

# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITORS

General Purpose Series (4V to 100V)

0201 to 1812 Sizes

NP0, X7R, X6S, X7S & X5R Dielectrics

Halogen Free & RoHS Compliance

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

## Multilayer Ceramic Capacitors

### 1. DESCRIPTION

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

WTC's MLCC is made by NP0, X7R, X6S, X7S and X5R dielectric material and which provides product with high electrical precision, stability and reliability.

### 2. FEATURES

- A wide selection of sizes is available (0201 to 1812).
- High capacitance in given case size.
- Capacitor with lead-free termination (pure Tin).

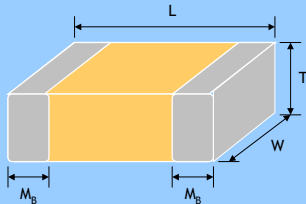
### 3. APPLICATIONS

- For general digital circuit.
- For power supply bypass capacitors.
- For consumer electronics.
- For telecommunication.

### 4. HOW TO ORDER

| <u>1206</u>                                                                                                                                                         | <u>B</u>                                                                                                    | <u>104</u>                                                                                                                                                  | <u>K</u>                                                                                                                                                              | <u>500</u>                                                                                                                                                                                                                                                                | <u>C</u>           | <u>I</u>                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------------|
| <u>Size</u>                                                                                                                                                         | <u>Dielectric</u>                                                                                           | <u>Capacitance</u>                                                                                                                                          | <u>Tolerance</u>                                                                                                                                                      | <u>Rated voltage</u>                                                                                                                                                                                                                                                      | <u>Termination</u> | <u>Packaging style</u>                      |
| Inch (mm)<br><b>0201</b> (0603)<br><b>0402</b> (1005)<br><b>0603</b> (1608)<br><b>0805</b> (2012)<br><b>1206</b> (3216)<br><b>1210</b> (3225)<br><b>1812</b> (4532) | <b>N</b> =NP0<br>(C0G)<br><b>B</b> =X7R<br><b>F</b> =Y5V<br><b>X</b> =X5R<br><b>S</b> =X6S<br><b>A</b> =X7S | Two significant digits followed by no. of zeros. And R is in place of decimal point.<br><br>eg.:<br>0R5=0.5pF<br>1R0=1.0pF<br>104=10x10 <sup>4</sup> =100nF | <b>A</b> =±0.05pF<br><b>B</b> =±0.1pF<br><b>C</b> =±0.25pF<br><b>D</b> =±0.5pF<br><b>F</b> =±1%<br><b>G</b> =±2%<br><b>J</b> =±5%<br><b>K</b> =±10%<br><b>M</b> =±20% | Two significant digits followed by no. of zeros. And R is in place of decimal point.<br><br><b>4R0</b> =4 VDC<br><b>6R3</b> =6.3 VDC<br><b>100</b> =10 VDC<br><b>160</b> =16 VDC<br><b>250</b> =25 VDC<br><b>350</b> =35 VDC<br><b>500</b> =50 VDC<br><b>101</b> =100 VDC | <b>C</b> =Cu/Ni/Sn | <b>T</b> =7" reeled<br><b>G</b> =13" reeled |

## 5. EXTERNAL DIMENSIONS

| Outline                                                                                                             | Size<br>Inch (mm) | L (mm)                                    | W (mm)                  | T (mm)/Symbol                             | Soldering<br>Method * | M <sub>B</sub> (mm)     |                                        |
|---------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------------------------|-------------------------|-------------------------------------------|-----------------------|-------------------------|----------------------------------------|
|  <p>Fig. 1 The outline of MLCC</p> | 01R5 (0402)       | 0.4±0.02                                  | 0.2±0.02                | 0.2±0.02                                  | V                     | R                       | 0.10±0.03                              |
|                                                                                                                     | 0201 (0603)       | 0.6±0.03                                  | 0.3±0.03                | 0.3±0.03                                  | L                     | R                       | 0.15±0.05                              |
|                                                                                                                     |                   | 0.6±0.05 <sup>#2</sup>                    | 0.3±0.05 <sup>#2</sup>  | 0.3±0.05 <sup>#2</sup>                    |                       |                         | 0.15±0.1/-0.05                         |
|                                                                                                                     |                   | 0.6±0.09 <sup>#3</sup>                    | 0.3±0.09 <sup>#3</sup>  | 0.3±0.09 <sup>#3</sup>                    |                       |                         |                                        |
|                                                                                                                     | 0402 (1005)       | 1.00±0.05                                 | 0.50±0.05               | 0.50±0.05                                 | N                     | R                       | 0.25<br>+0.05/-0.10                    |
|                                                                                                                     |                   | 1.00±0.20                                 | 0.50±0.20               | 0.5±0.20                                  | Q                     | R                       |                                        |
|                                                                                                                     |                   | 1.00±0.15 <sup>#6</sup>                   | 0.50±0.15 <sup>#6</sup> | 0.5±0.15 <sup>#6</sup>                    | E                     | R                       |                                        |
|                                                                                                                     | 0603 (1608)       | 1.60±0.10                                 | 0.80±0.10               | 0.80±0.07                                 | S                     | R / W                   | 0.40±0.15                              |
|                                                                                                                     |                   | 1.60+0.15/-0.10                           | 0.80+0.15/-0.10         | 0.50±0.10                                 | H                     | R / W                   |                                        |
|                                                                                                                     |                   | 1.60±0.20 <sup>#1</sup>                   | 0.80±0.20 <sup>#1</sup> | 0.8±0.20 <sup>#1</sup>                    | X                     | R / W                   |                                        |
|                                                                                                                     | 0805 (2012)       | 2.00±0.15                                 | 1.25±0.10               | 0.50±0.10                                 | H                     | R / W                   | 0.50±0.20                              |
|                                                                                                                     |                   |                                           |                         | 0.60±0.10                                 | A                     | R / W                   |                                        |
|                                                                                                                     |                   |                                           |                         | 0.80±0.10                                 | B                     | R / W                   |                                        |
|                                                                                                                     |                   |                                           |                         | 1.25±0.10                                 | D                     | R                       |                                        |
|                                                                                                                     |                   | 2.00±0.20                                 | 1.25±0.20               | 0.85±0.10                                 | T                     | R / W                   |                                        |
|                                                                                                                     |                   |                                           |                         | 1.25±0.20                                 | I                     | R                       |                                        |
|                                                                                                                     | 1206 (3216)       | 3.20±0.15                                 | 1.60±0.15               | 0.80±0.10                                 | B                     | R / W                   | 0.60±0.20<br>(0.5±0.25) <sup>***</sup> |
|                                                                                                                     |                   |                                           |                         | 0.95±0.10                                 | C                     | R                       |                                        |
|                                                                                                                     |                   |                                           |                         | 1.25±0.10                                 | D                     | R                       |                                        |
|                                                                                                                     |                   | 3.20±0.20                                 | 1.60±0.20               | 1.15±0.15                                 | J                     | R                       |                                        |
|                                                                                                                     |                   |                                           |                         | 1.60±0.20                                 | G                     | R                       |                                        |
|                                                                                                                     |                   |                                           |                         | 0.85±0.10                                 | T                     | R / W                   |                                        |
|                                                                                                                     | 1210 (3225)       | 3.20+0.30/-0.1 <sup>#5</sup>              | 1.60+0.30/-0.10         | 1.60+0.30/-0.10                           | P                     | R                       | 0.75±0.25                              |
|                                                                                                                     |                   |                                           |                         | 0.95±0.10                                 | C                     | R                       |                                        |
|                                                                                                                     |                   |                                           |                         | 0.85±0.10                                 | T                     | R                       |                                        |
|                                                                                                                     |                   | 3.20±0.30                                 | 2.50±0.20               | 1.25±0.10                                 | D                     | R                       |                                        |
|                                                                                                                     |                   |                                           |                         | 1.60±0.20                                 | G                     | R                       |                                        |
|                                                                                                                     |                   |                                           |                         | 2.00±0.20                                 | K                     | R                       |                                        |
|                                                                                                                     | 3.20±0.40         | 2.50±0.30                                 | 2.50±0.30               | M                                         | R                     |                         |                                        |
|                                                                                                                     |                   |                                           | 3.20±0.60 <sup>#4</sup> |                                           |                       | 2.50±0.50 <sup>#4</sup> | 2.50±0.50 <sup>#4</sup>                |
|                                                                                                                     |                   |                                           | 1808 (4520)             | 4.50±0.40<br>(4.5+0.5/-0.3) <sup>**</sup> | 2.03±0.25             | 1.25±0.10               | D                                      |
|                                                                                                                     | 1.40±0.15         | F                                         |                         |                                           |                       | R                       |                                        |
|                                                                                                                     | 1.60±0.20         | G                                         |                         |                                           |                       | R                       |                                        |
|                                                                                                                     | 2.00±0.20         | K                                         |                         |                                           |                       | R                       |                                        |
|                                                                                                                     | 1812 (4532)       | 4.50±0.40<br>(4.5+0.5/-0.3) <sup>**</sup> | 3.20±0.30               | 1.25±0.10                                 | D                     | R                       | 0.75±0.25<br>(0.5±0.25) <sup>***</sup> |
|                                                                                                                     |                   |                                           |                         | 1.60±0.20                                 | G                     | R                       |                                        |
| 3.20±0.40                                                                                                           |                   |                                           | 2.00±0.20               | K                                         | R                     |                         |                                        |
|                                                                                                                     |                   |                                           | 2.50±0.30               | M                                         | R                     |                         |                                        |
|                                                                                                                     |                   |                                           | 2.80±0.30               | U                                         | R                     |                         |                                        |

\* R = Reflow soldering process ; W = Wave soldering process.

\*\* For 1808/1812/1825\_200V~4000V and safety certificated products.

\*\*\* For 1206\_≥1000V, 1808/1812\_200V~4000V and safety certificated products.

#1: For 0603/Cap ≥ 10μF or 0603(≤6.3V)/Cap ≥ 4.7μF or 0603(>10V)/Cap > 1μF products,  
Excluding 0603X225(16V&25V), 0603S225(6.3V&16V), 0603X475(6.3V&16V), 0603S475(4V&6.3V).

#2: For 0201/ 0.1μF < Cap < 0.68μF products, Excluding 0201X334~474(≤6.3V) & 0201X224(≤10V).

#3: For 0201X334(16V&25V), 0201/Cap ≥ 0.68μF products, Excluding 0201X105\*6R3=>(L:0.6±0.05,W:0.3±0.05,T:0.3±0.05).

#4: For 1210(200V&250V)/Cap > 0.47μF products.

#5: For 1206(100V)/Cap ≥ 1.2μF products.

#6: For 0402X475M6R3CT products.

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## 6. GENERAL ELECTRICAL DATA

| Dielectric                 | NP0                                                                                                                                                                   | X7R                                     | X5R                   | X6S                   | X7S                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------|-----------------------|-----------------------|
| Size                       | 0201, 0402, 0603, 0805, 1206, 1210, 1812                                                                                                                              |                                         |                       |                       |                       |
| Capacitance range*         | 0.1pF to 0.1μF                                                                                                                                                        | 100pF to 47μF                           | 100pF to 220μF        | 0.1μF to 100μF        | 0.1μF to 100μF        |
| Capacitance tolerance**    | Cap≤5pF <sup>#1</sup> :<br>A (±0.05pF), B (±0.1pF),<br>C (±0.25pF)<br>5pF<Cap<10pF:<br>C (±0.25pF), D (±0.5pF)<br>Cap≥10pF:<br>F (±1%), G (±2%),<br>J (±5%), K (±10%) | J (±5%),<br>K (±10%),<br>M (±20%)       | K (±10%),<br>M (±20%) | K (±10%),<br>M (±20%) | K (±10%),<br>M (±20%) |
| Rated voltage (WVDC)       | 10V, 16V, 25V, 50V, 100V                                                                                                                                              | 4V, 6.3V, 10V, 16V, 25V, 35V, 50V, 100V |                       |                       |                       |
| Operating temperature      | -55 to +125°C                                                                                                                                                         |                                         | -55 to +85°C          | -55 to +105°C         | -55 to +125°C         |
| Capacitance characteristic | ±30ppm                                                                                                                                                                | ±15%                                    | ±15%                  | ±22%                  | ±22%                  |
| Termination                | Ni/Sn (lead-free termination)                                                                                                                                         |                                         |                       |                       |                       |

#1: NP0, 0.1pF product only provide B tolerance; 0603N0R3/0R4 provide B&C tolerance.

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

NP0: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25°C at ambient temperature

X7R/X6S/X5R/X7S: Please refer to page 13 "Reliability test conditions and requirements" for detail.

