Innovative Service Around the Globe YAGEO

# DATA SHEET

## SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

General Purpose & High Capacitance

Class 2, X7R

6.3 V TO 50 V

**100 pF to 22 µF**

**RoHS compliant & Halogen Free**

YAGEO Phycomp

Product Specification – June 16, 2017 V.18

## SCOPE

This specification describes X7R series chip capacitors with lead-free terminations.

## APPLICATIONS

- PCs, Hard disk, Game PCs
- DVDs, Video cameras
- Mobile phones
- Data processing

## FEATURES

- Supplied in tape on reel
- Nickel-barrier end termination
- RoHS compliant
- Halogen Free compliant

## ORDERING INFORMATION - GLOBAL PART NUMBER, PHYCOMP CTC & 12NC

All part numbers are identified by the series, size, tolerance, TC material, packing style, voltage, process code, termination and capacitance value.

**YAGEO BRAND ordering code**

**GLOBAL PART NUMBER (PREFERRED)**

| CC | XXXX | X | X | X7R | X | BB | XXX |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | | (4) | | (5) |

### (1) SIZE – INCH BASED (METRIC)

0201 (0603)
0402 (1005)
0603 (1608)
0805 (2012)
1206 (3216)
1210 (3225)
1812 (4532)

### (2) TOLERANCE

J = ±5% (1)
K = ±10%
M = ±20%

### (3) PACKING STYLE

R = Paper/PE taping reel; Reel 7 inch
K = Blister taping reel; Reel 7 inch
P = Paper/PE taping reel; Reel 13 inch
F = Blister taping reel; Reel 13 inch

### (4) RATED VOLTAGE

5 = 6.3 V
6 = 10 V
7 = 16 V
8 = 25 V
9 = 50 V

### (5) CAPACITANCE VALUE

2 significant digits+number of zeros
The 3rd digit signifies the multiplying factor, and letter R is decimal point
Example: 103 = $10 \times 10^3$ = 10,000 pF = 10 nF

**NOTE**

1. Tolerance ±5% is not available for full product range, please contact local sales force before ordering

## CONSTRUCTION

The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved metal electrodes are contained. This structure gives rise to a high capacitance per unit volume.

The inner electrodes are connected to the two end terminations and finally covered with a layer of plated tin (NiSn). The terminations are lead-free. A cross section of the structure is shown in Fig.1.

