

APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

Automotive Capacitors Series (MG)

0402 to 1812 Sizes

NP0, X7R, X5R, Dielectrics, 6.3V to 250V

RoHS Compliance

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

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

3. APPLICATIONS

- For Navigation & Information equipments.
- For entertainment equipments
- For comfortable equipments.

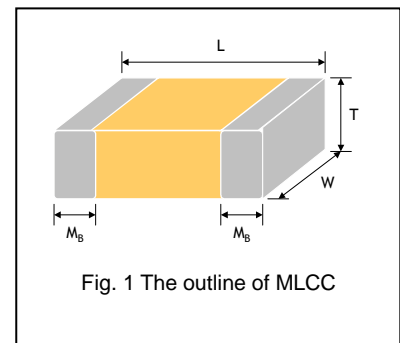
4. HOW TO ORDER

| <u>MG</u> | <u>31</u> | <u>B</u> | <u>104</u> | <u>K</u> | <u>500</u> | <u>C</u> | <u>I</u> |
|---|--|---|---|--|--|--------------------|--|
| <u>Series</u> | <u>Size</u> | <u>Dielectric</u> | <u>Capacitance</u> | <u>Tolerance</u> | <u>Rated voltage</u> | <u>Termination</u> | <u>Packaging style</u> |
| MG = Automotive (without AEC-Q200 certification) | 15 =0402 (1005) 18 =0603 (1608) 21 =0805 (2012) 31 =1206 (3216) 32 =1210 (3225) 43 =1812 (4532) | N =NP0 (C0G) B =X7R X =X5R | Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: 0R5=0.5pF 1R0=1.0pF 104=10x10 ⁴ =100nF | B =±0.1pF C =±0.25pF D =±0.5pF F =±1% G =±2% J =±5% K =±10% M =±20% | Two significant digits followed by no. of zeros. And R is in place of decimal point. 6R3 =6.3 VDC 100 =10 VDC 160 =16 VDC 250 =25 VDC 500 =50 VDC 101 =100 VDC 201 =200 VDC 251 =250 VDC | C =Cu/Ni/Sn | T =7" reeled R =7" reeled (2mm pitch for 0603 size; paper tape) G =13" reeled |

5. EXTERNAL DIMENSIONS

| Size Inch (mm) | L (mm) | W (mm) | T (mm)/Symbol | Remark | M _B (mm) | |
|-------------------|---------------------|---------------------|---------------------|--------|---------------------|---|
| 0402 (1005) | 1.00±0.05 | 0.50±0.05 | 0.50±0.05 | N | # | |
| 0603 (1608) | 1.60±0.10 | 0.80±0.10 | 0.80±0.07 | S | 0.40±0.15 | |
| | 1.60 +0.15/-0.10 | 0.80 +0.15/-0.10 | 0.80 +0.15/-0.10 | X | | |
| 0805 (2012) | 2.00±0.15 | 1.25±0.10 | 0.60±0.10 | A | 0.50±0.20 | |
| | | | 0.80±0.10 | B | | |
| | 1.25±0.10 | D | # | | | |
| | 2.00±0.20 | 1.25±0.20 | 1.25±0.20 | I | | # |
| 1206 (3216) | 3.20±0.15 | 1.60±0.15 | 0.80±0.10 | B | 0.60±0.20 | |
| | | | 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 | | # |
| 1812 (4532) | 4.50±0.40 | 3.20±0.30 | 1.25±0.10 | D | 0.75±0.25 | |
| | | | 2.00±0.20 | K | | # |

Reflow soldering only is recommended.



6. GENERAL ELECTRICAL DATA

| | | | |
|-----------------------------------|---|---|---------------------|
| Dielectric | NP0 | X7R | X5R |
| Size | 0402, 0603, 0805, 1206, 1210, 1812 | | |
| Capacitance range* | 0.5pF to 0.033μF | 100pF to 2.2μF | 0.056μF to 10μF |
| Capacitance tolerance** | J (±5%), K (±10%), M (±20%) Cap≤5pF: B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%) | | |
| Rated voltage (WVDC) | 16V, 25V, 50V, 100V | 10V, 16V, 25V, 50V, 100V, 200V, 250V | 6.3V, 10V, 16V, 25V |
| Tan δ* | Cap<30pF: Q≥400+20C Cap≥30pF: Q≥1000 | Note 1 | |
| Operating temperature | -55 to +125°C | | -55 to +85°C |
| Capacitance characteristic | ±30ppm/°C | ±15% | |
| Termination | 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 ambient condition for 24±2 hours before measurement.

Note 1: X7R/X5R

| Rated V | D.F. ≤ | Exception of D.F. ≤ |
|---------|--------|---|
| ≥100V | ≤3% | ≤6% 1206 ≥ 0.47μF |
| | | ≤7.5% 0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; TT series |
| ≥50V | ≤3% | ≤6% 0201(50V);0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF |
| | | ≤10% 1210 ≥ 4.7μF |
| | | ≤20% 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series |
| 35V | ≤5% | ≤20% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1210 ≥ 10μF |
| 25V | ≤5% | ≤10% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF |
| | | ≤14% 0603 ≥ 0.33μF; 1206 ≥ 4.7μF |
| | | ≤15% 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series |
| | | ≤20% 0402 ≥ 1μF |
| 16V | ≤5% | ≤10% 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF |
| | | ≤15% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 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); 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF |
| | | ≤20% 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series |
| 6.3V | ≤15% | ≤30% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF; TT series |
| 4V | ≤20% | --- |

7. CAPACITANCE RANGE (NP0 Dielectric)

7-1 0402, 0603, 0805 Sizes

| DIELECTRIC | | NP0 | | | | | | | | | | | | | | | | |
|---------------------|-------------|------|----|----|----|-----|------|----|----|----|-----|------|----|----|----|-----|-----|-----|
| SIZE | | 0402 | | | | | 0603 | | | | | 0805 | | | | | | |
| RATED VOLTAGE (VDC) | | 10 | 16 | 25 | 50 | 100 | 10 | 16 | 25 | 50 | 100 | 10 | 16 | 25 | 50 | 100 | 200 | 250 |
| Capacitance | 0.5pF (0R5) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 0.6pF (0R6) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 0.7pF (0R7) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 0.8pF (0R8) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 0.9pF (0R9) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 1.0pF (1R0) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 1.2pF (1R2) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 1.5pF (1R5) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 1.8pF (1R8) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 2.2pF (2R2) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 2.7pF (2R7) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 3.3pF (3R3) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 3.9pF (3R9) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 4.7pF (4R7) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 5.6pF (5R6) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 6.8pF (6R8) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 8.2pF (8R2) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 10pF (100) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 12pF (120) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 15pF (150) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 18pF (180) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 22pF (220) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 27pF (270) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 33pF (330) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 39pF (390) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 47pF (470) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 56pF (560) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 68pF (680) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 82pF (820) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | A |
| | 100pF (101) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | B |
| | 120pF (121) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | A | B |
| | 150pF (151) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | B | D |
| | 180pF (181) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | B | D |
| 220pF (221) | N | N | N | N | N | S | S | S | S | S | A | A | A | A | A | D | D | |
| 270pF (271) | | | | | | S | S | S | S | S | A | A | A | A | A | D | D | |
| 330pF (331) | | | | | | S | S | S | S | S | A | A | A | A | A | D | D | |
| 390pF (391) | | | | | | S | S | S | S | S | B | B | B | B | B | D | D | |
| 470pF (471) | | | | | | S | S | S | S | S | B | B | B | B | B | D | | |
| 560pF (561) | | | | | | S | S | S | S | S | B | B | B | B | B | D | | |
| 680pF (681) | | | | | | S | S | S | S | S | B | B | B | B | B | D | | |
| 820pF (821) | | | | | | S | S | S | S | S | B | B | B | B | B | D | | |
| 1,000pF (102) | | | | | | S | S | S | S | S | B | B | B | B | B | | | |
| 1,200pF (122) | | | | | | | | | | | B | B | B | B | B | | | |
| 1,500pF (152) | | | | | | | | | | | B | B | B | B | B | | | |
| 1,800pF (182) | | | | | | | | | | | B | B | B | B | B | | | |
| 2,200pF (222) | | | | | | | | | | | B | B | B | B | B | | | |
| 2,700pF (272) | | | | | | | | | | | D | D | D | D | D | | | |
| 3,300pF (332) | | | | | | | | | | | | | | | | | | |
| 3,900pF (392) | | | | | | | | | | | | | | | | | | |
| 4,700pF (472) | | | | | | | | | | | | | | | | | | |
| 5,600pF (562) | | | | | | | | | | | | | | | | | | |
| 6,800pF (682) | | | | | | | | | | | | | | | | | | |
| 8,200pF (822) | | | | | | | | | | | | | | | | | | |
| 0.010uF (103) | | | | | | | | | | | | | | | | | | |
| 0.012uF (123) | | | | | | | | | | | | | | | | | | |

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.