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



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## 7. CAPACITANCE RANGE

### 7-1. NP0 Dielectric 0201, 0402, 0603, 0805 Sizes

| DIELECTRIC          |               | NP0  |    |    |    |     |      |    |    |    |     |      |    |    |    |     |      |    |    |    |     |
|---------------------|---------------|------|----|----|----|-----|------|----|----|----|-----|------|----|----|----|-----|------|----|----|----|-----|
| SIZE                |               | 0201 |    |    |    |     | 0402 |    |    |    |     | 0603 |    |    |    |     | 0805 |    |    |    |     |
| RATED VOLTAGE (VDC) |               | 10   | 16 | 25 | 50 | 100 | 10   | 16 | 25 | 50 | 100 | 10   | 16 | 25 | 50 | 100 | 10   | 16 | 25 | 50 | 100 |
| Capacitance         | 0.1pF (0R1)   | L    | L  | L  | L  | L   | N    | N  | N  | N  |     |      |    |    |    |     |      |    |    |    |     |
|                     | 0.2pF (0R2)   | L    | L  | L  | L  | L   | N    | N  | N  | N  |     |      |    |    |    |     |      |    |    |    |     |
|                     | 0.3pF (0R3)   | L    | L  | L  | L  | L   | N    | N  | N  | N  |     | S    | S  | S  | S  |     |      |    |    |    |     |
|                     | 0.4pF (0R4)   | L    | L  | L  | L  | L   | N    | N  | N  | N  |     | S    | S  | S  | S  |     |      |    |    |    |     |
|                     | 0.5pF (0R5)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 0.6pF (0R6)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 0.7pF (0R7)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 0.8pF (0R8)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 0.9pF (0R9)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 1.0pF (1R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 1.2pF (1R2)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 1.5pF (1R5)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 1.8pF (1R8)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 2.0pF (2R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 2.2pF (2R2)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 2.7pF (2R7)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 3.0pF (3R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 3.3pF (3R3)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 3.9pF (3R9)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 4.0pF (4R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 4.7pF (4R7)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 5.0pF (5R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 5.6pF (5R6)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 6.0pF (6R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 6.8pF (6R8)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 7.0pF (7R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 8.0pF (8R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 8.2pF (8R2)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 9.0pF (9R0)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 10pF (100)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 12pF (120)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 15pF (150)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 18pF (180)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 22pF (220)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 27pF (270)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 33pF (330)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 39pF (390)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 47pF (470)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 56pF (560)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 68pF (680)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 82pF (820)    | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 100pF (101)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 120pF (121)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 150pF (151)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 180pF (181)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 220pF (221)   | L    | L  | L  | L  | L   | N    | N  | N  | N  | N   | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 270pF (271)   | L    | L  | L  |    |     | N    | N  | N  | N  |     | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 330pF (331)   | L    | L  | L  |    |     | N    | N  | N  | N  |     | S    | S  | S  | S  | S   | A    | A  | A  | A  | A   |
|                     | 390pF (391)   | L    | L  | L  |    |     | N    | N  | N  | N  |     | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |
|                     | 470pF (471)   | L    | L  | L  |    |     | N    | N  | N  | N  |     | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |
|                     | 560pF (561)   | L    | L  | L  |    |     | N    | N  | N  | N  |     | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |
|                     | 680pF (681)   | L    | L  | L  |    |     | N    | N  | N  | N  |     | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |
|                     | 820pF (821)   |      |    |    |    |     | N    | N  | N  | N  |     | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |
|                     | 1,000pF (102) |      |    |    |    |     | N    | N  | N  | N  |     | S    | S  | S  | S  | S   | B    | B  | B  | B  | B   |
|                     | 1,200pF (122) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | B    | B  | B  | B  | B   |
|                     | 1,500pF (152) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | B    | B  | B  | B  | B   |
|                     | 1,800pF (182) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | B    | B  | B  | B  | B   |
|                     | 2,200pF (222) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | B    | B  | B  | B  | B   |
|                     | 2,700pF (272) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | D    | D  | D  | D  | D   |
|                     | 3,300pF (332) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | D    | D  | D  | D  | D   |
|                     | 3,900pF (392) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | D    | D  | D  | D  | D   |
|                     | 4,700pF (472) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | D    | D  | D  | D  | D   |
|                     | 5,600pF (562) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | D    | D  | D  | D  | D   |
|                     | 6,800pF (682) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | D    | D  | D  | D  | D   |
|                     | 8,200pF (822) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | D    | D  | D  | D  | D   |
|                     | 0.010uF (103) |      |    |    |    |     |      |    |    |    |     | X    | X  | X  | X  | X   | D    | D  | D  | D  | D   |
|                     | 0.012uF (123) |      |    |    |    |     |      |    |    |    |     |      |    |    |    |     | D    | D  | D  | D  | D   |
|                     | 0.015uF (153) |      |    |    |    |     |      |    |    |    |     |      |    |    |    |     | D    | D  | D  | D  | D   |
|                     | 0.018uF (183) |      |    |    |    |     |      |    |    |    |     |      |    |    |    |     | D    | D  | D  | D  | D   |
|                     | 0.022uF (223) |      |    |    |    |     |      |    |    |    |     |      |    |    |    |     | D    | D  | D  | D  | D   |

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

2. The letter in cell with " \* " mark is expressed capacitance tolerance "J" (±5%) only.

3. For more information about products with special capacitance or other data, please contact WTC local representative.

Multilayer Ceramic Capacitors

Approval Sheet

7-1. NP0 Dielectric 1206, 1210, 1812 Sizes

| DIELECTRIC          |               | NP0  |    |    |    |     |      |    |    |    |     |      |    |    |     |
|---------------------|---------------|------|----|----|----|-----|------|----|----|----|-----|------|----|----|-----|
| SIZE                |               | 1206 |    |    |    |     | 1210 |    |    |    |     | 1812 |    |    |     |
| RATED VOLTAGE (VDC) |               | 10   | 16 | 25 | 50 | 100 | 10   | 16 | 25 | 50 | 100 | 16   | 25 | 50 | 100 |
| Capacitance         | 1.0pF (1R0)   |      |    |    |    |     |      |    |    |    |     |      |    |    |     |
|                     | 1.2pF (1R2)   | B    | B  | B  | B  | B   |      |    |    |    |     |      |    |    |     |
|                     | 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    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 12pF (120)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 15pF (150)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 18pF (180)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 22pF (220)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 27pF (270)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 33pF (330)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 39pF (390)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 47pF (470)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 56pF (560)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 68pF (680)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 82pF (820)    | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 100pF (101)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 120pF (121)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 150pF (151)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 180pF (181)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 220pF (221)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 270pF (271)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 330pF (331)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 390pF (391)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 470pF (471)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 560pF (561)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 680pF (681)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 820pF (821)   | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 1,000pF (102) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 1,200pF (122) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 1,500pF (152) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 1,800pF (182) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 2,200pF (222) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 2,700pF (272) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 3,300pF (332) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 3,900pF (392) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 4,700pF (472) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 5,600pF (562) | B    | B  | B  | B  | B   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 6,800pF (682) | C    | C  | C  | C  | C   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 8,200pF (822) | D    | D  | D  | D  | D   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 0.010μF (103) | D    | D  | D  | D  | D   | C    | C  | C  | C  | C   | D    | D  | D  | D   |
|                     | 0.012μF (123) | P    | P  | P  | P  | P   | D    | D  | D  | D  | D   | D    | D  | D  | D   |
|                     | 0.015μF (153) | P    | P  | P  | P  | P   | D    | D  | D  | D  | D   | D    | D  | D  | D   |
|                     | 0.018μF (183) | P    | P  | P  | P  | P   | K    | K  | K  | K  | K   | D    | D  | D  | D   |
|                     | 0.022μF (223) | P    | P  | P  | P  | P   | K    | K  | K  | K  | K   | D    | D  | D  | D   |
|                     | 0.027μF (273) | P    | P  | P  | P  |     | K    | K  | K  | K  | K   | D    | D  | D  | D   |
|                     | 0.033μF (333) | P    | P  | P  | P  |     | K    | K  | K  | K  | K   | D    | D  | D  | D   |
|                     | 0.039μF (393) | P    | P  | P  | P  |     | K    | K  | K  | K  | K   | M    | M  | M  | M   |
|                     | 0.047μF (473) | P    | P  | P  | P  |     | K    | K  | K  | K  | K   | M    | M  | M  | M   |
|                     | 0.056μF (563) | P    | P  | P  | P  |     |      |    |    |    |     | M    | M  | M  | M   |
|                     | 0.068μF (683) | P    | P  | P  | P  |     |      |    |    |    |     | M    | M  | M  | M   |
|                     | 0.082μF (823) | P    | P  | P  | P  |     |      |    |    |    |     | M    | M  | M  | M   |
|                     | 0.1μF (104)   | P    | P  | P  | P  |     |      |    |    |    |     | M    | M  | M  | M   |

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

2. The letter in cell with “\*” mark is expressed capacitance tolerance “J” (±5%) only.

3. For more information about products with special capacitance or other data, please contact WTC local representative.

Multilayer Ceramic Capacitors

7-2. X7R Dielectric 0201, 0402, 0603, 0805 Sizes

| DIELECTRIC          |               | X7R  |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      |    |    |    |    |    |     |   |
|---------------------|---------------|------|----|----|----|----|------|----|----|----|----|-----|------|----|----|----|----|-----|------|----|----|----|----|----|-----|---|
| SIZE                |               | 0201 |    |    |    |    | 0402 |    |    |    |    |     | 0603 |    |    |    |    |     | 0805 |    |    |    |    |    |     |   |
| RATED VOLTAGE (VDC) |               | 6.3  | 10 | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 | 100 | 6.3  | 10 | 16 | 25 | 50 | 100 | 6.3  | 10 | 16 | 25 | 35 | 50 | 100 |   |
| Capacitance         | 100pF (101)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 120pF (121)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 150pF (151)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 180pF (181)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 220pF (221)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 270pF (271)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 330pF (331)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 390pF (391)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 470pF (471)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 560pF (561)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 680pF (681)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 820pF (821)   |      |    | L  | L  | L  |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 1,000pF (102) | L    | L  | L  | L  | L  | N    | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 1,200pF (122) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 1,500pF (152) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 1,800pF (182) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 2,200pF (222) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 2,700pF (272) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 3,300pF (332) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 3,900pF (392) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 4,700pF (472) | L    | L  | L  | L  |    | N    | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 5,600pF (562) | L    | L  | L  | L  |    |      | N  | N  | N  | N  | N   |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 6,800pF (682) | L    | L  | L  |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 8,200pF (822) | L    | L  | L  |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 0.010μF (103) | L    | L  | L  | L  |    | N    | N  | N  | N  | N  |     |      | S  | S  | S  | S  | S   |      | B  | B  | B  |    | B  | B   |   |
|                     | 0.012μF (123) |      |    |    |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | X   |      | B  | B  | B  |    | B  | B   |   |
|                     | 0.015μF (153) |      |    |    |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | X   |      | B  | B  | B  |    | B  | B   |   |
|                     | 0.018μF (183) |      |    |    |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | X   |      | B  | B  | B  |    | B  | B   |   |
|                     | 0.022μF (223) |      | L  | L  |    |    | N    | N  | N  | N  | N  |     |      | S  | S  | S  | S  | X   |      | B  | B  | B  |    | B  | B   |   |
|                     | 0.027μF (273) |      |    |    |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | X   |      | B  | B  | B  |    | B  | D   |   |
|                     | 0.033μF (333) |      |    |    |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  |    | B   | D |
|                     | 0.039μF (393) |      |    |    |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  |    | B   | D |
|                     | 0.047μF (473) |      |    |    |    |    |      | N  | N  | N  | N  |     |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  |    | B   | D |
|                     | 0.056μF (563) |      |    |    |    |    |      | N  | N  | N  | E  |     |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  |    | B   | D |
|                     | 0.068μF (683) |      |    |    |    |    |      | N  | N  | N  | E  |     |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  |    | B   | D |
|                     | 0.082μF (823) |      |    |    |    |    |      | N  | N  | N  | E  |     |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  |    | B   | D |
|                     | 0.10μF (104)  |      |    |    |    |    | N    | N  | N  | N  | E  |     |      | S  | S  | S  | S  | X   | X    |    | B  | B  | B  |    | B   | D |
|                     | 0.12μF (124)  |      |    |    |    |    |      |    |    |    |    |     |      | S  | S  | S  | X  |     |      |    | B  | B  | B  |    | B   | I |
|                     | 0.15μF (154)  |      |    |    |    |    |      | N  |    |    |    |     |      | S  | S  | S  | X  | X   |      |    | D  | D  | D  |    | D   | I |
|                     | 0.18μF (184)  |      |    |    |    |    |      |    |    |    |    |     |      | S  | S  | S  | X  |     |      |    | D  | D  | D  |    | D   | I |
| 0.22μF (224)        |               |      |    |    |    | N  | N    | N  | N  |    |    |     | S    | S  | S  | X  | X  |     |      | D  | D  | D  |    | D  | I   |   |
| 0.27μF (274)        |               |      |    |    |    |    |      |    |    |    |    | X   | X    | X  | X  |    |    |     |      | D  | D  | D  |    | I  | I   |   |
| 0.33μF (334)        |               |      |    |    |    | N  | N    |    |    |    |    | X   | X    | X  | X  | X  |    |     |      | D  | D  | D  |    | I  | I   |   |
| 0.39μF (394)        |               |      |    |    |    |    |      |    |    |    |    | X   | X    | X  | X  |    |    |     |      | D  | D  | D  |    | I  | I   |   |
| 0.47μF (474)        |               |      |    |    |    | N  | N    |    |    |    |    | X   | X    | X  | X  | X  |    |     |      | D  | D  | D  |    | I  | I   |   |
| 0.56μF (564)        |               |      |    |    |    |    |      |    |    |    |    | X   | X    | X  |    |    |    |     |      | D  | D  | D  |    |    |     |   |
| 0.68μF (684)        |               |      |    |    |    |    |      |    |    |    |    | X   | X    | X  |    |    |    |     |      | D  | D  | D  |    | I  |     |   |
| 0.82μF (824)        |               |      |    |    |    |    |      |    |    |    |    | X   | X    | X  |    |    |    |     |      | D  | D  | D  |    |    |     |   |
| 1.0μF (105)         |               |      |    |    |    | N  |      |    |    |    |    | X   | X    | X  | X  | X  |    |     |      | D  | D  | D  | I  | I  |     |   |
| 1.5μF (155)         |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      | I  | I  | I  |    |    |     |   |
| 2.2μF (225)         |               |      |    |    |    |    |      |    |    |    |    | X   | X    | X  |    |    |    |     |      | I  | I  | I  | I  | I  |     |   |
| 3.3μF (335)         |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      |    |    |    |    |    |     |   |
| 4.7μF (475)         |               |      |    |    |    |    |      |    |    |    |    | X   | X    |    |    |    |    |     |      | I  | I  | I  |    |    |     |   |
| 6.8μF (685)         |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      |    |    |    |    |    |     |   |
| 10μF (106)          |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      | I  | I  | I* |    |    |     |   |
| 22μF (226)          |               |      |    |    |    |    |      |    |    |    |    |     |      |    |    |    |    |     |      |    |    |    |    |    |     |   |