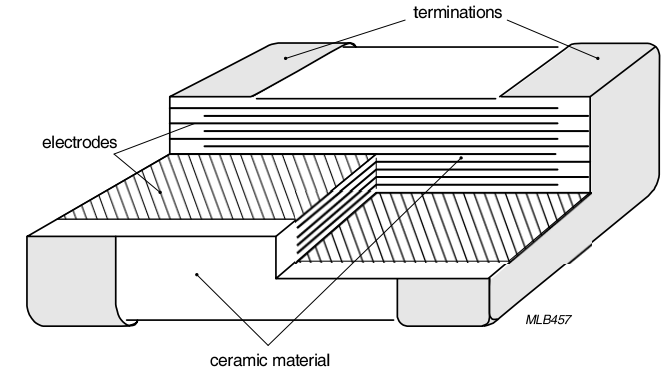



**Fig. 1** Surface mounted multilayer ceramic capacitor construction

## DIMENSION

**Table 1** For outlines see fig. 2

| TYPE | $L_1$ (mm) | W (mm) | T (MM) | $L_2$ / $L_3$ (mm) | | $L_4$ (mm) | DIMENSION CODE |
|---|---|---|---|---|---|---|---|
| | | | | min. | Max. | min. | |
| 0201 | 0.6 ±0.03 | 0.3 ±0.03 | 0.3 ±0.03 | 0.1 | 0.2 | 0.2 | BA |
| 0402 | 1.0 ±0.05 | 0.5 ±0.05 | 0.5 ±0.05 | 0.15 | 0.35 | 0.4 | CA |
| 0603 | 1.6 ±0.1 | 0.8 ±0.1 | 0.8 ±0.1 | 0.2 | 0.6 | 0.4 | DA |
| | 1.6 ±0.15 | 0.8 ±0.15 | 0.8 ±0.15 | 0.2 | 0.6 | 0.4 | DB |
| | 1.6 ±0.2 | 0.8 ±0.2 | 0.8 ±0.2 | 0.2 | 0.6 | 0.4 | DC |
| 0805 | 2.0 ±0.1 | 1.25 ±0.1 | 0.6 ±0.1 | 0.25 | 0.75 | 0.7 | E0 |
| | 2.0 ±0.1 | 1.25 ±0.1 | 0.85 ±0.1 | 0.25 | 0.75 | 0.7 | EA |
| | 2.0 ±0.2 | 1.25 ±0.2 | 1.25 ±0.2 | 0.25 | 0.75 | 0.7 | EB |
| 1206 | 3.2 ±0.15 | 1.6 ±0.15 | 0.85 ±0.1 | 0.25 | 0.75 | 1.4 | F0 |
| | 3.2 ±0.2 | 1.6 ±0.2 | 1.0 ±0.1 | 0.25 | 0.75 | 1.4 | F1 |
| | 3.2 ±0.2 | 1.6 ±0.2 | 1.15 ±0.1 | 0.25 | 0.75 | 1.4 | FA |
| | 3.2 ±0.3 | 1.6 ±0.2 | 1.6 ±0.2 | 0.25 | 0.8 | 1.4 | FC |
| | 3.2 ±0.3 | 1.6 ±0.3 | 1.6 ±0.3 | 0.3 | 0.9 | 1.4 | FD |
| 1210 | 3.2 ±0.2 | 2.5 ±0.2 | 0.85 ±0.1 | 0.25 | 0.75 | 1.4 | G0 |
| | 3.2 ±0.4 | 2.5 ±0.3 | 1.15 ±0.1 | 0.25 | 0.75 | 1.4 | G1 |
| | 3.2 ±0.4 | 2.5 ±0.3 | 1.25 ±0.2 | 0.25 | 0.75 | 1.4 | GA |
| | 3.2 ±0.4 | 2.5 ±0.3 | 1.6 ±0.2 | 0.25 | 0.75 | 1.4 | G2 |
| | 3.2 ±0.4 | 2.5 ±0.3 | 1.9 ±0.2 | 0.25 | 0.75 | 1.4 | GB |
| | 3.2 ±0.4 | 2.5 ±0.3 | 2.0 ±0.2 | 0.25 | 0.75 | 1.4 | G3 |
| | 3.2 ±0.4 | 2.5 ±0.3 | 2.5 ±0.2 | 0.25 | 0.75 | 1.0 | GC |
| | 3.2 ±0.4 | 2.5 ±0.3 | 2.5 ±0.3 | 0.25 | 0.75 | 1.0 | GD |
| 1812 | 4.5 ±0.2 | 3.2 ±0.2 | 0.85 ±0.1 | 0.25 | 0.75 | 2.2 | JA |
| | 4.5 ±0.2 | 3.2 ±0.2 | 1.15 ±0.1 | 0.25 | 0.75 | 2.2 | JB |
| | 4.5 ±0.4 | 3.2 ±0.4 | 1.6 ±0.2 | 0.25 | 0.75 | 2.2 | JC |

