

# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITORS

Automotive Capacitors Series (MG)

0201 to 1812 Sizes

NP0, X7R, X5R, Dielectrics,

6.3V to 1000V

Halogen Free & RoHS Compliance



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

**Multilayer Ceramic Capacitors**

**1. DESCRIPTION**

MLCC consists of a conducting material and electrodes. To manufacture a chip-type SMT and achieve miniaturization, high density and high efficiency, ceramic condensers are used.

WTC's MG series MLCC is made by NP0, X7R & X5R dielectrics and which provides product with high electrical precision, stability and reliability. Besides, MG series MLCC is tighten controlling in quality in line to assure quality performance in automotive applications.

**2. FEATURES**

- a. A wide selection of sizes is available (0402 to 1812).
- b. High capacitance in given case size.
- c. Capacitor with lead-free termination (pure Tin).

**3. APPLICATIONS**

- a. For Navigation & Information equipments.
- b. For entertainment equipments
- c. For comfortable equipments.

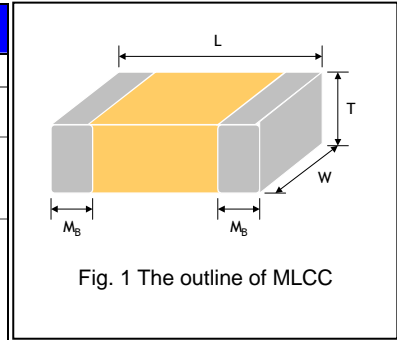
**4. HOW TO ORDER**

| <b>MG</b>  | <b>31</b>  | <b>B</b>  | <b>104</b>  | <b>K</b>   | <b>500</b>   | <b>C</b>           | <b>I</b>                                    |
|--|--|---|---|--|--|--------------------|---|
| <b>Series</b>  | <b>Size</b>  | <b>Dielectric</b>                                     | <b>Capacitance</b>  | <b>Tolerance</b>   | <b>Rated voltage</b>   | <b>Termination</b> | <b>Packaging style</b>                      |
| <b>MG=</b> Automotive (without AEC-Q200 certification) | <b>03=</b> 0201 (0603)<br><b>15=</b> 0402 (1005)<br><b>18=</b> 0603 (1608)<br><b>21=</b> 0805 (2012)<br><b>31=</b> 1206 (3216)<br><b>32=</b> 1210 (3225)<br><b>43=</b> 1812 (4532) | <b>N=</b> NP0 (C0G)<br><b>B=</b> X7R<br><b>X=</b> X5R | Two significant digits followed by no. of zeros. And R is in place of decimal point.<br>eg.:<br>0R5=0.5pF<br>1R0=1.0pF<br>104=10x10 <sup>4</sup> =100nF | <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><b>6R3=</b> 6.3 VDC<br><b>100=</b> 10 VDC<br><b>160=</b> 16 VDC<br><b>250=</b> 25 VDC<br><b>500=</b> 50 VDC<br><b>101=</b> 100 VDC<br><b>201=</b> 200 VDC<br><b>251=</b> 250 VDC<br><b>501=</b> 500 VDC<br><b>631=</b> 630 VDC<br><b>102=</b> 1000 VDC | <b>C=</b> Cu/Ni/Sn | <b>T=</b> 7" reeled<br><b>G=</b> 13" reeled |

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**5. EXTERNAL DIMENSIONS**

| Size<br>Inch (mm) | L (mm)                        | W (mm)              | T (mm)/Symbol       | Remark | M <sub>B</sub> (mm)       |
|-------------------|-------------------------------|---------------------|---------------------|--------|---------------------------|
| 0201 (0603)       | 0.60±0.03                     | 0.30±0.03           | 0.30±0.03           | L #    | 0.15±0.05                 |
| 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 #    |                           |
|                   |                               |                     | 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           | G #    |                           |
|                   | 3.20±0.3/-0.1                 | 1.60±0.3/0.1        | 1.60±0.30/-0.10     | 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**         | M #                 |        |                           |
| 1812 (4532)       | 4.50±0.40<br>(4.50±0.5/-0.3)* | 3.20±0.30           | 1.25±0.10           | D #    | 0.75±0.25<br>(0.50±0.25)* |
|                   |                               |                     | 2.00±0.20           | K #    |                           |
|                   | 3.20±0.40                     | 2.50±0.30           | M #                 |        |                           |



# Reflow soldering only is recommended.

\* For 1206\_1000V ~3000V; 1812\_200V~3000V products.

\*\* For 1210\_100V: Cap > 1μF, 250V: Cap >0.47μF, 400V~630V: Cap >0.22μF.



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**6. GENERAL ELECTRICAL DATA**

|                                   |  |                |                     |
|-----------------------------------|--|----------------|---------------------|
| <b>Dielectric</b>                 | NP0  | X7R            | X5R                 |
| <b>Size</b>                       | 0201, 0402, 0603, 0805, 1206, 1210, 1812   |                |                     |
| <b>Capacitance range*</b>         | 0.1pF to 0.033μF   | 100pF to 2.2μF | 0.056μF to 10μF     |
| <b>Capacitance tolerance**</b>    | Cap≤5pF: B (±0.1pF), C (±0.25pF)<br>5pF<Cap<10pF: C (±0.25pF), D (±0.5pF)<br>Cap≥10pF: F (±1%), G (±2%), J (±5%) |                |                     |
| <b>Rated voltage (WVDC)</b>       | 10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V, 1000V  |                | 6.3V, 10V, 16V, 25V |
| <b>Tan δ*</b>                     | Cap<30pF: Q≥400+20C<br>Cap≥30pF: Q≥1000  | Note 1         |                     |
| <b>Operating temperature</b>      | -55 to +125°C  |                | -55 to +85°C        |
| <b>Capacitance characteristic</b> | ±30ppm/°C  | ±15%           |                     |
| <b>Termination</b>                | Ni/Sn (lead-free termination)  |                |                     |

\* 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°C at ambient temperature  
Measured at 1.0±0.2Vrms, 1.0kHz±10% for C≤10μF; 0.5±0.2Vrms, 120Hz±20% for C>10μF, 30~70% related humidity, 25°C ambient temperature for X7R, X5R.

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

Note 1: X7R/X5R

| Rated vol. | D.F. ≤ | Exception of D.F. ≤ |  |
|------------|--------|---------------------|--|
| ≥ 100V     | ≤ 2.5% | ≤ 3%                | 1206 ≥ 0.47μF  |
|            |        | ≤ 5%                | 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series  |
|            |        | ≤ 10%               | 0805 > 0.22μF; 1210 ≥ 3.3μF  |
| 50V        | ≤ 2.5% | ≤ 3%                | 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF  |
|            |        | ≤ 5%                | 0201 ≥ 0.01μF; 1210 ≥ 4.7μF  |
|            |        | ≤ 10%               | 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series   |
| 35V        | ≤ 3.5% | ≤ 10%               | 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF  |
| 25V        | ≤ 3.5% | ≤ 5%                | 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF   |
|            |        | ≤ 7%                | 0603 ≥ 0.33μF; 1206 ≥ 4.7μF  |
|            |        | ≤ 10%               | 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series<br>0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF      |
|            |        | ≤ 12.5%             | 0402 ≥ 0.47μF  |
| 16V        | ≤ 3.5% | ≤ 5%                | 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF;<br>0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF                                   |
|            |        | ≤ 10%               | 0201 ≥ 0.1μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.22μF;<br>0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series       |
|            |        | ≤ 15%               | 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); TT series<br>0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5 |
| 10V        | ≤ 5%   | ≤ 15%               | 0201 ≥ 0.1μF; 0402 ≥ 1μF   |
|            |        | ≤ 20%               | 0402 ≥ 2.2μF   |
| 6.3V       | ≤ 10%  | ≤ 15%               | 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF;<br>1206 ≥ 47μF; 1210 ≥ 100μF; TT series                                 |
|            |        | ≤ 20%               | 0402 ≥ 2.2μF   |
| 4V         | ≤ 15%  | ---                 | ---  |

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**7. CAPACITANCE RANGE (NP0 Dielectric)**

**NP0 Dielectric 0201, 0402, 0603 Sizes**

| DIELECTRIC    | NP0           |      |    |    |    |      |    |    |    |     |      |    |    |    |     |     |     |
|---------------|---------------|------|----|----|----|------|----|----|----|-----|------|----|----|----|-----|-----|-----|
|               | SIZE          | 0201 |    |    |    | 0402 |    |    |    |     | 0603 |    |    |    |     |     |     |
|               | RATED VOLTAGE | 10   | 16 | 25 | 50 | 10   | 16 | 25 | 50 | 100 | 10   | 16 | 25 | 50 | 100 | 200 | 250 |
| Capacitance   | 0.1pF (0R1)   | L    | L  | L  | L  | N    | N  | N  | N  | N   |      |    |    |    |     |     |     |
|               | 0.2pF (0R2)   | L    | L  | L  | L  | N    | N  | N  | N  | N   |      |    |    |    |     |     |     |
|               | 0.3pF (0R3)   | L    | L  | L  | L  | N    | N  | N  | N  | N   |      |    |    |    |     |     |     |
|               | 0.4pF (0R4)   | L    | L  | L  | L  | N    | N  | N  | N  | N   |      |    |    |    |     |     |     |
|               | 0.5pF (0R5)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 0.6pF (0R6)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 0.7pF (0R7)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 0.8pF (0R8)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 0.9pF (0R9)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 1.0pF (1R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 1.2pF (1R2)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 1.5pF (1R5)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 1.8pF (1R8)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 2.0pF (2R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 2.2pF (2R2)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 2.7pF (2R7)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 3.0pF (3R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 3.3pF (3R3)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 3.9pF (3R9)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 4.0pF (4R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 4.7pF (4R7)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 5.0pF (5R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 5.6pF (5R6)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 6.0pF (6R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 6.8pF (6R8)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 7.0pF (7R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 8.0pF (8R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 8.2pF (8R2)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 9.0pF (9R0)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 10pF (100)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 12pF (120)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 15pF (150)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 18pF (180)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 22pF (220)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 27pF (270)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 33pF (330)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 39pF (390)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 47pF (470)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 56pF (560)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 68pF (680)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 82pF (820)    | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
|               | 100pF (101)   | L    | L  | L  | L  | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | S   | S   |
| 120pF (121)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  | S   | S   |     |
| 150pF (151)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  | S   | S   |     |
| 180pF (181)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  | S   | S   |     |
| 220pF (221)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  | S   | S   |     |
| 270pF (271)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  | X   | X   |     |
| 330pF (331)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  | X   | X   |     |
| 390pF (391)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  | X   | X   |     |
| 470pF (471)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  | X   | X   |     |
| 560pF (561)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  |     |     |     |
| 680pF (681)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  |     |     |     |
| 820pF (821)   |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  |     |     |     |
| 1,000pF (102) |               |      |    |    | N  | N    | N  | N  | N  | S   | S    | S  | S  | S  |     |     |     |
| 1,200pF (122) |               |      |    |    |    |      |    |    |    | X   | X    | X  | X  |    |     |     |     |
| 1,500pF (152) |               |      |    |    |    |      |    |    |    | X   | X    | X  | X  |    |     |     |     |
| 1,800pF (182) |               |      |    |    |    |      |    |    |    | X   | X    | X  | X  |    |     |     |     |
| 2,200pF (222) |               |      |    |    |    |      |    |    |    | X   | X    | X  | X  |    |     |     |     |
| 2,700pF (272) |               |      |    |    |    |      |    |    |    | X   | X    | X  | X  |    |     |     |     |
| 3,300pF (332) |               |      |    |    |    |      |    |    |    | X   | X    | X  | X  |    |     |     |     |
| 3,900pF (392) |               |      |    |    |    |      |    |    |    |     |      |    |    |    |     |     |     |
| 4,700pF (472) |               |      |    |    |    |      |    |    |    |     |      |    |    |    |     |     |     |
| 5,600pF (562) |               |      |    |    |    |      |    |    |    |     |      |    |    |    |     |     |     |
| 6,800pF (682) |               |      |    |    |    |      |    |    |    |     |      |    |    |    |     |     |     |
| 8,200pF (822) |               |      |    |    |    |      |    |    |    |     |      |    |    |    |     |     |     |
| 0.01μF (103)  |               |      |    |    |    |      |    |    |    |     |      |    |    |    |     |     |     |

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

**Multilayer Ceramic Capacitors  
NP0 Dielectric 0805 Size (Continued)**

| DIELECTRIC    |             | NP0  |    |    |    |     |     |     |     |     |
|---------------|-------------|------|----|----|----|-----|-----|-----|-----|-----|
| SIZE          |             | 0805 |    |    |    |     |     |     |     |     |
| RATED VOLTAGE |             | 10   | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 |
| Capacitance   | 0.5pF (0R5) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 0.6pF (0R6) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 0.7pF (0R7) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 0.8pF (0R8) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 0.9pF (0R9) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 1.0pF (1R0) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 1.2pF (1R2) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 1.5pF (1R5) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 1.8pF (1R8) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 2.2pF (2R2) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 2.7pF (2R7) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 3.3pF (3R3) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 3.9pF (3R9) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 4.7pF (4R7) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 5.6pF (5R6) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 6.8pF (6R8) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 8.2pF (8R2) | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 10pF (100)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 12pF (120)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 15pF (150)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 18pF (180)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 22pF (220)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 27pF (270)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 33pF (330)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 39pF (390)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 47pF (470)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 56pF (560)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 68pF (680)  | A    | A  | A  | A  | A   | A   | A   | A   | A   |
|               | 82pF (820)  | A    | A  | A  | A  | A   | A   | A   | B   | B   |
|               | 100pF (101) | A    | A  | A  | A  | A   | B   | B   | B   | B   |
|               | 120pF (121) | A    | A  | A  | A  | A   | B   | B   | D   | D   |
|               | 150pF (151) | A    | A  | A  | A  | A   | D   | D   | D   | D   |
|               | 180pF (181) | A    | A  | A  | A  | A   | D   | D   | D   | D   |
|               | 220pF (221) | A    | A  | A  | A  | A   | D   | D   | D   | D   |
|               | 270pF (271) | A    | A  | A  | A  | A   | D   | D   | D   | D   |
|               | 330pF (331) | A    | A  | A  | A  | A   | D   | D   | D   | D   |
|               | 390pF (391) | B    | B  | B  | B  | B   | D   | D   | D   | D   |
|               | 470pF (471) | B    | B  | B  | B  | B   | D   | D   | D   | D   |
|               | 560pF (561) | B    | B  | B  | B  | B   | D   | D   | D   | D   |
|               | 680pF (681) | B    | B  | B  | B  | B   | D   | D   | D   | D   |
| 820pF (821)   | B           | B    | B  | B  | B  | D   | D   | D   | D   |     |
| 1,000pF (102) | B           | B    | B  | B  | B  | D   | D   | D   | D   |     |
| 1,200pF (122) | B           | B    | B  | B  | B  | D   | D   | D   | D   |     |
| 1,500pF (152) | B           | B    | B  | B  | B  | D   | D   | D   | D   |     |
| 1,800pF (182) | B           | B    | B  | B  | B  | D   | D   | D   | D   |     |
| 2,200pF (222) | B           | B    | B  | B  | B  | D   | D   | D   | D   |     |
| 2,700pF (272) | D           | D    | D  | D  | D  | D   | D   | D   | D   |     |
| 3,300pF (332) | D           | D    | D  | D  | D  | D   | D   | D   | D   |     |
| 3,900pF (392) | D           | D    | D  | D  | D  | D   | D   | D   | D   |     |
| 4,700pF (472) | D           | D    | D  | D  | D  | D   | D   | D   | D   |     |
| 5,600pF (562) | D           | D    | D  | D  | D  | D   | D   | D   | D   |     |
| 6,800pF (682) | D           | D    | D  | D  | D  | D   | D   | D   | D   |     |
| 8,200pF (822) | D           | D    | D  | D  | D  | D   | D   | D   | D   |     |
| 0.01μF (103)  | D           | D    | D  | D  | D  | D   | D   | D   | D   |     |