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

2. The letter in cell with " \* " mark is expressed product not in 10% (code "K") tolerance.

Multilayer Ceramic Capacitors

Approval Sheet

7-2. X7R Dielectric 1206, 1210, 1812 Sizes

| DIELECTRIC          |               | X7R  |    |    |    |    |    |      |     |    |    |    |    |      |     |    |    |    |    |     |
|---------------------|---------------|------|----|----|----|----|----|------|-----|----|----|----|----|------|-----|----|----|----|----|-----|
| SIZE                |               | 1206 |    |    |    |    |    | 1210 |     |    |    |    |    | 1812 |     |    |    |    |    |     |
| RATED VOLTAGE (VDC) |               | 6.3  | 10 | 16 | 25 | 35 | 50 | 100  | 6.3 | 10 | 16 | 25 | 35 | 50   | 100 | 10 | 16 | 25 | 50 | 100 |
| Capacitance         | 100pF (101)   |      |    |    |    |    |    |      |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 120pF (121)   |      |    |    |    |    |    |      |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 150pF (151)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 180pF (181)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 220pF (221)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 270pF (271)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 330pF (331)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 390pF (391)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 470pF (471)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 560pF (561)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 680pF (681)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 820pF (821)   |      | B  | B  | B  |    | B  | B    |     |    |    |    |    |      |     |    |    |    |    |     |
|                     | 1,000pF (102) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 1,200pF (122) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 1,500pF (152) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 1,800pF (182) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 2,200pF (222) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 2,700pF (272) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 3,300pF (332) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 3,900pF (392) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 4,700pF (472) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 5,600pF (562) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 6,800pF (682) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 8,200pF (822) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.010μF (103) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.012μF (123) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.015μF (153) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.018μF (183) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.022μF (223) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.027μF (273) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.033μF (333) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.039μF (393) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.047μF (473) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.056μF (563) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.068μF (683) |      | B  | B  | B  |    | B  | B    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.082μF (823) |      | B  | B  | B  |    | B  | D    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.10μF (104)  |      | B  | B  | B  |    | B  | C    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.12μF (124)  |      | B  | B  | B  |    | B  | D    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.15μF (154)  |      | C  | C  | C  |    | C  | G    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
|                     | 0.18μF (184)  |      | C  | C  | C  |    | C  | G    | C   | C  | C  |    | C  | C    | C   | D  | D  | D  | D  | D   |
| 0.22μF (224)        |               | C    | C  | C  |    | C  | G  | C    | C   | C  |    | C  | C  | C    | D   | D  | D  | D  | D  |     |
| 0.27μF (274)        |               | C    | C  | C  |    | D  | G  | C    | C   | C  |    | C  | C  | G    | D   | D  | D  | D  | D  |     |
| 0.33μF (334)        |               | C    | C  | C  |    | D  | G  | C    | C   | C  |    | D  | C  | G    | D   | D  | D  | D  | D  |     |
| 0.39μF (394)        |               | C    | C  | J  |    | P  | G  | C    | C   | C  |    | D  | M  | M    | D   | D  | D  | D  | D  |     |
| 0.47μF (474)        |               | J    | J  | J  |    | P  | G  | C    | C   | C  |    | D  | M  | M    | D   | D  | D  | D  | K  |     |
| 0.56μF (564)        |               | J    | J  | J  |    | P  | P  | D    | D   | D  |    | D  | M  | M    | D   | D  | D  | D  | K  |     |
| 0.68μF (684)        |               | J    | J  | J  |    | P  | P  | D    | D   | D  |    | D  | K  | K    | D   | D  | D  | K  | K  |     |
| 0.82μF (824)        |               | J    | J  | J  |    | P  | P  | D    | D   | D  |    | D  | K  | K    | D   | D  | D  | K  | K  |     |
| 1.0μF (105)         |               | J    | J  | J  |    | P  | P  | D    | D   | D  |    | D  | K  | K    | D   | D  | D  | K  | K  |     |
| 1.5μF (155)         | J             | J    | J  | P  |    | P  |    |      | G   | G  |    | M  | M  | M    | D   | D  | D  | K  | K  |     |
| 2.2μF (225)         | J             | J    | J  | P  |    | P  | P  |      | G   | G  |    | M  | M  | M    | G   | G  | G  | M  | M  |     |
| 3.3μF (335)         |               | P    | P  | P  |    | P  |    |      | G   | G  |    | M  |    |      | K   | K  | K  | K  |    |     |
| 4.7μF (475)         | P             | P    | P  | P  |    | P  |    |      | K   | K  | K  |    | M  | M    | M   | M  | M  | M  |    |     |
| 6.8μF (685)         |               |      |    |    |    |    |    |      |     |    |    |    |    |      | M   | M  | M  | M  |    |     |
| 10μF (106)          | P             | P    | P  | P  | P  |    |    | K    | K   | K  | K  | M  | M  |      | M   | M  | M  | M  |    |     |
| 22μF (226)          | P             | P    | P* |    |    |    |    |      | M   | M  | M  |    |    |      | M   | M  | M  |    |    |     |
| 47μF (476)          |               |      |    |    |    |    |    | M    | M   |    |    |    |    |      |     |    |    |    |    |     |
| 100μF (107)         |               |      |    |    |    |    |    |      |     |    |    |    |    |      |     |    |    |    |    |     |

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with “\*” mark is expressed product not in 10% (code “K”) tolerance.

Multilayer Ceramic Capacitors

Approval Sheet

7-3. X5R Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes

| Dielectric          |               | X5R  |    |    |    |    |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|---------------------|---------------|------|----|----|----|----|------|-----|----|----|----|----|----|------|-----|----|----|----|----|----|
| Size                |               | 0201 |    |    |    |    | 0402 |     |    |    |    |    |    | 0603 |     |    |    |    |    |    |
| Rated Voltage (VDC) |               | 6.3  | 10 | 16 | 25 | 50 | 4    | 6.3 | 10 | 16 | 25 | 50 | 63 | 4    | 6.3 | 10 | 16 | 25 | 35 | 50 |
| Capacitance         | 100pF (101)   |      |    | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 150pF (151)   |      |    | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 220pF (221)   |      |    | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 330pF (331)   |      |    | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 470pF (471)   |      |    | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 680pF (681)   |      |    | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 820pF (821)   |      |    | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 1,000pF (102) |      | L  | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 1,500pF (152) |      | L  | L  | L  |    |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 2,200pF (222) |      | L  | L  | L  |    |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 2,700pF (272) |      | L  | L  | L  |    |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 3,300pF (332) |      | L  | L  | L  |    |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 4,700pF (472) |      | L  | L  | L  |    |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 6,800pF (682) |      | L  | L  | L  |    |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 0.010μF (103) | L    | L  | L  | L  | L  |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
|                     | 0.015μF (153) | L    | L  |    |    |    |      |     |    |    |    | N  |    |      |     |    |    |    |    |    |
|                     | 0.022μF (223) | L    | L  | L  | L  |    |      |     |    |    | N  | N  |    |      |     |    |    |    |    |    |
|                     | 0.033μF (333) | L    | L  |    |    |    |      |     |    | N  |    | N  |    |      |     |    |    |    |    |    |
|                     | 0.047μF (473) | L    | L  | L  | L  |    |      | N   | N  | N  |    | N  |    |      |     |    |    |    |    |    |
|                     | 0.068μF (683) | L    | L  |    |    |    |      | N   | N  | N  |    | E  |    |      |     |    |    |    |    |    |
|                     | 0.082μF (823) | L    | L  |    |    |    |      | N   | N  | N  |    | E  |    |      |     |    |    |    |    |    |
|                     | 0.10μF (104)  | L    | L  | L  | L  |    |      | N   | N  | N  | N  | E  |    |      |     |    |    |    |    |    |
|                     | 0.15μF (154)  |      |    |    |    |    |      | N   | N  | N  | N  |    |    |      |     |    |    |    |    |    |
|                     | 0.22μF (224)  | L    | L  | L  | L  |    |      | N   | N  | N  | N  | N  | N  |      | X   | X  | X  | X  |    |    |
|                     | 0.33μF (334)  | L    | L  | L  | L  |    |      | N   | N  | N  | N  |    |    |      | X   | X  | X  | X  |    |    |
|                     | 0.47μF (474)  | L    | L  |    |    |    |      | N   | N  | N  | N  | E  |    |      | X   | X  | X  | X  |    | X  |
|                     | 0.68μF (684)  |      |    |    |    |    |      | N   | N  |    |    |    |    |      | X   | X  | X  | X  |    |    |
|                     | 0.82μF (824)  |      |    |    |    |    |      |     |    |    |    |    |    |      | X   | X  | X  | X  |    |    |
|                     | 1.0μF (105)   | L    | L* | L* |    |    |      | N   | N  | N  | N  | E  |    |      | X   | X  | X  | X  | X  | X  |
|                     | 1.5μF (155)   |      |    |    |    |    |      |     |    |    |    |    |    |      | X   | X  |    |    |    |    |
| 2.2μF (225)         | L*            | L*   |    |    |    |    | N    | N   | E  | E  |    |    |    | X    | X   | X  | X  |    | X  |    |
| 3.3μF (335)         |               |      |    |    |    |    |      |     |    |    |    |    |    | X    | X   |    |    |    |    |    |
| 4.7μF (475)         |               |      |    |    |    |    | E    | E   | E* |    |    |    |    | X    | X   | X  | X  |    |    |    |
| 6.8μF (685)         |               |      |    |    |    |    |      |     |    |    |    |    |    |      |     |    |    |    |    |    |
| 10μF (106)          |               |      |    |    |    |    | E*   | E*  | E* |    |    |    |    | X    | X   | X  | X  | X  |    |    |
| 22μF (226)          |               |      |    |    |    |    | E*   | E*  |    |    |    |    |    | X*   | X*  | X* |    |    |    |    |
| 47μF (476)          |               |      |    |    |    |    |      |     |    |    |    |    |    | X*   | X*  |    |    |    |    |    |

| Dielectric          |             | X5R  |     |    |    |    |    |      |     |    |    |    |    |      |     |    |    |    |    |    |
|---------------------|-------------|------|-----|----|----|----|----|------|-----|----|----|----|----|------|-----|----|----|----|----|----|
| Size                |             | 0805 |     |    |    |    |    | 1206 |     |    |    |    |    | 1210 |     |    |    |    |    |    |
| Rated Voltage (VDC) |             | 4    | 6.3 | 10 | 16 | 25 | 50 | 4    | 6.3 | 10 | 16 | 25 | 50 | 4    | 6.3 | 10 | 16 | 25 | 35 | 50 |
| Capacitance         | 1.0μF (105) |      |     | D  | D  | D  | I  |      |     |    |    |    | P  |      |     |    |    |    |    |    |
|                     | 1.5μF (155) |      | I   | I  | I  | I  |    |      |     | J  | J  | P  | P  |      |     | K  | K  |    |    |    |
|                     | 2.2μF (225) |      | I   | I  | I  | I  | I  |      |     | J  | J  | P  | P  |      |     | K  | K  |    |    |    |
|                     | 3.3μF (335) |      | I   | I  | I  | I  |    |      |     | P  | P  | P  | P  |      |     |    |    |    |    |    |
|                     | 4.7μF (475) |      | I   | I  | I  | I  | I  |      | P   | P  | P  | P  | P  |      |     | K  | K  | K  |    |    |
|                     | 6.8μF (685) |      |     |    |    |    |    |      | P   | P  |    |    |    |      |     |    |    |    |    |    |
|                     | 10μF (106)  |      | I   | I  | I  | I  | I  |      | P   | P  | P  | P  | P  |      | K   | K  | K  | K  | M  | M  |
|                     | 22μF (226)  |      | I   | I* | I* | I* |    |      | P   | P  | P  | P  |    |      | M   | M  | M  | M  | M  |    |
|                     | 47μF (476)  | I*   | I*  | I* |    |    |    |      | P*  | P* | P* |    |    |      | M   | M  | M  | M* |    |    |
|                     | 100μF (107) | I*   | I*  |    |    |    |    |      | P   |    |    |    |    |      | M*  | M* | M* |    |    |    |
| 220μF (227)         |             |      |     |    |    |    | P* | P*   |     |    |    |    | M* | M*   |     |    |    |    |    |    |

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

2. The letter in cell with " \* " mark is expressed product not in 10% (code "K") tolerance.

Multilayer Ceramic Capacitors

7-5. X6S Dielectric 0201, 0402, 0603, 0805, 1206, 1210 Sizes

| Dielectric          |              | X6S  |     |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|---------------------|--------------|------|-----|----|----|----|------|----|----|----|------|-----|----|----|----|------|-----|----|----|----|----|------|----|----|----|----|------|----|----|----|----|----|---|--|--|
| Size                |              | 0201 |     |    |    |    | 0402 |    |    |    | 0603 |     |    |    |    | 0805 |     |    |    |    |    | 1206 |    |    |    |    | 1210 |    |    |    |    |    |   |  |  |
| Rated Voltage (VDC) |              | 4    | 6.3 | 10 | 16 | 25 | 6.3  | 10 | 16 | 25 | 4    | 6.3 | 10 | 16 | 25 | 4    | 6.3 | 10 | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 |    |   |  |  |
| Capacitance         | 0.10μF (104) | L    | L   | L  | L  | L  | N    |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 0.15μF (154) |      |     |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 0.22μF (224) |      | L   | L* |    |    | N    |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 0.33μF (334) |      |     |    |    |    | N    |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 0.47μF (474) | L    |     |    |    |    | N    |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 0.68μF (684) |      |     |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 1.0μF (105)  | L*   | L*  |    |    |    | N    | N  | N  | E  |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 1.5μF (155)  |      |     |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 2.2μF (225)  |      |     |    |    |    | E    | E  | E  |    |      | X   | X  | X  | X  |      |     |    | I  |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 3.3μF (335)  |      |     |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 4.7μF (475)  |      |     |    |    |    | E    | E  |    |    | X    | X   | X  | X  | X  |      |     |    |    | I  | I  |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 6.8uF (685)  |      |     |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    |    |    |   |  |  |
|                     | 10μF (106)   |      |     |    |    |    | E*   |    |    |    | X*   | X*  | X* | X* |    | I    | I   | I  | I  | I  |    |      |    |    | P  |    |      |    |    |    |    |    |   |  |  |
|                     | 22μF (226)   |      |     |    |    |    |      |    |    |    | X*   | X*  |    |    |    | I*   | I*  | I* | I* |    |    | P    | P* | P  |    |    |      |    |    |    | M  |    |   |  |  |
|                     | 47μF (476)   |      |     |    |    |    |      |    |    |    |      |     |    |    |    | I*   | I*  |    |    |    |    | P    |    |    |    |    |      |    |    |    | M  | M  | M |  |  |
| 100μF (107)         |              |      |     |    |    |    |      |    |    |    |      |     |    |    |    |      |     |    |    |    |    |      |    |    |    |    |      |    |    |    | M* | M* |   |  |  |

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with “\*” mark is expressed product not in 10% (code “K”) tolerance.