7-2 1206, 1210, 1812 Sizes (Continued)

| DIELECTRIC | | 1206 | | | | | NPO | | | | | 1812 | | | | |
|---------------------|---------------|------|----|----|----|-----|------|----|----|----|-----|------|----|----|----|-----|
| SIZE | | 1206 | | | | | 1210 | | | | | 1812 | | | | |
| RATED VOLTAGE (VDC) | | 10 | 16 | 25 | 50 | 100 | 10 | 16 | 25 | 50 | 100 | 10 | 16 | 25 | 50 | 100 |
| Capacitance | 1.0pF (1R0) | | | | | | | | | | | | | | | |
| | 1.2pF (1R2) | | | | | | | | | | | | | | | |
| | 1.5pF (1R5) | B | B | B | B | B | | | | | | | | | | |
| | 1.8pF (1R8) | B | B | B | B | B | | | | | | | | | | |
| | 2.2pF (2R2) | B | B | B | B | B | | | | | | | | | | |
| | 2.7pF (2R7) | B | B | B | B | B | | | | | | | | | | |
| | 3.3pF (3R3) | B | B | B | B | B | | | | | | | | | | |
| | 3.9pF (3R9) | B | B | B | B | B | | | | | | | | | | |
| | 4.7pF (4R7) | B | B | B | B | B | | | | | | | | | | |
| | 5.6pF (5R6) | B | B | B | B | B | | | | | | | | | | |
| | 6.8pF (6R8) | B | B | B | B | B | | | | | | | | | | |
| | 8.2pF (8R2) | B | B | B | B | B | | | | | | | | | | |
| | 10pF (100) | B | B | B | B | B | | | | | C | | | | | D |
| | 12pF (120) | B | B | B | B | B | | | | | C | | | | | D |
| | 15pF (150) | B | B | B | B | B | | | | | C | | | | | D |
| | 18pF (180) | B | B | B | B | B | | | | | C | | | | | D |
| | 22pF (220) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 27pF (270) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 33pF (330) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 39pF (390) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 47pF (470) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 56pF (560) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 68pF (680) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 82pF (820) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 100pF (101) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 120pF (121) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 150pF (151) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 180pF (181) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 220pF (221) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 270pF (271) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 330pF (331) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 390pF (391) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 470pF (471) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 560pF (561) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 680pF (681) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 820pF (821) | B | B | B | B | B | C | C | C | C | C | | | | | D |
| | 1,000pF (102) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D |
| | 1,200pF (122) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D |
| | 1,500pF (152) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D |
| | 1,800pF (182) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D |
| | 2,200pF (222) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D |
| | 2,700pF (272) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D |
| 3,300pF (332) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D | |
| 3,900pF (392) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D | |
| 4,700pF (472) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D | |
| 5,600pF (562) | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D | |
| 6,800pF (682) | C | C | C | C | | C | C | C | C | C | D | D | D | D | D | |
| 8,200pF (822) | D | D | D | D | | C | C | C | C | C | D | D | D | D | D | |
| 0.010μF (103) | D | D | D | D | | C | C | C | C | C | D | D | D | D | D | |
| 0.012μF (123) | | | | | | C | C | D | D | D | D | D | D | D | D | |
| 0.015μF (153) | | | | | | C | C | D | D | D | 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.

8. CAPACITANCE RANGE (X7R Dielectric)

8-1 X7R Dielectric 0402, 0603, 0805 Sizes

| DIELECTRIC | X7R | | | | | | | | | | | | | | | | |
|---------------|---------------------|------|----|----|----|------|----|----|----|-----|------|----|----|----|-----|-----|-----|
| | SIZE | 0402 | | | | 0603 | | | | | 0805 | | | | | | |
| | RATED VOLTAGE (VDC) | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 100 | 10 | 16 | 25 | 50 | 100 | 200 | 250 |
| Capacitance | 100pF (101) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 120pF (121) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 150pF (151) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 180pF (181) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 220pF (221) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 270pF (271) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 330pF (331) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 390pF (391) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 470pF (471) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 560pF (561) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 680pF (681) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 820pF (821) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 1,000pF (102) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 1,200pF (122) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 1,500pF (152) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 1,800pF (182) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 2,200pF (222) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 2,700pF (272) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 3,300pF (332) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 3,900pF (392) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 4,700pF (472) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | B | B |
| | 5,600pF (562) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | D | D |
| | 6,800pF (682) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | D | D |
| | 8,200pF (822) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | D | D |
| | 0.010μF (103) | N | N | N | N | S | S | S | S | S | B | B | B | B | B | D | D |
| | 0.012μF (123) | N | N | N | | S | S | S | S | | B | B | B | B | B | D | D |
| | 0.015μF (153) | N | N | N | | S | S | S | S | | B | B | B | B | B | D | D |
| | 0.018μF (183) | N | N | N | | S | S | S | S | | B | B | B | B | B | D | D |
| | 0.022μF (223) | N | N | N | | S | S | S | S | | B | B | B | B | B | D | D |
| | 0.027μF (273) | N | N | N | | S | S | S | S | | B | B | B | B | B | D | |
| | 0.033μF (333) | N | N | N | | S | S | S | X | | B | B | B | B | B | D | |
| | 0.039μF (393) | N | N | N | | S | S | S | X | | B | B | B | B | B | D | |
| | 0.047μF (473) | N | N | N | | S | S | S | X | | B | B | B | B | B | D | |
| | 0.056μF (563) | N | N | | | S | S | S | X | | B | B | B | B | B | D | |
| | 0.068μF (683) | N | N | | | S | S | S | X | | B | B | B | B | B | D | |
| 0.082μF (823) | N | N | | | S | S | S | X | | B | B | B | B | B | D | | |
| 0.10μF (104) | N | N | N | | S | S | S | X | | B | B | B | B | B | D | | |
| 0.12μF (124) | | | | | S | S | X | | | D | D | D | D | | | | |
| 0.15μF (154) | | | | | S | S | X | | | D | D | D | D | | | | |
| 0.18μF (184) | | | | | S | S | X | | | D | D | D | D | | | | |
| 0.22μF (224) | | | | | S | S | X | | | D | D | D | D | | | | |
| 0.27μF (274) | | | | | X | X | | | | D | D | D | | | | | |
| 0.33μF (334) | | | | | X | X | | | | D | D | D | | | | | |
| 0.39μF (394) | | | | | X | X | | | | D | D | D | | | | | |
| 0.47μF (474) | | | | | X | X | | | | D | D | D | | | | | |
| 0.56μF (564) | | | | | | | | | | D | D | D | | | | | |
| 0.68μF (684) | | | | | | | | | | D | D | D | | | | | |
| 0.82μF (824) | | | | | | | | | | D | D | D | | | | | |
| 1.00μF (105) | | | | | | | | | | D | D | D | | | | | |

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.

8-2 1206, 1210, 1812 Sizes(Continued)

| DIELECTRIC | | X7R | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|---------------|------|----|----|----|-----|-----|-----|----|------|----|----|-----|-----|-----|----|----|------|----|-----|-----|-----|---|--|--|
| SIZE | | 1206 | | | | | | | | 1210 | | | | | | | | 1812 | | | | | | | |
| RATED VOLTAGE (VDC) | | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | 10 | 16 | 25 | 50 | 100 | 200 | 250 | | | |
| Capacitance | 100pF (101) | | | | | | | | | | | | | | | | | | | | | | | | |
| | 120pF (121) | | | | | | | | | | | | | | | | | | | | | | | | |
| | 150pF (151) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 180pF (181) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 220pF (221) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 270pF (271) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 330pF (331) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 390pF (391) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 470pF (471) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 560pF (561) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 680pF (681) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 820pF (821) | B | B | B | B | B | D | D | | | | | | | | | | | | | | | | | |
| | 1,000pF (102) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 1,200pF (122) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 1,500pF (152) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 1,800pF (182) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 2,200pF (222) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 2,700pF (272) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 3,300pF (332) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 3,900pF (392) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 4,700pF (472) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 5,600pF (562) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 6,800pF (682) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 8,200pF (822) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 0.010μF (103) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 0.012μF (123) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 0.015μF (153) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 0.018μF (183) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 0.022μF (223) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 0.027μF (273) | B | B | B | B | B | D | D | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 0.033μF (333) | B | B | B | B | B | G | G | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| | 0.039μF (393) | B | B | B | B | B | G | G | C | C | C | C | C | C | C | D | D | D | D | D | D | D | D | | |
| 0.047μF (473) | B | B | B | B | B | G | G | C | C | C | C | C | D | D | D | D | D | D | D | D | D | D | | | |
| 0.056μF (563) | B | B | B | B | B | G | G | C | C | C | C | C | D | D | D | D | D | D | D | D | D | D | | | |
| 0.068μF (683) | B | B | B | B | B | G | G | C | C | C | C | C | G | G | D | D | D | D | D | D | D | D | | | |
| 0.082μF (823) | B | B | B | B | D | G | G | C | C | C | C | C | G | G | D | D | D | D | D | D | D | D | | | |
| 0.10μF (104) | B | B | B | B | D | G | G | C | C | C | C | C | G | G | D | D | D | D | D | D | D | D | | | |
| 0.12μF (124) | B | B | B | B | D | | | C | C | C | C | C | G | G | D | D | D | D | D | D | D | D | | | |
| 0.15μF (154) | C | C | C | C | G | | | C | C | C | C | D | M | M | D | D | D | D | D | D | K | K | | | |
| 0.18μF (184) | C | C | C | C | G | | | C | C | C | C | D | M | M | D | D | D | D | D | D | K | K | | | |
| 0.22μF (224) | C | C | C | C | G | | | C | C | C | C | D | M | M | D | D | D | D | D | D | K | K | | | |
| 0.27μF (274) | C | C | C | D | | | | C | C | C | C | G | M | M | D | D | D | D | D | D | K | K | | | |
| 0.33μF (334) | C | C | C | D | | | | C | C | C | D | G | M | M | D | D | D | D | D | D | K | K | | | |
| 0.39μF (394) | C | C | J | P | | | | C | C | C | D | M | M | M | D | D | D | D | D | D | K | K | | | |
| 0.47μF (474) | J | J | J | P | | | | C | C | C | D | M | M | M | D | D | D | D | D | D | K | K | | | |
| 0.56μF (564) | J | J | J | P | | | | D | D | D | D | M | | | D | D | D | D | D | D | K | | | | |
| 0.68μF (684) | J | J | J | P | | | | D | D | D | D | K | | | D | D | D | D | D | D | K | | | | |
| 0.82μF (824) | J | J | J | P | | | | D | D | D | D | K | | | D | D | D | D | D | D | K | | | | |
| 1.00μF (105) | J | J | J | P | | | | D | D | D | D | K | | | D | D | D | D | D | D | K | | | | |
| 1.50μF (155) | J | J | P | | | | | K | K | G | | | | | | | | | | | K | | | | |
| 2.20μF (225) | J | J | P | | | | | K | K | G | | | | | | | | | | | M | | | | |

- 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.

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 | 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.