Multilayer Ceramic Capacitors

Approval Sheet

**NP0 Dielectric 1206 Size (Continued)**

| DIELECTRIC    |             | NP0  |    |    |    |     |     |     |     |     |      |
|---------------|-------------|------|----|----|----|-----|-----|-----|-----|-----|------|
| SIZE          |             | 1206 |    |    |    |     |     |     |     |     |      |
| RATED VOLTAGE |             | 10   | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 |
| Capacitance   | 1.0pF (1R0) |      |    |    |    |     |     |     |     |     |      |
|               | 1.2pF (1R2) | B    | B  | B  | B  | B   | B   | B   | B   | B   |      |
|               | 1.5pF (1R5) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 1.8pF (1R8) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 2.2pF (2R2) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 2.7pF (2R7) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 3.3pF (3R3) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 3.9pF (3R9) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 4.7pF (4R7) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 5.6pF (5R6) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 6.8pF (6R8) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 8.2pF (8R2) | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 10pF (100)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 12pF (120)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 15pF (150)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 18pF (180)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | B    |
|               | 22pF (220)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 27pF (270)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 33pF (330)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 39pF (390)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 47pF (470)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 56pF (560)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 68pF (680)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 82pF (820)  | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 100pF (101) | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 120pF (121) | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 150pF (151) | B    | B  | B  | B  | B   | B   | B   | B   | B   | D    |
|               | 180pF (181) | B    | B  | B  | B  | B   | B   | B   | B   | B   | G    |
|               | 220pF (221) | B    | B  | B  | B  | B   | B   | B   | B   | B   | G    |
|               | 270pF (271) | B    | B  | B  | B  | B   | B   | C   | C   | C   | G    |
|               | 330pF (331) | B    | B  | B  | B  | B   | B   | C   | C   | C   | G    |
|               | 390pF (391) | B    | B  | B  | B  | B   | B   | C   | C   | C   | G    |
|               | 470pF (471) | B    | B  | B  | B  | B   | B   | C   | C   | C   | G    |
|               | 560pF (561) | B    | B  | B  | B  | B   | B   | C   | D   | D   | G    |
|               | 680pF (681) | B    | B  | B  | B  | B   | B   | C   | D   | D   | G    |
|               | 820pF (821) | B    | B  | B  | B  | B   | B   | C   | G   | G   | G    |
| 1,000pF (102) | B           | B    | B  | B  | B  | B   | C   | G   | G   | G   |      |
| 1,200pF (122) | B           | B    | B  | B  | B  | B   | C   | G   | G   |     |      |
| 1,500pF (152) | B           | B    | B  | B  | B  | B   | D   | G   | G   |     |      |
| 1,800pF (182) | B           | B    | B  | B  | B  | B   | D   | G   | G   |     |      |
| 2,200pF (222) | B           | B    | B  | B  | B  | B   | D   | G   | G   |     |      |
| 2,700pF (272) | B           | B    | B  | B  | B  | B   | D   | G   |     |     |      |
| 3,300pF (332) | B           | B    | B  | B  | B  | B   | D   | G   |     |     |      |
| 3,900pF (392) | B           | B    | B  | B  | B  | B   | D   | G   |     |     |      |
| 4,700pF (472) | B           | B    | B  | B  | B  | B   | D   | G   |     |     |      |
| 5,600pF (562) | B           | B    | B  | B  | B  | B   |     |     |     |     |      |
| 6,800pF (682) | C           | C    | C  | C  | C  | C   |     |     |     |     |      |
| 8,200pF (822) | D           | D    | D  | D  | D  | D   |     |     |     |     |      |
| 0.01μF (103)  | D           | D    | D  | D  | D  | D   |     |     |     |     |      |

**Multilayer Ceramic Capacitors**  
**NP0 Dielectric 1210 Size (Continued)**

| DIELECTRIC    |               | NP0  |    |    |    |     |     |     |     |     |      |
|---------------|---------------|------|----|----|----|-----|-----|-----|-----|-----|------|
| SIZE          |               | 1210 |    |    |    |     |     |     |     |     |      |
| RATED VOLTAGE |               | 10   | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 | 1000 |
| Capacitance   | 10pF (100)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 12pF (120)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 15pF (150)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 18pF (180)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 22pF (220)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 27pF (270)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 33pF (330)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 39pF (390)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 47pF (470)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 56pF (560)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 68pF (680)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 82pF (820)    | C    | C  | C  | C  | C   | C   | C   | C   | C   | C    |
|               | 100pF (101)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | D    |
|               | 120pF (121)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | D    |
|               | 150pF (151)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | D    |
|               | 180pF (181)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | D    |
|               | 220pF (221)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | G    |
|               | 270pF (271)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | G    |
|               | 330pF (331)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | G    |
|               | 390pF (391)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | G    |
|               | 470pF (471)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | G    |
|               | 560pF (561)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | G    |
|               | 680pF (681)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | G    |
|               | 820pF (821)   | C    | C  | C  | C  | C   | C   | C   | C   | C   | G    |
|               | 1,000pF (102) | C    | C  | C  | C  | C   | D   | D   | D   | D   | G    |
|               | 1,200pF (122) | C    | C  | C  | C  | C   | D   | D   | D   | D   |      |
|               | 1,500pF (152) | C    | C  | C  | C  | C   | D   | D   | D   | D   |      |
|               | 1,800pF (182) | C    | C  | C  | C  | C   | D   | D   | D   | D   |      |
|               | 2,200pF (222) | C    | C  | C  | C  | C   | D   | D   | D   | D   |      |
|               | 2,700pF (272) | C    | C  | C  | C  | C   | D   | D   | D   | D   |      |
|               | 3,300pF (332) | C    | C  | C  | C  | C   | D   | D   | D   | D   |      |
|               | 3,900pF (392) | C    | C  | C  | C  | C   | D   | D   | D   | D   |      |
|               | 4,700pF (472) | C    | C  | C  | C  | C   | G   | G   |     |     |      |
|               | 5,600pF (562) | C    | C  | C  | C  | C   | G   | G   |     |     |      |
| 6,800pF (682) | C             | C    | C  | C  | C  | G   | G   |     |     |     |      |
| 8,200pF (822) | C             | C    | C  | C  | C  | G   | G   |     |     |     |      |
| 0.010μF (103) | C             | C    | C  | C  | C  | G   | G   |     |     |     |      |
| 0.012μF (123) | C             | D    | D  | D  | D  |     |     |     |     |     |      |
| 0.015μF (153) | C             | D    | D  | D  | D  |     |     |     |     |     |      |
| 0.018μF (183) | K             | K    | K  | K  | K  |     |     |     |     |     |      |
| 0.022μF (223) | K             | K    | K  | K  | K  |     |     |     |     |     |      |
| 0.027μF (273) | K             | K    | K  | K  | K  |     |     |     |     |     |      |
| 0.033μF (333) | K             | K    | K  | K  | K  |     |     |     |     |     |      |
| 0.039μF (393) | K             | K    | K  | K  | K  |     |     |     |     |     |      |
| 0.047μF (473) | K             | K    | K  | K  | K  |     |     |     |     |     |      |



Multilayer Ceramic Capacitors

**NP0 Dielectric 1812 Size (Continued)**

| DIELECTRIC          | NP0  |    |    |    |     |
|---------------------|------|----|----|----|-----|
|                     | 1812 |    |    |    |     |
| SIZE                | 10   | 16 | 25 | 50 | 100 |
| RATED VOLTAGE (VDC) | 10   | 16 | 25 | 50 | 100 |
| 10pF (100)          |      |    |    |    | D   |
| 12pF (120)          |      |    |    |    | D   |
| 15pF (150)          |      |    |    |    | D   |
| 18pF (180)          |      |    |    |    | D   |
| 22pF (220)          |      |    |    |    | D   |
| 27pF (270)          |      |    |    |    | D   |
| 33pF (330)          |      |    |    |    | D   |
| 39pF (390)          |      |    |    |    | D   |
| 47pF (470)          |      |    |    |    | D   |
| 56pF (560)          |      |    |    |    | D   |
| 68pF (680)          |      |    |    |    | D   |
| 82pF (820)          |      |    |    |    | D   |
| 100pF (101)         |      |    |    |    | D   |
| 120pF (121)         |      |    |    |    | D   |
| 150pF (151)         |      |    |    |    | D   |
| 180pF (181)         |      |    |    |    | D   |
| 220pF (221)         |      |    |    |    | D   |
| 270pF (271)         |      |    |    |    | D   |
| 330pF (331)         |      |    |    |    | D   |
| 390pF (391)         |      |    |    |    | D   |
| 470pF (471)         |      |    |    |    | D   |
| 560pF (561)         |      |    |    |    | D   |
| 680pF (681)         |      |    |    |    | D   |
| 820pF (821)         |      |    |    |    | D   |
| 1,000pF (102)       | D    | D  | D  | D  | D   |
| 1,200pF (122)       | D    | D  | D  | D  | D   |
| 1,500pF (152)       | D    | D  | D  | D  | D   |
| 1,800pF (182)       | D    | D  | D  | D  | D   |
| 2,200pF (222)       | D    | D  | D  | D  | D   |
| 2,700pF (272)       | D    | D  | D  | D  | D   |
| 3,300pF (332)       | D    | D  | D  | D  | D   |
| 3,900pF (392)       | D    | D  | D  | D  | D   |
| 4,700pF (472)       | D    | D  | D  | D  | D   |
| 5,600pF (562)       | D    | D  | D  | D  | D   |
| 6,800pF (682)       | D    | D  | D  | D  | D   |
| 8,200pF (822)       | D    | D  | D  | D  | D   |
| 0.010μF (103)       | D    | D  | D  | D  | D   |
| 0.012μF (123)       | D    | D  | D  | D  | D   |
| 0.015μF (153)       | D    | D  | D  | D  | D   |
| 0.018μF (183)       | D    | D  | D  | D  | D   |
| 0.022μF (223)       | D    | D  | D  | D  | D   |
| 0.027μF (273)       | D    | D  | D  | D  | D   |
| 0.033μF (333)       | D    | D  | D  | D  | D   |
| 0.039μF (393)       |      |    |    |    |     |

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

Multilayer Ceramic Capacitors

**8. CAPACITANCE RANGE (X7R Dielectric)**

**X7R Dielectric 0201, 0402, 0603 Sizes**

| DIELECTRIC    | X7R           |      |    |    |    |      |    |    |    |      |    |    |    |     |
|---------------|---------------|------|----|----|----|------|----|----|----|------|----|----|----|-----|
|               | SIZE          | 0201 |    |    |    | 0402 |    |    |    | 0603 |    |    |    |     |
|               | RATED VOLTAGE | 10   | 16 | 25 | 50 | 10   | 16 | 25 | 50 | 10   | 16 | 25 | 50 | 100 |
| Capacitance   | 100pF (101)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 120pF (121)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 150pF (151)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 180pF (181)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 220pF (221)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 270pF (271)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 330pF (331)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 390pF (391)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 470pF (471)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 560pF (561)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 680pF (681)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 820pF (821)   | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 1,000pF (102) | L    | L  | L  | L  | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 1,200pF (122) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 1,500pF (152) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 1,800pF (182) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 2,200pF (222) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 2,700pF (272) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 3,300pF (332) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 3,900pF (392) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 4,700pF (472) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 5,600pF (562) | L    | L  | L  |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 6,800pF (682) | L    |    |    |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 8,200pF (822) | L    |    |    |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 0.010μF (103) | L    |    |    |    | N    | N  | N  | N  | S    | S  | S  | S  | S   |
|               | 0.012μF (123) |      |    |    |    | N    | N  | N  |    | S    | S  | S  | S  | X   |
|               | 0.015μF (153) |      |    |    |    | N    | N  | N  |    | S    | S  | S  | S  | X   |
|               | 0.018μF (183) |      |    |    |    | N    | N  | N  |    | S    | S  | S  | S  | X   |
|               | 0.022μF (223) |      |    |    |    | N    | N  | N  |    | S    | S  | S  | S  | X   |
|               | 0.027μF (273) |      |    |    |    | N    | N  | N  |    | S    | S  | S  | S  |     |
|               | 0.033μF (333) |      |    |    |    | N    | N  | N  |    | S    | S  | S  | X  |     |
|               | 0.039μF (393) |      |    |    |    | N    | N  | N  |    | S    | S  | S  | X  |     |
|               | 0.047μF (473) |      |    |    |    | N    | N  | N  |    | S    | S  | S  | X  |     |
|               | 0.056μF (563) |      |    |    |    | N    | N  |    |    | S    | S  | S  | X  |     |
| 0.068μF (683) |               |      |    |    | N  | N    |    |    | S  | S    | S  | X  |    |     |
| 0.082μF (823) |               |      |    |    | N  | N    |    |    | S  | S    | S  | X  |    |     |
| 0.10μF (104)  |               |      |    |    | N  | N    |    |    | S  | S    | S  | X  |    |     |
| 0.12μF (124)  |               |      |    |    |    |      |    |    | S  | S    | X  |    |    |     |
| 0.15μF (154)  |               |      |    |    |    |      |    |    | S  | S    | X  |    |    |     |
| 0.18μF (184)  |               |      |    |    |    |      |    |    | S  | S    | X  |    |    |     |
| 0.22μF (224)  |               |      |    |    |    |      |    |    | S  | S    | X  |    |    |     |
| 0.27μF (274)  |               |      |    |    |    |      |    |    | X  | X    | X  |    |    |     |
| 0.33μF (334)  |               |      |    |    |    |      |    |    | X  | X    | X  |    |    |     |
| 0.39μF (394)  |               |      |    |    |    |      |    |    | X  | X    | X  |    |    |     |
| 0.47μF (474)  |               |      |    |    |    |      |    |    | X  | X    | X  |    |    |     |