7-6. X7S Dielectric 0402, 0603, 0805, 1206, 1210 Sizes

| Dielectric          |             | X7S  |      |    |    |      |    |    |    |      |    |    |    |     |      |    |    |    |    |      |    |    |    |    |  |
|---------------------|-------------|------|------|----|----|------|----|----|----|------|----|----|----|-----|------|----|----|----|----|------|----|----|----|----|--|
| Size                |             | 0201 | 0402 |    |    | 0603 |    |    |    | 0805 |    |    |    |     | 1206 |    |    |    |    | 1210 |    |    |    |    |  |
| Rated Voltage (VDC) |             | 10V  | 6.3  | 10 | 16 | 6.3  | 10 | 16 | 25 | 10   | 16 | 25 | 50 | 100 | 6.3  | 10 | 16 | 25 | 50 | 6.3  | 10 | 16 | 25 | 50 |  |
| Capacitance         | 0.1μF (104) | L    |      |    |    |      |    |    |    |      |    |    |    | I   |      |    |    |    |    |      |    |    |    |    |  |
|                     | 1.0μF (105) |      |      | E  |    |      |    | X  |    |      |    |    |    |     |      |    |    |    |    |      |    |    |    |    |  |
|                     | 1.5μF (155) |      |      |    |    |      |    |    |    |      |    |    |    |     |      |    |    |    |    |      |    |    |    |    |  |
|                     | 2.2μF (225) |      | E    | E  |    |      |    |    | X  |      |    |    |    |     |      |    |    |    |    |      |    |    |    |    |  |
|                     | 3.3μF (335) |      |      |    |    |      |    |    |    |      |    |    |    |     |      |    |    |    |    |      |    |    |    |    |  |
|                     | 4.7μF (475) |      |      |    |    |      | X  | X  |    |      |    |    |    | I   |      |    |    |    |    |      |    |    |    |    |  |
|                     | 6.8uF (685) |      |      |    |    |      |    |    |    |      |    |    |    |     |      |    |    |    |    |      |    |    |    |    |  |
|                     | 10μF (106)  |      |      |    |    |      |    |    |    |      |    |    |    | I   | I    |    |    |    |    |      |    |    |    |    |  |
|                     | 22μF (226)  |      |      |    |    |      |    |    |    |      |    |    |    |     |      |    |    |    | P* |      |    |    |    |    |  |
|                     | 47μF (476)  |      |      |    |    |      |    |    |    |      |    |    |    |     |      | P* |    |    |    |      |    |    |    |    |  |
| 100μF (107)         |             |      |      |    |    |      |    |    |    |      |    |    |    |     |      |    |    |    |    |      |    |    | M* |    |  |

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with “\*” mark is expressed product not in 10% (code “K”) tolerance.

## 8. PACKAGING STYLE AND QUANTITY

| Size        | Thickness (mm)/Symbol |   | Paper tape |          | Plastic tape |          |
|-------------|-----------------------|---|------------|----------|--------------|----------|
|             |                       |   | 7" reel    | 13" reel | 7" reel      | 13" reel |
| 0201 (0603) | 0.30±0.03             | L | 15,000     | 70,000   | -            | -        |
|             | 0.30±0.05             | L | 15,000     | 50,000   | -            | -        |
|             | 0.30±0.09             | L | 15,000     | 50,000   | -            | -        |
| 0402 (1005) | 0.50±0.05             | N | 10,000     | 50,000   | -            | -        |
|             | 0.50±0.02/-0.05       | Q | 10,000     | 50,000   | -            | -        |
|             | 0.50±0.20             | E | 10,000     | -        | -            | -        |
| 0603 (1608) | 0.50±0.10             | H | 4,000      | -        | -            | -        |
|             | 0.80±0.07             | S | 4,000      | 15,000   | -            | -        |
|             | 0.80±0.15/-0.10       | X | 4,000      | 15,000   | -            | -        |
| 0805 (2012) | 0.50±0.10             | H | 4,000      | 15,000   | -            | -        |
|             | 0.60±0.10             | A | 4,000      | 15,000   | -            | -        |
|             | 0.80±0.10             | B | 4,000      | 15,000   | -            | -        |
|             | 0.85±0.10             | T | 4,000      | 15,000   | -            | -        |
|             | 1.25±0.10             | D | -          | -        | 3,000        | 10,000   |
|             | 1.25±0.20             | I | -          | -        | 3,000        | 10,000   |
| 1206 (3216) | 0.80±0.10             | B | 4,000      | 15,000   | -            | -        |
|             | 0.85±0.10             | T | 4,000      | 15,000   | -            | -        |
|             | 0.95±0.10             | C | -          | -        | 3,000        | 10,000   |
|             | 1.15±0.15             | J | -          | -        | 3,000        | 10,000   |
|             | 1.25±0.10             | D | -          | -        | 3,000        | 10,000   |
|             | 1.60±0.20             | G | -          | -        | 2,000        | 10,000   |
| 1210 (3225) | 1.60±0.30/-0.10       | P | -          | -        | 2,000        | 9,000    |
|             | 0.85±0.10             | T | -          | -        | 3,000        | 10,000   |
|             | 0.95±0.10             | C | -          | -        | 3,000        | 10,000   |
|             | 1.25±0.10             | D | -          | -        | 3,000        | 10,000   |
|             | 1.60±0.20             | G | -          | -        | 2,000        | -        |
|             | 2.00±0.20             | K | -          | -        | 1,000        | 6,000    |
| 1808 (4520) | 2.50±0.30             | M | -          | -        | 1,000        | 6,000    |
|             | 1.25±0.10             | D | -          | -        | 2,000        | 10,000   |
|             | 1.40±0.15             | F | -          | -        | 2,000        | 10,000   |
|             | 1.60±0.20             | G | -          | -        | 2,000        | 8,000    |
| 1812 (4532) | 2.00±0.20             | K | -          | -        | 1,000        | 6,000    |
|             | 1.25±0.10             | D | -          | -        | 1,000        | 5,000    |
|             | 1.60±0.20             | G | -          | -        | 1,000        | -        |
|             | 2.00±0.20             | K | -          | -        | 1,000        | -        |
|             | 2.50±0.30             | M | -          | -        | 500          | 3,000    |
|             | 2.80±0.30             | U | -          | -        | 500          | -        |

Unit: pieces

Multilayer Ceramic Capacitors

9. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.    | Item                            | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|--------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------|---------------------|--------|--------|--------------------|-------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|-----|--------|--------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------|-----|--------|-----------------------------------------------------------|-----|--------|---------------------------------------------|--------------------|--------------------------------------------------------------------------------------------|---------------------------------|-----|--------|----------------------------------------------------------------------------------------------|-----|------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------|-------|-----------------------------------------------|------------------------------------------------------------------------------------|--------------------|--------------------|-----|-------|-----|
| 1.     | Visual and Mechanical           | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | * No remarkable defect.<br>* Dimensions to conform to individual specification sheet.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| 2.     | Capacitance                     | *Test temp.: Room Temperature.<br>*Class I: (NP0)<br>≤1000pF, 1.0±0.2Vrms · 1MHz±10%<br>> 1000pF, 1.0±0.2Vrms · 1KHz±10%<br>Class II: (X7R, X7E, X6S, X5R,X7S)<br>C≤10μF, 1.0±0.2Vrms · 1KHz±10% **<br>C>10μF, 0.5±0.2Vrms · 120Hz±20%                                                                                                                                                                                                                                                                                                                                                                          | * Shall not exceed the limits given in the detailed spec.<br>NP0: Cap≥30pF, Q≥1000; Cap<30pF,Q≥400+20C<br>X7R:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| 3.     | Q/ D.F.<br>(Dissipation Factor) | ** Test condition: 0.5±0.2Vrms · 1KHz±10%<br>X7R:<br>0603/475(6.3V)<br>X5R <sup>#1</sup> :<br>0201 ≥ 224 (6.3V,10V,16V),<br>0402 ≥ 475 (6.3V,16V), 0402 ≥ 225(10V),<br>0603=106 (6.3V)<br>TT18X ≥ 475(10V) , TT15X series<br>X6S:<br>0201/474(4V),0201>104 (6.3V,10V),<br>0402 ≥ 225 (6.3V),<br>0402/475 (10V), 0603/106 (6.3V),<br>X7S:<br>0402/225(6.3V)<br><br>#1 Excluding<br>X5R/0201/105(6.3V);225(10V);224(16V),<br>0402X475M6R3, 0402X106M100<br>(1.0±0.2Vrms · 1KHz±10%)<br><br>*Before initial measurement (Class II only):<br>To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. | <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td rowspan="4">≥ 100V</td><td rowspan="4">≤ 2.5%</td><td>≤ 3% 1206 ≥ 0.47μF</td></tr><tr><td>≤ 3.5% 1812 ≥ 4.7μF;1825≥4.7μF;2220≥4.7μF;2225≥4.7μF</td></tr><tr><td>≤ 5% 0603 ≥ 0.068μF; 0805 &gt; 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF;</td></tr><tr><td>≤ 10% 0805 &gt; 0.22μF; 1210 ≥ 3.3μF</td></tr><tr><td rowspan="4">50V</td><td rowspan="4">≤ 2.5%</td><td>≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td></tr><tr><td>≤ 3.5% 1812 ≥ 4.7μF;1825≥4.7μF;2220≥4.7μF;2225≥4.7μF</td></tr><tr><td>≤ 5% 0201 ≥ 0.01uF; 0402≥0.012μF; 1210 ≥ 3.3μF</td></tr><tr><td>≤ 10% 0402&gt;0.047μF; 0603&gt;0.1μF; 0805/X7R&gt;0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td>35V</td><td>≤ 3.5%</td><td>≤ 10% 0603 ≥ 1μF; 0805≥2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td rowspan="4">25V</td><td rowspan="4">≤ 3.5%</td><td>≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF</td></tr><tr><td>≤ 7% 0603 ≥ 0.33μF</td></tr><tr><td>≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr><tr><td>≤ 12.5% 0402 ≥ 0.33μF</td></tr><tr><td>16V</td><td>≤ 3.5%</td><td>≤ 5% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td></tr><tr><td rowspan="4">10V</td><td rowspan="4">≤ 5%</td><td>≤ 10% 0201/X7R ≥ 0.022μF; 0402 ≥ 0.15uF; 0603&gt;0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr><tr><td>≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF</td></tr><tr><td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF</td></tr><tr><td>≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF</td></tr><tr><td>6.3V</td><td>≤ 10%</td><td>≤ 15% 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF</td></tr><tr><td rowspan="4">4V</td><td rowspan="4">≤ 15%</td><td>≤ 20% 0402 ≥ 2.2μF</td></tr><tr><td>---</td></tr><tr><td>---</td></tr><tr><td>---</td></tr></table> | Rated vol. | D.F. ≤                                                                                        | Exception of D.F. ≤ | ≥ 100V | ≤ 2.5% | ≤ 3% 1206 ≥ 0.47μF | ≤ 3.5% 1812 ≥ 4.7μF;1825≥4.7μF;2220≥4.7μF;2225≥4.7μF        | ≤ 5% 0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF; | ≤ 10% 0805 > 0.22μF; 1210 ≥ 3.3μF                            | 50V | ≤ 2.5% | ≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF | ≤ 3.5% 1812 ≥ 4.7μF;1825≥4.7μF;2220≥4.7μF;2225≥4.7μF                   | ≤ 5% 0201 ≥ 0.01uF; 0402≥0.012μF; 1210 ≥ 3.3μF | ≤ 10% 0402>0.047μF; 0603>0.1μF; 0805/X7R>0.47μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | 35V | ≤ 3.5% | ≤ 10% 0603 ≥ 1μF; 0805≥2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF   | 25V | ≤ 3.5% | ≤ 5% 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF | ≤ 7% 0603 ≥ 0.33μF | ≤ 10% 0201 ≥ 0.1μF; 0402 ≥ 0.056μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF | ≤ 12.5% 0402 ≥ 0.33μF           | 16V | ≤ 3.5% | ≤ 5% 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF | 10V | ≤ 5% | ≤ 10% 0201/X7R ≥ 0.022μF; 0402 ≥ 0.15uF; 0603>0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF | ≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.15μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF | ≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF                                                                        | ≤ 15% 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF | 6.3V | ≤ 10% | ≤ 15% 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF | 4V                                                                                 | ≤ 15%              | ≤ 20% 0402 ≥ 2.2μF | --- | ---   | --- |
|        |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Rated vol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | D.F. ≤     | Exception of D.F. ≤                                                                           |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
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|        |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td rowspan="4">≥ 100V</td><td rowspan="4">≤ 2.5%</td><td>≤ 3% 1206 ≥ 0.47μF</td></tr><tr><td>≤ 5% 0603 ≥ 0.068μF; 0805 &gt; 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF</td></tr><tr><td>≤ 10% 0805 &gt; 0.22μF; 1210 ≥ 3.3μF</td></tr><tr><td>≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF</td></tr><tr><td rowspan="4">50V</td><td rowspan="4">≤ 2.5%</td><td>≤ 5% 0201 ≥ 0.01uF; 0402 ≥ 0.012μF;1210 ≥ 3.3μF</td></tr><tr><td>≤ 10% 0402 ≥ 0.047μF; 0603&gt;0.1μF; 0805 ≥ 1μF;1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td>≤ 12.5% 1206=10μF</td></tr><tr><td>≤ 3.5% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td>35V</td><td>≤ 3.5%</td><td>≤ 10% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF</td></tr><tr><td rowspan="4">25V</td><td rowspan="4">≤ 3.5%</td><td>≤ 5% 0201=0.01μF; 0805 ≥ 1μF</td></tr><tr><td>≤ 7% 0603 ≥ 0.33μF</td></tr><tr><td>≤ 10% 0201&gt;0.01μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF</td></tr><tr><td>≤ 12.5% 0402 ≥ 0.33μF;0805=10μF</td></tr><tr><td>16V</td><td>≤ 3.5%</td><td>≤ 5% 0201=0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF</td></tr><tr><td rowspan="4">10V</td><td rowspan="4">≤ 5%</td><td>≤ 10% 0201&gt;0.01uF; 0402 ≥ 0.22uF; 0603&gt;0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF</td></tr><tr><td>≤ 12.5% 0402 ≥ 1μF;0805=10μF</td></tr><tr><td>≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5/X5R</td></tr><tr><td>≤ 12.5% 0805=10μF</td></tr><tr><td rowspan="4">6.3V</td><td rowspan="4">≤ 10%</td><td>≤ 15% 0201&gt;0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF</td></tr><tr><td>≤ 15% 0201&gt;0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF</td></tr><tr><td>≤ 20% 0402 ≥ 2.2μF</td></tr><tr><td>---</td></tr><tr><td>4V</td><td>≤ 15%</td><td>---</td></tr></table>                          | Rated vol. | D.F. ≤                                                                                        | Exception of D.F. ≤ | ≥ 100V | ≤ 2.5% | ≤ 3% 1206 ≥ 0.47μF | ≤ 5% 0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF | ≤ 10% 0805 > 0.22μF; 1210 ≥ 3.3μF                            | ≤ 3% 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF | 50V | ≤ 2.5% | ≤ 5% 0201 ≥ 0.01uF; 0402 ≥ 0.012μF;1210 ≥ 3.3μF              | ≤ 10% 0402 ≥ 0.047μF; 0603>0.1μF; 0805 ≥ 1μF;1206 ≥ 2.2μF; 1210 ≥ 10μF | ≤ 12.5% 1206=10μF                              | ≤ 3.5% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                 | 35V | ≤ 3.5% | ≤ 10% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF | 25V | ≤ 3.5% | ≤ 5% 0201=0.01μF; 0805 ≥ 1μF                | ≤ 7% 0603 ≥ 0.33μF | ≤ 10% 0201>0.01μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF   | ≤ 12.5% 0402 ≥ 0.33μF;0805=10μF | 16V | ≤ 3.5% | ≤ 5% 0201=0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF   | 10V | ≤ 5% | ≤ 10% 0201>0.01uF; 0402 ≥ 0.22uF; 0603>0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF        | ≤ 12.5% 0402 ≥ 1μF;0805=10μF                                                                | ≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5/X5R | ≤ 12.5% 0805=10μF                                                                    | 6.3V | ≤ 10% | ≤ 15% 0201>0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF     | ≤ 15% 0201>0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF | ≤ 20% 0402 ≥ 2.2μF | ---                | 4V  | ≤ 15% | --- |
|        |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Rated vol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | D.F. ≤     | Exception of D.F. ≤                                                                           |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| ≥ 100V | ≤ 2.5%                          | ≤ 3% 1206 ≥ 0.47μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 5% 0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 10% 0805 > 0.22μF; 1210 ≥ 3.3μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
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| 50V    | ≤ 2.5%                          | ≤ 5% 0201 ≥ 0.01uF; 0402 ≥ 0.012μF;1210 ≥ 3.3μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 10% 0402 ≥ 0.047μF; 0603>0.1μF; 0805 ≥ 1μF;1206 ≥ 2.2μF; 1210 ≥ 10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 12.5% 1206=10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 3.5% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| 35V    | ≤ 3.5%                          | ≤ 10% 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| 25V    | ≤ 3.5%                          | ≤ 5% 0201=0.01μF; 0805 ≥ 1μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 7% 0603 ≥ 0.33μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 10% 0201>0.01μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 12.5% 0402 ≥ 0.33μF;0805=10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| 16V    | ≤ 3.5%                          | ≤ 5% 0201=0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| 10V    | ≤ 5%                            | ≤ 10% 0201>0.01uF; 0402 ≥ 0.22uF; 0603>0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 12.5% 0402 ≥ 1μF;0805=10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 10% 0201 ≥ 0.012μF; 0402 ≥ 0.22μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF; 01R5/X5R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 12.5% 0805=10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| 6.3V   | ≤ 10%                           | ≤ 15% 0201>0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 15% 0201>0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ≤ 20% 0402 ≥ 2.2μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
|        |                                 | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |
| 4V     | ≤ 15%                           | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                                                               |                     |        |        |                    |                                                             |                                                              |                                                              |     |        |                                                              |                                                                        |                                                |                                                                            |     |        |                                                           |     |        |                                             |                    |                                                                                            |                                 |     |        |                                                                                              |     |      |                                                                                               |                                                                                             |                                                                                                       |                                                                                      |      |       |                                               |                                                                                    |                    |                    |     |       |     |