10. PACKAGING STYLE AND QUANTITY

| Size | Thickness (mm)/Symbol | | Paper tape | | Plastic tape | |
|-------------|-----------------------|---|------------|----------|--------------|----------|
| | | | 7" reel | 13" reel | 7" reel | 13" reel |
| 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 | - |

Unit: pieces

11. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|---|--|---------------|-----------------------|--------------------------|---|--|---|---|--|--|--|------------------------------------|---------------|---------------|--|---------------------------------|---|--------------------------------|--|--|--|--------------|---|-----|--------------|------------|--|------------|--|-------------|---|-----|--------------|---------------|--------------------------|------------|--|-----|------------|-------------|--|-------------|---|------|-------------|-------------|---|----|-------------|-----|----------------------------|------------|-------------|--------------------------|--|-------------------|----|----|---|-----|----|-----|-----|-----|----|----|---|----|---|-----------------------------|----|-------|-----------------------------|--------------------------------|----|-------|---|-----|-------|-----|-----------------------------|------|-----|-----|-----|
| 1. | Visual and Mechanical | --- | * No remarkable defect. * Dimensions to conform to individual specification sheet. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. | Capacitance | Class I: (NP0) | * Shall not exceed the limits given in the detailed spec. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3. | Q/ D.F. (Dissipation Factor) | <p>Class I: (NP0) $\leq 1000\text{pF}$, $1.0\pm 0.2\text{Vrms} \cdot 1\text{MHz}\pm 10\%$ $> 1000\text{pF}$, $1.0\pm 0.2\text{Vrms} \cdot 1\text{KHz}\pm 10\%$</p> <p>Class II: (X7R, X7E, X6S, X5R, Y5V) $C \leq 10\mu\text{F}$, $1.0\pm 0.2\text{Vrms} \cdot 1\text{KHz}\pm 10\%$ ** $C > 10\mu\text{F}$, $0.5\pm 0.2\text{Vrms} \cdot 120\text{Hz}\pm 20\%$</p> <p>** Test condition: $0.5\pm 0.2\text{Vrms} \cdot 1\text{KHz}\pm 10\%$ X7R: 0805=106(6.3V&10V) X5R: 01R5 ≥ 103, 0201 ≥ 224 (6.3V,10V), 0402 ≥ 475 (6.3V), 0402 ≥ 225(10V), 0603=106 (6.3V,10V), TT18X ≥ 475(10V) , TT15X series X6S:0201 ≥ 104 (6.3V),0402 ≥ 225 (6.3V), 0603 ≥ 106 (6.3V),</p> | <p>NP0: Cap$\geq 30\text{pF}$, Q≥ 1000; Cap$< 30\text{pF}$, Q$\geq 400+20\text{C}$ X7R,X5R,X6S:</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. \leq</th> <th colspan="2">Exception of D.F. \leq</th> </tr> </thead> <tbody> <tr> <td rowspan="2">$\geq 100\text{V}$</td> <td rowspan="2">$\leq 2.5\%$</td> <td>$\leq 3\%$</td> <td>1206 $\geq 0.47\mu\text{F}$</td> </tr> <tr> <td>$\leq 5\%$</td> <td>0805 $> 0.1\mu\text{F}$, 0603 $\geq 0.068\mu\text{F}$, 1206 $> 1\mu\text{F}$; TT series</td> </tr> <tr> <td rowspan="2">50V</td> <td rowspan="2">$\leq 2.5\%$</td> <td>$\leq 3\%$</td> <td>0201(50V); 0603 $\geq 0.047\mu\text{F}$; 0805 $\geq 0.18\mu\text{F}$; 1206 $\geq 0.47\mu\text{F}$</td> </tr> <tr> <td>$\leq 5\%$</td> <td>1210 $\geq 4.7\mu\text{F}$</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">$\leq 2.5\%$</td> <td>$\leq 10\%$</td> <td>0402 $\geq 0.1\mu\text{F}$; 0603 $> 0.1\mu\text{F}$; 0805 $\geq 1\mu\text{F}$; 1206 $\geq 2.2\mu\text{F}$; 1210 $\geq 10\mu\text{F}$; TT series</td> </tr> <tr> <td>$\leq 3.5\%$</td> <td>0603 $\geq 1\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1210 $\geq 10\mu\text{F}$</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">$\leq 3.5\%$</td> <td>$\leq 5\%$</td> <td>0201 $\geq 0.01\mu\text{F}$; 0805 $\geq 1\mu\text{F}$; 1210 $\geq 10\mu\text{F}$</td> </tr> <tr> <td>$\leq 7\%$</td> <td>0603 $\geq 0.33\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$</td> </tr> <tr> <td>$\leq 10\%$</td> <td>0402 $\geq 0.10\mu\text{F}$; 0603 $\geq 0.47\mu\text{F}$; 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0805 $\geq 1\mu\text{F}$; 1210 $\geq 10\mu\text{F}$ | $\leq 7\%$ | 0603 $\geq 0.33\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$ | $\leq 10\%$ | 0402 $\geq 0.10\mu\text{F}$; 0603 $\geq 0.47\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 6.8\mu\text{F}$; 1210 $\geq 22\mu\text{F}$; TT series | 16V | $\leq 3.5\%$ | $\leq 12.5\%$ | 0402 $\geq 1\mu\text{F}$ | $\leq 5\%$ | 0201 $\geq 0.01\mu\text{F}$; 0402 $\geq 0.033\mu\text{F}$; 0603 $\geq 0.15\mu\text{F}$; 0805 $\geq 0.68\mu\text{F}$; 1206 $\geq 2.2\mu\text{F}$; 1210 $\geq 4.7\mu\text{F}$ | 10V | $\leq 5\%$ | $\leq 10\%$ | 0201 $\geq 0.1\mu\text{F}$; 0402 $\geq 0.22\mu\text{F}$; 0603 $\geq 0.68\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 22\mu\text{F}$; TT series | $\leq 15\%$ | 0201 $\geq 0.012\mu\text{F}$; 0402 $\geq 0.33\mu\text{F}$ (0402/X7R $\geq 0.22\mu\text{F}$); TT series 0603 $\geq 0.33\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 2.2\mu\text{F}$; 1210 $\geq 22\mu\text{F}$ | 6.3V | $\leq 10\%$ | $\leq 15\%$ | 0201 $\geq 0.1\mu\text{F}$; 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| Rated vol. | D.F. \leq | Exception of D.F. \leq | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\geq 100\text{V}$ | $\leq 2.5\%$ | $\leq 3\%$ | 1206 $\geq 0.47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | $\leq 5\%$ | 0805 $> 0.1\mu\text{F}$, 0603 $\geq 0.068\mu\text{F}$, 1206 $> 1\mu\text{F}$; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 50V | $\leq 2.5\%$ | $\leq 3\%$ | 0201(50V); 0603 $\geq 0.047\mu\text{F}$; 0805 $\geq 0.18\mu\text{F}$; 1206 $\geq 0.47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | $\leq 5\%$ | 1210 $\geq 4.7\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V | $\leq 2.5\%$ | $\leq 10\%$ | 0402 $\geq 0.1\mu\text{F}$; 0603 $> 0.1\mu\text{F}$; 0805 $\geq 1\mu\text{F}$; 1206 $\geq 2.2\mu\text{F}$; 1210 $\geq 10\mu\text{F}$; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | $\leq 3.5\%$ | 0603 $\geq 1\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1210 $\geq 10\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V | $\leq 3.5\%$ | $\leq 5\%$ | 0201 $\geq 0.01\mu\text{F}$; 0805 $\geq 1\mu\text{F}$; 1210 $\geq 10\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | $\leq 7\%$ | 0603 $\geq 0.33\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | $\leq 10\%$ | 0402 $\geq 0.10\mu\text{F}$; 0603 $\geq 0.47\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 6.8\mu\text{F}$; 1210 $\geq 22\mu\text{F}$; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V | $\leq 3.5\%$ | $\leq 12.5\%$ | 0402 $\geq 1\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | $\leq 5\%$ | 0201 $\geq 0.01\mu\text{F}$; 0402 $\geq 0.033\mu\text{F}$; 0603 $\geq 0.15\mu\text{F}$; 0805 $\geq 0.68\mu\text{F}$; 1206 $\geq 2.2\mu\text{F}$; 1210 $\geq 4.7\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V | $\leq 5\%$ | $\leq 10\%$ | 0201 $\geq 0.1\mu\text{F}$; 0402 $\geq 0.22\mu\text{F}$; 0603 $\geq 0.68\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 22\mu\text{F}$; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | $\leq 15\%$ | 0201 $\geq 0.012\mu\text{F}$; 0402 $\geq 0.33\mu\text{F}$ (0402/X7R $\geq 0.22\mu\text{F}$); TT series 0603 $\geq 0.33\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 2.2\mu\text{F}$; 1210 $\geq 22\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V | $\leq 10\%$ | $\leq 15\%$ | 0201 $\geq 0.1\mu\text{F}$; 0402 $\geq 1\mu\text{F}$; 0603 $\geq 10\mu\text{F}$; 0805 $\geq 4.7\mu\text{F}$; 1206 $\geq 47\mu\text{F}$; 1210 $\geq 100\mu\text{F}$; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4V | $\leq 15\%$ | --- | 0402 $\geq 2.2\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated vol. | D.F. \leq | Exception of D.F. \leq | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\geq 50\text{V}$ | 5% | 7% | 0603 $\geq 0.1\mu\text{F}$; 0805 $\geq 0.47\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V | 7% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V | 5% | 7% | 0402 $\geq 0.047\mu\text{F}$; 0603 $\geq 0.1\mu\text{F}$; 0805 $\geq 0.33\mu\text{F}$; 1206 $\geq 1\mu\text{F}$; 1210 $\geq 4.7\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 9% | 0402 $\geq 0.068\mu\text{F}$; 0603 $\geq 0.47\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 22\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V (C $< 1.0\mu\text{F}$) | 7% | 12.5% | 0402 $\geq 0.22\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V (C $\geq 1.0\mu\text{F}$) | 9% | 12.5% | 0603 $\geq 2.2\mu\text{F}$; 0805 $\geq 3.3\mu\text{F}$; 1206 $\geq 10\mu\text{F}$; 1210 $\geq 22\mu\text{F}$; 1812 $\geq 47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V | 12.5% | 20% | 0402 $\geq 0.47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V | 20% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4. | Dielectric Strength | <p>To apply voltage ($\leq 100\text{V}$) 250%. Duration: 1 to 5 sec. * Charge and discharge current less than 50mA.</p> | <p>* To apply voltage: 200V~300V ≥ 2 times VDC 500V~999V ≥ 1.5 times VDC 1000V~3000V ≥ 1.2 times VDC * Cut-off, set at 10mA * TEST= 15 sec. * RAMP=0</p> <p>* No evidence of damage or flash over during test.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5. | Insulation Resistance | To apply rated voltage for max. 120 sec. | <p>10GΩ or RxC $\geq 500\Omega\cdot\text{F}$ whichever is smaller. Class II (X7R, X5R, X6S, Y5V)</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="6">10GΩ or RxC $\geq 100\Omega\cdot\text{F}$ whichever is smaller.