**X7R Dielectric 0805, 1206 Size**

Multilayer Ceramic Capacitors

Approval Sheet

| DIELECTRIC   | X7R                 |      |    |    |    |     |     |     |     |      |    |    |    |    |     |     |     |     |     |
|--------------|---------------------|------|----|----|----|-----|-----|-----|-----|------|----|----|----|----|-----|-----|-----|-----|-----|
|              | SIZE                | 0805 |    |    |    |     |     |     |     | 1206 |    |    |    |    |     |     |     |     |     |
|              | RATED VOLTAGE (VDC) | 10   | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630  | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 630 |
| Capacitance  | 100pF (101)         | B    | B  | B  | B  | B   | B   | B   | B   | B    |    |    |    |    |     | D   | D   | D   | D   |
|              | 120pF (121)         | B    | B  | B  | B  | B   | B   | B   | B   | B    |    |    |    |    |     | D   | D   | D   | D   |
|              | 150pF (151)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 180pF (181)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 220pF (221)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 270pF (271)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 330pF (331)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 390pF (391)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 470pF (471)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 560pF (561)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 680pF (681)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 820pF (821)         | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 1,000pF (102)       | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 1,200pF (122)       | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 1,500pF (152)       | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 1,800pF (182)       | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 2,200pF (222)       | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 2,700pF (272)       | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 3,300pF (332)       | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 3,900pF (392)       | B    | B  | B  | B  | B   | B   | B   | B   | B    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 4,700pF (472)       | B    | B  | B  | B  | B   | B   | B   | D   | D    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 5,600pF (562)       | B    | B  | B  | B  | B   | B   | B   | D   | D    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 6,800pF (682)       | B    | B  | B  | B  | B   | B   | B   | D   | D    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 8,200pF (822)       | B    | B  | B  | B  | B   | B   | B   | D   | D    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 0.010μF (103)       | B    | B  | B  | B  | B   | D   | D   | D   | D    | B  | B  | B  | B  | B   | D   | D   | D   | D   |
|              | 0.012μF (123)       | B    | B  | B  | B  | B   | D   | D   |     |      | B  | B  | B  | B  | B   | D   | D   |     |     |
|              | 0.015μF (153)       | B    | B  | B  | B  | B   | D   | D   |     |      | B  | B  | B  | B  | B   | D   | D   |     |     |
|              | 0.018μF (183)       | B    | B  | B  | B  | B   | D   | D   |     |      | B  | B  | B  | B  | B   | D   | D   |     |     |
|              | 0.022μF (223)       | B    | B  | B  | B  | B   | D   | D   |     |      | B  | B  | B  | B  | B   | D   | D   |     |     |
|              | 0.027μF (273)       | B    | B  | B  | B  | D   |     |     |     |      | B  | B  | B  | B  | B   | D   | D   |     |     |
|              | 0.033μF (333)       | B    | B  | B  | B  | D   |     |     |     |      | B  | B  | B  | B  | B   | G   | G   |     |     |
|              | 0.039μF (393)       | B    | B  | B  | B  | D   |     |     |     |      | B  | B  | B  | B  | B   | G   | G   |     |     |
|              | 0.047μF (473)       | B    | B  | B  | B  | D   |     |     |     |      | B  | B  | B  | B  | B   | G   | G   |     |     |
|              | 0.056μF (563)       | B    | B  | B  | B  | D   |     |     |     |      | B  | B  | B  | B  | B   | G   | G   |     |     |
|              | 0.068μF (683)       | B    | B  | B  | B  | D   |     |     |     |      | B  | B  | B  | B  | B   | G   | G   |     |     |
|              | 0.082μF (823)       | B    | B  | B  | B  | D   |     |     |     |      | B  | B  | B  | B  | D   | G   | G   |     |     |
|              | 0.10μF (104)        | B    | B  | B  | B  | D   |     |     |     |      | B  | B  | B  | B  | D   | G   | G   |     |     |
|              | 0.12μF (124)        | B    | B  | B  | D  |     |     |     |     |      | B  | B  | B  | B  | D   |     |     |     |     |
|              | 0.15μF (154)        | D    | D  | D  | D  |     |     |     |     |      | C  | C  | C  | C  | G   |     |     |     |     |
|              | 0.18μF (184)        | D    | D  | D  | D  |     |     |     |     |      | C  | C  | C  | C  | G   |     |     |     |     |
| 0.22μF (224) | D                   | D    | D  | D  |    |     |     |     |     | C    | C  | C  | C  | G  |     |     |     |     |     |
| 0.27μF (274) | D                   | D    | D  |    |    |     |     |     |     | C    | C  | C  | D  |    |     |     |     |     |     |
| 0.33μF (334) | D                   | D    | D  |    |    |     |     |     |     | C    | C  | C  | D  |    |     |     |     |     |     |
| 0.39μF (394) | D                   | D    | D  |    |    |     |     |     |     | C    | C  | J  | P  |    |     |     |     |     |     |
| 0.47μF (474) | D                   | D    | D  |    |    |     |     |     |     | J    | J  | J  | P  |    |     |     |     |     |     |
| 0.56μF (564) | D                   | D    | D  |    |    |     |     |     |     | J    | J  | J  | P  |    |     |     |     |     |     |
| 0.68μF (684) | D                   | D    | D  |    |    |     |     |     |     | J    | J  | J  | P  |    |     |     |     |     |     |
| 0.82μF (824) | D                   | D    | D  |    |    |     |     |     |     | J    | J  | J  | P  |    |     |     |     |     |     |
| 1.0μF (105)  | D                   | D    | D  |    |    |     |     |     |     | J    | J  | J  | P  |    |     |     |     |     |     |
| 1.5μF (155)  |                     |      |    |    |    |     |     |     |     | J    | J  | P  |    |    |     |     |     |     |     |
| 2.2μF (225)  |                     |      |    |    |    |     |     |     |     | J    | J  | P  |    |    |     |     |     |     |     |
| 4.7μF (475)  |                     |      |    |    |    |     |     |     |     |      |    |    |    |    |     |     |     |     |     |
| 10μF (106)   |                     |      |    |    |    |     |     |     |     |      |    |    |    |    |     |     |     |     |     |

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

**Multilayer Ceramic Capacitors  
X7R Dielectric 1210, 1812 Size**

| DIELECTRIC          |               | X7R  |    |    |    |     |     |     |     |      |    |    |    |    |     |     |     |
|---------------------|---------------|------|----|----|----|-----|-----|-----|-----|------|----|----|----|----|-----|-----|-----|
| SIZE                |               | 1210 |    |    |    |     |     |     |     | 1812 |    |    |    |    |     |     |     |
| RATED VOLTAGE (VDC) |               | 10   | 16 | 25 | 50 | 100 | 200 | 250 | 500 | 1000 | 10 | 16 | 25 | 50 | 100 | 200 | 250 |
| Capacitance         | 100pF (101)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 120pF (121)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 150pF (151)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 180pF (181)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 220pF (221)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 270pF (271)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 330pF (331)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 390pF (391)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 470pF (471)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 560pF (561)   |      |    |    |    |     |     | D   | D   | D    |    |    |    |    |     |     |     |
|                     | 680pF (681)   |      |    |    |    |     |     | C   | D   | D    |    |    |    |    |     |     |     |
|                     | 820pF (821)   |      |    |    |    |     |     | C   | D   | D    |    |    |    |    |     |     |     |
|                     | 1,000pF (102) | C    | C  | C  | C  | C   | C   | C   | D   | D    | D  | D  | D  | D  | D   | D   | D   |
|                     | 1,200pF (122) | C    | C  | C  | C  | C   | C   | C   | D   | D    | D  | D  | D  | D  | D   | D   | D   |
|                     | 1,500pF (152) | C    | C  | C  | C  | C   | C   | C   | D   | D    | D  | D  | D  | D  | D   | D   | D   |
|                     | 1,800pF (182) | C    | C  | C  | C  | C   | C   | C   | D   | D    | D  | D  | D  | D  | D   | D   | D   |
|                     | 2,200pF (222) | C    | C  | C  | C  | C   | C   | C   | D   | D    | D  | D  | D  | D  | D   | D   | D   |
|                     | 2,700pF (272) | C    | C  | C  | C  | C   | C   | C   | D   | D    | D  | D  | D  | D  | D   | D   | D   |
|                     | 3,300pF (332) | C    | C  | C  | C  | C   | C   | C   | D   | D    | D  | D  | D  | D  | D   | D   | D   |
|                     | 3,900pF (392) | C    | C  | C  | C  | C   | C   | C   | D   | G    | D  | D  | D  | D  | D   | D   | D   |
|                     | 4,700pF (472) | C    | C  | C  | C  | C   | C   | C   | D   | G    | D  | D  | D  | D  | D   | D   | D   |
|                     | 5,600pF (562) | C    | C  | C  | C  | C   | C   | C   | D   | G    | D  | D  | D  | D  | D   | D   | D   |
|                     | 6,800pF (682) | C    | C  | C  | C  | C   | C   | C   | D   | G    | D  | D  | D  | D  | D   | D   | D   |
|                     | 8,200pF (822) | C    | C  | C  | C  | C   | C   | C   | D   | G    | D  | D  | D  | D  | D   | D   | D   |
|                     | 0.010μF (103) | C    | C  | C  | C  | C   | C   | C   | D   | G    | D  | D  | D  | D  | D   | D   | D   |
|                     | 0.012μF (123) | C    | C  | C  | C  | C   | C   | C   | D   |      | D  | D  | D  | D  | D   | D   | D   |
|                     | 0.015μF (153) | C    | C  | C  | C  | C   | C   | C   | D   |      | D  | D  | D  | D  | D   | D   | D   |
|                     | 0.018μF (183) | C    | C  | C  | C  | C   | C   | C   | D   |      | D  | D  | D  | D  | D   | D   | D   |
|                     | 0.022μF (223) | C    | C  | C  | C  | C   | C   | C   | D   |      | D  | D  | D  | D  | D   | D   | D   |
|                     | 0.027μF (273) | C    | C  | C  | C  | C   | C   | C   | D   |      | D  | D  | D  | D  | D   | D   | D   |
|                     | 0.033μF (333) | C    | C  | C  | C  | C   | C   | C   | D   |      | D  | D  | D  | D  | D   | D   | D   |
|                     | 0.039μF (393) | C    | C  | C  | C  | C   | C   | C   | D   |      | D  | D  | D  | D  | D   | D   | D   |
| 0.047μF (473)       | C             | C    | C  | C  | C  | D   | D   |     |     | D    | D  | D  | D  | D  | D   | D   |     |
| 0.056μF (563)       | C             | C    | C  | C  | C  | D   | D   |     |     | D    | D  | D  | D  | D  | D   | D   |     |
| 0.068μF (683)       | C             | C    | C  | C  | C  | G   | G   |     |     | D    | D  | D  | D  | D  | D   | D   |     |
| 0.082μF (823)       | C             | C    | C  | C  | C  | G   | G   |     |     | D    | D  | D  | D  | D  | D   | D   |     |
| 0.10μF (104)        | C             | C    | C  | C  | C  | G   | G   |     |     | D    | D  | D  | D  | D  | D   | D   |     |
| 0.12μF (124)        | C             | C    | C  | C  | C  | G   | G   |     |     | D    | D  | D  | D  | D  | D   | D   |     |
| 0.15μF (154)        | D             | D    | D  | D  | D  | M   | M   |     |     | D    | D  | D  | D  | D  | K   | K   |     |
| 0.18μF (184)        | D             | D    | D  | D  | D  | M   | M   |     |     | D    | D  | D  | D  | D  | K   | K   |     |
| 0.22μF (224)        | D             | D    | D  | D  | D  | M   | M   |     |     | D    | D  | D  | D  | D  | K   | K   |     |
| 0.27μF (274)        | D             | D    | D  | D  | G  | M   | M   |     |     | D    | D  | D  | D  | D  | K   | K   |     |
| 0.33μF (334)        | D             | D    | D  | D  | G  | M   | M   |     |     | D    | D  | D  | D  | D  | K   | K   |     |
| 0.39μF (394)        | D             | D    | D  | D  | M  | M   | M   |     |     | D    | D  | D  | D  | D  | K   | K   |     |
| 0.47μF (474)        | D             | D    | D  | D  | M  | M   | M   |     |     | D    | D  | D  | D  | K  | K   | K   |     |
| 0.56μF (564)        | D             | D    | D  | D  | M  |     |     |     |     | D    | D  | D  | D  | K  |     |     |     |
| 0.68μF (684)        | D             | D    | D  | D  | K  |     |     |     |     | D    | D  | D  | K  | K  |     |     |     |
| 0.82μF (824)        | D             | D    | D  | D  | K  |     |     |     |     | D    | D  | D  | K  | K  |     |     |     |
| 1.00μF (105)        | D             | D    | D  | D  | K  |     |     |     |     | D    | D  | D  | K  | K  |     |     |     |
| 1.50μF (155)        | K             | K    | G  |    |    |     |     |     |     |      |    |    |    |    | K   |     |     |
| 2.20μF (225)        | K             | K    | G  |    |    |     |     |     |     |      |    |    |    |    | M   |     |     |

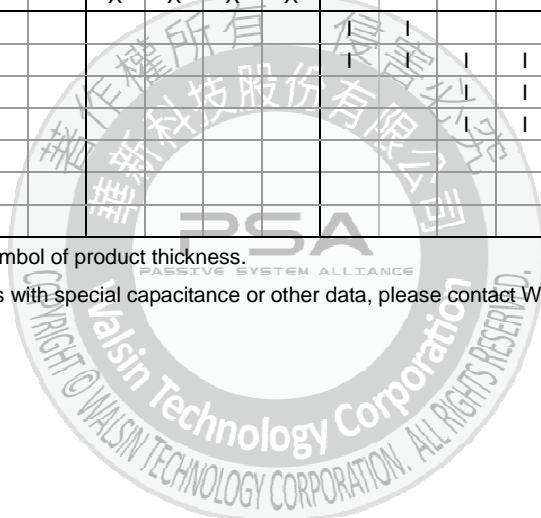
1. The letter in cell is expressed the symbol of product thickness.
2. For more information about products with special capacitance or other data, please contact WTC local representative.