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

Multilayer Ceramic Capacitors

| No. | Item                               | Test Condition                                                                                                | Requirements                                       |        |                     |                                                                                            |
|-----|------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------|--------|---------------------|--------------------------------------------------------------------------------------------|
|     | Q/ D.F.<br>(Dissipation<br>Factor) |                                                                                                               | X6S:                                               |        |                     |                                                                                            |
|     |                                    |                                                                                                               | Rated<br>vol.                                      | D.F. ≤ | Exception of D.F. ≤ |                                                                                            |
|     |                                    |                                                                                                               | ≥ 100V                                             | ≤ 2.5% | ≤ 3%                | 1206 ≥ 0.47μF                                                                              |
|     |                                    |                                                                                                               |                                                    |        | ≤ 5%                | 0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF                                     |
|     |                                    |                                                                                                               |                                                    |        | ≤ 10%               | 0805 > 0.22μF; 1210 ≥ 3.3μF                                                                |
|     |                                    |                                                                                                               | 50V                                                | ≤ 2.5% | ≤ 3%                | 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF                                    |
|     |                                    |                                                                                                               |                                                    |        | ≤ 5%                | 0201 ≥ 0.01μF; 1210 ≥ 3.3μF                                                                |
|     |                                    |                                                                                                               |                                                    |        | ≤ 10%               | 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF;<br>1206 ≥ 2.2μF; 1210 ≥ 10μF                     |
|     |                                    |                                                                                                               | 35V                                                | ≤ 3.5% | ≤ 10%               | 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                        |
|     |                                    |                                                                                                               | 25V                                                | ≤ 3.5% | ≤ 5%                | 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF                                                     |
|     |                                    |                                                                                                               |                                                    |        | ≤ 7%                | 0603 ≥ 0.33μF                                                                              |
|     |                                    |                                                                                                               |                                                    |        | ≤ 10%               | 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF;<br>0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF     |
|     |                                    |                                                                                                               |                                                    |        | ≤ 12.5%             | 0402 ≥ 0.33μF; 0805 = 10μF                                                                 |
|     |                                    |                                                                                                               | 16V                                                | ≤ 3.5% | ≤ 5%                | 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF;<br>0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF |
|     |                                    |                                                                                                               |                                                    |        | ≤ 10%               | 0201 ≥ 0.1μF; 0402 ≥ 0.22μF;<br>0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF     |
|     |                                    |                                                                                                               |                                                    |        | ≤ 12.5%             | 0402 = 1μF; 0805 = 10μF                                                                    |
|     |                                    |                                                                                                               | 10V                                                | ≤ 5%   | ≤ 10%               | 0201 ≥ 0.012μF; 0402 ≥ 0.22μF;<br>0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF   |
|     |                                    |                                                                                                               |                                                    |        | ≤ 12.5%             | 0805 = 10μF                                                                                |
|     |                                    |                                                                                                               |                                                    |        | ≤ 15%               | 0201 ≥ 0.1μF; 0402 ≥ 1μF                                                                   |
|     |                                    |                                                                                                               | 6.3V                                               | ≤ 10%  | ≤ 15%               | 0201 ≥ 0.1μF; 0402 ≥ 0.47μF; 0603 ≥ 10μF;<br>0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF       |
|     |                                    |                                                                                                               | 4V                                                 | ≤ 15%  | ≤ 20%               | 0402 ≥ 2.2μF                                                                               |
|     |                                    |                                                                                                               | X7S:                                               |        |                     |                                                                                            |
|     |                                    |                                                                                                               | Rated<br>vol.                                      | D.F. ≤ | Exception of D.F. ≤ |                                                                                            |
|     |                                    |                                                                                                               | ≥ 100V                                             | ≤ 2.5% | ≤ 3%                | 1206 ≥ 0.47μF                                                                              |
|     |                                    |                                                                                                               |                                                    |        | ≤ 5%                | 0603 ≥ 0.068μF; 0805 > 0.1μF; 1206 ≥ 1μF; 1210 ≥ 2.2μF                                     |
|     |                                    |                                                                                                               |                                                    |        | ≤ 10%               | 0805 > 0.22μF; 1210 ≥ 3.3μF                                                                |
|     |                                    |                                                                                                               | 50V                                                | ≤ 2.5% | ≤ 3%                | 0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.18μF; 1206 ≥ 0.47μF                                    |
|     |                                    |                                                                                                               |                                                    |        | ≤ 5%                | 0201 ≥ 0.01μF; 1210 ≥ 3.3μF                                                                |
|     |                                    |                                                                                                               |                                                    |        | ≤ 10%               | 0402 ≥ 0.012μF; 0603 > 0.1μF; 0805 ≥ 1μF;<br>1206 ≥ 2.2μF; 1210 ≥ 10μF                     |
|     |                                    |                                                                                                               | 35V                                                | ≤ 3.5% | ≤ 10%               | 0603 ≥ 1μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 10μF                                        |
|     |                                    |                                                                                                               | 25V                                                | ≤ 3.5% | ≤ 5%                | 0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF                                                     |
|     |                                    |                                                                                                               |                                                    |        | ≤ 7%                | 0603 ≥ 0.33μF                                                                              |
|     |                                    |                                                                                                               |                                                    |        | ≤ 10%               | 0201 ≥ 0.1μF; 0402 ≥ 0.10μF; 0603 ≥ 0.47μF;<br>0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF     |
|     |                                    |                                                                                                               |                                                    |        | ≤ 12.5%             | 0402 ≥ 0.33μF                                                                              |
|     |                                    |                                                                                                               | 16V                                                | ≤ 3.5% | ≤ 5%                | 0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 0.15μF;<br>0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF |
|     |                                    |                                                                                                               |                                                    |        | ≤ 10%               | 0201 ≥ 0.1μF; 0402 ≥ 0.22μF;<br>0603 > 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF     |
|     |                                    |                                                                                                               |                                                    |        | ≤ 12.5%             | 0402 = 1μF; 0805 = 10μF                                                                    |
|     |                                    |                                                                                                               | 10V                                                | ≤ 5%   | ≤ 10%               | 0201 ≥ 0.012μF; 0402 ≥ 0.22μF;<br>0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF   |
|     |                                    |                                                                                                               |                                                    |        | ≤ 12.5%             | 0805 = 10μF                                                                                |
|     |                                    |                                                                                                               |                                                    |        | ≤ 15%               | 0201 ≥ 0.1μF; 0402 ≥ 1μF                                                                   |
|     |                                    |                                                                                                               | 6.3V                                               | ≤ 10%  | ≤ 15%               | 0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF;<br>0805 ≥ 4.7μF; 1206 ≥ 47μF; 1210 ≥ 100μF          |
|     |                                    |                                                                                                               | 4V                                                 | ≤ 15%  | ≤ 20%               | 0402 ≥ 2.2μF                                                                               |
| 4.  | Dielectric<br>Strength             | * To apply voltage (≤100V) 250%.<br>* Duration: 1 to 5 sec.<br>* Charge and discharge current less than 50mA. | * No evidence of damage or flash over during test. |        |                     |                                                                                            |

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

| No                                                                                                                  | Item                    | Test Condition                                                                               | Requirements                                                                                                                                                        |                                                             |                                                                                                               |                              |
|---------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|------------------------------|
| 5.                                                                                                                  | Insulation Resistance   | *Test temp.: Room Temperature.<br>*To apply rated voltage for MAX. 120sec.                   | 10GΩ or $RxC \geq 500\Omega \cdot F$ whichever is smaller.<br>Class II (X7R, X7E, X5R,X6S,X7S,Y5V:)                                                                 |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | Rated voltage                                                                                                                                                       | Insulation Resistance                                       |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 100V: All X7R                                                                                                                                                       | 10GΩ or $RxC \geq 100 \Omega \cdot F$ whichever is smaller. |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 50V: 0402 $\geq 0.01\mu F$ ; 0603 $\geq 1\mu F$ ; 0805 $\geq 1\mu F$ ; 1206 $\geq 4.7\mu F$ ; 1210 $\geq 4.7\mu F$                                                  |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 35V: 0805 $\geq 2.2\mu F$ ; 1206 $\geq 2.2\mu F$ ; 1210 $\geq 10\mu F$                                                                                              |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 25V: 0402 $\geq 1\mu F$ ; 0603 $\geq 2.2\mu F$ ; 0805 $\geq 2.2\mu F$ ; 1206 $\geq 10\mu F$ ; 1210 $\geq 10\mu F$                                                   |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 16V: 0201 $\geq 0.1\mu F$ ; 0402 $\geq 0.22\mu F$ ; 0603 $\geq 1\mu F$ ; 0805 $\geq 2.2\mu F$ ; 1206 $\geq 10\mu F$ ; 1210 $\geq 4.7\mu F$                          |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 10V: 0201 $\geq 47nF$ ; 0402 $\geq 0.47\mu F$ ; 0603 $\geq 0.47\mu F$ ; 0805 $\geq 2.2\mu F$ ; 1206 $\geq 4.7\mu F$ ; 1210 $\geq 4.7\mu F$                          |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 6.3V ; 4V ; Size $\geq 1812$                                                                                                                                        |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | Rated voltage                                                                                                                                                       | Insulation Resistance                                       |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | All X6S items, All X7S items                                                                                                                                        | $RxC \geq 50 \Omega \cdot F$ .                              |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 100V: 1210 $\geq 3.3\mu F$                                                                                                                                          |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 50V: 0402 $\geq 0.1\mu F$ ; 0603 $\geq 2.2\mu F$ ; 0805 $\geq 10\mu F$ ; 1206 $\geq 10\mu F$                                                                        |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 35V: 0603 $\geq 1\mu F$ ;                                                                                                                                           |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 25V: 0201 $\geq 0.1\mu F$ ; 0402 $\geq 2.2\mu F$ ; 0603 $\geq 10\mu F$ ; 0805 $\geq 10\mu F$ ; 1206 $\geq 22\mu F$                                                  |                                                             |                                                                                                               |                              |
| 16V: 0603 $\geq 10\mu F$ ; 0402 $\geq 1\mu F$ ; 0201 $\geq 0.22\mu F$                                               |                         |                                                                                              |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| 10V: 0201 $\geq 0.1\mu F$ ; 0402 $\geq 1\mu F$ ; 0603 $\geq 10\mu F$ ; 0805 $\geq 4.7\mu F$                         |                         |                                                                                              |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| 6.3V: 0201 $\geq 0.1\mu F$ ; 0402 $\geq 1\mu F$ ; 0603 $\geq 4.7\mu F$ ; 0805 $\geq 4.7\mu F$ ; 1206 $\geq 10\mu F$ |                         |                                                                                              |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| 4V: 0603 $\geq 22\mu F$ ; 0805 $\geq 4.7\mu F$ ; 1206 $\geq 100\mu F$                                               |                         |                                                                                              |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| 6.                                                                                                                  | Temperature Coefficient | With no electrical load.                                                                     | T.C.                                                                                                                                                                | Operating Temp                                              | T.C.                                                                                                          | Capacitance Change           |
|                                                                                                                     |                         |                                                                                              | NPO                                                                                                                                                                 | -55~125°C at 25°C                                           | NPO                                                                                                           | Within $\pm 30ppm/^{\circ}C$ |
|                                                                                                                     |                         |                                                                                              | X7R                                                                                                                                                                 | -55~125°C at 25°C                                           | X7R                                                                                                           | Within $\pm 15\%$            |
|                                                                                                                     |                         |                                                                                              | X7S                                                                                                                                                                 | -55 ~ 125°C at 25°C                                         | X7S                                                                                                           | Within $\pm 22\%$            |
|                                                                                                                     |                         |                                                                                              | X5R                                                                                                                                                                 | -55~ 85°C at 25°C                                           | X5R                                                                                                           | Within $\pm 15\%$            |
|                                                                                                                     |                         |                                                                                              | X6S                                                                                                                                                                 | -55~105°C at 25°C                                           | X6S                                                                                                           | Within $\pm 22\%$            |
|                                                                                                                     |                         |                                                                                              | *Before initial measurement (Class II only):<br>To apply de-aging at 150°C for 1hr then set for 24 $\pm$ 2 hrs at room temp.<br>* Measurement voltage for Class II: |                                                             |                                                                                                               |                              |
|                                                                                                                     |                         |                                                                                              | 01005                                                                                                                                                               |                                                             | 0201                                                                                                          |                              |
|                                                                                                                     |                         |                                                                                              | Cap $\leq 0.01\mu F$ : 0.5V                                                                                                                                         |                                                             | Cap $\leq 0.1\mu F$ : 1V                                                                                      |                              |
|                                                                                                                     |                         |                                                                                              | Cap $\leq 0.01\mu F$ : 0.2V                                                                                                                                         |                                                             | 0.1 $\mu F \leq$ Cap $\leq 1\mu F$ : 0.2V*                                                                    |                              |
|                                                                                                                     |                         |                                                                                              |                                                                                                                                                                     |                                                             | Cap $\geq 1\mu F$ : 0.1V*                                                                                     |                              |
|                                                                                                                     |                         |                                                                                              | *0201X104/6.3V~25V: 0.5V<br>0201X224/10V~25V: 0.5V                                                                                                                  |                                                             | *0201B104/6.3V~10V: 0.3V<br>0201S104/6.3V~16V: 0.3V<br>0201S224/6.3V: 0.3V<br>0201X334/474/105-6.3V&10V: 0.3V |                              |
|                                                                                                                     |                         |                                                                                              | 0402                                                                                                                                                                |                                                             | 0603                                                                                                          |                              |
|                                                                                                                     |                         |                                                                                              | Cap $\leq 1\mu F$ : 1V                                                                                                                                              |                                                             | Cap $\leq 1\mu F$ : 1V                                                                                        |                              |
|                                                                                                                     |                         |                                                                                              | Cap $= 1\mu F$ : 0.5V**<br>0402B224-16V: 0.5V<br>0402B334/474-6.3V&10V: 0.5V<br>0402S334/474-6.3V: 0.5V<br>0402X225/475-6.3V: 0.5V                                  |                                                             | 1 $\mu F \leq$ Cap $\leq 4.7\mu F$ : 0.5V<br>0603X106-10V: 0.5V                                               |                              |
| 1 $\mu F <$ Cap $\leq 10\mu F$ : 0.2V<br>**0402B105M6R3V: 0.2V                                                      |                         | Cap $> 4.7\mu F$ : 0.2V                                                                      |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| Cap $\geq 10\mu F$ : 0.1V                                                                                           |                         |                                                                                              |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| 0805                                                                                                                |                         | 1206/1210                                                                                    |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| Cap $\leq 10\mu F$ : 1V                                                                                             |                         | Cap $\leq 10\mu F$ : 1V                                                                      |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| Cap $= 10\mu F$ : 0.5V<br>0805B475/6.3V~25V: 0.5V                                                                   |                         | 10 $\mu F <$ Cap $\leq 100\mu F$ : 0.5V                                                      |                                                                                                                                                                     |                                                             |                                                                                                               |                              |
| Cap $> 10\mu F$ : 0.2V                                                                                              |                         | Cap $> 100\mu F$ : 0.2V<br>1206X107-6.3V: 0.2V<br>1206A476-6.3V: 0.1V<br>1210S107-6.3V: 0.2V |                                                                                                                                                                     |                                                             |                                                                                                               |                              |

