

# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITORS

Middle & High Voltage Series (200V to 4kV)

0402 to 1812 Sizes

NP0 & X7R Dielectrics

Halogen Free & RoHS compliance



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

## 1. INTRODUCTION

WTC middle and high voltage series MLCC is designed by a special internal electrode pattern, which can reduce voltage concentrations by distributing voltage gradients throughout the entire capacitor. This special design also affords increased capacitance values in a given case size and voltage rating.

Capacitors with X7R dielectrics are not intended for AC line filtering applications. Capacitors may require protective surface coating to prevent external arcing.

## 2. FEATURES

- High voltage in a given case size.
- High stability and reliability.

## 3. APPLICATIONS

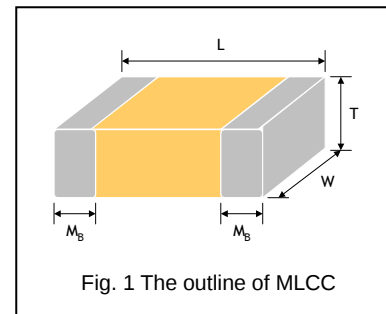
- Snubbers in high frequency power converters.
- High voltage coupling/DC blocking.
- DC-DC converters.
- Back-lighting inverters

## 4. HOW TO ORDER

| <u>1808</u>                                                                                                                                                         | <u>N</u>                                | <u>100</u>                                                                                                                                                 | <u>J</u>                                                                                                                                         | <u>202</u>                                                                                                                                                                                                                                                                                                                                                                         | <u>C</u>           | <u>I</u>                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------------|
| <u>Size</u>                                                                                                                                                         | <u>Dielectric</u>                       | <u>Capacitance</u>                                                                                                                                         | <u>Tolerance</u>                                                                                                                                 | <u>Rated voltage</u>                                                                                                                                                                                                                                                                                                                                                               | <u>Termination</u> | <u>Packaging</u>                            |
| Inch (mm)<br><b>0402</b> (1005)<br><b>0603</b> (1608)<br><b>0805</b> (2012)<br><b>1206</b> (3216)<br><b>1210</b> (3225)<br><b>1808</b> (4520)<br><b>1812</b> (4532) | <b>N</b> =NP0<br>(COG)<br><b>B</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 | <b>B</b> =±0.1pF<br><b>C</b> =±0.25pF<br><b>D</b> =±0.5pF<br><b>F</b> =±1%<br><b>G</b> =±2%<br><b>J</b> =±5%<br><b>K</b> =±10%<br><b>M</b> =±20% | Two significant digits followed by no. of zeros. And R is in place of decimal point.<br><br><b>201</b> =200 VDC<br><b>251</b> =250 VDC<br><b>401</b> =400 VDC<br><b>451</b> =450 VDC<br><b>501</b> =500 VDC<br><b>631</b> =630 VDC<br><b>102</b> =1000 VDC<br><b>152</b> =1500 VDC<br><b>202</b> =2000 VDC<br><b>252</b> =2500 VDC<br><b>302</b> =3000 VDC<br><b>402</b> =4000 VDC | <b>C</b> =Cu/Ni/Sn | <b>T</b> =7" reeled<br><b>G</b> =13" reeled |

## 5. EXTERNAL DIMENSIONS

| Size<br>Inch (mm) | L (mm)              | W (mm)              | T (mm)/Symbol       |           | Remark    | M <sub>B</sub> (mm)      |
|-------------------|---------------------|---------------------|---------------------|-----------|-----------|--------------------------|
| 0402 (1005)       | 1.00±0.05           | 0.50±0.05           | 0.50±0.05           | N         | #         | 0.25<br>+0.05/-0.10      |
| 0603(1608)        | 1.60±0.10           | 0.80±0.10           | 0.80±0.07           | S         |           | 0.40±0.15                |
|                   | 1.60<br>+0.15/-0.10 | 0.80<br>+0.15/-0.10 | 0.80<br>+0.15/-0.10 | X         |           |                          |
| 0805 (2012)       | 2.00±0.15           | 1.25±0.10           | 0.60±0.10           | A         |           | 0.50±0.20                |
|                   |                     |                     | 0.80±0.10           | B         |           |                          |
|                   |                     |                     | 1.25±0.10           | D         | #         |                          |
|                   | 2.00±0.20           | 1.25±0.20           | 1.25±0.20           | I         | #         |                          |
| 1206 (3216)       | 3.20±0.15           | 1.60±0.15           | 0.80±0.10           | B         |           | 0.60±0.20<br>(0.5±0.25)* |
|                   |                     |                     | 0.95±0.10           | C         | #         |                          |
|                   |                     |                     | 1.25±0.10           | D         | #         |                          |
|                   |                     |                     | 3.20±0.20           | 1.60±0.20 | 1.60±0.20 |                          |
|                   | 3.20+0.3/-0.1       | 1.60+0.3/-0.1       | 1.60+0.3/-0.1       | P         | #         |                          |
| 1210 (3225)       | 3.20±0.30           | 2.50±0.20           | 0.95±0.10           | C         | #         | 0.75±0.25                |
|                   |                     |                     | 1.25±0.10           | D         | #         |                          |
|                   | 3.20±0.40           | 2.50±0.30           | 1.60±0.20           | G         | #         |                          |
|                   |                     |                     | 2.00±0.20           | K         | #         |                          |
|                   |                     |                     | 2.50±0.30           | M         | #         |                          |
|                   | 3.20±0.60**         | 2.50±0.50**         | 2.50±0.50**         |           |           |                          |
| 1808 (4520)       | 4.50+0.5/-0.3       | 2.03±0.25           | 1.25±0.10           | D         | #         | 0.50±0.25                |
|                   |                     |                     | 1.60±0.20           | G         | #         |                          |
|                   |                     |                     | 2.00±0.20           | K         | #         |                          |
| 1812 (4532)       | 4.50+0.5/-0.3       | 3.20±0.30           | 1.25±0.10           | D         | #         | 0.50±0.25                |
|                   |                     |                     | 1.60±0.20           | G         | #         |                          |
|                   |                     |                     | 2.00±0.20           | K         | #         |                          |
|                   |                     | 3.20±0.40           | 2.50±0.30           | M         | #         |                          |
|                   |                     |                     | 2.80±0.30           | U         | #         |                          |



# Reflow soldering only is recommended.

\* For 1206\_1000V ~3000V products.

