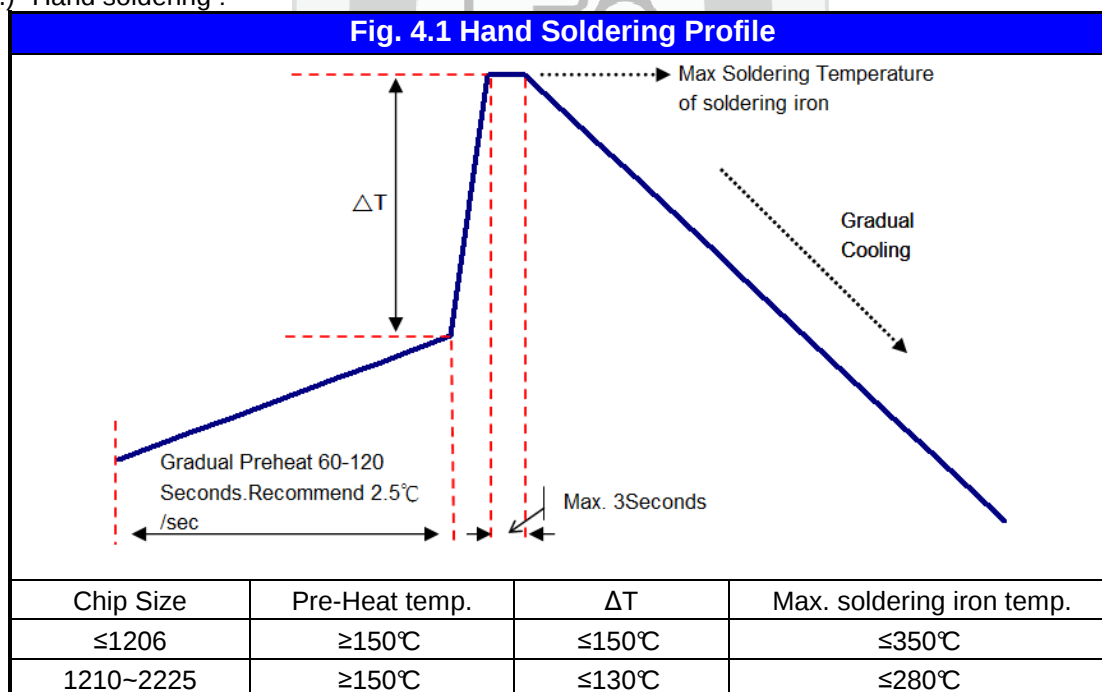
### Preheat

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

### Soldering

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

a.) Hand soldering :



\* Soldering iron tip diameter ≤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.

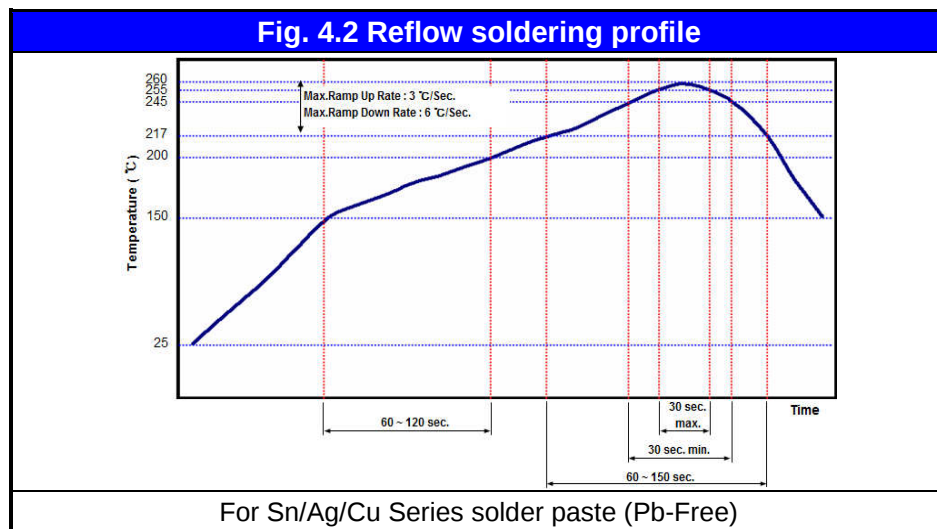
\* The tip of iron should not contact the ceramic body directly.

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

\* Forced air cooling is not allowed.

## Multilayer Ceramic Capacitors

b.) Reflow soldering :



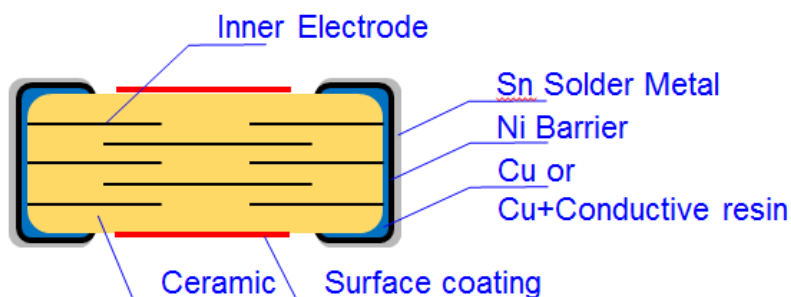
### ❑ Cooling

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.

### ❑ Constructions



## FOOTPRINT DIMENSIONS

| Size Inch (mm) | Item | Dimension (mm) | Fig. 5 Illustration of Footprint |
|----------------|------|----------------|----------------------------------|
| 1808(4520)     | D1   | 6.40~7.50      | <p>Dimensions in millimeters</p> |
|                | D2   | 1.45~1.75      |                                  |
|                | D3   | 3.50~4.00      |                                  |
|                | D4   | 1.45~1.75      |                                  |
|                | D5   | 1.80~2.00      |                                  |
| 1812(4532)     | D1   | 6.40~7.50      |                                  |
|                | D2   | 1.45~1.75      |                                  |
|                | D3   | 3.50~4.00      |                                  |
|                | D4   | 1.45~1.75      |                                  |
|                | D5   | 2.50~2.80      |                                  |
| 2211(5728)     | D1   | 7.80           |                                  |
|                | D2   | 1.75           |                                  |
|                | D3   | 4.30           |                                  |
|                | D4   | 1.75           |                                  |
|                | D5   | 2.50           |                                  |
| 2220(5750)     | D1   | 7.80           |                                  |
|                | D2   | 1.75           |                                  |
|                | D3   | 4.30           |                                  |
|                | D4   | 1.75           |                                  |
|                | D5   | 4.60           |                                  |