**OUTLINES**

For dimension see Table 1

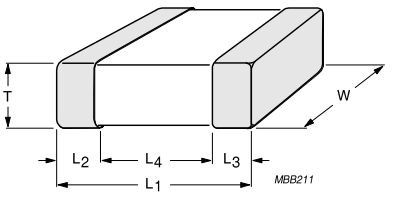



**Fig. 2** Surface mounted multilayer ceramic capacitor dimension

## CAPACITANCE RANGE & THICKNESS FOR X7R

Table 2 Sizes from 0201 to 0402

| CAP. | 0201 | | | | | 0402 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6.3 V | 10 V | 16 V | 25 V | 50 V | 6.3 V | 10 V | 16 V | 25 V | 50 V |
| 100 pF | BA | BA | BA | BA | BA | CA | CA | CA | CA | CA |
| 150 pF | BA | BA | BA | BA | BA | CA | CA | CA | CA | CA |
| 220 pF | BA | BA | BA | BA | BA | CA | CA | CA | CA | CA |
| 330 pF | BA | BA | BA | BA | BA | CA | CA | CA | CA | CA |
| 470 pF | BA | BA | BA | BA | BA | CA | CA | CA | CA | CA |
| 680 pF | BA | BA | BA | BA | BA | CA | CA | CA | CA | CA |
| 1.0 nF | BA | BA | BA | BA | BA | CA | CA | CA | CA | CA |
| 1.5 nF | BA | BA | BA | BA | | CA | CA | CA | CA | CA |
| 2.2 nF | BA | BA | BA | BA | | CA | CA | CA | CA | CA |
| 3.3 nF | BA | BA | BA | BA | | CA | CA | CA | CA | CA |
| 4.7 nF | BA | BA | BA | BA | | CA | CA | CA | CA | CA |
| 6.8 nF | BA | BA | BA | BA | | CA | CA | CA | CA | CA |
| 10 nF | BA | BA | BA | BA | | CA | CA | CA | CA | CA |
| 15 nF | | | | | | CA | CA | CA | CA | CA |
| 22 nF | | | | | | CA | CA | CA | CA | CA |
| 33 nF | | | | | | CA | CA | CA | CA | CA |
| 47 nF | | | | | | CA | CA | CA | CA | CA |
| 68 nF | | | | | | CA | CA | CA | CA | |
| 100 nF | BA | | | | | CA | CA | CA | CA | CA |
| 150 nF | | | | | | | | | | |
| 220 nF | | | | | | CA | CA | CA | | |
| 330 nF | | | | | | | | | | |
| 470 nF | | | | | | CA | CA | | | |
| 680 nF | | | | | | | | | | |
| 1.0 µF | | | | | | CA | | | | |
| 2.2 µF | | | | | | | | | | |
| 4.7 µF | | | | | | | | | | |
| 10 µF | | | | | | | | | | |
| 22 µF | | | | | | | | | | |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering

## CAPACITANCE RANGE & THICKNESS FOR X7R

Table 3 Sizes from 0603 to 0805

| CAP. | 0603 | | | | | 0805 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6.3 V | 10 V | 16 V | 25 V | 50 V | 6.3 V | 10 V | 16 V | 25 V | 50 V |
| 100 pF | DA | DA | DA | DA | DA | | | | | |
| 150 pF | DA | DA | DA | DA | DA | | | | | |
| 220 pF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 330 pF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 470 pF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 680 pF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 1.0 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 1.5 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 2.2 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 3.3 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 4.7 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 6.8 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 10 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 15 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 22 nF | DA | DA | DA | DA | DA | E0 | E0 | E0 | E0 | E0 |
| 33 nF | DA | DA | DA | DA | DA | EA | EA | EA | EA | EA |
| 47 nF | DA | DA | DA | DA | DA | EA | EA | EA | EA | EA |
| 68 nF | DA | DA | DA | DA | DA | EA | EA | EA | EA | EA |
| 100 nF | DA | DA | DA | DA | DA | EA | EA | EA | EA | EA |
| 150 nF | DA | DA | DA | DA | DA | EA | EA | EA | EA | EA |
| 220 nF | DA | DA | DA | DA | DA | EA | EA | EA | EA | EB |
| 330 nF | DA | DA | DA | DA | | EB | EB | EB | EB | EB |
| 470 nF | DA | DA | DA | DA | DA | EB | EB | EB | EB | EB |
| 680 nF | DA | DA | DA | DA | | EB | EB | EB | EB | EB |
| 1.0 µF | DA | DA | DA | DA | DB | EB | EB | EB | EB | EB |
| 2.2 µF | DA | DA | DC | | | EB | EB | EB | EB | EB |
| 4.7 µF | DC | | | | | EB | EB | EB | EB | |
| 10 µF | | | | | | EB | EB | EB | | |
| 22 µF | | | | | | | | | | |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering

## CAPACITANCE RANGE & THICKNESS FOR X7R

Table 4 Size 1206

| CAP. | 1206 | | | | |
|---|---|---|---|---|---|
| | 6.3 V | 10 V | 16 V | 25 V | 50 V |
| 100 pF | | | | | |
| 150 pF | | | | | |
| 220 pF | F0 | F0 | F0 | F0 | F0 |
| 330 pF | F0 | F0 | F0 | F0 | F0 |
| 470 pF | F0 | F0 | F0 | F0 | F0 |
| 680 pF | F0 | F0 | F0 | F0 | F0 |
| 1.0 nF | F0 | F0 | F0 | F0 | F0 |
| 1.5 nF | F0 | F0 | F0 | F0 | F0 |
| 2.2 nF | F0 | F0 | F0 | F0 | F0 |
| 3.3 nF | F0 | F0 | F0 | F0 | F0 |
| 4.7 nF | F0 | F0 | F0 | F0 | F0 |
| 6.8 nF | F0 | F0 | F0 | F0 | F0 |
| 10 nF | F0 | F0 | F0 | F0 | F0 |
| 15 nF | F0 | F0 | F0 | F0 | F0 |
| 22 nF | F0 | F0 | F0 | F0 | F0 |
| 33 nF | F0 | F0 | F0 | F0 | F0 |
| 47 nF | F0 | F0 | F0 | F0 | F0 |
| 68 nF | F0 | F0 | F0 | F0 | F0 |
| 100 nF | F0 | F0 | F0 | F0 | F0 |
| 150 nF | F0 | F0 | F0 | F0 | FA |
| 220 nF | F0 | F0 | F0 | F0 | FA |
| 330 nF | F0 | F0 | F0 | F0 | F0 |
| 470 nF | F0 | F0 | F0 | F0 | F1 |
| 680 nF | FA | FA | FA | FA | FC |
| 1.0 µF | FA | FA | FA | FA | FC |
| 2.2 µF | FA | FA | FA | FA | FC |
| 4.7 µF | FC | FC | FC | FC | FC |
| 10 µF | FC | FC | FC | FC | |
| 22 µF | FC | FC | FD | | |
| 47 µF | | | | | |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering
4. Please contact local sales force for special ordering code before ordering