Multilayer Ceramic Capacitors

**9. CAPACITANCE RANGE (X5R Dielectric)**

| DIELECTRIC         |               | X5R  |    |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|--------------------|---------------|------|----|----|----|------|----|----|----|------|----|----|----|------|----|----|----|------|----|---|
| SIZE               |               | 0402 |    |    |    | 0603 |    |    |    | 0805 |    |    |    | 1206 |    |    |    | 1210 |    |   |
| RATED VOLTAGE(VDC) |               | 6.3  | 10 | 16 | 25 | 6.3  | 10 | 16 | 25 | 6.3  | 10 | 16 | 25 | 6.3  | 10 | 16 | 25 | 10   | 16 |   |
| Capacitance        | 0.027µF (273) |      |    |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.033µF (333) |      |    |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.039µF (393) |      |    |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.047µF (473) |      |    |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.056µF (563) |      | N  |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.068µF (683) |      | N  |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.082µF (823) |      | N  |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.10µF (104)  |      | N  | N  |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.15µF (154)  |      | N  | N  |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.22µF (224)  | N    | N  | N  |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |
|                    | 0.27µF (274)  | N    | N  |    |    |      |    | X  | X  | X    |    |    |    |      |    |    |    |      |    |   |
|                    | 0.33µF (334)  | N    | N  |    |    |      |    | X  | X  | X    |    |    |    |      |    |    |    |      |    |   |
|                    | 0.39µF (394)  | N    |    |    |    |      |    | X  | X  | X    |    |    |    |      |    |    |    |      |    |   |
|                    | 0.47µF (474)  | N    |    |    |    |      |    | X  | X  | X    |    |    |    |      |    |    |    |      |    |   |
|                    | 0.68µF (684)  | N    |    |    |    |      |    | X  | X  | X    |    |    |    |      |    |    |    |      |    |   |
|                    | 0.82µF (824)  | N    |    |    |    |      | X  | X  | X  | X    |    |    |    |      |    |    |    |      |    |   |
|                    | 1.0µF (105)   |      |    |    |    |      | X  | X  | X  | X    |    |    |    |      |    |    |    |      |    |   |
|                    | 1.5µF (155)   |      |    |    |    |      |    |    |    |      | I  | I  |    |      |    | J  | J  | P    | K  | K |
|                    | 2.2µF (225)   |      |    |    |    |      |    |    |    |      | I  | I  | I  | I    |    | J  | J  | P    | K  | K |
|                    | 3.3µF (335)   |      |    |    |    |      |    |    |    |      |    |    | I  | I    | P  | P  | P  | P    | K  | K |
| 4.7µF (475)        |               |      |    |    |    |      |    |    |    |      |    | I  | I  | P    | P  | P  | P  | K    | K  |   |
| 6.8µF (685)        |               |      |    |    |    |      |    |    |    |      |    |    |    | P    | P  |    |    |      |    |   |
| 10µF (106)         |               |      |    |    |    |      |    |    |    |      |    |    |    | P    |    |    |    |      |    |   |
| 22µF (226)         |               |      |    |    |    |      |    |    |    |      |    |    |    |      |    |    |    |      |    |   |

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



**Multilayer Ceramic Capacitors**  
**10. PACKAGING STYLE AND QUANTITY**

| Size        | Thickness (mm)/Symbol |   | Paper tape |          | Plastic tape |          |
|-------------|-----------------------|---|------------|----------|--------------|----------|
|             |                       |   | 7" reel    | 13" reel | 7" reel      | 13" reel |
| 0201 (0603) | 0.30±0.03             | L | 15k        | 70k      | -            | -        |
| 0402 (1005) | 0.50±0.05             | N | 10k        | 50k      | -            | -        |
| 0603 (1608) | 0.80±0.07             | S | 4k         | 15k      | -            | -        |
|             | 0.80+0.15/-0.10       | X | 4k         | 15k      | -            | -        |
| 0805 (2012) | 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 (3216) | 0.80±0.10             | B | 4k         | 15k      | -            | -        |
|             | 0.95±0.10             | C | -          | -        | 3k           | 10k      |
|             | 1.15±0.15             | J | -          | -        | 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 (3225) | 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       |
| 1812 (4532) | 1.25±0.10             | D | -          | -        | 1k           | 5k       |
|             | 2.00±0.20             | K | -          | -        | 1k           | -        |
|             | 2.50±0.30             | M | -          | -        | 0.5k         | 3k       |

Unit: pieces



Multilayer Ceramic Capacitors

11. 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                                    | Class I: (NP0)<br>≤ 1000pF, 1.0±0.2Vrms · 1MHz±10%<br>> 1000pF, 1.0±0.2Vrms · 1KHz±10%  | * Shall not exceed the limits given in the detailed spec.<br>NP0: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C<br>X7R, X5R, X6S, X7S:  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 3.  | Q/ D.F.<br>(Dissipation Factor)                | Class II: (X7R, X7E, X6S, X5R, X7S, Y5V)<br>C ≤ 10μF, 1.0±0.2Vrms · 1KHz±10% **<br>C > 10μF, 0.5±0.2Vrms · 120Hz±20%<br><br>** Test condition: 0.5±0.2Vrms · 1KHz±10%<br>X7R:<br>0805=106(6.3V), 0603/475(6.3V)<br>X5R:<br>0201 ≥ 224 (6.3V, 10V, 16V) <sup>#1</sup> ,<br>0402 ≥ 475 (6.3V, 16V), 0402 ≥ 225(10V),<br>0603=106 (6.3V, 10V),<br>TT18X ≥ 475(10V) , TT15X series<br>X6S:<br>0201 ≥ 104 (6.3V, 10V) <sup>#1</sup> ,<br>0402 ≥ 225 (6.3V),<br>0402/475 (10V), 0603/106 (6.3V),<br>X7S:<br>0402/225(6.3V)<br><br>#1 Excluding<br>X5R/0201/105(6.3V);225(10V),<br>X6S/0201/104(10V)<br>(1.0±0.2Vrms · 1KHz±10%)<br><br>*Before initial measurement (Class II only):<br>To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. | <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 100V</td> <td rowspan="3">≤ 2.5%</td> <td>≤ 3%</td> <td>1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 5%</td> <td>0805 &gt; 0.1μF; 0603 ≥ 0.068μF; 1206 &gt; 1μF; 1210 ≥ 2.2μF; TT series</td> </tr> <tr> <td>≤ 10%</td> <td>0805 &gt; 0.22μF; 1210 ≥ 3.3μF</td> </tr> <tr> <td rowspan="3">50V</td> <td rowspan="3">≤ 2.5%</td> <td>≤ 3%</td> <td>0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 5%</td> <td>0201 ≥ 0.01μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 10%</td> <td>0402 ≥ 0.012μF; 0603 &gt; 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td> </tr> <tr> <td rowspan="3">35V</td> <td rowspan="3">≤ 3.5%</td> <td>≤ 10%</td> <td>0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 5%</td> <td>0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 7%</td> <td>0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤ 3.5%</td> <td>≤ 10%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 0.10μF &amp; (0402/X7R ≥ 0.056μF); TT series</td> </tr> <tr> <td>≤ 10%</td> <td>0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 12.5%</td> <td>0402 ≥ 0.47μF</td> </tr> <tr> <td rowspan="3">16V</td> <td rowspan="3">≤ 3.5%</td> <td>≤ 5%</td> <td>0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 10%</td> <td>0201 ≥ 0.1μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>≤ 15%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF</td> </tr> <tr> <td rowspan="3">10V</td> <td rowspan="3">≤ 5%</td> <td>≤ 10%</td> <td>0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); TT series</td> </tr> <tr> <td>≤ 10%</td> <td>0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5</td> </tr> <tr> <td>≤ 15%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF</td> </tr> <tr> <td rowspan="3">6.3V</td> <td rowspan="3">≤ 10%</td> <td>≤ 15%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td> </tr> <tr> <td>≤ 20%</td> <td>0402 ≥ 2.2μF</td> </tr> <tr> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="3">4V</td> <td rowspan="3">≤ 15%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> | Rated vol.  | D.F. ≤   | Exception of D.F. ≤ |                       | ≥ 100V        | ≤ 2.5%                                      | ≤ 3%   | 1206 ≥ 0.47μF                                | ≤ 5%  | 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series                    | ≤ 10%   | 0805 > 0.22μF; 1210 ≥ 3.3μF        | 50V           | ≤ 2.5%                | ≤ 3%                         | 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF | ≤ 5%               | 0201 ≥ 0.01μF; 1210 ≥ 4.7μF                               | ≤ 10%            | 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series | 35V   | ≤ 3.5%  | ≤ 10%  | 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | ≤ 5%                    | 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF         | ≤ 7%  | 0603 ≥ 0.33μF; 1206 ≥ 4.7μF | 25V                       | ≤ 3.5% | ≤ 10% | 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series | ≤ 10% | 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF | ≤ 12.5% | 0402 ≥ 0.47μF | 16V | ≤ 3.5% | ≤ 5% | 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF | ≤ 10% | 0201 ≥ 0.1μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series | ≤ 15% | 0201 ≥ 0.1μF; 0402 ≥ 1μF | 10V | ≤ 5% | ≤ 10% | 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); TT series | ≤ 10% | 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5 | ≤ 15% | 0201 ≥ 0.1μF; 0402 ≥ 1μF | 6.3V | ≤ 10% | ≤ 15% | 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series | ≤ 20% | 0402 ≥ 2.2μF | --- | --- | 4V | ≤ 15% | --- | --- |
| Rated vol.  | D.F. ≤   | Exception of D.F. ≤   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| ≥ 100V  | ≤ 2.5%   | ≤ 3%  | 1206 ≥ 0.47μF   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 5%  | 0805 > 0.1μF; 0603 ≥ 0.068μF; 1206 > 1μF; 1210 ≥ 2.2μF; TT series   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 10%   | 0805 > 0.22μF; 1210 ≥ 3.3μF   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 50V   | ≤ 2.5%   | ≤ 3%  | 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 5%  | 0201 ≥ 0.01μF; 1210 ≥ 4.7μF   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 10%   | 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 35V   | ≤ 3.5%   | ≤ 10%   | 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 5%  | 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 7%  | 0603 ≥ 0.33μF; 1206 ≥ 4.7μF   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 25V   | ≤ 3.5%   | ≤ 10%   | 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 10%   | 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 12.5%   | 0402 ≥ 0.47μF   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 16V   | ≤ 3.5%   | ≤ 5%  | 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 10%   | 0201 ≥ 0.1μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 15%   | 0201 ≥ 0.1μF; 0402 ≥ 1μF  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 10V   | ≤ 5%   | ≤ 10%   | 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); TT series  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 10%   | 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 15%   | 0201 ≥ 0.1μF; 0402 ≥ 1μF  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 6.3V  | ≤ 10%  | ≤ 15%   | 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ≤ 20%   | 0402 ≥ 2.2μF  |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | ---   | ---   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 4V  | ≤ 15%  | ---   | ---   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | 4.  | Dielectric Strength   | To apply voltage (≤100V) 250%.<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>Duration: 1 to 5 sec.<br>Charge and discharge current less than 50mA. | * No evidence of damage or flash over during test.   |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
|   |  | 5.  | Insulation Resistance   | Rated voltage: ≤100V<br>To apply rated voltage for MAX. 120sec.<br><br>*Before initial measurement (Class II only):<br>To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.                               | <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: All X7R</td> <td rowspan="7">10GΩ or RxC ≥ 100 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0402 &gt; 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>35V: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF</td> </tr> <tr> <td>16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF</td> </tr> <tr> <td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF</td> </tr> <tr> <td>6.3V ; 4V ; TT series; Size ≥ 1812</td> </tr> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> <tr> <td>All X6S items, All X7S items</td> <td rowspan="8">RxC ≥ 50 Ω-F.</td> </tr> <tr> <td>100V: 1210 ≥ 3.3μF</td> </tr> <tr> <td>50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF</td> </tr> <tr> <td>35V: 0603 ≥ 1μF;</td> </tr> <tr> <td>25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF</td> </tr> <tr> <td>16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF</td> </tr> <tr> <td>10V: 0201 &gt; 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF; TT21 &gt; 4.7μF</td> </tr> <tr> <td>6.3V: 0201 ≥ 0.1μF; 0603 &gt; 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF; TT15 &gt; 1.0μF</td> </tr> <tr> <td>4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF</td> </tr> </tbody> </table><br><table border="1"> <tbody> <tr> <td>Rated voltage: 200~630V</td> <td>To apply rated voltage (500V max.) for 60 sec.</td> <td rowspan="2">≥ 10GΩ or RxC ≥ 100Ω-F whichever is smaller</td> </tr> <tr> <td>Rated voltage: ≥ 630V</td> <td>To apply 500V for 60 sec.</td> </tr> </tbody> </table> | Rated voltage       | Insulation Resistance | 100V: All X7R | 10GΩ or RxC ≥ 100 Ω-F whichever is smaller. | 50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF | 35V: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | 25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF | 16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF | 10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF | 6.3V ; 4V ; TT series; Size ≥ 1812 | Rated voltage | Insulation Resistance | All X6S items, All X7S items | RxC ≥ 50 Ω-F.   | 100V: 1210 ≥ 3.3μF | 50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF | 35V: 0603 ≥ 1μF; | 25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF         | 16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF | 10V: 0201 > 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF; TT21 > 4.7μF | 6.3V: 0201 ≥ 0.1μF; 0603 > 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF; TT15 > 1.0μF | 4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF          | Rated voltage: 200~630V | To apply rated voltage (500V max.) for 60 sec. | ≥ 10GΩ or RxC ≥ 100Ω-F whichever is smaller | Rated voltage: ≥ 630V       | To apply 500V for 60 sec. |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| Rated voltage   | Insulation Resistance                          |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 100V: All X7R   | 10GΩ or RxC ≥ 100 Ω-F whichever is smaller.    |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF                  |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 35V: 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF  |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 25V: 0402 ≥ 1μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF                   |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF    |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 6.3V ; 4V ; TT series; Size ≥ 1812  |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| Rated voltage   | Insulation Resistance                          |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| All X6S items, All X7S items  | RxC ≥ 50 Ω-F.                                  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 100V: 1210 ≥ 3.3μF  |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 50V: 0402 ≥ 0.1μF; 0603 ≥ 2.2μF; 0805 ≥ 10μF; 1206 ≥ 10μF                               |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 35V: 0603 ≥ 1μF;  |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 25V: 0201 ≥ 0.1μF; 0402 ≥ 2.2μF; 0603 ≥ 10μF; 0805 ≥ 10μF; 1206 ≥ 22μF                  |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 16V: 0603 ≥ 10μF; 0402 ≥ 1μF; 0201 ≥ 0.22μF   |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 10V: 0201 > 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 47μF; TT21 > 4.7μF                   |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 6.3V: 0201 ≥ 0.1μF; 0603 > 4.7μF; 0805 ≥ 47μF; 1206 ≥ 10μF; TT15 > 1.0μF                |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| 4V: 0603 ≥ 22μF; 0805 ≥ 47μF; 1206 ≥ 100μF  |  |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| Rated voltage: 200~630V   | To apply rated voltage (500V max.) for 60 sec. | ≥ 10GΩ or RxC ≥ 100Ω-F whichever is smaller   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |
| Rated voltage: ≥ 630V   | To apply 500V for 60 sec.                      |   |   |   |  |                     |                       |               |   |  |  |   |  |   |                                    |               |                       |                              |   |                    |   |                  |  |   |   |  |   |                         |  |   |                             |                           |        |       |   |       |  |         |               |     |        |      |   |       |   |       |                          |     |      |       |  |       |  |       |                          |      |       |       |   |       |              |     |     |    |       |     |     |