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

Multilayer Ceramic Capacitors

Approval Sheet

| No.  | Item                             | Test Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Requirements                                                                                                                                                                                                                                                                                                                |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                                                                               |
|------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|---|----------------------------|------|---|------------|-----|---|----------------------------|------|---|------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7.   | Adhesive Strength of Termination | <ul style="list-style-type: none"><li>* Pressurizing force : 2N (0201) and 5N (≤0603) and 10N (&gt;0603)</li><li>* Test time: 10±1 sec.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"><li>* No remarkable damage or removal of the terminations.</li></ul>                                                                                                                                                                                                                      |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                                                                               |
| 8.   | Vibration Resistance             | <ul style="list-style-type: none"><li>* Vibration frequency: 10~55 Hz/min.</li><li>* Total amplitude: 1.5mm</li><li>* Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)</li><li>* Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li><li>* Cap./DF(Q) Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li></ul>                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"><li>* No remarkable damage.</li><li>* Cap change and Q/D.F.: To meet initial spec.</li></ul>                                                                                                                                                                                              |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                                                                               |
| 9.   | Solderability                    | <ul style="list-style-type: none"><li>* Solder temperature: 235±5°C</li><li>* Dipping time: 2±0.5 sec.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 95% min. coverage of all metalized area.                                                                                                                                                                                                                                                                                    |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                                                                               |
| 10.  | Bending Test                     | <ul style="list-style-type: none"><li>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec.</li><li>* Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li><li>* Measurement to be made after keeping at room temp. for 24±2 hrs.</li></ul>                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"><li>* No remarkable damage.</li><li>* Cap change : NP0: within ±5% or 0.5pF whichever is larger X7R, X5R, X6S, X7S: within ±12.5% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</li></ul> |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                                                                               |
| 11.  | Resistance to Soldering Heat     | <ul style="list-style-type: none"><li>* Solder temperature: 260±5°C</li><li>* Dipping time: 10±1 sec</li><li>* Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.</li><li>* Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li><li>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li></ul>                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"><li>* No remarkable damage.</li><li>* Cap change: NP0: within ±2.5% or 0.25pF whichever is larger X7R, X5R, X6S, X7S: within ±7.5%</li><li>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</li><li>* 25% max. leaching on each edge.</li></ul>                      |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                                                                               |
| 12.  | Temperature Cycle                | <ul style="list-style-type: none"><li>* Conduct the five cycles according to the temperatures and time.</li></ul> <table><tr><th>Step</th><th>Temp. (°C)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. operating temp. +0/-3</td><td>30±3</td></tr><tr><td>2</td><td>Room temp.</td><td>2~3</td></tr><tr><td>3</td><td>Max. operating temp. +3/-0</td><td>30±3</td></tr><tr><td>4</td><td>Room temp.</td><td>2~3</td></tr></table> <ul style="list-style-type: none"><li>* Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li><li>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li></ul> | 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 | <ul style="list-style-type: none"><li>* No remarkable damage.</li><li>* Cap change : NP0: within ±2.5% or 0.25pF whichever is larger X7R, X5R, X6S, X7S: within ±7.5%</li><li>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</li></ul> |
| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                             |            |             |   |                            |      |   |            |     |   |                            |      |   |            |     |                                                                                                                                                                                                                                                               |

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

Multilayer Ceramic Capacitors

| No.                                                                      | Item                                       | Test Condition                                                                                                                                                                                                                                                                                                                            | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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|                                                    |      |              |      |                                                                                                                                          |      |              |     |     |      |                                                   |     |       |      |                                                                                               |      |                                                                                                |      |      |      |                                                                                        |    |      |     |     |               |                       |                          |                                            |                                                          |                                                 |                                                                          |                                                                       |                                                                        |                                          |
|--------------------------------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------|---------------------|--|-------|-----|-----|--------------|-----|------------------------------------------------|-------|------------------------------------------------|------|--------------------------|-----|-----|-----|---------------------------------------------------|-----|------------------------------------------------|------|-----------------------------------------|------|------------------------------------------------------------------------------|-----|-----|------|---------------------------------------------|-----|-----|------|----------------------------------------------------|------|--------------|------|------------------------------------------------------------------------------------------------------------------------------------------|------|--------------|-----|-----|------|---------------------------------------------------|-----|-------|------|-----------------------------------------------------------------------------------------------|------|------------------------------------------------------------------------------------------------|------|------|------|----------------------------------------------------------------------------------------|----|------|-----|-----|---------------|-----------------------|--------------------------|--------------------------------------------|----------------------------------------------------------|-------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------|
| 13.                                                                      | Humidity (Damp Heat) Steady State          | <p>*Test temp.: 40±2°C</p> <p>*Humidity: 90~95%RH</p> <p>*Test time: 500+24/-0hrs.</p> <p>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p> | <p>* No remarkable damage.</p> <p>* Cap change:<br/>NP0: within ±5% or 0.5pF whichever is larger<br/>X7R, X5R, X6S, X7S: ≥10V**,within ±12.5%; ≤6.3V within ±25%;<br/>**10V: 0603 ≥4.7μF;0402 ≥1μF;0201 ≥0.1μF, within ±25%;</p> <p>* Q/D.F. value:<br/>NP0: More than 30pF Q≥350, 10pF≤C≤30pF, Q≥275+2.5C<br/>Less than 10pF Q≥200+10C<br/>X7R, X5R, X6S, X7S:</p> <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th colspan="2">Exception of D.F. ≤</th></tr><tr><td rowspan="4">≥100V</td><td rowspan="4">≤3%</td><td>≤6%</td><td>1206 ≥0.47μF</td></tr><tr><td>≤7%</td><td>1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr><tr><td>≤7.5%</td><td>0603 ≥0.068μF;0805&gt;0.1μF;1206 ≥1μF;1210 ≥2.2μF</td></tr><tr><td>≤20%</td><td>0805 &gt;0.22μF;1210 ≥3.3μF</td></tr><tr><td rowspan="4">50V</td><td rowspan="4">≤3%</td><td>≤6%</td><td>0201(50V);0603 ≥0.047μF;0805 ≥0.18μF;1206 ≥0.47μF</td></tr><tr><td>≤7%</td><td>1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr><tr><td>≤10%</td><td>0201 ≥0.01uF; 0402 ≥0.012μF;1210 ≥3.3μF</td></tr><tr><td>≤20%</td><td>0402 ≥0.047μF;0603&gt;0.1μF;0805 ≥1μF(0805/X7R&gt;0.47μF); 1206 ≥2.2μF;1210 ≥10μF;</td></tr><tr><td>35V</td><td>≤5%</td><td>≤20%</td><td>0603 ≥1μF;0805≥2.2μF;1206 ≥2.2μF;1210 ≥10μF</td></tr><tr><td rowspan="4">25V</td><td rowspan="4">≤5%</td><td>≤10%</td><td>0201 ≥0.01μF(0201/X5R=0.01μF;0805 ≥1μF;1210 ≥10μF*</td></tr><tr><td>≤14%</td><td>0603 ≥0.33μF</td></tr><tr><td>≤15%</td><td>0201 ≥0.1μF(0201/X5R&gt;0.01μF);0603 ≥0.47μF;TT series 0402 ≥0.10μF(0402/X7R ≥0.056μF);0805 ≥2.2μF; 1206 ≥4.7μF;1210 ≥22μF(1210/X5R ≥10μF)*</td></tr><tr><td>≤20%</td><td>0402 ≥0.33μF</td></tr><tr><td>16V</td><td>≤5%</td><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 ≥0.01μF(0201/X7R ≥0.022μF);0402 ≥0.033μF; 0603&gt;0.47μF;0805 ≥2.2μF;1206 ≥4.7μF;1210 ≥22μF</td></tr><tr><td>≤20%</td><td>0201 ≥0.012μF;0402 ≥0.22μF (0402/X7R ≥0.15μF); 0603 ≥0.33μF;0805 ≥2.2μF;1206 ≥2.2μF;1210 ≥22μF</td></tr><tr><td>6.3V</td><td>≤15%</td><td>≤30%</td><td>0201 ≥0.1μF;0402 ≥1μF(0402/X6S ≥0.47μF); 0603 ≥10μF;0805 ≥4.7μF;1206 ≥47μF;1210 ≥100μF</td></tr><tr><td>4V</td><td>≤20%</td><td>---</td><td>---</td></tr></table> <p>*I.R.: ≥10V, 1GΩ or 50 Ω-F whichever is smaller.</p> <p>Class II (X7R, X5R, X6S, X7S)</p> <table><tr><th>Rated voltage</th><th>Insulation Resistance</th></tr><tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="7">1GΩ or Rx C ≥ 10 Ω-F whichever is smaller.</td></tr><tr><td>50V: 0402&gt;0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF</td></tr><tr><td>35V:0603≥1μF;0805≥2.2μF; 1206 ≥2.2μF;1210 ≥10μF</td></tr><tr><td>25V:0201 ≥0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF</td></tr><tr><td>16V: 0201 ≥0.1uF;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 : All X6S/X7S items; Size≥1812</td></tr></table> | Rated vol. | D.F. ≤ | Exception of D.F. ≤ |  | ≥100V | ≤3% | ≤6% | 1206 ≥0.47μF | ≤7% | 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF | ≤7.5% | 0603 ≥0.068μF;0805>0.1μF;1206 ≥1μF;1210 ≥2.2μF | ≤20% | 0805 >0.22μF;1210 ≥3.3μF | 50V | ≤3% | ≤6% | 0201(50V);0603 ≥0.047μF;0805 ≥0.18μF;1206 ≥0.47μF | ≤7% | 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF | ≤10% | 0201 ≥0.01uF; 0402 ≥0.012μF;1210 ≥3.3μF | ≤20% | 0402 ≥0.047μF;0603>0.1μF;0805 ≥1μF(0805/X7R>0.47μF); 1206 ≥2.2μF;1210 ≥10μF; | 35V | ≤5% | ≤20% | 0603 ≥1μF;0805≥2.2μF;1206 ≥2.2μF;1210 ≥10μF | 25V | ≤5% | ≤10% | 0201 ≥0.01μF(0201/X5R=0.01μF;0805 ≥1μF;1210 ≥10μF* | ≤14% | 0603 ≥0.33μF | ≤15% | 0201 ≥0.1μF(0201/X5R>0.01μF);0603 ≥0.47μF;TT series 0402 ≥0.10μF(0402/X7R ≥0.056μF);0805 ≥2.2μF; 1206 ≥4.7μF;1210 ≥22μF(1210/X5R ≥10μF)* | ≤20% | 0402 ≥0.33μF | 16V | ≤5% | ≤10% | 0603 ≥0.15μF;0805 ≥0.68μF;1206 ≥2.2μF;1210 ≥4.7μF | 10V | ≤7.5% | ≤15% | 0201 ≥0.01μF(0201/X7R ≥0.022μF);0402 ≥0.033μF; 0603>0.47μF;0805 ≥2.2μF;1206 ≥4.7μF;1210 ≥22μF | ≤20% | 0201 ≥0.012μF;0402 ≥0.22μF (0402/X7R ≥0.15μF); 0603 ≥0.33μF;0805 ≥2.2μF;1206 ≥2.2μF;1210 ≥22μF | 6.3V | ≤15% | ≤30% | 0201 ≥0.1μF;0402 ≥1μF(0402/X6S ≥0.47μF); 0603 ≥10μF;0805 ≥4.7μF;1206 ≥47μF;1210 ≥100μF | 4V | ≤20% | --- | --- | Rated voltage | Insulation Resistance | 100V: All X7R;1210≥3.3μF | 1GΩ or Rx C ≥ 10 Ω-F whichever is smaller. | 50V: 0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF | 35V:0603≥1μF;0805≥2.2μF; 1206 ≥2.2μF;1210 ≥10μF | 25V:0201 ≥0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF | 16V: 0201 ≥0.1uF;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 : All X6S/X7S items; Size≥1812 |
| Rated vol.                                                               | D.F. ≤                                     | Exception of D.F. ≤                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |
| ≥100V                                                                    | ≤3%                                        | ≤6%                                                                                                                                                                                                                                                                                                                                       | 1206 ≥0.47μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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                                    |                                                                        |                                          |
|                                                                          |                                            | ≤7%                                                                                                                                                                                                                                                                                                                                       | 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                    |                                                                        |                                          |
|                                                                          |                                            | ≤7.5%                                                                                                                                                                                                                                                                                                                                     | 0603 ≥0.068μF;0805>0.1μF;1206 ≥1μF;1210 ≥2.2μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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|                                                    |      |              |      |                                                                                                                                          |      |              |     |     |      |                                                   |     |       |      |                                                                                               |      |                                                                                                |      |      |      |                                                                                        |    |      |     |     |               |                       |                          |                                            |                                                          |                                                 |                                                                          |                                                                       |                                                                        |                                          |
|                                                                          |                                            | ≤20%                                                                                                                                                                                                                                                                                                                                      | 0805 >0.22μF;1210 ≥3.3μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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                                    |                                                                        |                                          |
| 50V                                                                      | ≤3%                                        | ≤6%                                                                                                                                                                                                                                                                                                                                       | 0201(50V);0603 ≥0.047μF;0805 ≥0.18μF;1206 ≥0.47μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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|                                                                          |                                            | ≤7%                                                                                                                                                                                                                                                                                                                                       | 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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|                                                                          |                                            | ≤10%                                                                                                                                                                                                                                                                                                                                      | 0201 ≥0.01uF; 0402 ≥0.012μF;1210 ≥3.3μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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                                    |                                                                        |                                          |
|                                                                          |                                            | ≤20%                                                                                                                                                                                                                                                                                                                                      | 0402 ≥0.047μF;0603>0.1μF;0805 ≥1μF(0805/X7R>0.47μF); 1206 ≥2.2μF;1210 ≥10μF;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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                                    |                                                                        |                                          |
| 35V                                                                      | ≤5%                                        | ≤20%                                                                                                                                                                                                                                                                                                                                      | 0603 ≥1μF;0805≥2.2μF;1206 ≥2.2μF;1210 ≥10μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                    |                                                                        |                                          |
| 25V                                                                      | ≤5%                                        | ≤10%                                                                                                                                                                                                                                                                                                                                      | 0201 ≥0.01μF(0201/X5R=0.01μF;0805 ≥1μF;1210 ≥10μF*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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|                                                                          |                                            | ≤14%                                                                                                                                                                                                                                                                                                                                      | 0603 ≥0.33μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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                                    |                                                                        |                                          |
|                                                                          |                                            | ≤15%                                                                                                                                                                                                                                                                                                                                      | 0201 ≥0.1μF(0201/X5R>0.01μF);0603 ≥0.47μF;TT series 0402 ≥0.10μF(0402/X7R ≥0.056μF);0805 ≥2.2μF; 1206 ≥4.7μF;1210 ≥22μF(1210/X5R ≥10μF)*                                                                                                                                                                                                                                                                                                                                                                                                                           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|                                                                          |                                            | ≤20%                                                                                                                                                                                                                                                                                                                                      | 0402 ≥0.33μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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                                    |                                                                        |                                          |
| 16V                                                                      | ≤5%                                        | ≤10%                                                                                                                                                                                                                                                                                                                                      | 0603 ≥0.15μF;0805 ≥0.68μF;1206 ≥2.2μF;1210 ≥4.7μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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                                    |                                                                        |                                          |
| 10V                                                                      | ≤7.5%                                      | ≤15%                                                                                                                                                                                                                                                                                                                                      | 0201 ≥0.01μF(0201/X7R ≥0.022μF);0402 ≥0.033μF; 0603>0.47μF;0805 ≥2.2μF;1206 ≥4.7μF;1210 ≥22μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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|                                                                          |                                            | ≤20%                                                                                                                                                                                                                                                                                                                                      | 0201 ≥0.012μF;0402 ≥0.22μF (0402/X7R ≥0.15μF); 0603 ≥0.33μF;0805 ≥2.2μF;1206 ≥2.2μF;1210 ≥22μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                    |                                                                        |                                          |
| 6.3V                                                                     | ≤15%                                       | ≤30%                                                                                                                                                                                                                                                                                                                                      | 0201 ≥0.1μF;0402 ≥1μF(0402/X6S ≥0.47μF); 0603 ≥10μF;0805 ≥4.7μF;1206 ≥47μF;1210 ≥100μF                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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| 4V                                                                       | ≤20%                                       | ---                                                                                                                                                                                                                                                                                                                                       | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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| Rated voltage                                                            | Insulation Resistance                      |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |
| 100V: All X7R;1210≥3.3μF                                                 | 1GΩ or Rx C ≥ 10 Ω-F whichever is smaller. |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |
| 50V: 0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF                 |                                            |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |
| 35V:0603≥1μF;0805≥2.2μF; 1206 ≥2.2μF;1210 ≥10μF                          |                                            |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |
| 25V:0201 ≥0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF |                                            |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |
| 16V: 0201 ≥0.1uF;0402≥0.22μF;0603≥1μF;0805≥2.2μF; 1206≥10μF;1210≥47μF    |                                            |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |
| 10V:0201≥47nF;0402≥0.47μF;0603≥0.47μF;0805≥2.2μF; 1206≥4.7μF;1210≥47μF   |                                            |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |
| 6.3V ; 4V : All X6S/X7S items; Size≥1812                                 |                                            |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                    |                                                                        |                                          |