## CAPACITANCE RANGE & THICKNESS FOR X7R

Table 5 Sizes from 1210 to 1812

| CAP. | 1210 | | | | | 1812 |
|---|---|---|---|---|---|---|
| | 6.3 V | 10 V | 16 V | 25 V | 50 V | 50 V |
| 100 pF | | | | | | |
| 150 pF | | | | | | |
| 220 pF | | | | | | |
| 330 pF | | | | | | |
| 470 pF | | | | | | |
| 680 pF | | | | | | |
| 1.0 nF | | | | | | |
| 1.5 nF | | | | | | |
| 2.2 nF | G0 | G0 | G0 | G0 | G0 | |
| 3.3 nF | G0 | G0 | G0 | G0 | G0 | |
| 4.7 nF | G0 | G0 | G0 | G0 | G0 | JA |
| 6.8 nF | G0 | G0 | G0 | G0 | G0 | JA |
| 10 nF | G0 | G0 | G0 | G0 | G0 | JA |
| 15 nF | G0 | G0 | G0 | G0 | G0 | JA |
| 22 nF | G0 | G0 | G0 | G0 | G0 | JA |
| 33 nF | G0 | G0 | G0 | G0 | G0 | JA |
| 47 nF | G0 | G0 | G0 | G0 | G0 | JA |
| 68 nF | G0 | G0 | G0 | G0 | G0 | JA |
| 100 nF | G0 | G0 | G0 | G0 | G0 | JB |
| 150 nF | G0 | G0 | G0 | G0 | G1 | JB |
| 220 nF | G0 | G0 | G0 | G0 | G1 | JB |
| 330 nF | G0 | G0 | G0 | G0 | G1 | JB |
| 470 nF | G1 | G1 | G1 | G1 | GA | JB |
| 680 nF | G1 | G1 | G1 | G1 | GA | JC |
| 1.0 µF | GA | GA | GA | GA | GA | JC |
| 2.2 µF | G3 | G3 | G3 | G3 | G3 | |
| 4.7 µF | GB | GB | GB | GB | GD | |
| 10 µF | GB | GB | GB | GB | GD | |
| 22 µF | GC | GC | GC | GC | | |
| 47 µF | GC | GC | | | | |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering
4. Please contact local sales force for special ordering code before ordering