Multilayer Ceramic Capacitors

| No.                | Item                             | Test Condition  | Requirements  |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
|--------------------|----------------------------------|---|---|----------------|-------------|-------------------|----------------------------|-------------------|-----|---------------------|-----|-------------------|----------------------------|-------------------|-----|-------------------|-------|---|------------------|---------------|------------------|---------------------|--|---------------|------|------|-------------|-------------|---------------|---------------------|--------------------|-----------------|----------------|--|------|-----------|--------------|--------------|----------------|----------------------|----------------|-----------------|--|------|--------------------|-----|------------------|-----|-------------|-----|-------------|-----|-------------|-----|-------------|-----|------------------|
| 6.                 | Temperature Coefficient          | <p>With no electrical load.</p> <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp</th> </tr> </thead> <tbody> <tr> <td>NPO</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7S</td> <td>-55 ~ 125°C at 25°C</td> </tr> <tr> <td>X5R</td> <td>-55~ 85°C at 25°C</td> </tr> <tr> <td>X6S</td> <td>-55~105°C at 25°C</td> </tr> <tr> <td>Y5V</td> <td>-25~ 85°C at 20°C</td> </tr> </tbody> </table> <p>*Before initial measurement (Class II only):<br/>To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.<br/>* Measurement voltage for Class II:</p> <table border="1"> <thead> <tr> <th>01005</th> <th>0201</th> </tr> </thead> <tbody> <tr> <td>Cap≤0.01μF: 0.5V</td> <td>Cap&lt;0.1μF: 1V</td> </tr> <tr> <td>Cap&gt;0.01μF: 0.2V</td> <td>0.1μF≤Cap&lt;1μF: 0.2V</td> </tr> <tr> <td></td> <td>Cap≥1μF: 0.1V</td> </tr> <tr> <th>0402</th> <th>0603</th> </tr> <tr> <td>Cap&lt;1μF: 1V</td> <td>Cap≤1μF: 1V</td> </tr> <tr> <td>Cap=1μF: 0.5V</td> <td>1μF&lt;Cap≤4.7μF: 0.5V</td> </tr> <tr> <td>1μF&lt;Cap&lt;10μF: 0.2V</td> <td>Cap&gt;4.7μF: 0.2V</td> </tr> <tr> <td>Cap≥10μF: 0.1V</td> <td></td> </tr> <tr> <th>0805</th> <th>1206/1210</th> </tr> <tr> <td>Cap&lt;10μF: 1V</td> <td>Cap≤10μF: 1V</td> </tr> <tr> <td>Cap=10μF: 0.5V</td> <td>10μF&lt;Cap≤100μF: 0.5V</td> </tr> <tr> <td>Cap&gt;10μF: 0.2V</td> <td>Cap&gt;100μF: 0.2V</td> </tr> </tbody> </table> | T.C.  | Operating Temp | NPO         | -55~125°C at 25°C | X7R                        | -55~125°C at 25°C | X7S | -55 ~ 125°C at 25°C | X5R | -55~ 85°C at 25°C | X6S                        | -55~105°C at 25°C | Y5V | -25~ 85°C at 20°C | 01005 | 0201  | Cap≤0.01μF: 0.5V | Cap<0.1μF: 1V | Cap>0.01μF: 0.2V | 0.1μF≤Cap<1μF: 0.2V |  | Cap≥1μF: 0.1V | 0402 | 0603 | Cap<1μF: 1V | Cap≤1μF: 1V | Cap=1μF: 0.5V | 1μF<Cap≤4.7μF: 0.5V | 1μF<Cap<10μF: 0.2V | Cap>4.7μF: 0.2V | Cap≥10μF: 0.1V |  | 0805 | 1206/1210 | Cap<10μF: 1V | Cap≤10μF: 1V | Cap=10μF: 0.5V | 10μF<Cap≤100μF: 0.5V | Cap>10μF: 0.2V | Cap>100μF: 0.2V | <table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>NPO</td> <td>Within ±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> <tr> <td>X7S</td> <td>Within ±22%</td> </tr> <tr> <td>X5R</td> <td>Within ±15%</td> </tr> <tr> <td>X6S</td> <td>Within ±22%</td> </tr> <tr> <td>Y5V</td> <td>Within +30%/-80%</td> </tr> </tbody> </table> | T.C. | Capacitance Change | NPO | Within ±30ppm/°C | X7R | Within ±15% | X7S | Within ±22% | X5R | Within ±15% | X6S | Within ±22% | Y5V | Within +30%/-80% |
| T.C.               | Operating Temp                   |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| NPO                | -55~125°C at 25°C                |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| X7R                | -55~125°C at 25°C                |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| X7S                | -55 ~ 125°C at 25°C              |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| X5R                | -55~ 85°C at 25°C                |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| X6S                | -55~105°C at 25°C                |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Y5V                | -25~ 85°C at 20°C                |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 01005              | 0201                             |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Cap≤0.01μF: 0.5V   | Cap<0.1μF: 1V                    |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Cap>0.01μF: 0.2V   | 0.1μF≤Cap<1μF: 0.2V              |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
|                    | Cap≥1μF: 0.1V                    |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 0402               | 0603                             |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Cap<1μF: 1V        | Cap≤1μF: 1V                      |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Cap=1μF: 0.5V      | 1μF<Cap≤4.7μF: 0.5V              |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 1μF<Cap<10μF: 0.2V | Cap>4.7μF: 0.2V                  |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Cap≥10μF: 0.1V     |                                  |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 0805               | 1206/1210                        |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Cap<10μF: 1V       | Cap≤10μF: 1V                     |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Cap=10μF: 0.5V     | 10μF<Cap≤100μF: 0.5V             |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Cap>10μF: 0.2V     | Cap>100μF: 0.2V                  |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| T.C.               | Capacitance Change               |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| NPO                | Within ±30ppm/°C                 |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| X7R                | Within ±15%                      |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| X7S                | Within ±22%                      |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| X5R                | Within ±15%                      |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| X6S                | Within ±22%                      |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| Y5V                | Within +30%/-80%                 |   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 7.                 | Adhesive Strength of Termination | <p>* Pressurizing force :<br/>2N (0201) and 5N (≤0603) and 10N (&gt;0603)<br/>* Test time: 10±1 sec.</p>  | * No remarkable damage or removal of the terminations.  |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 8.                 | Vibration Resistance             | <p>* Vibration frequency: 10~55 Hz/min.<br/>* Total amplitude: 1.5mm<br/>* Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)<br/>*Before initial measurement (Class II only):<br/>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.</p>  | <p>* No remarkable damage.<br/>* Cap change and Q/D.F.: To meet initial spec.</p>   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 9.                 | Solderability                    | <p>* Solder temperature: 235±5°C<br/>* Dipping time: 2±0.5 sec.</p>   | 95% min. coverage of all metalized area.  |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 10.                | Bending Test                     | <p>* 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):<br/>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.</p>  | <p>* No remarkable damage.<br/>* Cap change :<br/>NPO: within ±5% or 0.5pF whichever is larger<br/>X7R, X5R, X6S, X7S: within ±12.5%<br/>Y5V: within ±30%<br/>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</p> |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 11.                | Resistance to Soldering Heat     | <p>* 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.</p>  | <p>* No remarkable damage.<br/>* Cap change:<br/>NPO: within ±2.5% or 0.25pF whichever is larger<br/>X7R, X5R, X6S, X7S: within ±7.5%<br/>Y5V: within ±20%<br/>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.<br/>* 25% max. leaching on each edge.</p>                                  |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |
| 12.                | Temperature Cycle                | <p>* Conduct the five cycles according to the temperatures and time.</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <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.<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.</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.<br/>* Cap change :<br/>NPO: within ±2.5% or 0.25pF whichever is larger<br/>X7R, X5R, X6S, X7S: within ±7.5%<br/>Y5V: within ±20%<br/>* 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   |   |                |             |                   |                            |                   |     |                     |     |                   |                            |                   |     |                   |       |   |                  |               |                  |                     |  |               |      |      |             |             |               |                     |                    |                 |                |  |      |           |              |              |                |                      |                |                 |  |      |                    |     |                  |     |             |     |             |     |             |     |             |     |                  |



Multilayer Ceramic Capacitors

| No.   | Item                                      | Test Condition   | Requirements  |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|---|---|--|---|---------------|-----------------------|-----------------------------|---|--|--|--|--|---|--|--|-----------------------------------|--|-----|------|---|--|-----------------------------------|-----|------|---|--|---------------------|--|-----|------|---|---|---|-----|--------|---|---|------|-------|---|-----------|----|-------|-----|
| 13.   | Humidity (Damp Heat) Steady State         | *Test temp.: 40±2°C<br>*Humidity: 90-95%RH<br>*Test time: 500+24/-0hrs.<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 ±5% or 0.5pF whichever is larger<br>X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤6.3V within ±25%;<br>TT series & C≥ 1uF, within ±25%<br>**10V: 0603 ≥4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%;<br>Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40%<br>* Q/D.F. value:<br>NP0: More than 30pF Q≥350, 10pF≤C≤30pF, Q≥275+2.5C<br>Less than 10pF Q≥200+10C<br>X7R, X5R, X6S, X7S: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Rated V</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 100V</td> <td rowspan="3">≤ 3%</td> <td>≤ 6% 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 7.5% 0805 &gt; 0.1μF, 0603 ≥ 0.068μF, 1206 &gt; 1μF; 1210 ≥ 2.2μF; TT series</td> </tr> <tr> <td>≤ 20% 0805 &gt; 0.22μF; 1210 ≥ 3.3μF</td> </tr> <tr> <td rowspan="3">50V</td> <td rowspan="3">≤ 3%</td> <td>≤ 6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td>≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>≤ 20% 0402 ≥ 0.012μF; 0603 &gt; 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td> </tr> <tr> <td rowspan="3">35V</td> <td rowspan="3">≤ 5%</td> <td>≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td>≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td rowspan="4">25V</td> <td rowspan="4">≤ 5%</td> <td>≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF &amp; (0402/X7R ≥ 0.056μF); TT series</td> </tr> <tr> <td>≤ 15% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 20% 0402 ≥ 0.47μF</td> </tr> <tr> <td>≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td rowspan="3">16V</td> <td rowspan="3">≤ 5%</td> <td>≤ 15% 0201 ≥ 0.01μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td> </tr> <tr> <td>≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series: 01R5</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤ 7.5%</td> <td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td> </tr> <tr> <td>≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">≤ 15%</td> <td>≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series</td> </tr> <tr> <td>≤ 20% ---</td> </tr> <tr> <td>4V</td> <td>≤ 20%</td> <td>---</td> </tr> </tbody> </table> | Rated V       | D.F. ≤                | Exception of D.F. ≤         | ≥ 100V                                    | ≤ 3%   | ≤ 6% 1206 ≥ 0.47μF                                       | ≤ 7.5% 0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; 1210 ≥ 2.2μF; TT series               | ≤ 20% 0805 > 0.22μF; 1210 ≥ 3.3μF  | 50V   | ≤ 3%   | ≤ 6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF | ≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF | ≤ 20% 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series | 35V | ≤ 5% | ≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | ≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF | ≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF | 25V | ≤ 5% | ≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series | ≤ 15% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF | ≤ 20% 0402 ≥ 0.47μF | ≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF | 16V | ≤ 5% | ≤ 15% 0201 ≥ 0.01μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series | ≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF | ≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series: 01R5 | 10V | ≤ 7.5% | ≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series | ≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series | 6.3V | ≤ 15% | ≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series | ≤ 20% --- | 4V | ≤ 20% | --- |
| Rated V   | D.F. ≤                                    | Exception of D.F. ≤  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| ≥ 100V  | ≤ 3%                                      | ≤ 6% 1206 ≥ 0.47μF   |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 7.5% 0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; 1210 ≥ 2.2μF; TT series   |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 20% 0805 > 0.22μF; 1210 ≥ 3.3μF  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 50V   | ≤ 3%                                      | ≤ 6% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF   |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 10% 0201 ≥ 0.01μF; 1210 ≥ 4.7μF  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 20% 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series   |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 35V   | ≤ 5%                                      | ≤ 20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF   |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 25V   | ≤ 5%                                      | ≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.10μF & (0402/X7R ≥ 0.056μF); TT series  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 15% 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF   |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 20% 0402 ≥ 0.47μF  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF   |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 16V   | ≤ 5%                                      | ≤ 15% 0201 ≥ 0.01μF (0201/X7R ≥ 0.022μF); 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 15% 0201 ≥ 0.012μF; 0402 ≥ 0.33μF (0402/X7R ≥ 0.22μF); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series: 01R5  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 10V   | ≤ 7.5%                                    | ≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 6.3V  | ≤ 15%                                     | ≤ 30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   | ≤ 20% ---  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 4V  | ≤ 20%                                     | ---  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   |  | *I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller.<br>Class.II (X7R, X5R, X6S, X7S, Y5V)  |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
|   |   |  | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: All X7R; 1210 ≥ 3.3μF</td> <td rowspan="7">1GΩ or RxC ≥ 10 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0402 &gt; 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>25V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF</td> </tr> <tr> <td>16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF</td> </tr> <tr> <td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF</td> </tr> <tr> <td>6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812</td> </tr> </tbody> </table>   | Rated voltage | Insulation Resistance | 100V: All X7R; 1210 ≥ 3.3μF | 1GΩ or RxC ≥ 10 Ω-F whichever is smaller. | 50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF | 35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | 25V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF | 16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF | 10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF | 6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812 |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| Rated voltage   | Insulation Resistance                     |  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 100V: All X7R; 1210 ≥ 3.3μF   | 1GΩ or RxC ≥ 10 Ω-F whichever is smaller. |  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 50V: 0402 > 0.01μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF                  |   |  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 35V: 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                |   |  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 25V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 2.2μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 10μF  |   |  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 16V: 0201 ≥ 0.1μF; 0402 ≥ 0.22μF; 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 10μF; 1210 ≥ 47μF    |   |  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 10V: 0201 ≥ 47nF; 0402 ≥ 0.47μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 47μF |   |  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |
| 6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812                                  |   |  |   |               |                       |                             |   |  |  |  |  |   |  |  |                                   |  |     |      |   |  |                                   |     |      |   |  |                     |  |     |      |   |   |   |     |        |   |   |      |       |   |           |    |       |     |