\*\* For 1210(100V)/Cap>1μF or 1210(250V)/Cap>0.47μF or 1210(400V~630V)/Cap>0.22μF

## 6. GENERAL ELECTRICAL DATA

|                                      |                                                                                                                        |                                            |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| <b>Dielectric</b>                    | NP0                                                                                                                    | X7R                                        |
| <b>Size</b>                          | 0402, 0603, 0805, 1206, 1210, 1808, 1812                                                                               |                                            |
| <b>Capacitance*</b>                  | 0.1pF to 0.022μF                                                                                                       | 100pF to 1.0μF                             |
| <b>Capacitance tolerance***</b>      | Cap≤5pF: C (±0.25pF)<br>5pF<Cap<10pF: D (±0.5pF)<br>Cap≥10pF: F (±1%), G (±2%), J (±5%), K (±10%)                      | J (±5%) <sup>#1</sup> , K (±10%), M (±20%) |
| <b>Rated voltage (WVDC)</b>          | 200V to 4000V                                                                                                          |                                            |
| <b>Q/DF*</b>                         | Cap<30pF: Q≥400+20C<br>Cap≥30pF: Q≥1000                                                                                | DF≤2.5%                                    |
| <b>Insulation resistance at Ur**</b> | Ur=200~630V: ≥10GΩ or RxC≥100Ω·F whichever is smaller<br>Ur=1000~3000V: ≥10GΩ                                          |                                            |
| <b>Dielectric strength</b>           | 200~300V: ≥2 x WVDC<br>400V~450V: ≥1.2 x WVDC<br>500~999V: ≥1.5 x WVDC<br>1000~3000V: ≥1.2 x WVDC<br>4000: ≥1.1 x WVDC |                                            |
| <b>Operating temperature</b>         | -55 to +125℃                                                                                                           |                                            |
| <b>Capacitance characteristic</b>    | ±30ppm                                                                                                                 | ±15%                                       |
| <b>Termination</b>                   | Ni/Sn (lead-free termination)                                                                                          |                                            |

#1: X7R products can provide optional J(±5%) capacitance tolerance.

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

NP0: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25℃ at ambient temperature  
X7R, X5R: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25℃ ambient temperature.

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

## 7. CAPACITANCE RANGE (MIDDLE VOLTAGE - 200V to 630V)

### 7-1 NP0 Dielectric

| DIELECTRIC          |               | NP0  |     |      |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |      |     |     |     |   |   |
|---------------------|---------------|------|-----|------|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|------|-----|-----|-----|---|---|
| SIZE                |               | 0402 |     | 0603 |     | 0805 |     |     |     | 1206 |     |     |     | 1210 |     |     |     | 1808 |     | 1812 |     |     |     |   |   |
| RATED VOLTAGE (VDC) |               | 200  | 250 | 200  | 250 | 200  | 250 | 500 | 630 | 200  | 250 | 500 | 630 | 200  | 250 | 500 | 630 | 500  | 630 | 200  | 250 | 500 | 630 |   |   |
| Capacitance         | 0.1pF (0R1)   | N    | N   |      |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |      |     |     |     |   |   |
|                     | 0.2pF (0R2)   | N    | N   |      |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |      |     |     |     |   |   |
|                     | 0.3pF (0R3)   | N    | N   |      |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |      |     |     |     |   |   |
|                     | 0.4pF (0R4)   | N    | N   |      |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |      |     |     |     |   |   |
|                     | 0.5pF (0R5)   | N    | N   | S    | S   | A    | A   | A   | A   |      |     |     |     |      |     |     |     |      |     |      |     |     |     |   |   |
|                     | 1.0pF (1R0)   | N    | N   | S    | S   | A    | A   | A   | A   |      |     |     |     |      |     |     |     |      |     |      |     |     |     |   |   |
|                     | 1.2pF (1R2)   | N    | N   | S    | S   | A    | A   | A   | A   |      |     |     |     |      |     |     |     |      |     |      |     |     |     |   |   |
|                     | 1.5pF (1R5)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     |      |     |      |     |     |     |   |   |
|                     | 1.8pF (1R8)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 2.2pF (2R2)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 2.7pF (2R7)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 3.3pF (3R3)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 3.9pF (3R9)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 4.7pF (4R7)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 5.6pF (5R6)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 6.8pF (6R8)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 8.2pF (8R2)   | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   |      |     |     |     | D    | D   |      |     |     |     |   |   |
|                     | 10pF (100)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 12pF (120)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 15pF (150)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 18pF (180)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 22pF (220)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 27pF (270)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 33pF (330)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 39pF (390)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 47pF (470)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 56pF (560)    | N    | N   | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 68pF (680)    | N    |     | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 82pF (820)    | N    |     | S    | S   | A    | A   | A   | A   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 100pF (101)   | N    |     | S    | S   | A    | B   | B   | B   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 120pF (121)   |      |     | S    | S   | A    | B   | D   | D   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 150pF (151)   |      |     | S    | S   | B    | D   | D   | D   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 180pF (181)   |      |     | S    | S   | B    | D   | D   | D   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 220pF (221)   |      |     | S    | S   | D    | D   | D   | D   | B    | B   | B   | B   | C    | C   | C   | C   | D    | D   | D    | D   | D   | D   | D | D |
|                     | 270pF (271)   |      |     | X    | X   | D    | D   | D   | D   | B    | C   | C   | C   | C    | C   | C   | C   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 330pF (331)   |      |     | X    | X   | D    | D   | D   | D   | B    | C   | C   | C   | C    | C   | C   | C   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 390pF (391)   |      |     | X    | X   | D    | D   | D   | D   | B    | C   | C   | C   | C    | C   | C   | C   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 470pF (471)   |      |     | X    | X   | D    | D   | I   | I   | C    | C   | C   | C   | C    | C   | C   | C   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 560pF (561)   |      |     | X    | X   | D    | D   | I   | I   | C    | D   | D   | D   | C    | C   | C   | C   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 680pF (681)   |      |     | X    | X   | D    | D   | I   | I   | C    | D   | D   | D   | C    | C   | C   | C   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 820pF (821)   |      |     | X    | X   | D    | D   | I   | I   | C    | G   | G   | G   | C    | C   | C   | C   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 1,000pF (102) |      |     | X    | X   | D    | D   | I   | I   | C    | G   | G   | G   | D    | D   | D   | D   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 1,200pF (122) |      |     | X    | X   | D    | D   | I   | I   | C    | G   | G   | G   | D    | D   | D   | D   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 1,500pF (152) |      |     | X    | X   | D    | D   | I   | I   | D    | G   | G   | G   | D    | D   | D   | D   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 1,800pF (182) |      |     | X    | X   | D    | D   | I   | I   | D    | G   | G   | G   | D    | D   | D   | D   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 2,200pF (222) |      |     | X    | X   | D    | D   | I   | I   | D    | G   | G   | G   | D    | D   | D   | D   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 2,700pF (272) |      |     |      |     | I    | I   |     |     | D    | G   | G   | G   | D    | D   | D   | D   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 3,300pF (332) |      |     |      |     | I    | I   |     |     | D    | G   | G   | G   | D    | D   | D   | D   | K    | K   | D    | D   | D   | D   | D | D |
|                     | 3,900pF (392) |      |     |      |     | I    | I   |     |     | D    | G   | G   | G   | D    | D   | D   | D   |      |     | D    | D   | D   | D   | D | D |
|                     | 4,700pF (472) |      |     |      |     | I    | I   |     |     | D    | G   | G   | G   | G    | G   | G   | G   |      |     | D    | D   | D   | D   | D | D |
|                     | 5,600pF (562) |      |     |      |     |      |     |     |     | G    | G   | G   | G   | G    | G   | G   | G   |      |     | D    | D   | D   | D   | D | D |
|                     | 6,800pF (682) |      |     |      |     |      |     |     |     | G    | G   | G   | G   | G    | G   | G   | G   |      |     | D    | D   | D   | D   | D | D |
|                     | 8,200pF (822) |      |     |      |     |      |     |     |     | G    | G   | G   | G   | G    | G   | G   | G   |      |     |      |     | D   | D   | D | D |
|                     | 0.010μF (103) |      |     |      |     |      |     |     |     | G    | G   | G   | G   | G    | G   | K   | K   |      |     |      |     |     | D   | D | D |
|                     | 0.012μF (123) |      |     |      |     |      |     |     |     |      |     |     |     | K    | K   | M   | M   |      |     |      |     |     | G   | G | G |
|                     | 0.015μF (153) |      |     |      |     |      |     |     |     |      |     |     |     | K    | K   | M   | M   |      |     |      |     |     | G   | G | G |
|                     | 0.018μF (183) |      |     |      |     |      |     |     |     |      |     |     |     | K    | K   | K   | K   |      |     |      |     |     | K   | K | K |
|                     | 0.022μF (223) |      |     |      |     |      |     |     |     |      |     |     |     | K    | K   | K   | K   |      |     |      |     |     | K   | K | K |
|                     | 0.027μF (273) |      |     |      |     |      |     |     |     |      |     |     |     | K    | K   | M   | M   |      |     |      |     |     |     |   |   |
|                     | 0.033μF (333) |      |     |      |     |      |     |     |     |      |     |     |     | K    | K   | M   | M   |      |     |      |     |     |     |   |   |
|                     | 0.039μF (393) |      |     |      |     |      |     |     |     |      |     |     |     | K    | K   |     |     |      |     |      |     |     |     |   |   |
|                     | 0.047μF (473) |      |     |      |     |      |     |     |     |      |     |     |     | K    | K   |     |     |      |     |      |     |     |     |   |   |