## THICKNESS CLASSES AND PACKING QUANTITY

Table 6

| SIZE CODE | THICKNESS CLASSIFICATION | TAPE WIDTH QUANTITY PER REEL | Ø180 MM / 7 INCH | | Ø330 MM / 13 INCH | | QUANTITY PER BULK CASE |
|---|---|---|---|---|---|---|---|
| | | | Paper | Blister | Paper | Blister | |
| 0201 | 0.3 ±0.03 mm | 8 mm | 15,000 | --- | 50,000 | --- | --- |
| 0402 | 0.5 ±0.05 mm | 8 mm | 10,000 | --- | 50,000 | --- | 50,000 |
| 0603 | 0.8 ±0.1 mm | 8 mm | 4,000 | --- | 15,000 | --- | 15,000 |
| 0805 | 0.6 ±0.1 mm | 8 mm | 4,000 | --- | 20,000 | --- | 10,000 |
| | 0.85 ±0.1 mm | 8 mm | 4,000 | --- | 15,000 | --- | 8,000 |
| | 1.25 ±0.2 mm | 8 mm | --- | 3,000 | --- | 10,000 | 5,000 |
| 1206 | 0.6 ±0.1 mm | 8 mm | 4,000 | --- | 20,000 | --- | --- |
| | 0.85 ±0.1 mm | 8 mm | 4,000 | --- | 15,000 | --- | --- |
| | 1.00 / 1.15 ±0.1 mm | 8 mm | --- | 3,000 | --- | 10,000 | --- |
| | 1.25 ±0.2 mm | 8 mm | --- | 3,000 | --- | 10,000 | --- |
| | 1.6 ±0.15 mm | 8 mm | --- | 2,500 | --- | 10,000 | --- |
| | 1.6 ±0.2 mm | 8 mm | --- | 2,000 | --- | 8,000 | --- |
| 1210 | 0.6 / 0.7 ±0.1 mm | 8 mm | --- | 4,000 | --- | 15,000 | --- |
| | 0.85 ±0.1 mm | 8 mm | --- | 4,000 | --- | 10,000 | --- |
| | 1.15 ±0.1 mm | 8 mm | --- | 3,000 | --- | 10,000 | --- |
| | 1.15 ±0.15 mm | 8 mm | --- | 3,000 | --- | 10,000 | --- |
| | 1.25 ±0.2 mm | 8 mm | --- | 3,000 | --- | --- | --- |
| | 1.5 ±0.1 mm | 8 mm | --- | 2,000 | --- | --- | --- |
| | 1.6 / 1.9 ±0.2 mm | 8 mm | --- | 2,000 | --- | --- | --- |
| | 2.0 ±0.2 mm | 8 mm | --- | 2,000<br>1,000 | --- | --- | --- |
| | 2.5 ±0.2 mm | 8 mm | --- | 1,000<br>500 | --- | --- | --- |
| 1808 | 1.15 ±0.15 mm | 12 mm | --- | 3,000 | --- | --- | --- |
| | 1.25 ±0.2 mm | 12 mm | --- | 3,000 | --- | --- | --- |
| | 1.35 ±0.15 mm | 12 mm | --- | 2,000 | --- | --- | --- |
| | 1.5 ±0.1 mm | 12 mm | --- | 2,000 | --- | --- | --- |
| | 1.6 ±0.2 mm | 12 mm | --- | 2,000 | --- | 8,000 | --- |
| | 2.0 ±0.2 mm | 12 mm | --- | 2,000 | --- | --- | --- |
| 1812 | 0.6 / 0.85 ±0.1 mm | 12 mm | --- | 2,000 | --- | --- | --- |
| | 1.15 ±0.1 mm | 12 mm | --- | 1,000 | --- | --- | --- |
| | 1.25 ±0.2 mm | 12 mm | --- | 1,000 | --- | --- | --- |
| | 1.5 ±0.1 mm | 12 mm | --- | 1,000 | --- | --- | --- |
| | 1.6 ±0.2 mm | 12 mm | --- | 1,000 | --- | --- | --- |
| | 2.0 ±0.2 mm | 12 mm | --- | 1,000 | --- | --- | --- |
| | 2.5 ±0.2 mm | 12 mm | --- | 500 | --- | --- | --- |

## ELECTRICAL CHARACTERISTICS

### X7R DIELECTRIC CAPACITORS; NISN TERMINATIONS

Unless otherwise specified, all test and measurements shall be made under standard atmospheric conditions for testing as given in 5.3 of IEC 60068-1:

- Temperature: 15 °C to 35 °C
- Relative humidity: 25% to 75%
- Air pressure: 86 kPa to 106 kPa

Before the measurements are made, the capacitor shall be stored at the measuring temperature for a time sufficient to allow the entire capacitor to reach this temperature.

The period as prescribed for recovery at the end of a test is normally sufficient for this purpose.