Multilayer Ceramic Capacitors

| No  | Item   | Test Condition  | Requirements   |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|---|--|---|--|--|---|--|---|--|--|---|--|------|---|-----|------|---|-----|------|---|-----|------|--|-----|--------|--|------|-------|---|----|-------|-----|
| 14  | Humidity (Damp Heat) Load  | *Test temp. : 40±2°C  | * No remarkable damage.<br>Cap change:<br>NP0: ±7.5% or 0.75pF whichever is larger.<br>X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤6.3V within ±25%;<br>TT series & C≥ 1uF, within ±25%<br>**10V: 0603 ≥4.7µF; 0402 ≥ 1µF; 0201 ≥ 0.1µF, within ±25%;<br>Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40%<br>Q/D.F. value:<br>NP0: C≥30pF, Q≥200; C<30pF, Q≥100+10/3C<br>X7R, X5R, X6S, X7S: |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  | *Humidity : 90~95%RH  |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  | *Test time : 500+24/-0 hrs.   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  | *To apply voltage :<br>Rated voltage (MAX. 500V)  |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  | *Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  | *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.     |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  |   |  | <table border="1"> <thead> <tr> <th>Rated V</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥ 100V</td> <td>≤ 3%</td> <td>≤ 6% 1206 ≥ 0.47µF<br/>≤ 7.5% 0805 &gt; 0.1µF, 0603 ≥ 0.068µF, 1206 &gt; 1µF; 1210 ≥ 2.2µF; TT series<br/>≤ 20% 0805 &gt; 0.22µF; 1210 ≥ 3.3µF</td> </tr> <tr> <td rowspan="3">50V</td> <td>≤ 3%</td> <td>≤ 6% 0201(50V); 0603 ≥ 0.047µF; 0805 ≥ 0.18µF; 1206 ≥ 0.47µF<br/>≤ 10% 0201 ≥ 0.01µF; 1210 ≥ 4.7µF<br/>≤ 20% 0402 ≥ 0.012µF; 0603 &gt; 0.1µF; 0805 ≥ 1µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF; TT series</td> </tr> <tr> <td rowspan="2">35V</td> <td>≤ 5%</td> <td>≤ 20% 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF<br/>≤ 10% 0201 ≥ 0.01µF; 0805 ≥ 1µF; 1210 ≥ 10µF</td> </tr> <tr> <td rowspan="4">25V</td> <td>≤ 5%</td> <td>≤ 14% 0603 ≥ 0.33µF; 1206 ≥ 4.7µF<br/>≤ 15% 0201 ≥ 0.1µF; 0402 ≥ 0.10µF &amp; (0402/X7R ≥ 0.056µF); TT series<br/>≤ 20% 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 6.8µF; 1210 ≥ 22µF<br/>0402 ≥ 0.47µF</td> </tr> <tr> <td rowspan="2">16V</td> <td>≤ 5%</td> <td>≤ 10% 0603 ≥ 0.15µF; 0805 ≥ 0.68µF; 1206 ≥ 2.2µF; 1210 ≥ 4.7µF<br/>≤ 15% 0201 ≥ 0.01µF (0201/X7R ≥ 0.022µF); 0402 ≥ 0.033µF;<br/>0603 ≥ 0.68µF; 0805 ≥ 2.2µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF; TT series</td> </tr> <tr> <td rowspan="2">10V</td> <td>≤ 7.5%</td> <td>≤ 15% 0201 ≥ 0.012µF; 0402 ≥ 0.33µF (0402/X7R ≥ 0.22µF);<br/>≤ 20% 0603 ≥ 0.33µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 22µF</td> </tr> <tr> <td rowspan="2">6.3V</td> <td>≤ 15%</td> <td>≤ 30% 0201 ≥ 0.1µF; 0402 ≥ 1µF; TT series; 01R5<br/>0201 ≥ 0.1µF; 0402 ≥ 1µF; 0603 ≥ 10µF;<br/>0805 ≥ 4.7µF; 1206 ≥ 47µF; 1210 ≥ 100µF; TT series</td> </tr> <tr> <td>4V</td> <td>≤ 20%</td> <td>---</td> </tr> </tbody> </table> | Rated V   | D.F. ≤   | Exception of D.F. ≤   | ≥ 100V   | ≤ 3%   | ≤ 6% 1206 ≥ 0.47µF<br>≤ 7.5% 0805 > 0.1µF, 0603 ≥ 0.068µF, 1206 > 1µF; 1210 ≥ 2.2µF; TT series<br>≤ 20% 0805 > 0.22µF; 1210 ≥ 3.3µF | 50V  | ≤ 3% | ≤ 6% 0201(50V); 0603 ≥ 0.047µF; 0805 ≥ 0.18µF; 1206 ≥ 0.47µF<br>≤ 10% 0201 ≥ 0.01µF; 1210 ≥ 4.7µF<br>≤ 20% 0402 ≥ 0.012µF; 0603 > 0.1µF; 0805 ≥ 1µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF; TT series | 35V | ≤ 5% | ≤ 20% 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF<br>≤ 10% 0201 ≥ 0.01µF; 0805 ≥ 1µF; 1210 ≥ 10µF | 25V | ≤ 5% | ≤ 14% 0603 ≥ 0.33µF; 1206 ≥ 4.7µF<br>≤ 15% 0201 ≥ 0.1µF; 0402 ≥ 0.10µF & (0402/X7R ≥ 0.056µF); TT series<br>≤ 20% 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 6.8µF; 1210 ≥ 22µF<br>0402 ≥ 0.47µF | 16V | ≤ 5% | ≤ 10% 0603 ≥ 0.15µF; 0805 ≥ 0.68µF; 1206 ≥ 2.2µF; 1210 ≥ 4.7µF<br>≤ 15% 0201 ≥ 0.01µF (0201/X7R ≥ 0.022µF); 0402 ≥ 0.033µF;<br>0603 ≥ 0.68µF; 0805 ≥ 2.2µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF; TT series | 10V | ≤ 7.5% | ≤ 15% 0201 ≥ 0.012µF; 0402 ≥ 0.33µF (0402/X7R ≥ 0.22µF);<br>≤ 20% 0603 ≥ 0.33µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 22µF | 6.3V | ≤ 15% | ≤ 30% 0201 ≥ 0.1µF; 0402 ≥ 1µF; TT series; 01R5<br>0201 ≥ 0.1µF; 0402 ≥ 1µF; 0603 ≥ 10µF;<br>0805 ≥ 4.7µF; 1206 ≥ 47µF; 1210 ≥ 100µF; TT series | 4V | ≤ 20% | --- |
|   |  | Rated V   |  | D.F. ≤   | Exception of D.F. ≤   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
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|   |  |   |  | 50V  | ≤ 3%  | ≤ 6% 0201(50V); 0603 ≥ 0.047µF; 0805 ≥ 0.18µF; 1206 ≥ 0.47µF<br>≤ 10% 0201 ≥ 0.01µF; 1210 ≥ 4.7µF<br>≤ 20% 0402 ≥ 0.012µF; 0603 > 0.1µF; 0805 ≥ 1µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF; TT series        |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  |   |  |  | 35V   | ≤ 5%   | ≤ 20% 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF<br>≤ 10% 0201 ≥ 0.01µF; 0805 ≥ 1µF; 1210 ≥ 10µF   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  | 25V   |  |  |   | ≤ 5%   | ≤ 14% 0603 ≥ 0.33µF; 1206 ≥ 4.7µF<br>≤ 15% 0201 ≥ 0.1µF; 0402 ≥ 0.10µF & (0402/X7R ≥ 0.056µF); TT series<br>≤ 20% 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 6.8µF; 1210 ≥ 22µF<br>0402 ≥ 0.47µF |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
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|   |  |   |  |  | 10V   | ≤ 7.5%   | ≤ 15% 0201 ≥ 0.012µF; 0402 ≥ 0.33µF (0402/X7R ≥ 0.22µF);<br>≤ 20% 0603 ≥ 0.33µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 22µF  |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
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| 4V  | ≤ 20%  | ---   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   | *I.R.: ≥10V, 500MΩ or 25 Ω-F whichever is smaller.<br>Class II (X7R, X5R, X6S, X7S, Y5V)   |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   | <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: All X7R; 1210 ≥ 3.3µF</td> <td rowspan="7">500MΩ or RxC ≥ 5 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0402 &gt; 0.01µF; 0603 ≥ 1µF; 0805 ≥ 1µF; 1206 ≥ 4.7µF; 1210 ≥ 4.7µF</td> </tr> <tr> <td>35V: 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF</td> </tr> <tr> <td>25V: 0201 ≥ 0.1µF; 0402 ≥ 0.22µF; 0603 ≥ 2.2µF; 0805 ≥ 2.2µF; 1206 ≥ 10µF; 1210 ≥ 10µF</td> </tr> <tr> <td>16V: 0201 ≥ 0.1µF; 0402 ≥ 0.22µF; 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 10µF; 1210 ≥ 47µF</td> </tr> <tr> <td>10V: 0201 ≥ 47nF; 0402 ≥ 0.47µF; 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 4.7µF; 1210 ≥ 47µF</td> </tr> <tr> <td>6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812</td> </tr> </tbody> </table> | Rated voltage   | Insulation Resistance  | 100V: All X7R; 1210 ≥ 3.3µF  | 500MΩ or RxC ≥ 5 Ω-F whichever is smaller.  | 50V: 0402 > 0.01µF; 0603 ≥ 1µF; 0805 ≥ 1µF; 1206 ≥ 4.7µF; 1210 ≥ 4.7µF   | 35V: 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF  | 25V: 0201 ≥ 0.1µF; 0402 ≥ 0.22µF; 0603 ≥ 2.2µF; 0805 ≥ 2.2µF; 1206 ≥ 10µF; 1210 ≥ 10µF | 16V: 0201 ≥ 0.1µF; 0402 ≥ 0.22µF; 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 10µF; 1210 ≥ 47µF | 10V: 0201 ≥ 47nF; 0402 ≥ 0.47µF; 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 4.7µF; 1210 ≥ 47µF   | 6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812 |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
| Rated voltage   | Insulation Resistance  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
| 100V: All X7R; 1210 ≥ 3.3µF   | 500MΩ or RxC ≥ 5 Ω-F whichever is smaller.   |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
| 50V: 0402 > 0.01µF; 0603 ≥ 1µF; 0805 ≥ 1µF; 1206 ≥ 4.7µF; 1210 ≥ 4.7µF                  |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
| 35V: 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF                                |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
| 25V: 0201 ≥ 0.1µF; 0402 ≥ 0.22µF; 0603 ≥ 2.2µF; 0805 ≥ 2.2µF; 1206 ≥ 10µF; 1210 ≥ 10µF  |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
| 16V: 0201 ≥ 0.1µF; 0402 ≥ 0.22µF; 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1206 ≥ 10µF; 1210 ≥ 47µF    |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
| 10V: 0201 ≥ 47nF; 0402 ≥ 0.47µF; 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 4.7µF; 1210 ≥ 47µF |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
| 6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥ 1812                                  |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |
|   |  |   |  |  |   |  |   |  |  |   |  |      |   |     |      |   |     |      |   |     |      |  |     |        |  |      |       |   |    |       |     |