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

Multilayer Ceramic Capacitors

Approval Sheet

7-2 X7R Dielectric

| DIELECTRIC          |               | X7R  |     |      |     |     |     |      |     |     |     |     |     |      |     |     |     |     |     |      |     |      |     |     |     |     |  |
|---------------------|---------------|------|-----|------|-----|-----|-----|------|-----|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|------|-----|------|-----|-----|-----|-----|--|
| SIZE                |               | 0603 |     | 0805 |     |     |     | 1206 |     |     |     |     |     | 1210 |     |     |     |     |     | 1808 |     | 1812 |     |     |     |     |  |
| RATED VOLTAGE (VDC) |               | 200  | 250 | 200  | 250 | 500 | 630 | 200  | 250 | 400 | 450 | 500 | 630 | 200  | 250 | 400 | 450 | 500 | 630 | 500  | 630 | 200  | 250 | 450 | 500 | 630 |  |
| Capacitance         | 100pF (101)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   |      |     |      |     |     |     |     |  |
|                     | 120pF (121)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   |      |     |      |     |     |     |     |  |
|                     | 150pF (151)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 180pF (181)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 220pF (221)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 270pF (271)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 330pF (331)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 390pF (391)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 470pF (471)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 560pF (561)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | D    | D   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 680pF (681)   | X    | X   | B    | B   | B   | B   | B    | B   |     |     | B   | B   | C    | C   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 820pF (821)   | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   |      |     |     |     |     |  |
|                     | 1,000pF (102) | X    | X   | B    | B   | B   | B   | B    | B   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 1,200pF (122) | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 1,500pF (152) | X    | X   | B    | B   | B   | B   | D    | D   |     |     | B   | B   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 1,800pF (182) | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 2,200pF (222) | X    | X   | B    | B   | B   | B   | B    | B   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 2,700pF (272) | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 3,300pF (332) | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 3,900pF (392) | X    | X   | B    | B   | B   | B   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 4,700pF (472) | X    | X   | B    | B   | D   | D   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | D    | D   | D    | D   | D   | D   | D   |  |
|                     | 5,600pF (562) | X    | X   | D    | D   | D   | D   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 6,800pF (682) | X    | X   | D    | D   | D   | D   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 8,200pF (822) | X    | X   | D    | D   | D   | D   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.010μF (103) | X    | X   | D    | D   | D   | D   | B    | B   |     |     | C   | C   | C    | C   |     |     | D   | D   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.012μF (123) |      |     | D    | D   | D   | D   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.015μF (153) |      |     | D    | D   | D   | D   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.018μF (183) |      |     | D    | D   | D   | D   | D    | D   |     |     | D   | D   | C    | C   |     |     | D   | D   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.022μF (223) |      |     | D    | D   | D   | D   | D    | D   |     |     | G   | G   | C    | C   |     |     | D   | D   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.027μF (273) |      |     | D    | D   | D   | D   | D    | D   |     |     | G   | G   | C    | C   |     |     | G   | G   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.033μF (333) |      |     | D    | D   | D   |     | G    | G   |     |     | G   | G   | C    | C   |     |     | G   | G   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.039μF (393) |      |     | D    | D   |     |     | G    | G   |     |     | G   | G   | C    | C   |     |     | G   | G   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.047μF (473) |      |     | D    | D   |     |     | G    | G   |     |     | G   | G   | D    | D   |     |     | G   | G   | K    | K   | D    | D   | D   | D   | D   |  |
|                     | 0.056μF (563) |      |     | D    | D   |     |     | G    | G   |     |     | G   | G   | D    | D   |     |     | G   | G   | K    | K   | D    | D   | K   | K   | K   |  |
|                     | 0.068μF (683) |      |     | D    | D   |     |     | G    | G   | G   | G   | G   | G   | G    | G   |     |     | K   | K   | K    | K   | D    | D   | K   | K   | K   |  |
|                     | 0.082μF (823) |      |     | D    |     |     |     | G    | G   | G   | G   |     | G   | G    |     |     |     | K   | K   | K    | K   | D    | D   | K   | K   | K   |  |
|                     | 0.10μF (104)  |      |     | D    |     |     |     | G    | G   | G   | G   |     | G   | G    |     |     |     | K   | K   |      |     | D    | D   | K   | K   | K   |  |
|                     | 0.12μF (124)  |      |     |      |     |     |     | G    | G   |     |     |     | G   | G    | M   | M   | M   | M   |     |      |     | D    | D   | M   | M   | M   |  |
|                     | 0.15μF (154)  |      |     |      |     |     |     | G    | G   |     |     |     | M   | M    | M   | M   | M   | M   |     |      |     | K    | K   | M   | M   | M   |  |
|                     | 0.18μF (184)  |      |     |      |     |     |     | G    | G   |     |     |     | M   | M    | M   | M   |     |     |     |      |     | K    | K   | M   | M   | M   |  |
|                     | 0.22μF (224)  |      |     |      |     |     |     | G    | G   |     |     |     | M   | M    | M   | M   |     |     |     |      |     | K    | K   | M   | M   | M   |  |
|                     | 0.27μF (274)  |      |     |      |     |     |     |      |     |     |     |     | M   | M    | M   | M   |     |     |     |      |     | K    | K   | M   | M   |     |  |
|                     | 0.33μF (334)  |      |     |      |     |     |     |      |     |     |     |     | M   | M    | M   | M   |     |     |     |      |     | K    | K   | M   | M   |     |  |
|                     | 0.39μF (394)  |      |     |      |     |     |     |      |     |     |     |     | M   | M    |     |     |     |     |     |      |     | K    | K   | M   | M   |     |  |
|                     | 0.47μF (474)  |      |     |      |     |     |     |      |     |     |     |     | M   | M    |     |     |     |     |     |      |     | K    | K   | M   | M   |     |  |
|                     | 0.56μF (564)  |      |     |      |     |     |     |      |     |     |     |     | M   | M    |     |     |     |     |     |      |     | M    | M   | M   |     |     |  |
|                     | 0.68μF (684)  |      |     |      |     |     |     |      |     |     |     |     | M   | M    |     |     |     |     |     |      |     | M    | M   | M   |     |     |  |
|                     | 0.82μF (824)  |      |     |      |     |     |     |      |     |     |     |     |     |      |     |     |     |     |     |      |     | M    | M   | U   |     |     |  |
|                     | 1.0μF (105)   |      |     |      |     |     |     |      |     |     |     |     |     |      |     |     |     |     |     |      |     | M    | M   | U   |     |     |  |