Table 7

| DESCRIPTION | | | | | | | | VALUE |
|---|---|---|---|---|---|---|---|---|
| Capacitance range | | | | | | | | 100 pF to 47 µF |
| Capacitance tolerance | | | | | | | | ±5%, ±10%, ±20% |
| Dissipation factor (D.F.) | | | | | | | | |
| X7R | | 0201 | 0402 | 0603 | 0805 | 1206 | 1210 | |
| | ≤10V | 100pF to 10nF | 100pF to 100nF | 100pF to 1µF | 150pF to 2.2µF | 220pF to 2.2µF | 2.2nF to 2.2µF | ≤5% |
| | | 100nF | 220nF to 470nF | 2.2µF to 4.7µF | 4.7µF to 10µF | 4.7µF to 22µF | 4.7µF to 47µF | ≤10% |
| | | | 1µF | | | | | ≤12.5% |
| | 16V | 100pF to 1.2nF | 100pF to 22nF | 100pF to 220nF | 150pF to 470nF | 220pF to 1µF | 2.2nF to 1µF | ≤ 3.5% |
| | | 1.5nF to 10nF | 27nF to 100nF | 470nF to 1.0µF | 680 nF to 2.2µF | 2.2µF | 2.2µF | ≤ 5% |
| | | | 220nF | 2.2µF | 4.7µF to 10µF | 4.7µF to 22µF | 4.7µF to 22µF | ≤10% |
| | 25V | 100pF to 470pF | 100pF to 10nF | 100pF to 39nF | 150pF to 180nF | 220pF to 680nF | 2.2nF to 1µF | ≤ 2.5% |
| | | | 12 nF to 47nF | 47nF to 220nF | 220nF to 470nF | 1µF | | ≤ 3.5% |
| | | 560pF to 10nF | 56nF to 100nF | | 680nF to 1µF | 2.2µF | 2.2µF | ≤ 5% |
| | | | | 270nF to 1µF | 2.2µF to 4.7µF | 4.7µF to 22µF | 4.7µF to 22µF | ≤10% |
| | 50V | 100pF to 1nF | 100pF to 10nF | 100pF to 39nF | 150pF to 180nF | 220pF to 470nF | 2.2nF to 1µF | ≤2.5% |
| | | | 12 nF to 47nF | 47nF to 220nF | 220nF to 470nF | 680nF to 1µF | | ≤ 3.5% |
| | | | | | 680nF | | | ≤ 5% |
| | | | 100nF | 470nF to 1µF | 1µF to 2.2µF | 2.2µF to 4.7µF | 2.2µF to 10µF | ≤10% |
| Insulation resistance after 1 minute at $U_r$ (DC) | | | | | | | | $R_{ins}$ ≥ 10 GΩ or $R_{ins}$ × $C_r$ ≥ 500/100/50* seconds whichever is less |
| Maximum capacitance change as a function of temperature (temperature characteristic/coefficient): | | | | | | | | ±15% |
| Operating temperature range: | | | | | | | | –55 °C to +125 °C |

**NOTE**

* Rins ≥ 10 GΩ or Rins × Cr ≥ 500Ω.F:
  - 0201 : 100pF to 10nF
  - 0402 : 100pF to 220nF
  - 0603 : 100pF to 1uF
  - 0805 : 220pF to 1uF, 2.2uF/6.3V to 16V
  - 1206/1210 : 220pF to 1uF, 2.2uF/6.3V to 25V, 4.7uF/6.3V to 16V
  - 1812 : 4.7nF to 1uF

* Rins × Cr ≥ 100Ω.F:
  - 0201 : 100nF/6.3V
  - 0402 : 470nF/6.3V to 10V
  - 0603 : 2.2uF/6.3V to 16V
  - 0805 : 2.2uF/25V to 50V, 4.7uF/6.3V to 25V 10uF/6.3V to 16V
  - 1206 : 2.2uF/50V, 4.7uF/25V to 50V, 10uF/6.3V to 25V, 22uF/6.3V to 16V
  - 1210 : 2.2uF/50V, 4.7uF/25V to 50V, 10uF/6.3V to 50V, 22uF/6.3V to 16V, 47uF/6.3V to 10V