Multilayer Ceramic Capacitors

| No  | Item   | Test Condition   | Requirements   |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|---|--|--|--|-----------------------|--|--|---|---|---|--|---|----------|---|------|---------------------|--|----------|---|------|------|---------------------|----------|-------------|-----|-----------------------------------|----------|----------|--|--------|-----------|--|---------|-----------|--|------|-----------------|-----------|-----------|---------------|------|---|-----|----------|---|------|-----------------|----------|----------------|--------|---|-----------------------------------|-----|----------|--|------|-----------------|--|----------|-------------|---------|----------------------|-----|----------|----------------------|------|-----------------|--|----------|-------------|-------|---------|-----|----------|---|------|-----------------|---|----------|-----|------|----------|------|----------|---|------|----------|---|----------|-----|-----------|----------|-----|------|-----|------|---------|-----|------|-----|------|---------|-----|------|-----|------|---------|-----|------|-----|------|---------|-----|------|-----|-----|-----|-----|
| 15.   | High Temperature Load (Endurance)              | Test temp. :<br>NP0, X7R/X7E/X7S: 125±3°C<br>X6S: 105±3°C<br>X5R, Y5V: 85±3°C<br>Test time: 1000+24/-0 hrs.<br>To apply voltage:<br>(1) ≤6.3V or C ≥10µF or TT series: 150% of rated voltage.<br>(2) 10V ≤Ur<500V: 200% of rated voltage.<br>(3) 500V: 150% of rated voltage.<br>(4) Ur ≥630V: 120% of rated voltage.<br>(5) 100% of rated voltage for below range.  | * No remarkable damage.<br>Cap change:<br>NP0: ±3.0% or ±0.3pF whichever is larger<br>X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤6.3V within ±25%;<br>TT series & C ≥ 1µF, within ±25%<br>**10V: 0603 ≥ 4.7µF; 0402 ≥ 1µF; 0201 ≥ 0.1µF, within ±25%;<br>Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40%<br>Q/D.F. value:<br>NP0: More than 30pF, Q≥350<br>10pF≤C<30pF, Q≥275+2.5C<br>Less than 10pF, Q≥200+10C<br>X7R, X5R, X6S, X7S: |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated voltage</th> <th>Capacitance range</th> <th>Rated V.D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0201</td> <td rowspan="2">X5R/X7R/X6S</td> <td>≤10V</td> <td>C ≥0.1µF</td> <td rowspan="2">≥100V</td> <td>≤3%</td> <td>≤6%<br/>1206 ≥0.47µF</td> </tr> <tr> <td>≥16V</td> <td>C &gt;0.1µF</td> <td>≤7.5%<br/>0805 &gt;0.1µF, 0603 ≥0.068µF, 1206&gt;1µF; 1210 ≥2.2µF; TT series</td> </tr> <tr> <td rowspan="4">0402</td> <td rowspan="2">X5R</td> <td>≤16V</td> <td>C &gt;1.0µF</td> <td rowspan="4">50V</td> <td>≤3%</td> <td>≤20%<br/>0805 &gt;0.22µF; 1210 ≥3.3µF</td> </tr> <tr> <td>25V, 50V</td> <td>C ≥1.0µF</td> <td>≤6%<br/>0201(50V); 0603 ≥0.047µF; 0805 ≥0.18µF; 1206 ≥0.47µF</td> </tr> <tr> <td>6.3V</td> <td>C &gt;1.0µF</td> <td>≤10%<br/>0201 ≥0.01µF; 1210 ≥4.7µF</td> </tr> <tr> <td>10V~25V</td> <td>C ≥1.0µF</td> <td>≤20%<br/>0402 ≥0.012µF; 0603&gt;0.1µF; 0805 ≥1µF; 1206 ≥2.2µF; 1210 ≥10µF; TT series</td> </tr> <tr> <td rowspan="2">0603</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>6.3V, 10V</td> <td>C ≥1.0µF</td> <td rowspan="2">35V</td> <td>≤5%</td> <td>≤20%<br/>0603 ≥1µF; 0805 ≥2.2µF; 1206 ≥2.2µF; 1210 ≥10µF</td> </tr> <tr> <td>4V</td> <td>C ≥22µF</td> <td>≤10%<br/>0201 ≥0.01µF; 0805 ≥1µF; 1210 ≥10µF</td> </tr> <tr> <td rowspan="3">0805</td> <td rowspan="3">X5R/X7R/X6S/X7S</td> <td>25V, 35V</td> <td>C ≥1.0µF</td> <td rowspan="3">25V</td> <td>≤5%</td> <td>≤14%<br/>0603 ≥0.33µF; 1206 ≥4.7µF</td> </tr> <tr> <td>4V</td> <td>C ≥47µF</td> <td>≤15%<br/>0201 ≥0.1µF; 0402 ≥0.10µF &amp; (0402/X7R ≥0.056µF); TT series</td> </tr> <tr> <td>6.3V</td> <td>C ≥22µF</td> <td>≤20%<br/>0603 ≥0.47µF; 0805 ≥2.2µF; 1206 ≥6.8µF; 1210 ≥22µF</td> </tr> <tr> <td rowspan="2">1206</td> <td rowspan="2">X5R/X7R/X6S</td> <td>10V~50V</td> <td>C ≥10µF</td> <td rowspan="2">16V</td> <td>≤5%</td> <td>≤10%<br/>0402 ≥0.47µF</td> </tr> <tr> <td>4V</td> <td>C ≥22µF</td> <td>≤15%<br/>0603 ≥0.15µF; 0805 ≥0.68µF; 1206 ≥2.2µF; 1210 ≥4.7µF</td> </tr> <tr> <td rowspan="2">1210</td> <td rowspan="2">X5R/X7R/X6S</td> <td>≤6.3V</td> <td>C ≥47µF</td> <td rowspan="2">10V</td> <td>≤7.5%</td> <td>≤15%<br/>0201 ≥0.01µF(0201/X7R ≥0.022µF); 0402 ≥0.033µF; 0603 ≥0.68µF; 0805 ≥2.2µF; 1206 ≥4.7µF; 1210 ≥22µF; TT series</td> </tr> <tr> <td>16V</td> <td>C ≥47µF</td> <td>≤15%<br/>0201 ≥0.012µF; 0402 ≥0.33µF(0402/X7R ≥0.22µF); 0603 ≥0.33µF; 0805 ≥2.2µF; 1206 ≥2.2µF; 1210 ≥22µF</td> </tr> <tr> <td rowspan="2">TT15</td> <td rowspan="2">X5R</td> <td>100V</td> <td>C ≥3.3µF</td> <td rowspan="2">6.3V</td> <td>≤15%</td> <td>≤20%<br/>0201 ≥0.1µF; 0402 ≥1µF; TT series: 01R5</td> </tr> <tr> <td>6.3V</td> <td>C &gt;1.0µF</td> <td>≤30%<br/>0201 ≥0.1µF; 0402 ≥1µF; 0603 ≥10µF; 0805 ≥4.7µF; 1206 ≥47µF; 1210 ≥100µF; TT series</td> </tr> <tr> <td rowspan="2">TT18</td> <td rowspan="2">Y5V</td> <td>6.3V, 10V</td> <td>C ≥2.2µF</td> <td rowspan="2">4V</td> <td>≤20%</td> <td>---</td> </tr> <tr> <td>6.3V</td> <td>C ≥10µF</td> <td>---</td> </tr> <tr> <td rowspan="2">TT21</td> <td rowspan="2">Y5V</td> <td>6.3V</td> <td>C ≥10µF</td> <td rowspan="2">---</td> <td>≤15%</td> <td>---</td> </tr> <tr> <td>≤10V</td> <td>C ≥10µF</td> <td>---</td> </tr> <tr> <td rowspan="2">TT31</td> <td rowspan="2">Y5V</td> <td>6.3V</td> <td>C ≥22µF</td> <td rowspan="2">---</td> <td>≤20%</td> <td>---</td> </tr> <tr> <td>---</td> <td>---</td> <td>---</td> </tr> </tbody> </table> | Size   | Dielectric            | Rated voltage  | Capacitance range  | Rated V.D.F. ≤  | Exception of D.F. ≤   | 0201  | X5R/X7R/X6S  | ≤10V  | C ≥0.1µF | ≥100V   | ≤3%  | ≤6%<br>1206 ≥0.47µF | ≥16V   | C >0.1µF | ≤7.5%<br>0805 >0.1µF, 0603 ≥0.068µF, 1206>1µF; 1210 ≥2.2µF; TT series | 0402 | X5R  | ≤16V                | C >1.0µF | 50V         | ≤3% | ≤20%<br>0805 >0.22µF; 1210 ≥3.3µF | 25V, 50V | C ≥1.0µF | ≤6%<br>0201(50V); 0603 ≥0.047µF; 0805 ≥0.18µF; 1206 ≥0.47µF              | 6.3V   | C >1.0µF  | ≤10%<br>0201 ≥0.01µF; 1210 ≥4.7µF                            | 10V~25V | C ≥1.0µF  | ≤20%<br>0402 ≥0.012µF; 0603>0.1µF; 0805 ≥1µF; 1206 ≥2.2µF; 1210 ≥10µF; TT series | 0603 | X5R/X7R/X6S/X7S | 6.3V, 10V | C ≥1.0µF  | 35V           | ≤5%  | ≤20%<br>0603 ≥1µF; 0805 ≥2.2µF; 1206 ≥2.2µF; 1210 ≥10µF | 4V  | C ≥22µF  | ≤10%<br>0201 ≥0.01µF; 0805 ≥1µF; 1210 ≥10µF | 0805 | X5R/X7R/X6S/X7S | 25V, 35V | C ≥1.0µF       | 25V    | ≤5%   | ≤14%<br>0603 ≥0.33µF; 1206 ≥4.7µF | 4V  | C ≥47µF  | ≤15%<br>0201 ≥0.1µF; 0402 ≥0.10µF & (0402/X7R ≥0.056µF); TT series | 6.3V | C ≥22µF         | ≤20%<br>0603 ≥0.47µF; 0805 ≥2.2µF; 1206 ≥6.8µF; 1210 ≥22µF | 1206     | X5R/X7R/X6S | 10V~50V | C ≥10µF              | 16V | ≤5%      | ≤10%<br>0402 ≥0.47µF | 4V   | C ≥22µF         | ≤15%<br>0603 ≥0.15µF; 0805 ≥0.68µF; 1206 ≥2.2µF; 1210 ≥4.7µF | 1210     | X5R/X7R/X6S | ≤6.3V | C ≥47µF | 10V | ≤7.5%    | ≤15%<br>0201 ≥0.01µF(0201/X7R ≥0.022µF); 0402 ≥0.033µF; 0603 ≥0.68µF; 0805 ≥2.2µF; 1206 ≥4.7µF; 1210 ≥22µF; TT series | 16V  | C ≥47µF         | ≤15%<br>0201 ≥0.012µF; 0402 ≥0.33µF(0402/X7R ≥0.22µF); 0603 ≥0.33µF; 0805 ≥2.2µF; 1206 ≥2.2µF; 1210 ≥22µF | TT15     | X5R | 100V | C ≥3.3µF | 6.3V | ≤15%     | ≤20%<br>0201 ≥0.1µF; 0402 ≥1µF; TT series: 01R5 | 6.3V | C >1.0µF | ≤30%<br>0201 ≥0.1µF; 0402 ≥1µF; 0603 ≥10µF; 0805 ≥4.7µF; 1206 ≥47µF; 1210 ≥100µF; TT series | TT18     | Y5V | 6.3V, 10V | C ≥2.2µF | 4V  | ≤20% | --- | 6.3V | C ≥10µF | --- | TT21 | Y5V | 6.3V | C ≥10µF | --- | ≤15% | --- | ≤10V | C ≥10µF | --- | TT31 | Y5V | 6.3V | C ≥22µF | --- | ≤20% | --- | --- | --- | --- |
|   |  | Size   | Dielectric   | Rated voltage         | Capacitance range  | Rated V.D.F. ≤   | Exception of D.F. ≤   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 0201   | X5R/X7R/X6S  | ≤10V                  | C ≥0.1µF   | ≥100V  | ≤3%   | ≤6%<br>1206 ≥0.47µF   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | ≥16V                  | C >0.1µF   |  | ≤7.5%<br>0805 >0.1µF, 0603 ≥0.068µF, 1206>1µF; 1210 ≥2.2µF; TT series                                     |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 0402   | X5R  | ≤16V                  | C >1.0µF   | 50V  | ≤3%   | ≤20%<br>0805 >0.22µF; 1210 ≥3.3µF   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | 25V, 50V              | C ≥1.0µF   |  | ≤6%<br>0201(50V); 0603 ≥0.047µF; 0805 ≥0.18µF; 1206 ≥0.47µF   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  | 6.3V   | C >1.0µF              | ≤10%<br>0201 ≥0.01µF; 1210 ≥4.7µF  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  | 10V~25V  | C ≥1.0µF              | ≤20%<br>0402 ≥0.012µF; 0603>0.1µF; 0805 ≥1µF; 1206 ≥2.2µF; 1210 ≥10µF; TT series |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 0603   | X5R/X7R/X6S/X7S  | 6.3V, 10V             | C ≥1.0µF   | 35V  | ≤5%   | ≤20%<br>0603 ≥1µF; 0805 ≥2.2µF; 1206 ≥2.2µF; 1210 ≥10µF   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | 4V                    | C ≥22µF  |  | ≤10%<br>0201 ≥0.01µF; 0805 ≥1µF; 1210 ≥10µF   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 0805   | X5R/X7R/X6S/X7S  | 25V, 35V              | C ≥1.0µF   | 25V  | ≤5%   | ≤14%<br>0603 ≥0.33µF; 1206 ≥4.7µF   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | 4V                    | C ≥47µF  |  | ≤15%<br>0201 ≥0.1µF; 0402 ≥0.10µF & (0402/X7R ≥0.056µF); TT series  |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | 6.3V                  | C ≥22µF  |  | ≤20%<br>0603 ≥0.47µF; 0805 ≥2.2µF; 1206 ≥6.8µF; 1210 ≥22µF  |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 1206   | X5R/X7R/X6S  | 10V~50V               | C ≥10µF  | 16V  | ≤5%   | ≤10%<br>0402 ≥0.47µF  |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | 4V                    | C ≥22µF  |  | ≤15%<br>0603 ≥0.15µF; 0805 ≥0.68µF; 1206 ≥2.2µF; 1210 ≥4.7µF  |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 1210   | X5R/X7R/X6S  | ≤6.3V                 | C ≥47µF  | 10V  | ≤7.5%   | ≤15%<br>0201 ≥0.01µF(0201/X7R ≥0.022µF); 0402 ≥0.033µF; 0603 ≥0.68µF; 0805 ≥2.2µF; 1206 ≥4.7µF; 1210 ≥22µF; TT series |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | 16V                   | C ≥47µF  |  | ≤15%<br>0201 ≥0.012µF; 0402 ≥0.33µF(0402/X7R ≥0.22µF); 0603 ≥0.33µF; 0805 ≥2.2µF; 1206 ≥2.2µF; 1210 ≥22µF |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | TT15   | X5R  | 100V                  | C ≥3.3µF   | 6.3V   | ≤15%  | ≤20%<br>0201 ≥0.1µF; 0402 ≥1µF; TT series: 01R5   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | 6.3V                  | C >1.0µF   |  | ≤30%<br>0201 ≥0.1µF; 0402 ≥1µF; 0603 ≥10µF; 0805 ≥4.7µF; 1206 ≥47µF; 1210 ≥100µF; TT series               |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | TT18   | Y5V  | 6.3V, 10V             | C ≥2.2µF   | 4V   | ≤20%  | ---   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | 6.3V                  | C ≥10µF  |  | ---   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | TT21   | Y5V  | 6.3V                  | C ≥10µF  | ---  | ≤15%  | ---   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  | ≤10V                  | C ≥10µF  |  | ---   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| TT31  | Y5V  | 6.3V   | C ≥22µF  | ---                   | ≤20%   | ---  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | ---  | ---  |                       | ---  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| **1WV items must follow de-rating conditions.   |  | Y5V:   |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| (6) 150% of rated voltage for below range.  |  | <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated voltage</th> <th>Capacitance range</th> <th>Rated vol.</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0201</td> <td rowspan="2">X5R/X6S</td> <td>≤6.3V</td> <td>C ≥47µF</td> <td>≥50V</td> <td>≤7.5%</td> <td>≤10%<br/>0603 ≥0.1µF; 0805 ≥0.47µF; 1206 ≥4.7µF</td> </tr> <tr> <td>16V, 25V</td> <td>C =0.1µF</td> <td>35V</td> <td>≤10%</td> <td>≤20%<br/>1210 ≥6.8µF</td> </tr> <tr> <td rowspan="3">0402</td> <td rowspan="2">X7R/X5R/X6S</td> <td>50V</td> <td>C ≥0.1µF</td> <td rowspan="3">25V</td> <td>≤7.5%</td> <td>≤10%<br/>0402 ≥0.047µF; 0603 ≥0.1µF; 0805 ≥0.33µF; 1206 ≥1µF; 1210 ≥4.7µF</td> </tr> <tr> <td>10~25V</td> <td>C ≥0.22µF</td> <td>≤15%<br/>0402 ≥0.068µF; 0603 ≥0.47µF; 1206 ≥4.7µF; 1210 ≥22µF</td> </tr> <tr> <td>16V</td> <td>C ≥0.47µF</td> <td>≤20%<br/>0402 ≥0.068µF; 0603 ≥0.68µF</td> </tr> <tr> <td rowspan="4">0603</td> <td rowspan="2">X7S</td> <td>50V~100V</td> <td>C &gt;0.22µF</td> <td rowspan="2">16V (C&lt;1.0µF)</td> <td>≤10%</td> <td>≤12.5%<br/>0402 ≥0.068µF; 0603 ≥0.68µF</td> </tr> <tr> <td>50V</td> <td>C &gt;0.1µF</td> <td>≤20%<br/>0402 ≥0.22µF</td> </tr> <tr> <td>X7R</td> <td>50V</td> <td>C &gt;0.1µF</td> <td rowspan="2">16V (C ≥1.0µF)</td> <td>≤12.5%</td> <td>≤20%<br/>0603 ≥2.2µF; 0805 ≥3.3µF; 1206 ≥10µF; 1210 ≥22µF; 1812 ≥47µF;</td> </tr> <tr> <td>X5R</td> <td>50V</td> <td>C ≥1.0µF</td> <td>≤30%<br/>0402 ≥0.47µF</td> </tr> <tr> <td rowspan="2">0805</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>10V, 16V, 100V</td> <td>C ≥1.0µF</td> <td rowspan="2">6.3V</td> <td>≤20%</td> <td>≤30%<br/>0402 ≥0.47µF</td> </tr> <tr> <td>50V</td> <td>C ≥1.0µF</td> <td>---</td> </tr> <tr> <td rowspan="2">1206</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>50V</td> <td>C ≥1.0µF</td> <td rowspan="2">---</td> <td>≤30%</td> <td>---</td> </tr> <tr> <td>35V</td> <td>C ≥2.2µF</td> <td>---</td> </tr> <tr> <td rowspan="2">1210</td> <td rowspan="2">X5R/X7R/X6S/X7S</td> <td>10~25V</td> <td>C ≥4.7µF</td> <td rowspan="2">---</td> <td>---</td> <td>---</td> </tr> <tr> <td>16V</td> <td>C ≥4.7µF</td> <td>---</td> </tr> <tr> <td rowspan="2">1825</td> <td rowspan="2">X7R</td> <td rowspan="2">100V~250V</td> <td rowspan="2">C ≥1.0µF</td> <td rowspan="2">---</td> <td rowspan="2">---</td> <td>---</td> </tr> <tr> <td>---</td> <td>---</td> </tr> </tbody> </table>   | Size   | Dielectric            | Rated voltage  | Capacitance range  | Rated vol.  | D.F. ≤  | Exception of D.F. ≤   | 0201   | X5R/X6S   | ≤6.3V    | C ≥47µF   | ≥50V | ≤7.5%               | ≤10%<br>0603 ≥0.1µF; 0805 ≥0.47µF; 1206 ≥4.7µF | 16V, 25V | C =0.1µF  | 35V  | ≤10% | ≤20%<br>1210 ≥6.8µF | 0402     | X7R/X5R/X6S | 50V | C ≥0.1µF                          | 25V      | ≤7.5%    | ≤10%<br>0402 ≥0.047µF; 0603 ≥0.1µF; 0805 ≥0.33µF; 1206 ≥1µF; 1210 ≥4.7µF | 10~25V | C ≥0.22µF | ≤15%<br>0402 ≥0.068µF; 0603 ≥0.47µF; 1206 ≥4.7µF; 1210 ≥22µF | 16V     | C ≥0.47µF | ≤20%<br>0402 ≥0.068µF; 0603 ≥0.68µF  | 0603 | X7S             | 50V~100V  | C >0.22µF | 16V (C<1.0µF) | ≤10% | ≤12.5%<br>0402 ≥0.068µF; 0603 ≥0.68µF                   | 50V | C >0.1µF | ≤20%<br>0402 ≥0.22µF                        | X7R  | 50V             | C >0.1µF | 16V (C ≥1.0µF) | ≤12.5% | ≤20%<br>0603 ≥2.2µF; 0805 ≥3.3µF; 1206 ≥10µF; 1210 ≥22µF; 1812 ≥47µF; | X5R                               | 50V | C ≥1.0µF | ≤30%<br>0402 ≥0.47µF   | 0805 | X5R/X7R/X6S/X7S | 10V, 16V, 100V   | C ≥1.0µF | 6.3V        | ≤20%    | ≤30%<br>0402 ≥0.47µF | 50V | C ≥1.0µF | ---                  | 1206 | X5R/X7R/X6S/X7S | 50V  | C ≥1.0µF | ---         | ≤30%  | ---     | 35V | C ≥2.2µF | ---   | 1210 | X5R/X7R/X6S/X7S | 10~25V  | C ≥4.7µF | --- | ---  | ---      | 16V  | C ≥4.7µF | ---   | 1825 | X7R      | 100V~250V   | C ≥1.0µF | --- | ---       | ---      | --- | ---  |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| Size  | Dielectric                                     | Rated voltage  | Capacitance range  | Rated vol.            | D.F. ≤   | Exception of D.F. ≤  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 0201  | X5R/X6S  | ≤6.3V  | C ≥47µF  | ≥50V                  | ≤7.5%  | ≤10%<br>0603 ≥0.1µF; 0805 ≥0.47µF; 1206 ≥4.7µF                           |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 16V, 25V   | C =0.1µF   | 35V                   | ≤10%   | ≤20%<br>1210 ≥6.8µF  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 0402  | X7R/X5R/X6S                                    | 50V  | C ≥0.1µF   | 25V                   | ≤7.5%  | ≤10%<br>0402 ≥0.047µF; 0603 ≥0.1µF; 0805 ≥0.33µF; 1206 ≥1µF; 1210 ≥4.7µF |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 10~25V   | C ≥0.22µF  |                       | ≤15%<br>0402 ≥0.068µF; 0603 ≥0.47µF; 1206 ≥4.7µF; 1210 ≥22µF                     |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   | 16V  | C ≥0.47µF  | ≤20%<br>0402 ≥0.068µF; 0603 ≥0.68µF  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 0603  | X7S  | 50V~100V   | C >0.22µF  | 16V (C<1.0µF)         | ≤10%   | ≤12.5%<br>0402 ≥0.068µF; 0603 ≥0.68µF                                    |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 50V  | C >0.1µF   |                       | ≤20%<br>0402 ≥0.22µF   |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   | X7R  | 50V  | C >0.1µF   | 16V (C ≥1.0µF)        | ≤12.5%   | ≤20%<br>0603 ≥2.2µF; 0805 ≥3.3µF; 1206 ≥10µF; 1210 ≥22µF; 1812 ≥47µF;    |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   | X5R  | 50V  | C ≥1.0µF   |                       | ≤30%<br>0402 ≥0.47µF   |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 0805  | X5R/X7R/X6S/X7S                                | 10V, 16V, 100V   | C ≥1.0µF   | 6.3V                  | ≤20%   | ≤30%<br>0402 ≥0.47µF   |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 50V  | C ≥1.0µF   |                       | ---  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 1206  | X5R/X7R/X6S/X7S                                | 50V  | C ≥1.0µF   | ---                   | ≤30%   | ---  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 35V  | C ≥2.2µF   |                       | ---  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 1210  | X5R/X7R/X6S/X7S                                | 10~25V   | C ≥4.7µF   | ---                   | ---  | ---  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  | 16V  | C ≥4.7µF   |                       | ---  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 1825  | X7R  | 100V~250V  | C ≥1.0µF   | ---                   | ---  | ---  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  |                       |  | ---  | ---   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| * Before initial measurement (Class II only): To apply de-rating at 150% for 24+2 hrs at room temp. per de-rating table for 1µF or 10µF then set for 24+2 hrs at room temp. |  | I.R.: ≥10V, 1GΩ or 50 Ω·F whichever is smaller.<br>Class II (X7R, X5R, X6S, X7S, Y5V)  | Insulation Resistance  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| ** De-rating conditions:  |  | <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: All X7R; 1210 ≥3.3µF</td> <td rowspan="5">1GΩ or RxC<br/>≥10 Ω·F<br/>whichever is smaller.</td> </tr> <tr> <td>50V: 0402&gt;0.01µF; 0603≥1µF; 0805≥1µF; 1206≥4.7µF; 1210≥4.7µF</td> </tr> <tr> <td>35V: 0603≥1µF; 0805≥2.2µF; 1206 ≥2.2µF; 1210 ≥10µF</td> </tr> <tr> <td>25V: 0201 ≥0.1µF; 0402 ≥0.22µF; 0603 ≥2.2µF; 0805 ≥2.2µF; 1206 ≥1µF; 1210 ≥10µF</td> </tr> <tr> <td>16V: 0201 ≥0.1µF; 0402 ≥0.22µF; 0603 ≥1µF; 0805 ≥2.2µF; 1206 ≥10µF; 1210 ≥47µF</td> </tr> <tr> <td>10V: 0201 ≥47nF; 0402 ≥0.47µF; 0603 ≥0.47µF; 0805 ≥2.2µF; 1206 ≥4.7µF; 1210 ≥47µF</td> <td></td> </tr> <tr> <td>6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥1812</td> <td></td> </tr> </tbody> </table>  | Rated voltage  | Insulation Resistance | 100V: All X7R; 1210 ≥3.3µF   | 1GΩ or RxC<br>≥10 Ω·F<br>whichever is smaller.                           | 50V: 0402>0.01µF; 0603≥1µF; 0805≥1µF; 1206≥4.7µF; 1210≥4.7µF  | 35V: 0603≥1µF; 0805≥2.2µF; 1206 ≥2.2µF; 1210 ≥10µF  | 25V: 0201 ≥0.1µF; 0402 ≥0.22µF; 0603 ≥2.2µF; 0805 ≥2.2µF; 1206 ≥1µF; 1210 ≥10µF | 16V: 0201 ≥0.1µF; 0402 ≥0.22µF; 0603 ≥1µF; 0805 ≥2.2µF; 1206 ≥10µF; 1210 ≥47µF | 10V: 0201 ≥47nF; 0402 ≥0.47µF; 0603 ≥0.47µF; 0805 ≥2.2µF; 1206 ≥4.7µF; 1210 ≥47µF |          | 6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥1812 |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| Rated voltage   | Insulation Resistance                          |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 100V: All X7R; 1210 ≥3.3µF  | 1GΩ or RxC<br>≥10 Ω·F<br>whichever is smaller. |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 50V: 0402>0.01µF; 0603≥1µF; 0805≥1µF; 1206≥4.7µF; 1210≥4.7µF  |  |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 35V: 0603≥1µF; 0805≥2.2µF; 1206 ≥2.2µF; 1210 ≥10µF  |  |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 25V: 0201 ≥0.1µF; 0402 ≥0.22µF; 0603 ≥2.2µF; 0805 ≥2.2µF; 1206 ≥1µF; 1210 ≥10µF   |  |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 16V: 0201 ≥0.1µF; 0402 ≥0.22µF; 0603 ≥1µF; 0805 ≥2.2µF; 1206 ≥10µF; 1210 ≥47µF  |  |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 10V: 0201 ≥47nF; 0402 ≥0.47µF; 0603 ≥0.47µF; 0805 ≥2.2µF; 1206 ≥4.7µF; 1210 ≥47µF   |  |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
| 6.3V ; 4V ; TT series ; All X6S/X7S items; Size ≥1812   |  |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |
|   |  |  |  |                       |  |  |   |   |   |  |   |          |   |      |                     |  |          |   |      |      |                     |          |             |     |                                   |          |          |  |        |           |  |         |           |  |      |                 |           |           |               |      |   |     |          |   |      |                 |          |                |        |   |                                   |     |          |  |      |                 |  |          |             |         |                      |     |          |                      |      |                 |  |          |             |       |         |     |          |   |      |                 |   |          |     |      |          |      |          |   |      |          |   |          |     |           |          |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |      |         |     |      |     |     |     |     |