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

## 8. CAPACITANCE RANGE (HIGH VOLTAGE - 1kV to 4kV)

### 8-1 NP0 Dielectric

| DIELECTRIC    |               | NP0  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
|---------------|---------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| SIZE          |               | 0805 | 1206 |      |      | 1210 |      |      | 1808 |      |      |      |      | 1812 |      |      |      |      |   |
| RATED VOLTAGE |               | 1000 | 1000 | 1500 | 2000 | 1000 | 1500 | 2000 | 1000 | 1500 | 2000 | 3000 | 4000 | 1000 | 1500 | 2000 | 3000 | 4000 |   |
| Capacitance   | 0.5pF (0R5)   | D    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
|               | 1.0pF (1R0)   | D    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
|               | 1.2pF (1R2)   | D    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
|               | 1.5pF (1R5)   | D    | B    | B    | B    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
|               | 1.8pF (1R8)   | D    | B    | B    | B    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
|               | 2.0pF (2R0)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 2.2pF (2R2)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 2.7pF (2R7)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 3.3pF (3R3)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 3.9pF (3R9)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 4.7pF (4R7)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 5.6pF (5R6)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 6.8pF (6R8)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 8.2pF (8R2)   | D    | B    | B    | B    |      |      |      | D    | D    | D    | D    |      |      |      |      |      |      |   |
|               | 10pF (100)    | D    | B    | B    | B    | C    | C    | C    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D |
|               | 12pF (120)    | D    | B    | B    | B    | C    | C    | C    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D |
|               | 15pF (150)    | D    | B    | B    | B    | C    | C    | C    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D |
|               | 18pF (180)    | D    | B    | B    | B    | C    | C    | C    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D |
|               | 22pF (220)    | D    | B    | B    | B    | C    | C    | C    | D    | D    | D    | D    | G    |      | D    | D    | D    | D    | D |
|               | 27pF (270)    | D    | B    | B    | B    | C    | C    | C    | D    | D    | D    | D    | G    |      | D    | D    | D    | D    | D |
|               | 33pF (330)    | D    | B    | C    | C    | C    | C    | C    | D    | D    | D    | D    |      |      | D    | D    | D    | D    |   |
|               | 39pF (390)    | D    | B    | C    | C    | C    | C    | C    | D    | D    | D    | D    |      |      | D    | D    | D    | D    |   |
|               | 47pF (470)    | D    | B    | C    | C    | C    | C    | C    | D    | D    | D    | D    |      |      | D    | D    | D    | D    |   |
|               | 56pF (560)    | D    | B    | D    | D    | C    | D    | D    | D    | D    | D    | D    |      |      | D    | D    | D    | D    |   |
|               | 68pF (680)    | D    | B    | D    | D    | C    | D    | D    | D    | D    | D    | D    |      |      | D    | D    | D    | D    |   |
|               | 82pF (820)    | D    | B    | D    | D    | C    | D    | D    | D    | D    | D    | D    |      |      | D    | D    | D    | D    |   |
|               | 100pF (101)   | D    | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    |      | D    | D    | D    | D    |   |
|               | 120pF (121)   | D    | D    | G    | G    | D    | D    | D    | D    | D    | D    | D    | K    |      | D    | D    | D    | D    |   |
|               | 150pF (151)   | D    | D    | G    | G    | D    | G    | G    | D    | K    | K    | K    |      |      | D    | D    | D    | D    |   |
|               | 180pF (181)   | D    | G    | G    | G    | D    | G    | G    | D    | K    | K    | K    |      |      | D    | D    | K    | K    |   |
|               | 220pF (221)   | D    | G    | G    | G    | G    | G    | G    | D    | K    | K    | K    |      |      | D    | D    | K    | K    |   |
|               | 270pF (271)   | D    | G    | P    | P    | G    | K    | K    | K    | K    | K    | K    |      |      | D    | K    | K    | K    |   |
|               | 330pF (331)   | D    | G    | P    | P    | G    | K    | K    | K    | K    | K    | K    |      |      | D    | K    | K    | K    |   |
|               | 390pF (391)   | D    | G    | P    | P    | G    | M    | M    | K    | K    | K    | K    |      |      | D    | K    | K    | K    |   |
|               | 470pF (471)   |      | G    |      |      | G    | M    | M    | K    | K    | K    |      |      |      | K    | K    | K    | K    |   |
|               | 560pF (561)   |      | G    |      |      | G    |      |      | K    | K    | K    |      |      |      | K    | K    | K    |      |   |
|               | 680pF (681)   |      | G    |      |      | G    |      |      | K    | K    | K    |      |      |      | K    | K    | K    |      |   |
|               | 820pF (821)   |      | G    |      |      | G    |      |      | K    | D    | D    |      |      |      | K    | K    | K    |      |   |
|               | 1,000pF (102) |      | G    |      |      | G    |      |      | K    | G    | G    |      |      |      | K    | K    | K    |      |   |
|               | 1,200pF (122) |      | G    |      |      | K    |      |      | G    | G    | G    |      |      |      | K    |      |      |      |   |
|               | 1,500pF (152) |      | G    |      |      | K    |      |      | K    | K    | K    |      |      |      | K    |      |      |      |   |
|               | 1,800pF (182) |      | G    |      |      | K    |      |      | K    | K    | K    |      |      |      | K    |      |      |      |   |
|               | 2,200pF (222) |      | G    |      |      | K    |      |      | K    | K    | K    |      |      |      | K    |      |      |      |   |
|               | 2,700pF (272) |      | G    |      |      | K    |      |      | K    |      |      |      |      |      | K    |      |      |      |   |
|               | 3,300pF (332) |      | G    |      |      | K    |      |      | K    |      |      |      |      |      | K    |      |      |      |   |
| 3,900pF (392) |               | G    |      |      | K    |      |      |      |      |      |      |      |      | M    |      |      |      |      |   |
| 4,700pF (472) |               | G    |      |      | K    |      |      |      |      |      |      |      |      | M    |      |      |      |      |   |