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

Multilayer Ceramic Capacitors

| No                                                                       | Item                                      | Test Condition                                                                                                                                                                                                                                                                                                                                                                                         | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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------------------------------------|
| 14                                                                       | Humidity (Damp Heat) Load                 | <p>*Test temp. : 40±2°C</p> <p>*Humidity : 90~95%RH</p> <p>*Test time : 500+24/-0 hrs.</p> <p>*To apply voltage :<br/>Rated voltage (MAX. 500V)</p> <p>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p> | <p>* No remarkable damage.</p> <p>Cap change:<br/>NP0: ±7.5% or 0.75pF whichever is larger.<br/>X7R, X5R, X6S, X7S: ≥10V**,within ±12.5%; ≤6.3V within ±25%;<br/>**10V: 0603 ≥4.7μF;0402 ≥1μF;0201 ≥0.1μF, within ±25%;<br/>Y5V: ≥10V, within ±30%; ≤6.3V, within +30/-40%</p> <p>Q/D.F. value:<br/>NP0: C≥30pF,Q≥200;C&lt;30pF, Q≥100+10/3C<br/>X7R, X5R, X6S, X7S:</p> <table><tr><th>Rated vol.</th><th>D.F. ≤</th><th>Exception of D.F. ≤</th></tr><tr><td rowspan="4">100V</td><td rowspan="4">≤3%</td><td>≤6% 1206 ≥0.47μF</td></tr><tr><td>≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr><tr><td>≤7.5% 0603 ≥0.068μF;0805 &gt;0.1μF;1206 ≥1μF;1210 ≥2.2μF</td></tr><tr><td>≤20% 0805 &gt;0.22μF;1210 ≥3.3μF</td></tr><tr><td rowspan="4">50V</td><td rowspan="4">≤3%</td><td>≤6% 0201(50V);0603 ≥0.047μF;0805 ≥0.18μF;1206 ≥0.47μF</td></tr><tr><td>≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF</td></tr><tr><td>≤10% 0201 ≥0.01uF; 0402 ≥0.012μF;1210 ≥3.3μF</td></tr><tr><td>≤20% 0402 ≥0.047μF;0603&gt;0.1μF;0805 ≥1μF(0805/X7R&gt;0.47μF); 1206 ≥2.2μF;1210 ≥10μF;</td></tr><tr><td>35V</td><td>≤5%</td><td>≤20% 0603 ≥1μF;0805≥2.2μF;1206 ≥2.2μF;1210 ≥10μF</td></tr><tr><td rowspan="4">25V</td><td rowspan="4">≤5%</td><td>≤10% 0201 ≥0.01μF(0201/X5R=0.01μF;0805 ≥1μF;1210 ≥10μF*</td></tr><tr><td>≤14% 0603 ≥0.33μF</td></tr><tr><td>0201 ≥0.1μF(0201/X5R&gt;0.01μF);0603 ≥0.47μF;TT series</td></tr><tr><td>0402 ≥0.10μF(0402/X7R ≥0.056μF);0805 ≥2.2μF; 1206 ≥4.7μF;1210 ≥22μF(1210/X5R ≥10μF)*</td></tr><tr><td rowspan="2">16V</td><td rowspan="2">≤5%</td><td>≤20% 0402 ≥0.33μF</td></tr><tr><td>≤10% 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% 0201 ≥0.01μF(0201/X7R ≥0.022μF);0402 ≥0.033μF; 0603&gt;0.47μF;0805 ≥2.2μF;1206 ≥4.7μF;1210 ≥22μF</td></tr><tr><td>0201 ≥0.012μF;0402 ≥0.22μF (0402/X7R ≥0.15μF); 0603 ≥0.33μF;0805 ≥2.2μF;1206 ≥2.2μF;1210 ≥22μF</td></tr><tr><td>6.3V</td><td>≤15%</td><td>≤30% 0201 ≥0.1μF;0402 ≥1μF(0402/X6S ≥0.47μF); 0603 ≥10μF;0805 ≥4.7μF;1206 ≥47μF;1210 ≥100μF</td></tr><tr><td>4V</td><td>≤20%</td><td>--</td></tr></table> <p>*I.R.: ≥10V, 500MQ or 25 Ω-F whichever is smaller.<br/>Class II (X7R, X5R, X6S, X7S)</p> <table><tr><th>Rated voltage</th><th>Insulation Resistance</th></tr><tr><td>100V: All X7R;1210≥3.3μF</td><td rowspan="7">500MQ or RxC ≥5 Ω-F whichever is smaller.</td></tr><tr><td>50V: 0402&gt;0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF</td></tr><tr><td>35V:0603≥1μF;0805≥2.2μF; 1206 ≥2.2μF;1210 ≥10μF</td></tr><tr><td>25V:0201 ≥0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF</td></tr><tr><td>16V: 0201 ≥0.1uF;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 ; All X6S/X7S items; Size≥1812</td></tr></table> | Rated vol. | D.F. ≤ | Exception of D.F. ≤ | 100V | ≤3% | ≤6% 1206 ≥0.47μF | ≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF | ≤7.5% 0603 ≥0.068μF;0805 >0.1μF;1206 ≥1μF;1210 ≥2.2μF | ≤20% 0805 >0.22μF;1210 ≥3.3μF | 50V | ≤3% | ≤6% 0201(50V);0603 ≥0.047μF;0805 ≥0.18μF;1206 ≥0.47μF | ≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF | ≤10% 0201 ≥0.01uF; 0402 ≥0.012μF;1210 ≥3.3μF | ≤20% 0402 ≥0.047μF;0603>0.1μF;0805 ≥1μF(0805/X7R>0.47μF); 1206 ≥2.2μF;1210 ≥10μF; | 35V | ≤5% | ≤20% 0603 ≥1μF;0805≥2.2μF;1206 ≥2.2μF;1210 ≥10μF | 25V | ≤5% | ≤10% 0201 ≥0.01μF(0201/X5R=0.01μF;0805 ≥1μF;1210 ≥10μF* | ≤14% 0603 ≥0.33μF | 0201 ≥0.1μF(0201/X5R>0.01μF);0603 ≥0.47μF;TT series | 0402 ≥0.10μF(0402/X7R ≥0.056μF);0805 ≥2.2μF; 1206 ≥4.7μF;1210 ≥22μF(1210/X5R ≥10μF)* | 16V | ≤5% | ≤20% 0402 ≥0.33μF | ≤10% 0603 ≥0.15μF;0805 ≥0.68μF;1206 ≥2.2μF;1210 ≥4.7μF | 10V | ≤7.5% | ≤15% 0201 ≥0.01μF(0201/X7R ≥0.022μF);0402 ≥0.033μF; 0603>0.47μF;0805 ≥2.2μF;1206 ≥4.7μF;1210 ≥22μF | 0201 ≥0.012μF;0402 ≥0.22μF (0402/X7R ≥0.15μF); 0603 ≥0.33μF;0805 ≥2.2μF;1206 ≥2.2μF;1210 ≥22μF | 6.3V | ≤15% | ≤30% 0201 ≥0.1μF;0402 ≥1μF(0402/X6S ≥0.47μF); 0603 ≥10μF;0805 ≥4.7μF;1206 ≥47μF;1210 ≥100μF | 4V | ≤20% | -- | Rated voltage | Insulation Resistance | 100V: All X7R;1210≥3.3μF | 500MQ or RxC ≥5 Ω-F whichever is smaller. | 50V: 0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF | 35V:0603≥1μF;0805≥2.2μF; 1206 ≥2.2μF;1210 ≥10μF | 25V:0201 ≥0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF | 16V: 0201 ≥0.1uF;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 ; All X6S/X7S items; Size≥1812 |
| Rated vol.                                                               | D.F. ≤                                    | Exception of D.F. ≤                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
| 100V                                                                     | ≤3%                                       | ≤6% 1206 ≥0.47μF                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | ≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | ≤7.5% 0603 ≥0.068μF;0805 >0.1μF;1206 ≥1μF;1210 ≥2.2μF                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | ≤20% 0805 >0.22μF;1210 ≥3.3μF                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
| 50V                                                                      | ≤3%                                       | ≤6% 0201(50V);0603 ≥0.047μF;0805 ≥0.18μF;1206 ≥0.47μF                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | ≤7% 1812 ≥4.7μF;1825≥4.7μF; 2220≥4.7μF; 2225≥4.7μF                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | ≤10% 0201 ≥0.01uF; 0402 ≥0.012μF;1210 ≥3.3μF                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | ≤20% 0402 ≥0.047μF;0603>0.1μF;0805 ≥1μF(0805/X7R>0.47μF); 1206 ≥2.2μF;1210 ≥10μF;                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
| 35V                                                                      | ≤5%                                       | ≤20% 0603 ≥1μF;0805≥2.2μF;1206 ≥2.2μF;1210 ≥10μF                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
| 25V                                                                      | ≤5%                                       | ≤10% 0201 ≥0.01μF(0201/X5R=0.01μF;0805 ≥1μF;1210 ≥10μF*                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | ≤14% 0603 ≥0.33μF                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | 0201 ≥0.1μF(0201/X5R>0.01μF);0603 ≥0.47μF;TT series                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | 0402 ≥0.10μF(0402/X7R ≥0.056μF);0805 ≥2.2μF; 1206 ≥4.7μF;1210 ≥22μF(1210/X5R ≥10μF)*                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 16V                                                                      | ≤5%                                       | ≤20% 0402 ≥0.33μF                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | ≤10% 0603 ≥0.15μF;0805 ≥0.68μF;1206 ≥2.2μF;1210 ≥4.7μF                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 10V                                                                      | ≤7.5%                                     | ≤15% 0201 ≥0.01μF(0201/X7R ≥0.022μF);0402 ≥0.033μF; 0603>0.47μF;0805 ≥2.2μF;1206 ≥4.7μF;1210 ≥22μF                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                               |
|                                                                          |                                           | 0201 ≥0.012μF;0402 ≥0.22μF (0402/X7R ≥0.15μF); 0603 ≥0.33μF;0805 ≥2.2μF;1206 ≥2.2μF;1210 ≥22μF                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 6.3V                                                                     | ≤15%                                      | ≤30% 0201 ≥0.1μF;0402 ≥1μF(0402/X6S ≥0.47μF); 0603 ≥10μF;0805 ≥4.7μF;1206 ≥47μF;1210 ≥100μF                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 4V                                                                       | ≤20%                                      | --                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| Rated voltage                                                            | Insulation Resistance                     |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 100V: All X7R;1210≥3.3μF                                                 | 500MQ or RxC ≥5 Ω-F whichever is smaller. |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 50V: 0402>0.01μF;0603≥1μF;0805≥1μF;1206≥4.7μF;1210≥4.7μF                 |                                           |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 35V:0603≥1μF;0805≥2.2μF; 1206 ≥2.2μF;1210 ≥10μF                          |                                           |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 25V:0201 ≥0.1uF; 0402≥0.22μF; 0603≥2.2μF;0805≥2.2μF; 1206≥10μF;1210≥10μF |                                           |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 16V: 0201 ≥0.1uF;0402≥0.22μF;0603≥1μF;0805≥2.2μF; 1206≥10μF;1210≥47μF    |                                           |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 10V:0201≥47nF;0402≥0.47μF;0603≥0.47μF;0805≥2.2μF; 1206≥4.7μF;1210≥47μF   |                                           |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 6.3V ; 4V ; All X6S/X7S items; Size≥1812                                 |                                           |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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\* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