Multilayer Ceramic Capacitors

**APPENDIXES**

■ **Tape & reel dimensions**

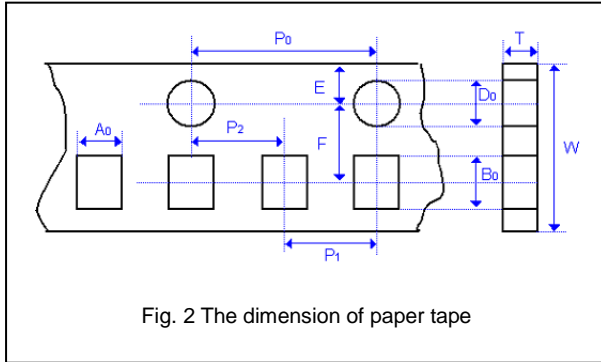


Fig. 2 The dimension of paper tape

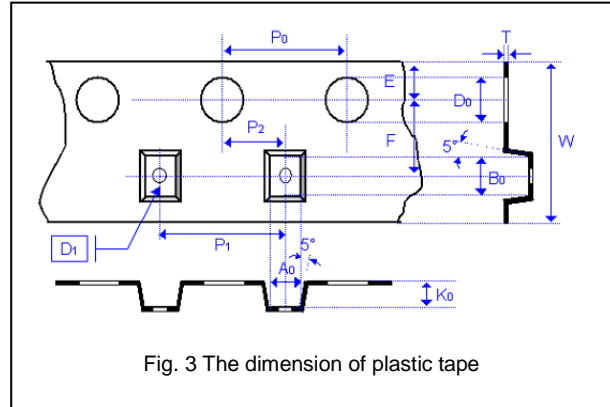


Fig. 3 The dimension of plastic tape

| Size                    | 0201             | 0402             | 0603             | 0805             |                  |                  | 1206             |                  |                  | 1210             |                  |                  | 1808             | 1812             |                  |
|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Thickness               | L                | N,E              | S,H,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              |
| <b>A<sub>0</sub></b>    | 0.40<br>+/-0.10  | 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           | < 3.20           | < 2.50           | < 3.90           | < 3.90           |
| <b>B<sub>0</sub></b>    | 0.70<br>+/-0.10  | 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           | < 4.00           | < 5.30           | < 5.30           | < 5.30           |
| <b>T</b>                | ≤ 0.55           | ≤ 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   | 0.25<br>+/-0.1   | 0.25<br>+/-0.1   | 0.25<br>+/-0.1   |
| <b>K<sub>0</sub></b>    | -                | -                | -                | -                | -                | < 2.50           | -                | < 2.50           | < 2.50           | < 1.50           | < 2.50           | < 3.20           | < 2.50           | < 2.50           | < 3.50           |
| <b>W</b>                | 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 |
| <b>P<sub>0</sub></b>    | 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  |
| <b>10xP<sub>0</sub></b> | 40.00<br>+/-0.10 | 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 |
| <b>P<sub>1</sub></b>    | 2.00<br>+/-0.05  | 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  | 8.00<br>+/-0.10  | 8.00<br>+/-0.10  |
| <b>P<sub>2</sub></b>    | 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  |
| <b>D<sub>0</sub></b>    | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  | 1.50<br>+0.1/-0  |
| <b>D<sub>1</sub></b>    | -                | -                | -                | -                | -                | 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  |
| <b>E</b>                | 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  |
| <b>F</b>                | 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  | 5.50<br>+/-0.10  | 5.50<br>+/-0.10  | 5.50<br>+/-0.10  |

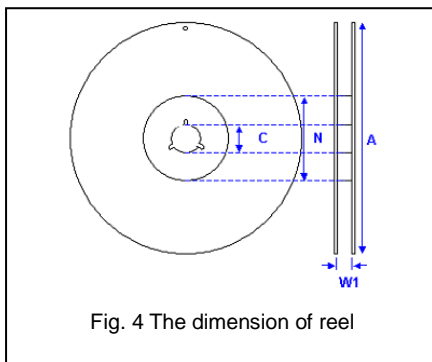
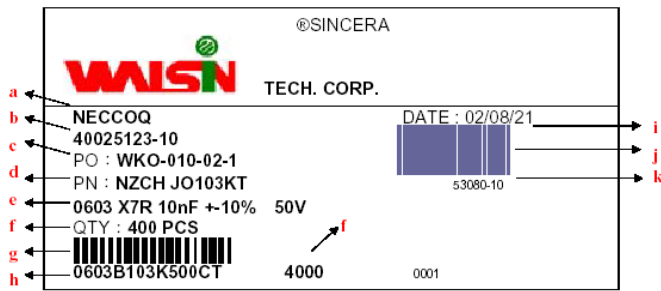


Fig. 4 The dimension of reel

| Size                 | 0201, 0402, 0603, 0805, 1206, 1210 |               |               | 1808, 1812    |
|----------------------|------------------------------------|---------------|---------------|---------------|
| Reel size            | 7"                                 | 10"           | 13"           | 7"            |
| <b>C</b>             | 13.0+0.5/-0.2                      | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 |
| <b>W<sub>1</sub></b> | 8.4+1.5/-0                         | 8.4+1.5/-0    | 8.4+1.5/-0    | 12.4+2.0/-0   |
| <b>A</b>             | 178.0±1.0                          | 250.0±1.0     | 330.0±1.0     | 178.0±1.0     |
| <b>N</b>             | 60.0+1.0/-0                        | 100.0±1.0     | 100±1.0       | 60.0+1.0/-0   |

Multilayer Ceramic Capacitors

Description of customer label



- 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

Storage and handling conditions

- (1) To store products at 5 to 40°C ambient temperature and 20 to 70% related humidity conditions.
- (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<sub>2</sub> within oven are recommended.

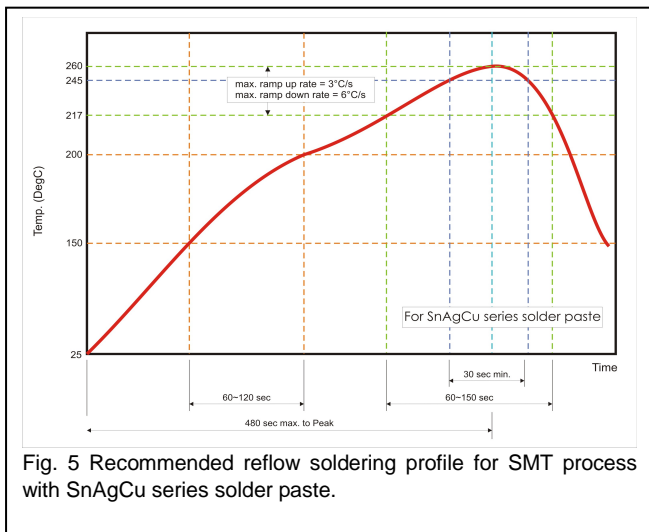


Fig. 5 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

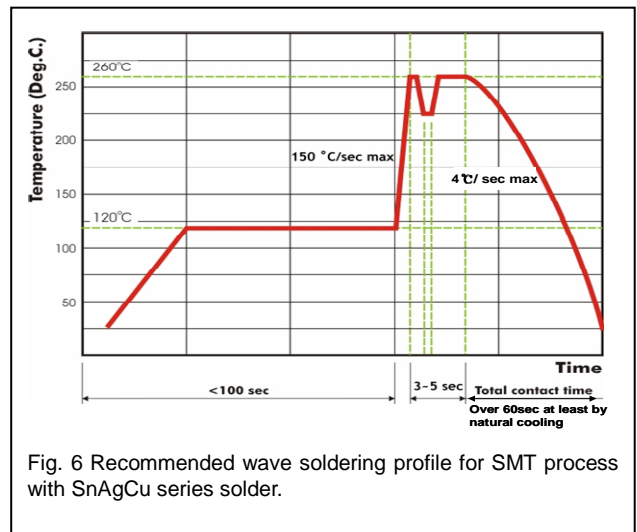


Fig. 6 Recommended wave soldering profile for SMT process with SnAgCu series solder.