| 5,600pF (562) |               |      |      |      | K    |      |      |      |      |      |      |      |      | M    |      |      |      |      |   |
| 6,800pF (682) |               |      |      |      | K    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 8,200pF (822) |               |      |      |      | K    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 0.010μF (103) |               |      |      |      | M    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 0.012μF (123) |               |      |      |      | M    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 0.015μF (153) |               |      |      |      | M    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 0.018μF (183) |               |      |      |      | M    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |
| 0.022μF (223) |               |      |      |      | M    |      |      |      |      |      |      |      |      |      |      |      |      |      |   |

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

Multilayer Ceramic Capacitors

Approval Sheet

8-2 X7R Dielectric

| DIELECTRIC    |               | X7R  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|---------------|---------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| SIZE          |               | 0805 | 1206 |      |      |      | 1210 |      |      | 1808 |      |      |      |      | 1812 |      |      |      |      |
| RATED VOLTAGE |               | 1000 | 1000 | 1500 | 2000 | 2500 | 1000 | 1500 | 2000 | 1000 | 1500 | 2000 | 3000 | 4000 | 1000 | 1500 | 2000 | 3000 | 4000 |
| Capacitance   | 100pF (101)   | B    | D    | D    | D    | D    | D    | D    | D    |      |      |      |      |      |      |      |      |      |      |
|               | 120pF (121)   | B    | D    | D    | D    | D    | D    | D    | D    |      |      |      |      |      |      |      |      |      |      |
|               | 150pF (151)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    |      |      |      |      |      |
|               | 180pF (181)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    |      |      |      |      |      |
|               | 220pF (221)   | B    | B    | D    | B    | D    | D    | D    | D    | D    | D    | D    | D    | K    |      |      |      |      |      |
|               | 270pF (271)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    | D    | D    | D    | K    | K    |
|               | 330pF (331)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    | K    | D    | D    | D    | K    | K    |
|               | 390pF (391)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    | K    | D    | D    | D    | K    | K    |
|               | 470pF (471)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    | K    | D    | D    | D    | K    | K    |
|               | 560pF (561)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    | K    | D    | D    | D    | K    | K    |
|               | 680pF (681)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    | K    | D    | D    | D    | K    | K    |
|               | 820pF (821)   | B    | D    | D    | D    | D    | D    | D    | D    | D    | D    | D    | K    | K    | D    | D    | D    | K    | K    |
|               | 1,000pF (102) | B    | D    | D    | B    | D    | D    | D    | D    | D    | K    | K    | K    | K    | D    | D    | D    | K    | K    |
|               | 1,200pF (122) | B    | D    | G    | G    | G    | D    | M    | M    | D    | K    | K    | K    |      | D    | D    | D    | K    | M    |
|               | 1,500pF (152) | D    | D    | G    | G    | G    | D    | M    | M    | D    | K    | K    | K    |      | D    | D    | D    | K    | M    |
|               | 1,800pF (182) | D    | D    | G    | G    | G    | D    | M    | M    | D    | K    | K    | K    |      | D    | D    | D    | M    | M    |
|               | 2,200pF (222) | D    | D    | G    | G    | G    | D    | M    | M    | D    | K    | K    | K    |      | D    | D    | D    | M    |      |
|               | 2,700pF (272) | D    | D    | G    | G    |      | D    | M    | M    | D    | K    | K    | K    |      | D    | D    | D    | M    |      |
|               | 3,300pF (332) | D    | D    | G    | G    |      | D    | M    | M    | D    | K    | K    | K    |      | D    | K    | K    | M    |      |
|               | 3,900pF (392) | D    | D    | G    |      |      | G    | M    | M    | D    | K    | K    |      |      | D    | K    | K    | M    |      |
|               | 4,700pF (472) | D    | D    | G    |      |      | G    | M    | M    | D    | K    | K    |      |      | D    | K    | K    | M    |      |
|               | 5,600pF (562) | D    | D    | G    |      |      | G    | M    | M    | K    | K    | K    |      |      | D    | M    | M    | M    |      |
|               | 6,800pF (682) | D    | D    | G    |      |      | G    | M    | M    | K    | K    | K    |      |      | D    | M    | M    | M    |      |
|               | 8,200pF (822) | D    | D    | G    |      |      | G    | M    | M    | K    | K    | K    |      |      | D    | M    | M    |      |      |
|               | 0.010μF (103) | D    | D    | G    |      |      | G    | M    |      | K    | K    | K    |      |      | D    | M    | M    |      |      |
|               | 0.012μF (123) |      | G    |      |      |      | G    |      |      | K    |      |      |      |      | K    | M    | M    |      |      |
|               | 0.015μF (153) |      | G    |      |      |      | G    |      |      | K    |      |      |      |      | K    | M    | M    |      |      |
|               | 0.018μF (183) |      |      |      |      |      | G    |      |      | K    |      |      |      |      | M    | M    | M    |      |      |
|               | 0.022μF (223) |      |      |      |      |      | G    |      |      | K    |      |      |      |      | M    | M    | M    |      |      |
|               | 0.033μF (333) |      |      |      |      |      | G    |      |      | K    |      |      |      |      | M    |      |      |      |      |
|               | 0.039μF (393) |      |      |      |      |      | K    |      |      | K    |      |      |      |      | M    |      |      |      |      |
|               | 0.047μF (473) |      |      |      |      |      | M    |      |      | K    |      |      |      |      | M    |      |      |      |      |
|               | 0.056μF (563) |      |      |      |      |      |      |      |      | K    |      |      |      |      | M    |      |      |      |      |
|               | 0.068μF (683) |      |      |      |      |      |      |      |      |      |      |      |      |      | M    |      |      |      |      |
|               | 0.10μF (104)  |      |      |      |      |      |      |      |      |      |      |      |      |      | M    |      |      |      |      |