</td> </tr> <tr> <td>50V: 0603 $\geq 1\mu\text{F}$; 0805 $\geq 1\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 4.7\mu\text{F}$</td> </tr> <tr> <td>35V: 0805 $\geq 2.2\mu\text{F}$; 1210 $\geq 10\mu\text{F}$</td> </tr> <tr> <td>25V: 0402 $\geq 1\mu\text{F}$; 0603 $\geq 2.2\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 10\mu\text{F}$; 1210 $\geq 10\mu\text{F}$</td> </tr> <tr> <td>16V: 0402 $\geq 0.22\mu\text{F}$; 0603 $\geq 1\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 10\mu\text{F}$; 1210 $\geq 47\mu\text{F}$</td> </tr> <tr> <td>10V: 0201 $\geq 47\text{nF}$; 0402 $\geq 0.47\mu\text{F}$; 0603 $\geq 0.47\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 47\mu\text{F}$</td> </tr> <tr> <td>6.3V ; 4V</td> <td rowspan="7">RxC $\geq 50\Omega\cdot\text{F}$.</td> </tr> <tr> <td>Rated voltage</td> </tr> <tr> <td>All X6S items</td> </tr> <tr> <td>50V: 0402 $\geq 0.1\mu\text{F}$; 0603 $\geq 2.2\mu\text{F}$; 0805 $\geq 10\mu\text{F}$; 1206 $\geq 10\mu\text{F}$</td> </tr> <tr> <td>35V: 0603 $\geq 1\mu\text{F}$;</td> </tr> <tr> <td>25V: 0201 $\geq 0.1\mu\text{F}$; 0402 $\geq 0.22\mu\text{F}$; 0603 $\geq 10\mu\text{F}$; 1206 $\geq 22\mu\text{F}$</td> </tr> <tr> <td>16V: 0603 $\geq 10\mu\text{F}$</td> </tr> <tr> <td>10V: 0201 $> 0.1\mu\text{F}$; 0603 $\geq 10\mu\text{F}$; 0805 $\geq 47\mu\text{F}$</td> </tr> <tr> <td>6.3V: 0201 $\geq 0.1\mu\text{F}$; 1206 $\geq 10\mu\text{F}$</td> </tr> <tr> <td>4V: 0603 $\geq 22\mu\text{F}$; 0805 $\geq 47\mu\text{F}$</td> </tr> </tbody> </table> | Rated voltage | Insulation Resistance | 100V: X7R | 10G Ω or RxC $\geq 100\Omega\cdot\text{F}$ whichever is smaller. | 50V: 0603 $\geq 1\mu\text{F}$; 0805 $\geq 1\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 4.7\mu\text{F}$ | 35V: 0805 $\geq 2.2\mu\text{F}$; 1210 $\geq 10\mu\text{F}$ | 25V: 0402 $\geq 1\mu\text{F}$; 0603 $\geq 2.2\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 10\mu\text{F}$; 1210 $\geq 10\mu\text{F}$ | 16V: 0402 $\geq 0.22\mu\text{F}$; 0603 $\geq 1\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 10\mu\text{F}$; 1210 $\geq 47\mu\text{F}$ | 10V: 0201 $\geq 47\text{nF}$; 0402 $\geq 0.47\mu\text{F}$; 0603 $\geq 0.47\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 47\mu\text{F}$ | 6.3V ; 4V | RxC $\geq 50\Omega\cdot\text{F}$. | Rated voltage | All X6S items | 50V: 0402 $\geq 0.1\mu\text{F}$; 0603 $\geq 2.2\mu\text{F}$; 0805 $\geq 10\mu\text{F}$; 1206 $\geq 10\mu\text{F}$ | 35V: 0603 $\geq 1\mu\text{F}$; | 25V: 0201 $\geq 0.1\mu\text{F}$; 0402 $\geq 0.22\mu\text{F}$; 0603 $\geq 10\mu\text{F}$; 1206 $\geq 22\mu\text{F}$ | 16V: 0603 $\geq 10\mu\text{F}$ | 10V: 0201 $> 0.1\mu\text{F}$; 0603 $\geq 10\mu\text{F}$; 0805 $\geq 47\mu\text{F}$ | 6.3V: 0201 $\geq 0.1\mu\text{F}$; 1206 $\geq 10\mu\text{F}$ | 4V: 0603 $\geq 22\mu\text{F}$; 0805 $\geq 47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated voltage | Insulation Resistance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100V: X7R | 10G Ω or RxC $\geq 100\Omega\cdot\text{F}$ whichever is smaller. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 50V: 0603 $\geq 1\mu\text{F}$; 0805 $\geq 1\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 4.7\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V: 0805 $\geq 2.2\mu\text{F}$; 1210 $\geq 10\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V: 0402 $\geq 1\mu\text{F}$; 0603 $\geq 2.2\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 10\mu\text{F}$; 1210 $\geq 10\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V: 0402 $\geq 0.22\mu\text{F}$; 0603 $\geq 1\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 10\mu\text{F}$; 1210 $\geq 47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V: 0201 $\geq 47\text{nF}$; 0402 $\geq 0.47\mu\text{F}$; 0603 $\geq 0.47\mu\text{F}$; 0805 $\geq 2.2\mu\text{F}$; 1206 $\geq 4.7\mu\text{F}$; 1210 $\geq 47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V ; 4V | RxC $\geq 50\Omega\cdot\text{F}$. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated voltage | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| All X6S items | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 50V: 0402 $\geq 0.1\mu\text{F}$; 0603 $\geq 2.2\mu\text{F}$; 0805 $\geq 10\mu\text{F}$; 1206 $\geq 10\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V: 0603 $\geq 1\mu\text{F}$; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V: 0201 $\geq 0.1\mu\text{F}$; 0402 $\geq 0.22\mu\text{F}$; 0603 $\geq 10\mu\text{F}$; 1206 $\geq 22\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V: 0603 $\geq 10\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V: 0201 $> 0.1\mu\text{F}$; 0603 $\geq 10\mu\text{F}$; 0805 $\geq 47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V: 0201 $\geq 0.1\mu\text{F}$; 1206 $\geq 10\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4V: 0603 $\geq 22\mu\text{F}$; 0805 $\geq 47\mu\text{F}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | |
|------------|---|--|--|----------------|-------------|-------------------|----------------------------|-------------------|-----|-------------------|-----|-------------------|----------------------------|-------------------|---|------------|--------------------|--|------------------|-----|-------------|-----|-------------|-----|-------------|-----|------------------|
| | Insulation Resistance | Rated voltage: 200~630V To apply rated voltage (500V max.) for 60 sec. Rated voltage: ≥630V To apply 500V for 60 sec. | ≥10GΩ or RxC≥100Ω·F whichever is smaller ≥10GΩ | | | | | | | | | | | | | | | | | | | | | | | | |
| 6. | Temperature Coefficient | With no electrical load. <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>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> | T.C. | Operating Temp | NPO | -55~125°C at 25°C | X7R | -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 | <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>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% | 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 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X5R | -55~ 85°C at 25°C | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X6S | -55~105°C at 25°C | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Y5V | -25~ 85°C at 20°C | | | | | | | | | | | | | | | | | | | | | | | | | | |
| T.C. | Capacitance Change | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NPO | Within ±30ppm/°C | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X7R | Within ±15% | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X5R | Within ±15% | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X6S | Within ±22% | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Y5V | Within +30%/-80% | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7. | Adhesive Strength of Termination | * Pressurizing force : 1N (0201) and 5N (≤0603) and 10N (>0603) * Test time: 10±1 sec. | * No remarkable damage or removal of the terminations. | | | | | | | | | | | | | | | | | | | | | | | | |
| 8. | Vibration Resistance | * Vibration frequency: 10~55 Hz/min. * Total amplitude: 1.5mm * Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.) * Measurement to be made after keeping at room temp. for 24±2 hrs. | * No remarkable damage. * Cap change and Q/D.F.: To meet initial spec. | | | | | | | | | | | | | | | | | | | | | | | | |
| 9. | Solderability | * Solder temperature: 235±5°C * Dipping time: 2±0.5 sec. | 95% min. coverage of all metalized area. | | | | | | | | | | | | | | | | | | | | | | | | |
| 10. | Bending Test | * The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec. * Measurement to be made after keeping at room temp. for 24±2 hrs. | * No remarkable damage. * Cap change : NPO: within ±5% or 0.5pF whichever is larger X7R, X5R, X6S: within ±12.5% Y5V: within ±30% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.) | | | | | | | | | | | | | | | | | | | | | | | | |
| 11. | Resistance to Soldering Heat | * Solder temperature: 260±5°C * Dipping time: 10±1 sec * Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder. * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs. | * No remarkable damage. * Cap change: NPO: within ±2.5% or 0.25pF whichever is larger X7R, X5R, X6S: within ±7.5% Y5V: within ±20% * Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge. | | | | | | | | | | | | | | | | | | | | | | | | |
| 12. | Temperature Cycle | * Conduct the five cycles according to the temperatures and time. <table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs. | Step | Temp. (°C) | Time (min.) | 1 | Min. operating temp. +0/-3 | 30±3 | 2 | Room temp. | 2~3 | 3 | Max. operating temp. +3/-0 | 30±3 | 4 | Room temp. | 2~3 | * No remarkable damage. * Cap change : NPO: within ±2.5% or 0.25pF whichever is larger X7R, X5R, X6S: within ±7.5% Y5V: within ±20% * Q/D.F., I.R. and dielectric strength: To meet initial requirements. | | | | | | | | | |
| Step | Temp. (°C) | Time (min.) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Min. operating temp. +0/-3 | 30±3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Room temp. | 2~3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Max. operating temp. +3/-0 | 30±3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Room temp. | 2~3 | | | | | | | | | | | | | | | | | | | | | | | | | |