* Rins × Cr ≥ 50Ω.F:
  - 0402 : 1uF/6.3V
  - 0603 : 4.7uF/6.3V

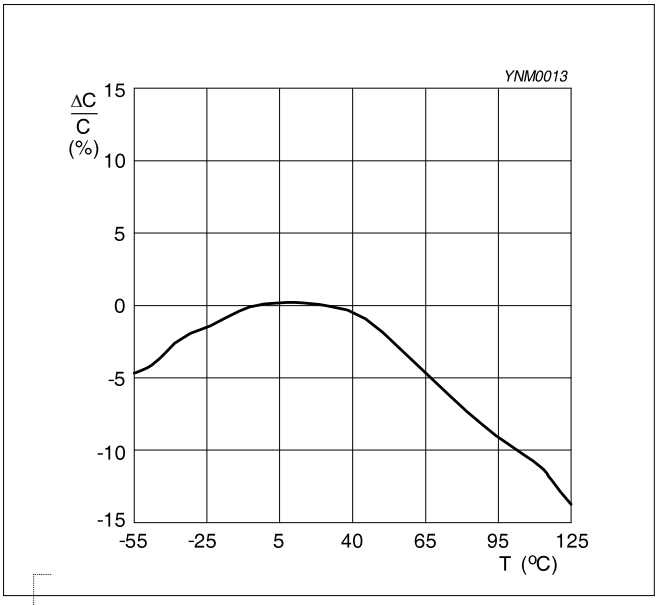



**Fig. 3** Typical capacitance change as a function of temperature

Size 0201 10 nF / 16 V
Solid lines: Impedance / Dotted lines: ESR

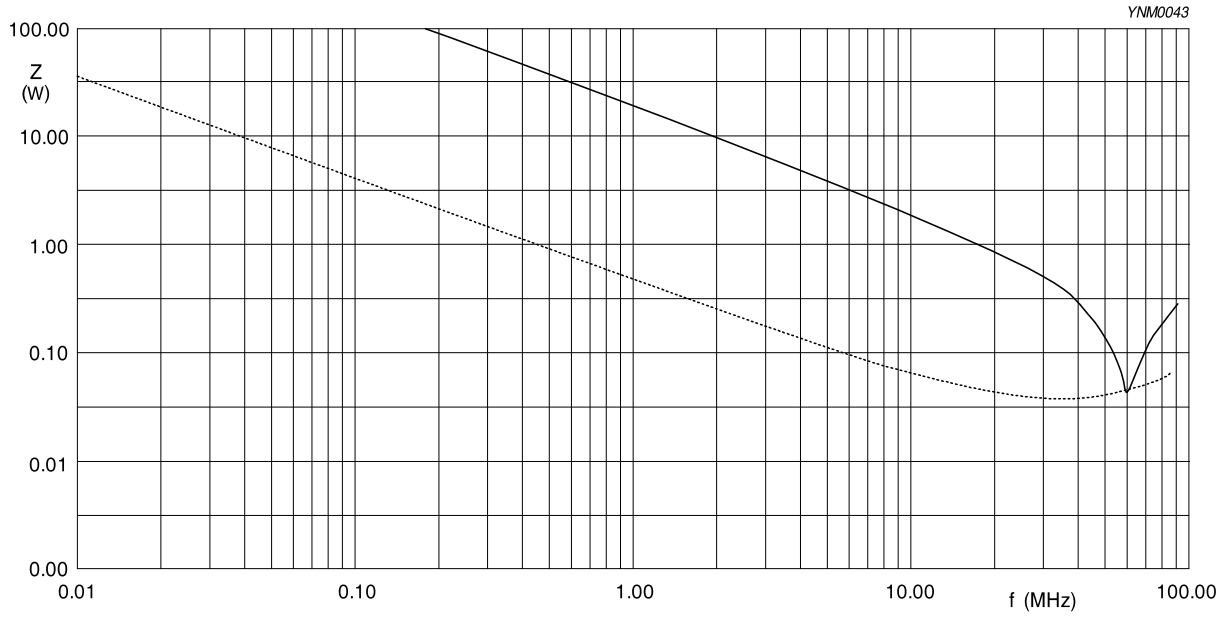



**Fig. 4** Impedance ESR vs. frequency characteristics for multilayer chip capacitors

Size 0402 100 nF / 16 V