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

9. PACKAGING DIMENSION AND QUANTITY

| Size | Thickness/Symbol (mm) |   | Paper tape |          | Plastic tape |          |
|------|-----------------------|---|------------|----------|--------------|----------|
|      |                       |   | 7" reel    | 13" reel | 7" reel      | 13" reel |
| 0402 | 0.50±0.05             | N | 10k        | 50k      | -            | -        |
| 0603 | 0.80±0.07             | S | 4k         | 15k      | -            | -        |
|      | 0.80 +0.15/-0.10      | X | 4k         | 15k      | -            | -        |
| 0805 | 0.60±0.10             | A | 4k         | 15k      | -            | -        |
|      | 0.80±0.10             | B | 4k         | 15k      | -            | -        |
|      | 1.25±0.10             | D | -          | -        | 3k           | 10k      |
|      | 1.25±0.20             | I | -          | -        | 3k           | 10k      |
| 1206 | 0.80±0.10             | B | 4k         | 15k      | -            | -        |
|      | 0.95±0.10             | C | -          | -        | 3k           | 10k      |
|      | 1.25±0.10             | D | -          | -        | 3k           | 10k      |
|      | 1.60±0.20             | G | -          | -        | 2k           | 10k      |
|      | 1.60+0.30/-0.10       | P | -          | -        | 2k           | 9k       |
| 1210 | 0.95±0.10             | C | -          | -        | 3k           | 10k      |
|      | 1.25±0.10             | D | -          | -        | 3k           | 10k      |
|      | 1.60±0.20             | G | -          | -        | 2k           | -        |
|      | 2.00±0.20             | K | -          | -        | 1k           | 6k       |
|      | 2.50±0.30             | M | -          | -        | 1k           | 6k       |
| 1808 | 1.25±0.10             | D | -          | -        | 2k           | 10k      |
|      | 1.60±0.20             | G | -          | -        | 2k           | 8k       |
|      | 2.00±0.20             | K | -          | -        | 1k           | 6k       |
| 1812 | 1.25±0.10             | D | -          | -        | 1k           | 5k       |
|      | 1.60±0.20             | G | -          | -        | 1k           | -        |
|      | 2.00±0.20             | K | -          | -        | 1k           | -        |
|      | 2.50±0.30             | M | -          | -        | 0.5k         | 3k       |