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--|---|--|--|--|--|--|---|--|------|--|--|------------------|---|---|---------------|---|---|-----|-----|--------------------------------|--|----------------|-----|-----|---|---|-----|-------|---|--|------|------|--|-----|----|------|-----|
| 13. | Humidity (Damp Heat) Steady State | * Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/0hrs. * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs. | * No remarkable damage. * Cap change: NP0: within ±5% or 0.5pF whichever is larger X7R, X5R, X6S: ≥10V**, within ±12.5%; ≤6.3V within ±25%; TT series & C≥1uF, within ±25% **10V: 0603 ≥4.7μF; 0402 ≥1μF; 0201 ≥0.1μF, within ±25%; Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40% * Q/D.F. value: NP0: More than 30pF Q≥350, 10pF≤C≤30pF, Q≥275+2.5C Less than 10pF Q≥200+10C X7R, X5R, X6S: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="2">≥100V</td> <td rowspan="2">≤3%</td> <td>≤6% 1206 ≥0.47μF</td> </tr> <tr> <td>≤7.5% 0805 > 0.1μF, 0603 ≥0.068μF, 1206 > 1μF; TT series</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% 1210 ≥4.7μF</td> </tr> <tr> <td>≤20% 0402 ≥0.1μF; 0603 > 0.1μF; 0805 ≥1μF; 1206 ≥2.2μF; 1210 ≥10μF; TT series</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">≤5%</td> <td>≤20% 0603 ≥1μF; 0805 ≥2.2μF; 1210 ≥10μF</td> </tr> <tr> <td>≤10% 0201 ≥0.01μF; 0805 ≥1μF; 1210 ≥10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤5%</td> <td>≤14% 0603 ≥0.33μF; 1206 ≥4.7μF</td> </tr> <tr> <td>≤15% 0402 ≥0.10μF; 0603 ≥0.47μF; 0805 ≥2.2μF; 1206 ≥6.8μF; 1210 ≥22μF; TT series</td> </tr> <tr> <td>≤20% 0402 ≥1μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤5%</td> <td>≤10% 0603 ≥0.15μF; 0805 ≥0.68μF; 1206 ≥2.2μF; 1210 ≥4.7μF</td> </tr> <tr> <td>≤15% 0201 ≥0.01μF; 0402 ≥0.033μF; 0603 ≥0.68μF; 0805 ≥2.2μF; 1206 ≥4.7μF; 1210 ≥22μF; TT series</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤7.5%</td> <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</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>---</td> </tr> <tr> <td>4V</td> <td>≤20%</td> <td>---</td> </tr> </tbody> </table> | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | ≥100V | ≤3% | ≤6% 1206 ≥0.47μF | ≤7.5% 0805 > 0.1μF, 0603 ≥0.068μF, 1206 > 1μF; TT series | ≥50V | ≤3% | ≤6% 0201(50V); 0603 ≥0.047μF; 0805 ≥0.18μF; 1206 ≥0.47μF | ≤10% 1210 ≥4.7μF | ≤20% 0402 ≥0.1μF; 0603 > 0.1μF; 0805 ≥1μF; 1206 ≥2.2μF; 1210 ≥10μF; TT series | 35V | ≤5% | ≤20% 0603 ≥1μF; 0805 ≥2.2μF; 1210 ≥10μF | ≤10% 0201 ≥0.01μF; 0805 ≥1μF; 1210 ≥10μF | 25V | ≤5% | ≤14% 0603 ≥0.33μF; 1206 ≥4.7μF | ≤15% 0402 ≥0.10μF; 0603 ≥0.47μF; 0805 ≥2.2μF; 1206 ≥6.8μF; 1210 ≥22μF; TT series | ≤20% 0402 ≥1μF | 16V | ≤5% | ≤10% 0603 ≥0.15μF; 0805 ≥0.68μF; 1206 ≥2.2μF; 1210 ≥4.7μF | ≤15% 0201 ≥0.01μF; 0402 ≥0.033μF; 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); 0603 ≥0.33μF; 0805 ≥2.2μF; 1206 ≥2.2μF; 1210 ≥22μF | ≤20% 0201 ≥0.1μF; 0402 ≥1μF; TT series | 6.3V | ≤15% | ≤30% 0201 ≥0.1μF; 0402 ≥1μF; 0603 ≥10μF; 0805 ≥4.7μF; 1206 ≥47μF; 1210 ≥100μF; TT series | --- | 4V | ≤20% | --- |
| | | | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | ≥100V | ≤3% | ≤6% 1206 ≥0.47μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | ≥50V | ≤3% | ≤6% 0201(50V); 0603 ≥0.047μF; 0805 ≥0.18μF; 1206 ≥0.47μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | ≤10% 1210 ≥4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | ≤20% 0402 ≥0.1μF; 0603 > 0.1μF; 0805 ≥1μF; 1206 ≥2.2μF; 1210 ≥10μF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 35V | ≤5% | ≤20% 0603 ≥1μF; 0805 ≥2.2μF; 1210 ≥10μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | 25V | ≤5% | ≤14% 0603 ≥0.33μF; 1206 ≥4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | ≤20% 0402 ≥1μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V | ≤5% | ≤10% 0603 ≥0.15μF; 0805 ≥0.68μF; 1206 ≥2.2μF; 1210 ≥4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 10V | ≤7.5% | ≤15% 0201 ≥0.012μF; 0402 ≥0.33μF (0402/X7R ≥0.22μF); 0603 ≥0.33μF; 0805 ≥2.2μF; 1206 ≥2.2μF; 1210 ≥22μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4V | ≤20% | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Y5V: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Rated vol. | D.F. ≤ | Exception of D.F. ≤ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≥50V | 7.5% | 10% 0603 ≥0.1μF; 0805 ≥0.47μF; 1206 ≥4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V | 10% | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V | 7.5% | 10% 0402 ≥0.047μF; 0603 ≥0.1μF; 0805 ≥0.33μF; 1206 ≥1μF; 1210 ≥4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 15% 0402 ≥0.068μF; 0603 ≥0.47μF; 1206 ≥4.7μF; 1210 ≥22μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V (C<1.0μF) | 10% | 12.5% 0402 ≥0.068μF; 0603 ≥0.68μF 20% 0402 ≥0.22μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V (C≥1.0μF) | 12.5% | 20% 0603 ≥2.2μF; 0805 ≥3.3μF; 1206 ≥10μF; 1210 ≥22μF; 1812 ≥47μF; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V | 20% | 30% 0402 ≥0.47μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V | 30% | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller. Class II (X7R, X5R, X6S, Y5V) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 35V: 0603 ≥1μF; 0805 ≥2.2μF; 1210 ≥10μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V: 0201 ≥0.1uF; 0402 ≥0.22μF; 0603 ≥2.2μF; 0805 ≥2.2μF; 1206 ≥10μF; 1210 ≥10μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| No | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|---|---|-----------|--------|---------------------|--|-------|-----|-----|---------------|-------|---|------|-----|-----|---|------|--------------|------|--|-----|-----|------|---------------------------------------|-----|-----|------|--|------|-----------------------------|------|--|-----|-----|------|------------|------|--|-----|-------|------|--|------|-------------------------------------|------|------|------|---|----|------|-----|-----|------------|--------|---------------------|--|------|------|-----|---|-----|-----|-----|-----|-----|------|-----|---|-----|--|---------------|-----|-------|-------------------------------|-----------------|-------|-----|---------------|-----|--|-----|-----|-----|---------------|------|-----|-----|-----|---------------|-----------------------|-----------|--|---|--|--|--|---|---------------------------------------|
| 14 | Humidity (Damp Heat) Load | <p>* Test temp.: 40±2°C * Humidity: 90~95%RH * Test time: 500+24/-0 hrs. * To apply voltage : Rated voltage (Max. 500V). * Before initial measurement (Class II only): To apply test voltage for 1hr at 40°C and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.</p> | <p>* No remarkable damage. Cap change: NP0: ±7.5% or 0.75pF whichever is larger. X7R, X5R, X6S: ≥10V**, within ±12.5%; ≤6.3V within ±25%; TT series & C ≥ 1uF, within ±25% **10V: 0603 ≥ 4.7µF; 0402 ≥ 1µF; 0201 ≥ 0.1µF, within ±25%; Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40% Q/D.F. value: NP0: C≥30pF, Q≥200; C<30pF, Q≥100+10/3C X7R, X5R, X6S:</p> <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="2">≥100V</td> <td rowspan="2">≤3%</td> <td>≤6%</td> <td>1206 ≥ 0.47µF</td> </tr> <tr> <td>≤7.5%</td> <td>0805 > 0.1µF, 0603 ≥ 0.068µF, 1206 > 1µF; TT series</td> </tr> <tr> <td rowspan="3">≥50V</td> <td rowspan="3">≤3%</td> <td>≤6%</td> <td>0201(50V); 0603 ≥ 0.047µF; 0805 ≥ 0.18µF; 1206 ≥ 0.47µF</td> </tr> <tr> <td>≤10%</td> <td>1210 ≥ 4.7µF</td> </tr> <tr> <td>≤20%</td> <td>0402 ≥ 0.1µF; 0603 > 0.1µF; 0805 ≥ 1µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF; TT series</td> </tr> <tr> <td>35V</td> <td>≤5%</td> <td>≤20%</td> <td>0603 ≥ 1µF; 0805 ≥ 2.2µF; 1210 ≥ 10µF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤5%</td> <td>≤10%</td> <td>0201 ≥ 0.01µF; 0805 ≥ 1µF; 1210 ≥ 10µF</td> </tr> <tr> <td>≤14%</td> <td>0603 ≥ 0.33µF; 1206 ≥ 4.7µF</td> </tr> <tr> <td>≤15%</td> <td>0402 ≥ 0.10µF; 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 6.8µF; 1210 ≥ 22µF; TT series</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤5%</td> <td>≤20%</td> <td>0402 ≥ 1µF</td> </tr> <tr> <td>≤10%</td> <td>0603 ≥ 0.15µF; 0805 ≥ 0.68µF; 1206 ≥ 2.2µF; 1210 ≥ 4.7µF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤7.5%</td> <td>≤15%</td> <td>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%</td> <td>0201 ≥ 0.1µF; 0402 ≥ 1µF; TT series</td> </tr> <tr> <td>6.3V</td> <td>≤15%</td> <td>≤30%</td> <td>0201 ≥ 0.1µF; 0402 ≥ 1µF; 0603 ≥ 10µF; 0805 ≥ 4.7µF; 1206 ≥ 47µF; 1210 ≥ 100µF; TT series</td> </tr> <tr> <td>4V</td> <td>≤20%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>Y5V:</p> <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>≥50V</td> <td>7.5%</td> <td>10%</td> <td>0603 ≥ 0.1µF; 0805 ≥ 0.47µF; 1206 ≥ 4.7µF</td> </tr> <tr> <td>35V</td> <td>10%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">7.5%</td> <td>10%</td> <td>0402 ≥ 0.047µF; 0603 ≥ 0.1µF; 0805 ≥ 0.33µF; 1206 ≥ 1µF; 1210 ≥ 4.7µF</td> </tr> <tr> <td>15%</td> <td>0402 ≥ 0.068µF; 0603 ≥ 0.47µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF</td> </tr> <tr> <td>16V (C<1.0µF)</td> <td>10%</td> <td>12.5%</td> <td>0402 ≥ 0.068µF; 0603 ≥ 0.68µF</td> </tr> <tr> <td rowspan="2">16V (C ≥ 1.0µF)</td> <td rowspan="2">12.5%</td> <td>20%</td> <td>0402 ≥ 0.22µF</td> </tr> <tr> <td>20%</td> <td>0603 ≥ 2.2µF; 0805 ≥ 3.3µF; 1206 ≥ 10µF; 1210 ≥ 22µF; 1812 ≥ 47µF;</td> </tr> <tr> <td>10V</td> <td>20%</td> <td>30%</td> <td>0402 ≥ 0.47µF</td> </tr> <tr> <td>6.3V</td> <td>30%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>*I.R.: ≥10V, 500MΩ or 25 Ω-F whichever is smaller. Class II (X7R, X5R, X6S, Y5V)</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="7">500MΩ or RxC ≥ 5 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0402 ≥ 0.1µF; 0603 ≥ 1µF; 0805 ≥ 1µF; 1206 ≥ 4.7µF; 1210 ≥ 4.7µF</td> </tr> <tr> <td>35V: 0603 ≥ 1µF; 0805 ≥ 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 items</td> </tr> </tbody> </table> | Rated vol | D.F. ≤ | Exception of D.F. ≤ | | ≥100V | ≤3% | ≤6% | 1206 ≥ 0.47µF | ≤7.5% | 0805 > 0.1µF, 0603 ≥ 0.068µF, 1206 > 1µF; TT series | ≥50V | ≤3% | ≤6% | 0201(50V); 0603 ≥ 0.047µF; 0805 ≥ 0.18µF; 1206 ≥ 0.47µF | ≤10% | 1210 ≥ 4.7µF | ≤20% | 0402 ≥ 0.1µF; 0603 > 0.1µF; 0805 ≥ 1µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF; TT series | 35V | ≤5% | ≤20% | 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1210 ≥ 10µF | 25V | ≤5% | ≤10% | 0201 ≥ 0.01µF; 0805 ≥ 1µF; 1210 ≥ 10µF | ≤14% | 0603 ≥ 0.33µF; 1206 ≥ 4.7µF | ≤15% | 0402 ≥ 0.10µF; 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 6.8µF; 1210 ≥ 22µF; TT series | 16V | ≤5% | ≤20% | 0402 ≥ 1µF | ≤10% | 0603 ≥ 0.15µF; 0805 ≥ 0.68µF; 1206 ≥ 2.2µF; 1210 ≥ 4.7µF | 10V | ≤7.5% | ≤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 | 6.3V | ≤15% | ≤30% | 0201 ≥ 0.1µF; 0402 ≥ 1µF; 0603 ≥ 10µF; 0805 ≥ 4.7µF; 1206 ≥ 47µF; 1210 ≥ 100µF; TT series | 4V | ≤20% | --- | --- | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | | ≥50V | 7.5% | 10% | 0603 ≥ 0.1µF; 0805 ≥ 0.47µF; 1206 ≥ 4.7µF | 35V | 10% | --- | --- | 25V | 7.5% | 10% | 0402 ≥ 0.047µF; 0603 ≥ 0.1µF; 0805 ≥ 0.33µF; 1206 ≥ 1µF; 1210 ≥ 4.7µF | 15% | 0402 ≥ 0.068µF; 0603 ≥ 0.47µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF | 16V (C<1.0µF) | 10% | 12.5% | 0402 ≥ 0.068µF; 0603 ≥ 0.68µF | 16V (C ≥ 1.0µF) | 12.5% | 20% | 0402 ≥ 0.22µF | 20% | 0603 ≥ 2.2µF; 0805 ≥ 3.3µF; 1206 ≥ 10µF; 1210 ≥ 22µF; 1812 ≥ 47µF; | 10V | 20% | 30% | 0402 ≥ 0.47µF | 6.3V | 30% | --- | --- | Rated voltage | Insulation Resistance | 100V: X7R | 500MΩ or RxC ≥ 5 Ω-F whichever is smaller. | 50V: 0402 ≥ 0.1µF; 0603 ≥ 1µF; 0805 ≥ 1µF; 1206 ≥ 4.7µF; 1210 ≥ 4.7µF | 35V: 0603 ≥ 1µF; 0805 ≥ 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 items |
| Rated vol | D.F. ≤ | Exception of D.F. ≤ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≥100V | ≤3% | ≤6% | 1206 ≥ 0.47µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤7.5% | 0805 > 0.1µF, 0603 ≥ 0.068µF, 1206 > 1µF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≥50V | ≤3% | ≤6% | 0201(50V); 0603 ≥ 0.047µF; 0805 ≥ 0.18µF; 1206 ≥ 0.47µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤10% | 1210 ≥ 4.7µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤20% | 0402 ≥ 0.1µF; 0603 > 0.1µF; 0805 ≥ 1µF; 1206 ≥ 2.2µF; 1210 ≥ 10µF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V | ≤5% | ≤20% | 0603 ≥ 1µF; 0805 ≥ 2.2µF; 1210 ≥ 10µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V | ≤5% | ≤10% | 0201 ≥ 0.01µF; 0805 ≥ 1µF; 1210 ≥ 10µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤14% | 0603 ≥ 0.33µF; 1206 ≥ 4.7µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤15% | 0402 ≥ 0.10µF; 0603 ≥ 0.47µF; 0805 ≥ 2.2µF; 1206 ≥ 6.8µF; 1210 ≥ 22µF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V | ≤5% | ≤20% | 0402 ≥ 1µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤10% | 0603 ≥ 0.15µF; 0805 ≥ 0.68µF; 1206 ≥ 2.2µF; 1210 ≥ 4.7µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V | ≤7.5% | ≤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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V | ≤15% | ≤30% | 0201 ≥ 0.1µF; 0402 ≥ 1µF; 0603 ≥ 10µF; 0805 ≥ 4.7µF; 1206 ≥ 47µF; 1210 ≥ 100µF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4V | ≤20% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated vol. | D.F. ≤ | Exception of D.F. ≤ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≥50V | 7.5% | 10% | 0603 ≥ 0.1µF; 0805 ≥ 0.47µF; 1206 ≥ 4.7µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V | 10% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V | 7.5% | 10% | 0402 ≥ 0.047µF; 0603 ≥ 0.1µF; 0805 ≥ 0.33µF; 1206 ≥ 1µF; 1210 ≥ 4.7µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 15% | 0402 ≥ 0.068µF; 0603 ≥ 0.47µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V (C<1.0µF) | 10% | 12.5% | 0402 ≥ 0.068µF; 0603 ≥ 0.68µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V (C ≥ 1.0µF) | 12.5% | 20% | 0402 ≥ 0.22µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 20% | 0603 ≥ 2.2µF; 0805 ≥ 3.3µF; 1206 ≥ 10µF; 1210 ≥ 22µF; 1812 ≥ 47µF; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V | 20% | 30% | 0402 ≥ 0.47µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V | 30% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated voltage | Insulation Resistance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100V: X7R | 500MΩ or RxC ≥ 5 Ω-F whichever is smaller. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 50V: 0402 ≥ 0.1µF; 0603 ≥ 1µF; 0805 ≥ 1µF; 1206 ≥ 4.7µF; 1210 ≥ 4.7µF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V: 0603 ≥ 1µF; 0805 ≥ 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 items | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| No | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|---------------------|---|---|--|--|--|---|---------------------------------------|-------------|-----------|-----------|--------|------|------|---------------|-----------------|--------------------|----------------|-----------|------------|--------|---------------------|---|------------|----------|------|---|---|-------------|---------------------|---------------|------------------------|------|-------|--------------|-----|----------|-------|--|------|-------------|-------------------|---|------|-----------------------|---------------|---------------------------------------|--------------------|----------|-------|--|------|--------------------|-------------|-----------------------|-------------------------------|------|------------|-----------------------------|-----------|--------------------|-------|--|--|-------------|-----|----------|-----------|--------|---------------|------------|------|-----|-----------|-----------|-------|--|------|-----|------|----------|------|-------|-------|--|------|-----|------|----------|-------|-------------------------------------|