Multilayer Ceramic Capacitors

Approval Sheet

| No  | Item                              | Test Condition                                                                                                                                                            | Requirements                                                                                                                                                                                                 |  |  |  |  |
|-----|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| 15. | High Temperature Load (Endurance) | Test temp. :<br>NP0, X7R/X7E/X7S: 125±3°C<br>X6S: 105±3°C<br>X5R, 85±3°C<br>Test time: 1000+24/-0 hrs.<br>To apply voltage:<br>(1) 100% of rated voltage for below range. | * No remarkable damage.<br>Cap change:<br>NP0: ±3.0% or ±0.3pF whichever is larger<br>X7R, X5R, X6S, X7S: ≥10V**, within ±12.5%; ≤ 6.3V within ±25%;<br>**10V: 0603≥4.7μF; 0402≥1μF; 0201≥0.1μF, within ±25% |  |  |  |  |
|     |                                   |                                                                                                                                                                           | Q/D.F. value:<br>NP0: More than 30pF, Q≥350<br>10pF≤C<30pF, Q≥275+2.5C<br>Less than 10pF, Q≥200+10C<br>X7R, X5R, X6S, X7S:                                                                                   |  |  |  |  |
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\* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

## APPENDIXES

### ■ Tape & reel dimensions

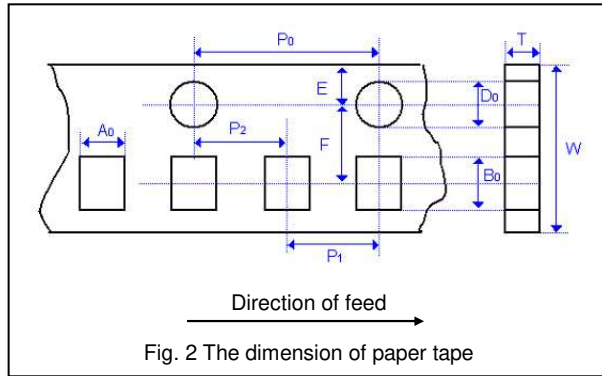


Fig. 2 The dimension of paper tape

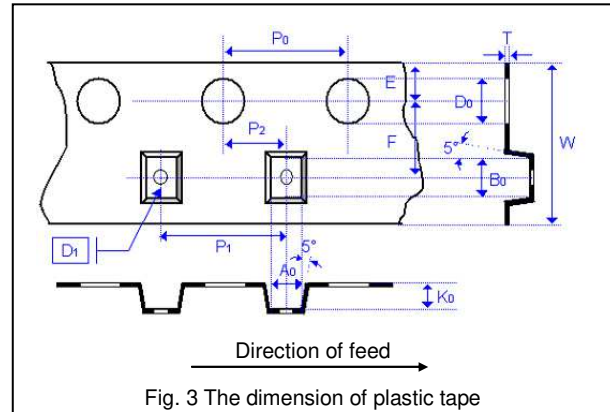


Fig. 3 The dimension of plastic tape

| Size              | 0201             | 0402             | 0603             | 0805             |                  |                  | 1206             |                  |                  | 1210             |                  |                  |                  | 1808             |                  | 1812             |                  |                  |
|-------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Thickness         | L                | N,E              | S,H,X            | A,H              | B,T              | D,I              | B,T              | C,J,D            | G,P              | T                | C,D              | G,K              | M                | D,F              | G,K              | D,F              | G,K              | M,U              |
| A <sub>0</sub>    | 0.40<br>+/-0.10  | 0.70<br>+/-0.20  | 1.05<br>+/-0.30  | 1.50<br>+/-0.20  | 1.50<br>+/-0.20  | < 1.80           | 1.90<br>+/-0.50  | < 2.00           | < 2.30           | < 3.05           | < 3.05           | < 3.05           | < 3.20           | < 2.50           | < 2.50           | < 3.90           | < 3.90           | < 3.90           |
| B <sub>0</sub>    | 0.70<br>+/-0.10  | 1.20<br>+/-0.20  | 1.80<br>+/-0.30  | 2.30<br>+/-0.20  | 2.30<br>+/-0.20  | < 2.70           | 3.50<br>+/-0.50  | < 3.70           | < 4.00           | < 3.80           | < 3.80           | < 3.80           | < 4.00           | < 5.30           | < 5.30           | < 5.30           | < 5.30           | < 5.30           |
| T                 | ≤ 0.55           | ≤ 0.80           | ≤ 1.20           | ≤ 1.15           | ≤ 1.20           | 0.23<br>+/-0.1   | ≤ 1.20           | 0.23<br>+/-0.1   | 0.23<br>+/-0.1   | 0.23<br>+/-0.1   | 0.23<br>+/-0.1   | 0.23<br>+/-0.1   | 0.23<br>+/-0.1   | 0.25<br>+/-0.1   | 0.25<br>+/-0.1   | 0.25<br>+/-0.1   | 0.25<br>+/-0.1   | 0.25<br>+/-0.1   |
| K <sub>0</sub>    | 0.44<br>+/-0.05  | -                | -                | -                | -                | < 2.50           | -                | < 2.50           | < 2.50           | < 1.50           | < 2.00           | < 2.50           | < 3.20           | < 2.50           | < 2.50           | < 2.50           | < 2.50           | < 3.50           |
| W                 | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 8.00<br>+/-0.30  | 12.00<br>+/-0.30 | 12.00<br>+/-0.30 | 12.00<br>+/-0.30 | 12.00<br>+/-0.30 | 12.00<br>+/-0.30 |
| P <sub>0</sub>    | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  | 4.00<br>+/-0.10  |
| 10xP <sub>0</sub> | 40.00<br>+/-0.10 | 40.00<br>+/-0.10 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 | 40.00<br>+/-0.20 |
| P <sub>1</sub>    | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  |
| P <sub>2</sub>    | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.05  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  | 2.00<br>+/-0.10  |
| D <sub>0</sub>    | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  | 1.50<br>+/-0.10  |
| D <sub>1</sub>    | -                | -                | -                | -                | -                | 1.00<br>+/-0.10  | -                | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  | 1.00<br>+/-0.10  |
| E                 | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  | 1.75<br>+/-0.10  |
| F                 | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  | 3.50<br>+/-0.05  |

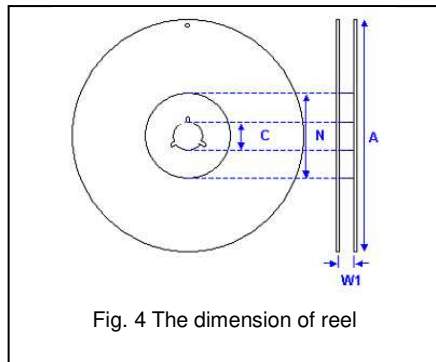
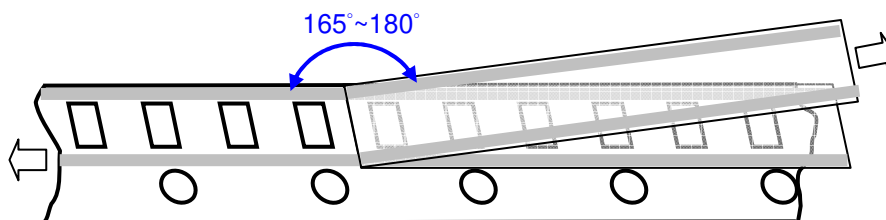


Fig. 4 The dimension of reel

| Size           | 0201, 0402, 0603, 0805, 1206, 1210 |           |           | 1812        |
|----------------|------------------------------------|-----------|-----------|-------------|
| Reel size      | 7"                                 | 10"       | 13"       | 7"          |
| C              | 13.0±0.5                           | 13.0±0.5  | 13.0±0.5  | 13.0±0.5    |
| W <sub>1</sub> | 10.0±1.5                           | 10.0±1.5  | 10.0±1.5  | 12.4±2.0/-0 |
| A              | 178.0±2.0                          | 250.0±2.0 | 330.0±2.0 | 178.0±2.0   |
| N              | 60.0±1.0/-0                        | 50 min    | 50 min    | 60.0±1.0/-0 |

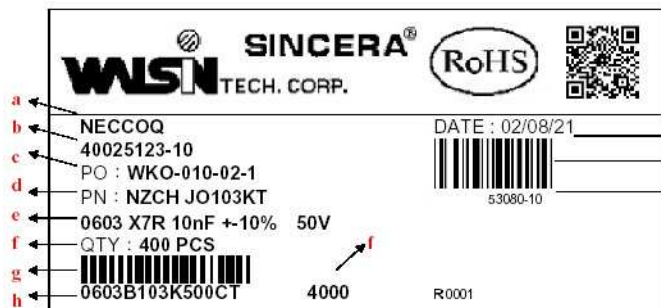
### ■ Peeling force (EIA-481)

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



## Multilayer Ceramic Capacitors

### Example of customer label



\*Customized label is available upon request

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

### Constructions

| No. | Name             | NPO                      | X7R, X5R, X6S, X7S       |
|-----|------------------|--------------------------|--------------------------|
| ①   | Ceramic material | CaZrO <sub>3</sub> based | BaTiO <sub>3</sub> based |
| ②   | Inner electrode  |                          | Ni                       |
| ③   | Termination      | Inner layer              | Cu                       |
| ④   |                  | Middle layer             | Ni                       |
| ⑤   |                  | Outer layer              | Sn                       |

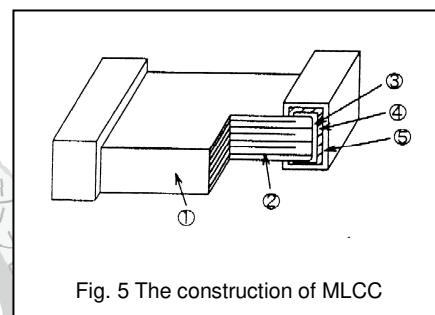


Fig. 5 The construction of MLCC

### Storage and handling conditions

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

#### Cautions:

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

## Multilayer Ceramic Capacitors

### ■ Recommended soldering conditions

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

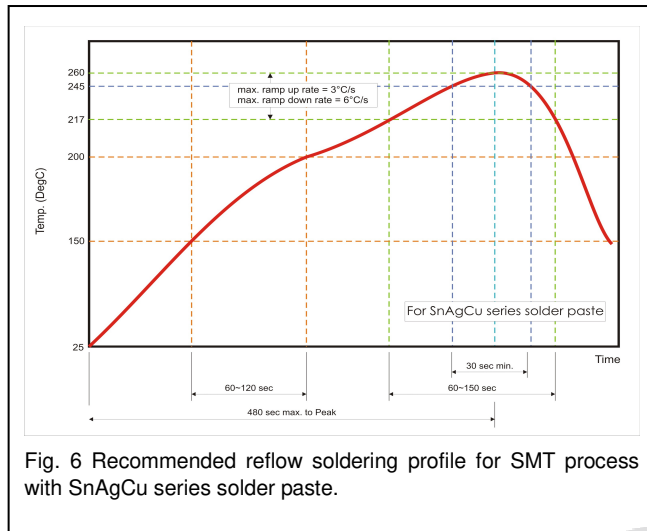


Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

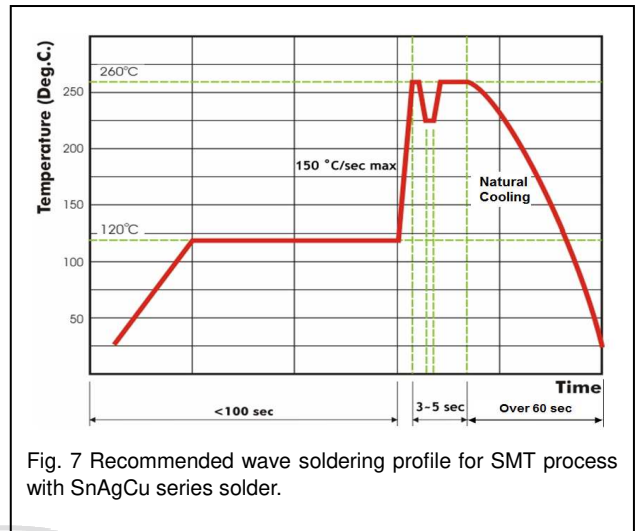


Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.