Unit: pieces

## 10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.  | Item                             | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                 | Requirements                                                                                                                                                                                                                                                         |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
|------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----|-------------------|-----|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|-----|------------------|-----|-------------|
| 1.   | Visual and Mechanical            | ---                                                                                                                                                                                                                                                                                                                                                                                                            | * No remarkable defect.<br>* Dimensions to conform to individual specification sheet.                                                                                                                                                                                |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 2.   | Capacitance                      | * Test temp.: Room Temperature.                                                                                                                                                                                                                                                                                                                                                                                | * Shall not exceed the limits given in the detailed spec.                                                                                                                                                                                                            |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 3.   | Q/ D.F.<br>(Dissipation Factor)  | Class I: (NP0)<br>Cap≤1000pF, 1.0±0.2Vrms, 1MHz±10%<br>Cap>1000pF, 1.0±0.2Vrms, 1KHz±10%<br>Class II: (X7R)<br>1.0±0.2Vrms, 1kHz±10%<br>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .                                                                                                                                                   | NP0: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C<br>X7R: ≤2.5%                                                                                                                                                                                                             |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 4.   | Dielectric Strength              | * To apply voltage:<br>200V~300V                    ≥2 times VDC<br>400V~450V                   ≥1.2 times VDC<br>500V~999V                   ≥1.5 times VDC<br>1000V~3000V                ≥1.2 times VDC<br>4000V                         ≥1.1 times VDC<br>* Duration: 1 to 5 sec.<br>* Charge & discharge current less than 50mA.                                                                           | * No evidence of damage or flash over during test.                                                                                                                                                                                                                   |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 5.   | Insulation Resistance            | * Test temp.: Room Temperature. To apply rated voltage<br>Rated voltage: 200~630V                (500V max.) for 60 sec.<br>* Test temp.: Room Temperature. To apply 500V for 60 sec.<br>Rated voltage: ≥630V                                                                                                                                                                                                  | ≥10GΩ or RxC≥100Ω-F whichever is smaller                                                                                                                                                                                                                             |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 6.   | Temperature Coefficient          | With no electrical load.<br><table><tr><th>T.C.</th><th>Operating Temp</th></tr><tr><td>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><br>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .                                                                                                 | T.C.                                                                                                                                                                                                                                                                 | Operating Temp | 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>NP0</td><td>Within ±30ppm/°C</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr></table> | T.C. | Capacitance Change | NP0 | Within ±30ppm/°C | X7R | Within ±15% |
| T.C. | Operating Temp                   |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                      |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| NP0  | -55~125°C at 25°C                |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                      |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| X7R  | -55~125°C at 25°C                |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                      |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| T.C. | Capacitance Change               |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                      |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| NP0  | Within ±30ppm/°C                 |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                      |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| X7R  | Within ±15%                      |                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                      |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 7.   | Adhesive Strength of Termination | * Pressurizing force :<br>5N (≤0603) and 10N (>0603)<br>* Test time: 10±1 sec.                                                                                                                                                                                                                                                                                                                                 | * No remarkable damage or removal of the terminations.                                                                                                                                                                                                               |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 8.   | Vibration Resistance             | * Vibration frequency: 10~55 Hz/min.<br>* Total amplitude: 1.5mm<br>* Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)<br>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .<br>*Cap./DF(Q) Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.                           | * No remarkable damage.<br>* Cap change and Q/D.F.: To meet initial spec.                                                                                                                                                                                            |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 9.   | Solderability                    | * Solder temperature: 235±5°C<br>* Dipping time: 2±0.5 sec.                                                                                                                                                                                                                                                                                                                                                    | 95% min. coverage of all metalized area.                                                                                                                                                                                                                             |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 10.  | Bending Test                     | * The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec.<br>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .<br>* Measurement to be made after keeping at room temp. for 24±2 hrs. | * No remarkable damage.<br>* Cap change :<br>NP0: within ±5.0% or ±0.5pF whichever is larger.<br>X7R: within ±12.5%<br>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.) |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |
| 11.  | Resistance to Soldering Heat     | * Solder temperature: 260±5°C<br>* Dipping time: 10±1 sec<br>* Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.<br>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .<br>*Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.             | * No remarkable damage.<br>* Cap change:<br>NP0: within ±2.5% or ±0.25pF whichever is larger.<br>X7R: within ±7.5%<br>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.<br>* 25% max. leaching on each edge.                                     |                |     |                   |     |                   |                                                                                                                                                         |      |                    |     |                  |     |             |

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

| No.  | Item                              | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Requirements                                                                                                                                                                                                                                                                                                  |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                           |
|------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|---|----------------------------|------|---|------------|-----|---|----------------------------|------|---|------------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12.  | Temperature Cycle                 | <p>* Conduct the five cycles according to the temperatures and time.</p> <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> <p>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p>                                                    | 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 | <p>No remarkable damage.</p> <p>Cap change :<br/>NP0: within ±2.5% or ±0.25pF whichever is larger.<br/>X7R: within ±7.5%</p> <p>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</p> |
| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                               |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                           |
| 13.  | Humidity (Damp Heat) Steady State | <p>* Test temp.: 40±2°C</p> <p>* Humidity: 90~95% RH</p> <p>* Test time: 500+24/-0hrs.</p> <p>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p>                                                                                                                                                                                                                                                                                                                                                         | <p>* No remarkable damage.</p> <p>* Cap change: NP0: within ±5.0% or ±0.5pF whichever is larger.<br/>X7R: within ±12.5%</p> <p>* Q/D.F. value:<br/>NP0: Cap≥30pF, Q≥350; 10pF≤Cap&lt;30pF, Q≥275+2.5C<br/>Cap&lt;10pF, Q≥200+10C<br/>X7R: ≤3.0%</p> <p>* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.</p>    |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                           |
| 14.  | Humidity (Damp Heat) Load         | <p>* Test temp.: 40±2°C</p> <p>* Humidity: 90~95%RH</p> <p>* Test time: 500+24/-0 hrs.</p> <p>* To apply voltage : rated voltage (Max. 500V)</p> <p>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p>                                                                                                                                                                                                                                                                                                   | <p>* No remarkable damage.</p> <p>* Cap change: NP0: within ±7.5% or ±0.75pF whichever is larger.<br/>X7R: within ±12.5%</p> <p>* Q/D.F. value:<br/>NP0: Cap≥30pF, Q≥200; Cap&lt;30pF, Q≥100+10/3C<br/>X7R: ≤3.0%</p> <p>* I.R.: ≥500MΩ or RxC≥25Ω-F whichever is smaller.</p>                                |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                           |
| 15.  | High Temperature Load (Endurance) | <p>* Test temp.:<br/>NP0, X7R: 125±3°C</p> <p>* To apply voltage:</p> <p>(1) 1206/NP0 (3kV) ≥1.5pF: 100% of rated voltage.<br/>1812N472&amp;1812N562(1KV): 100% of rated voltage.</p> <p>(2) 200V~300V: 200% of rated voltage.</p> <p>(3) 400V~450V: 120% of rated voltage.</p> <p>(4) 500V: 150% of rated voltage.</p> <p>(5) 630V~3000V: 120% of rated voltage.</p> <p>(6) 4000V: 110% of rated voltage.</p> <p>* Test time: 1000+24/-0 hrs.</p> <p>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p> | <p>* No remarkable damage.</p> <p>* Cap change: NP0: within ±3.0% or ±0.3pF whichever is larger.<br/>X7R: within ±12.5%</p> <p>* Q/D.F. value:<br/>NP0: Cap≥30pF, Q≥350<br/>10pF≤Cap&lt;30pF, Q≥275+2.5C<br/>Cap&lt;10pF, Q≥200+10C<br/>X7R: ≤3.0%</p> <p>* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.</p> |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                           |