| 15. | High Temperature Load (Endurance) | Test temp. : NP0, X7R/X7E: 125±3°C X6S: 105±3°C X5R, Y5V: 85±3°C Test time: 1000+24/-0 hrs. To apply voltage: (1) ≤ 6.3V or C ≥ 10μF or TT series: 150% of rated voltage. (2) 10V ≤ Ur < 500V: 200% of rated voltage. (3) 500V: 150% of rated voltage. (4) Ur ≥ 630V: 120% of rated voltage. (5) 100% of rated voltage for below range. | * No remarkable damage. Cap change: NP0: ±3.0% or ±0.3pF whichever is larger X7R, X5R, X6S: ≥10V**, within ±12.5%; ≤ 6.3V within ±25%; TT series & C ≥ 1μF, within ±25% **10V: 0603 ≥ 4.7μF; 0402 ≥ 1μF; 0201 ≥ 0.1μF, within ±25%; Y5V: ≥10V, within ±30%; ≤ 6.3V, within +30/-40% Q/D.F. value: NP0: More than 30pF, Q ≥ 350 10pF ≤ C < 30pF, Q ≥ 275+2.5C Less than 10pF, Q ≥ 200+10C X7R, X5R, X6S: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <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 colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>0201</td> <td>X5R/X7R/X6S</td> <td>≤ 10V</td> <td>C ≥ 0.1μF</td> <td>≥ 100V</td> <td>≤ 3%</td> <td>≤ 6%</td> <td>1206 ≥ 0.47μF</td> </tr> <tr> <td rowspan="2">0402</td> <td rowspan="2">X5R/X7R/X6S Y5V</td> <td>6.3V, 10V, 25V</td> <td>C ≥ 1.0μF</td> <td rowspan="2">≥ 50V</td> <td rowspan="2">≤ 3%</td> <td>≤ 7.5%</td> <td>0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; TT series</td> </tr> <tr> <td>4V</td> <td>C ≥ 22μF</td> <td>≤ 6%</td> <td>0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td> </tr> <tr> <td rowspan="2">0603</td> <td rowspan="2">X5R/X7R/X6S</td> <td>6.3V, 10V, 25V, 35V</td> <td>C ≥ 4.7μF</td> <td rowspan="2">35V</td> <td rowspan="2">≤ 5%</td> <td>≤ 10%</td> <td>1210 ≥ 4.7μF</td> </tr> <tr> <td>4V</td> <td>C ≥ 22μF</td> <td>≤ 20%</td> <td>0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series</td> </tr> <tr> <td rowspan="2">0805</td> <td rowspan="2">X5R/X7R/X6S</td> <td>4V, 6.3V, 10V-50V</td> <td>C ≥ 47μF C ≥ 22μF C ≥ 10μF</td> <td rowspan="2">25V</td> <td rowspan="2">≤ 5%</td> <td>≤ 20%</td> <td>0603 ≥ 1μF; 0805 ≥ 2.2μF; 1210 ≥ 10μF</td> </tr> <tr> <td>6.3V</td> <td>C ≥ 22μF</td> <td>≤ 10%</td> <td>0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td> </tr> <tr> <td rowspan="2">1206</td> <td rowspan="2">X5R/X7R/X6S NP0</td> <td>6.3V, 3000V</td> <td>C ≥ 47μF C ≥ 1.5pF</td> <td rowspan="2">16V</td> <td rowspan="2">≤ 5%</td> <td>≤ 14%</td> <td>0603 ≥ 0.33μF; 1206 ≥ 4.7μF</td> </tr> <tr> <td>6.3V</td> <td>C ≥ 47μF</td> <td>≤ 15%</td> <td>0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>1210</td> <td>X5R/X7R/X6S</td> <td>16V</td> <td>C ≥ 47μF</td> <td rowspan="2">10V</td> <td rowspan="2">≤ 7.5%</td> <td>≤ 20%</td> <td>0402 ≥ 1μF</td> </tr> <tr> <td>TT18</td> <td>Y5V</td> <td>6.3V, 10V</td> <td>C ≥ 2.2μF</td> <td>≤ 10%</td> <td>0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>TT21</td> <td>Y5V</td> <td>6.3V</td> <td>C ≥ 10μF</td> <td rowspan="2">6.3V</td> <td rowspan="2">≤ 15%</td> <td>≤ 15%</td> <td>0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series</td> </tr> <tr> <td>TT31</td> <td>Y5V</td> <td>6.3V</td> <td>C ≥ 22μF</td> <td>≤ 20%</td> <td>0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series</td> </tr> </tbody> </table> | Size | Dielectric | Rated voltage | Capacitance range | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | | 0201 | X5R/X7R/X6S | ≤ 10V | C ≥ 0.1μF | ≥ 100V | ≤ 3% | ≤ 6% | 1206 ≥ 0.47μF | 0402 | X5R/X7R/X6S Y5V | 6.3V, 10V, 25V | C ≥ 1.0μF | ≥ 50V | ≤ 3% | ≤ 7.5% | 0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; TT series | 4V | C ≥ 22μF | ≤ 6% | 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF | 0603 | X5R/X7R/X6S | 6.3V, 10V, 25V, 35V | C ≥ 4.7μF | 35V | ≤ 5% | ≤ 10% | 1210 ≥ 4.7μF | 4V | C ≥ 22μF | ≤ 20% | 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series | 0805 | X5R/X7R/X6S | 4V, 6.3V, 10V-50V | C ≥ 47μF C ≥ 22μF C ≥ 10μF | 25V | ≤ 5% | ≤ 20% | 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1210 ≥ 10μF | 6.3V | C ≥ 22μF | ≤ 10% | 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF | 1206 | X5R/X7R/X6S NP0 | 6.3V, 3000V | C ≥ 47μF C ≥ 1.5pF | 16V | ≤ 5% | ≤ 14% | 0603 ≥ 0.33μF; 1206 ≥ 4.7μF | 6.3V | C ≥ 47μF | ≤ 15% | 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series | 1210 | X5R/X7R/X6S | 16V | C ≥ 47μF | 10V | ≤ 7.5% | ≤ 20% | 0402 ≥ 1μF | TT18 | Y5V | 6.3V, 10V | C ≥ 2.2μF | ≤ 10% | 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF | TT21 | Y5V | 6.3V | C ≥ 10μF | 6.3V | ≤ 15% | ≤ 15% | 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series | TT31 | Y5V | 6.3V | C ≥ 22μF | ≤ 20% | 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series |
| | | Size | Dielectric | Rated voltage | Capacitance range | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0201 | X5R/X7R/X6S | ≤ 10V | C ≥ 0.1μF | ≥ 100V | ≤ 3% | ≤ 6% | 1206 ≥ 0.47μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0402 | X5R/X7R/X6S Y5V | 6.3V, 10V, 25V | C ≥ 1.0μF | ≥ 50V | ≤ 3% | ≤ 7.5% | 0805 > 0.1μF, 0603 ≥ 0.068μF, 1206 > 1μF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 4V | C ≥ 22μF | | | ≤ 6% | 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0603 | X5R/X7R/X6S | 6.3V, 10V, 25V, 35V | C ≥ 4.7μF | 35V | ≤ 5% | ≤ 10% | 1210 ≥ 4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 4V | C ≥ 22μF | | | ≤ 20% | 0402 ≥ 0.1μF; 0603 > 0.1μF; 0805 ≥ 1μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 0805 | X5R/X7R/X6S | 4V, 6.3V, 10V-50V | C ≥ 47μF C ≥ 22μF C ≥ 10μF | 25V | ≤ 5% | ≤ 20% | 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1210 ≥ 10μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 6.3V | C ≥ 22μF | | | ≤ 10% | 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 1206 | X5R/X7R/X6S NP0 | 6.3V, 3000V | C ≥ 47μF C ≥ 1.5pF | 16V | ≤ 5% | ≤ 14% | 0603 ≥ 0.33μF; 1206 ≥ 4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 6.3V | C ≥ 47μF | | | ≤ 15% | 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 6.8μF; 1210 ≥ 22μF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 1210 | X5R/X7R/X6S | 16V | C ≥ 47μF | 10V | ≤ 7.5% | ≤ 20% | 0402 ≥ 1μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | TT18 | Y5V | 6.3V, 10V | C ≥ 2.2μF | | | ≤ 10% | 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | TT21 | Y5V | 6.3V | C ≥ 10μF | 6.3V | ≤ 15% | ≤ 15% | 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TT31 | Y5V | 6.3V | C ≥ 22μF | ≤ 20% | 0201 ≥ 0.1μF; 0402 ≥ 1μF; TT series | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **1WV items must follow de-rating conditions | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | (6) 150% of rated voltage for below range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Size | Dielectric | Rated voltage | Capacitance | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0201 | X5R/X7R/X6 | 16V/25V | C ≥ 0.1μF | Y5V: | ≤ 20% | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0402 | X5R/X7R/X6 S | 50V | C ≥ 0.1μF | | | Y5V: | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 10~25V | C ≥ 0.22μF | ≥ 50V | 7.5% | 10% | 0603 ≥ 0.1μF; 0805 ≥ 0.47μF; 1206 ≥ 4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0603 | X7R X5R/X7R/X6 | 50V 10~50V | C > 0.1μF C ≥ 1.0μF | 35V | 10% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Y5V | 16V | C ≥ 2.2μF | 25V | 7.5% | 10% | 0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0805 | X5R/X7R/X6 X5R/X7R | 10~50V 50V | C ≥ 4.7μF C ≥ 2.2μF | 16V (C < 1.0μF) | | | 10% | 15% | 0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Y5V | 100V | | C ≥ 0.47μF | 12.5% | | 0402 ≥ 0.068μF; 0603 ≥ 0.68μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1206 | X5R/X7R/X6 | 100V | C > 1.0μF | 16V (C ≥ 1.0μF) | 12.5% | 20% | 0603 ≥ 2.2μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2220 | X7R | 100V | C ≥ 6.8μF | | | 20% | 0402 ≥ 0.47μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 10V | 20% | 30% | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 6.3V | 30% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Before initial measurement (Class II only): To apply test voltage for 1hr at test temp. and then set for 24±2 hrs at room temp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Measurement to be made after keeping at room temp. for 24±2 hrs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * De-rating conditions: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| *I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Class II (X7R, X5R, X6S, Y5V) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>100V: X7R</td> <td rowspan="7">1GΩ or RxC ≥ 10 Ω-F whichever is smaller.</td> </tr> <tr> <td>50V: 0402 ≥ 0.1μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF</td> </tr> <tr> <td>35V: 0603 ≥ 1μF; 0805 ≥ 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 items</td> </tr> </tbody> </table> | | Rated voltage | Insulation Resistance | 100V: X7R | 1GΩ or RxC ≥ 10 Ω-F whichever is smaller. | 50V: 0402 ≥ 0.1μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF | 35V: 0603 ≥ 1μF; 0805 ≥ 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 items | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated voltage | Insulation Resistance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100V: X7R | 1GΩ or RxC ≥ 10 Ω-F whichever is smaller. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 50V: 0402 ≥ 0.1μF; 0603 ≥ 1μF; 0805 ≥ 1μF; 1206 ≥ 4.7μF; 1210 ≥ 4.7μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35V: 0603 ≥ 1μF; 0805 ≥ 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 items | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