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

## APPENDIXES

### ■ Tape & reel dimensions

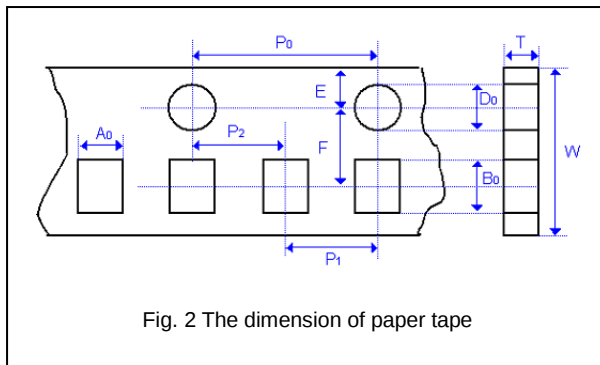


Fig. 2 The dimension of paper tape

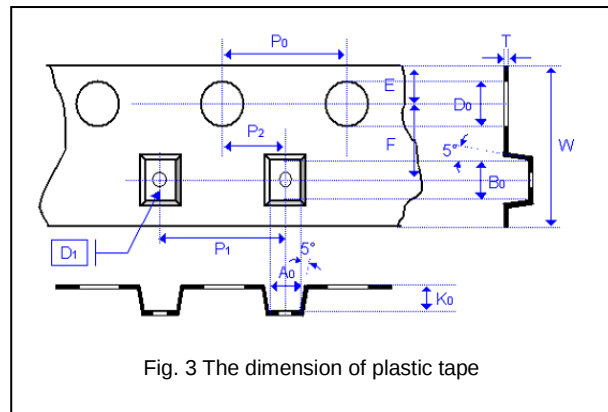


Fig. 3 The dimension of plastic tape

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

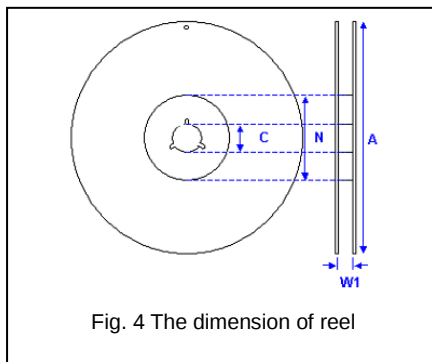
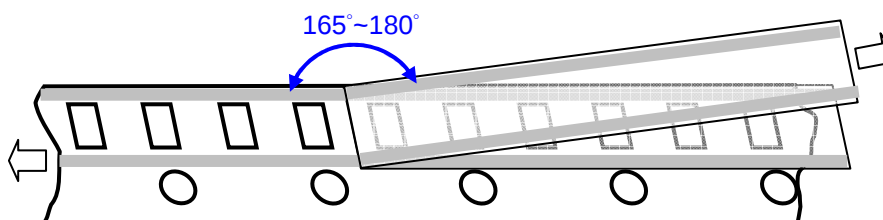


Fig. 4 The dimension of reel

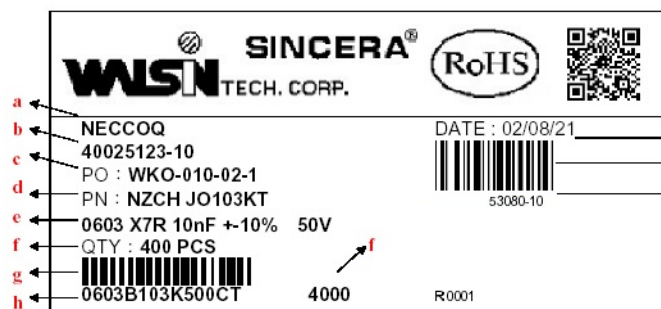
| Size           | 0402, 0603, 0805, 1206, 1210 |           |           | 1808, 1812  |
|----------------|------------------------------|-----------|-----------|-------------|
| Reel size      | 7"                           | 10"       | 13"       | 7"          |
| C              | 13.0±0.5                     | 13.0±0.5  | 13.0±0.5  | 13.0±0.5    |
| W <sub>1</sub> | 10.0±1.5                     | 10.0±1.5  | 10.0±1.5  | 12.4±2.0/-0 |
| A              | 178.0±2.0                    | 250.0±2.0 | 330.0±2.0 | 178.0±2.0   |
| N              | 60.0±1.0/-0                  | 50 min    | 50 min    | 60.0±1.0/-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±10 mm/min.



## Example of customer label



\*Customized label is available upon request

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

## Constructions

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

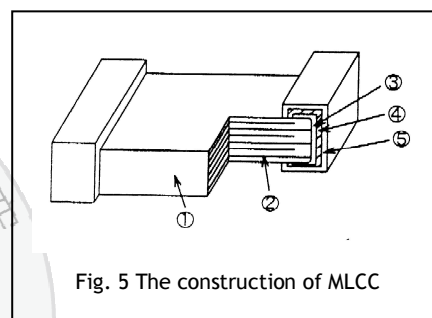


Fig. 5 The construction of MLCC

## Storage and handling conditions

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

Cautions:

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

## Recommended soldering conditions

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

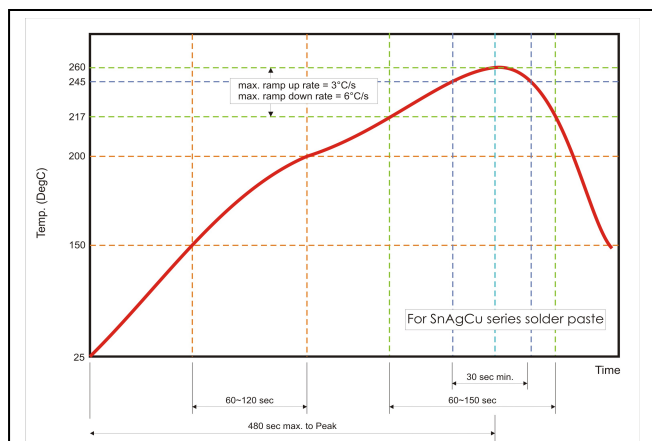


Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

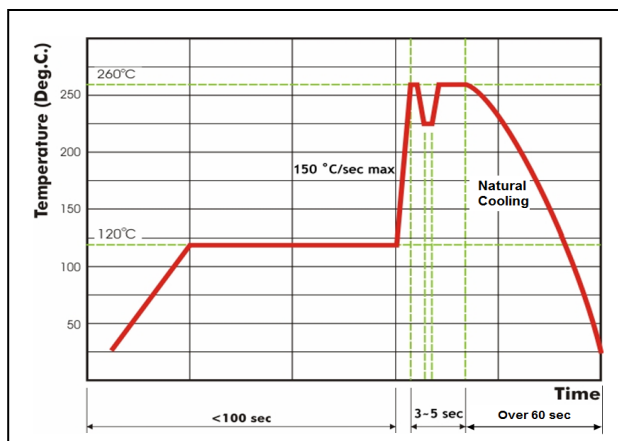


Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.