APPENDICES

▣ Tape & reel dimensions

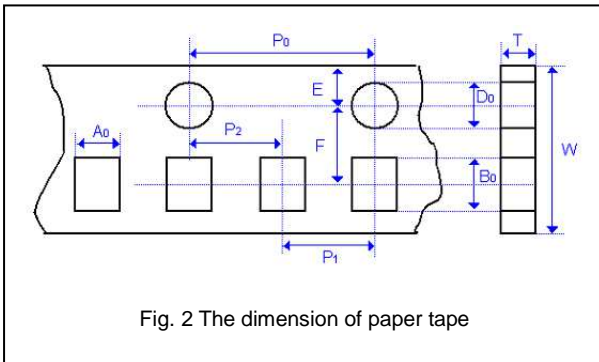


Fig. 2 The dimension of paper tape

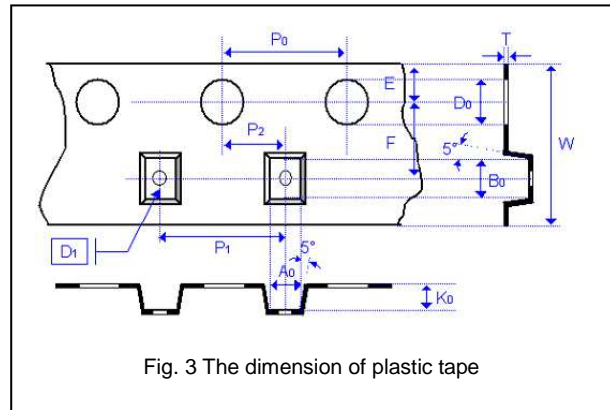


Fig. 3 The dimension of plastic tape

| Size | 0402 | 0603 | 0805 | | | 1206 | | | 1210 | | 1812 |
|-------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|
| Thickness | N | S, X | A | B | C, D, I | B | C, J, D | G | C, D, G | M | D, K |
| A ₀ | 0.62±0.05 | 1.02±0.05 | 1.50±0.10 | 1.50±0.10 | <1.57 | 2.00±0.10 | <1.85 | <1.95 | <2.97 | <2.97 | <3.81 |
| B ₀ | 1.12±0.05 | 1.80±0.05 | 2.30±0.10 | 2.30±0.10 | <2.40 | 3.50±0.10 | <3.46 | <3.67 | <3.73 | <3.73 | <5.30 |
| T | 0.60±0.05 | 0.95±0.05 | 0.75±0.05 | 0.95±0.05 | 0.23±0.05 | 0.95±0.05 | 0.23±0.05 | 0.23±0.05 | 0.23±0.05 | 0.23±0.05 | 0.25±0.05 |
| K ₀ | - | - | - | - | <2.50 | - | <2.50 | <2.50 | <2.50 | <3.00 | <2.50 |
| W | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 12.0±0.20 |
| P ₀ | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.100 | 4.00±0.10 | 4.00±0.10 |
| 10xP ₀ | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 |
| P ₁ | 2.00±0.05 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 8.00±0.10 |
| P ₂ | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 |
| D ₀ | 1.55±0.05 | 1.55±0.05 | 1.55±0.05 | 1.55±0.05 | 1.50±0.05 | 1.50±0.05 | 1.50±0.05 | 1.50±0.05 | 1.50±0.05 | 1.50±0.05 | 1.50±0.05 |
| D ₁ | - | - | - | - | 1.00±0.10 | - | 1.00±0.10 | 1.00±0.10 | 1.00±0.10 | 1.00±0.10 | 1.50±0.10 |
| E | 1.75±0.05 | 1.75±0.05 | 1.75±0.05 | 1.75±0.05 | 1.75±0.10 | 1.75±0.10 | 1.75±0.10 | 1.75±0.10 | 1.75±0.10 | 1.75±0.10 | 1.75±0.10 |
| F | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 5.50±0.05 |

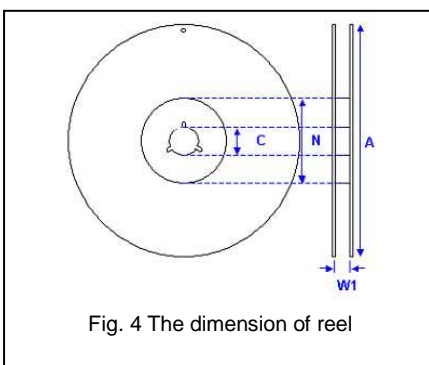
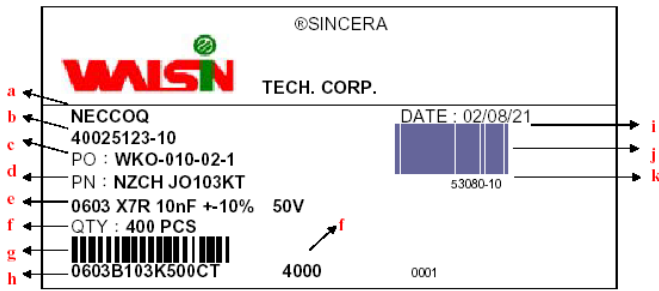


Fig. 4 The dimension of reel

| Size | 0402, 0603, 0805, 1206, 1210 | | | 1812 |
|----------------|------------------------------|---------------|---------------|---------------|
| Reel size | 7" | 10" | 13" | 7" |
| C | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 |
| W ₁ | 8.4+1.5/-0 | 8.4+1.5/-0 | 8.4+1.5/-0 | 12.4+2.0/-0 |
| A | 178.0±0.10 | 250.0±1.0 | 330.0±1.0 | 178.0±0.10 |
| N | 60.0+1.0/-0 | 100.0±1.0 | 100±1.0 | 60.0+1.0/-0 |

☐ 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 N₂ within oven are recommended.

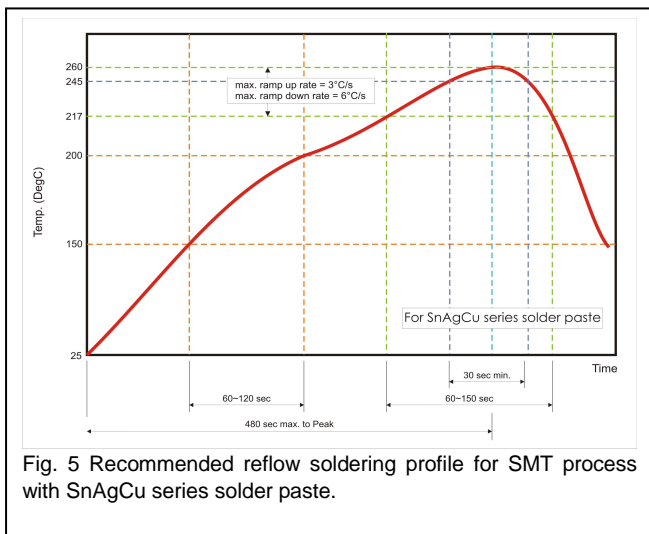


Fig. 5 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

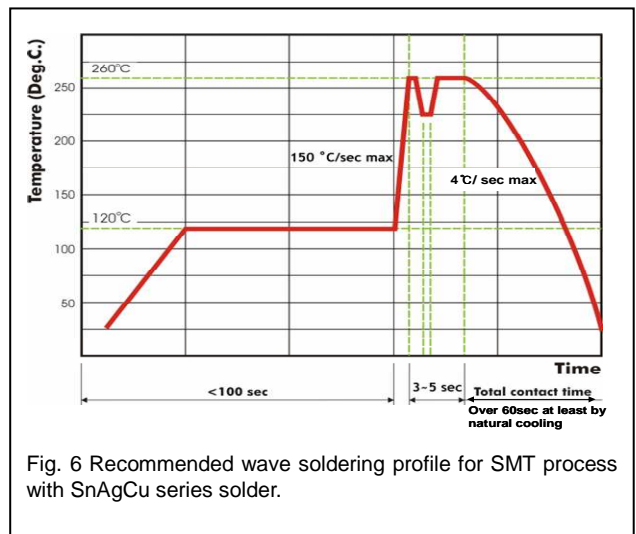


Fig. 6 Recommended wave soldering profile for SMT process with SnAgCu series solder.