Solid lines: Impedance / Dotted lines: ESR

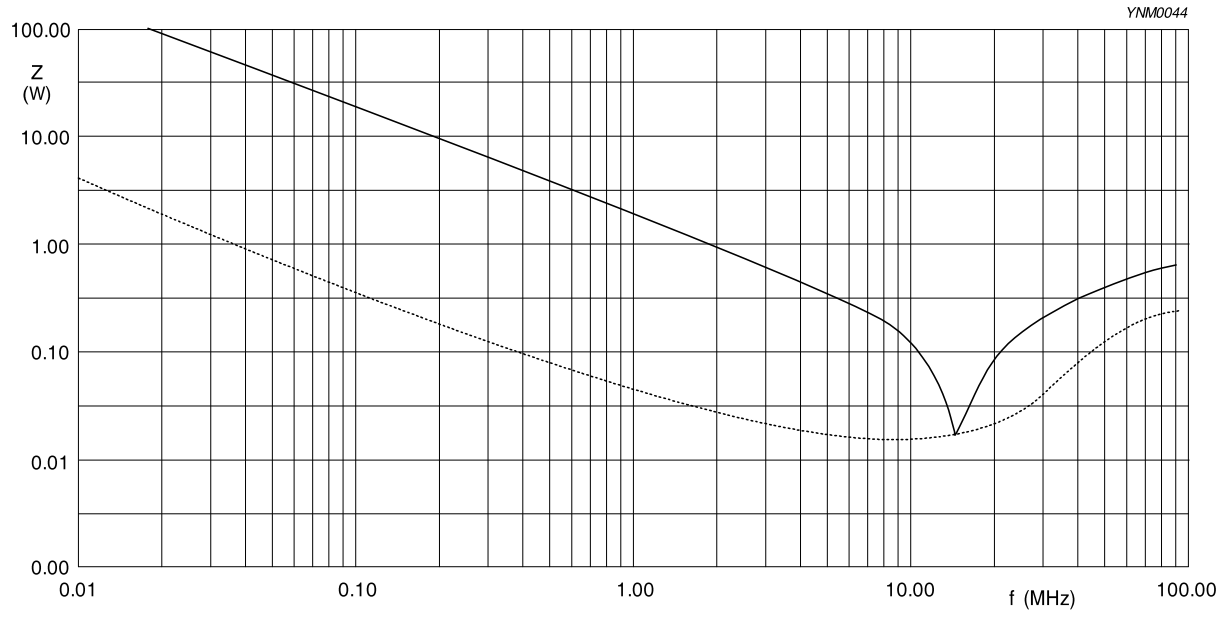



**Fig. 5** Impedance ESR vs. frequency characteristics for multilayer chip capacitors

Size 0603 1 µF / 16 V
Solid lines: Impedance / Dotted lines: ESR

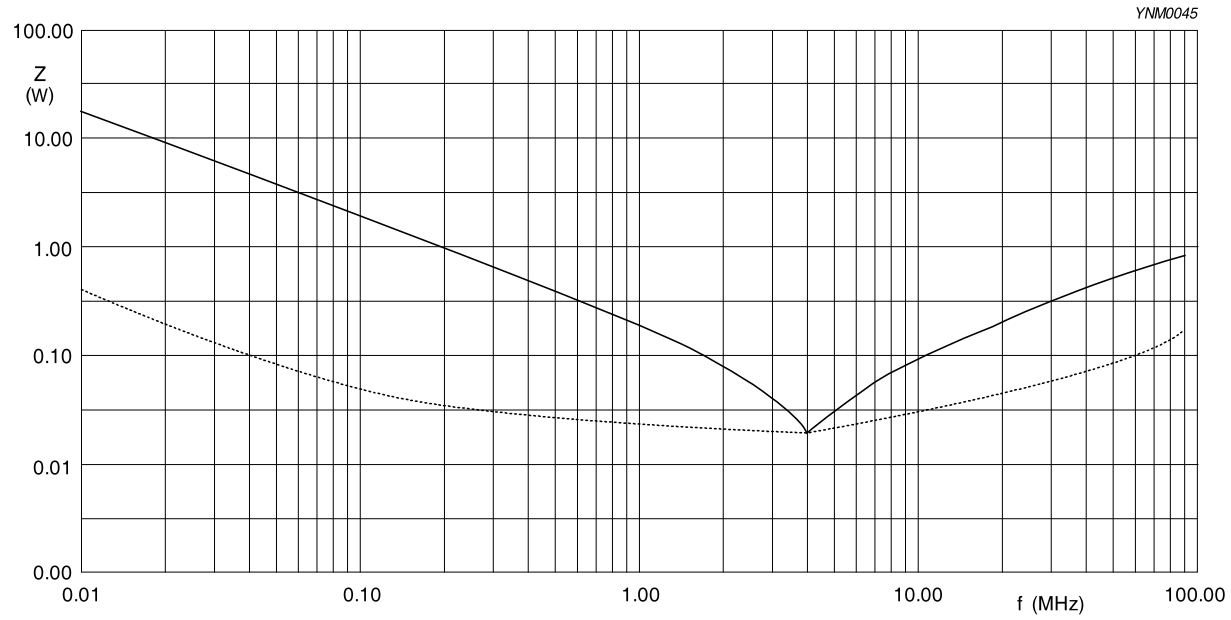



**Fig. 6** Impedance ESR vs. frequency characteristics for multilayer chip capacitors

Size 0805 1 µF / 16 V
Solid lines: Impedance / Dotted lines: ESR

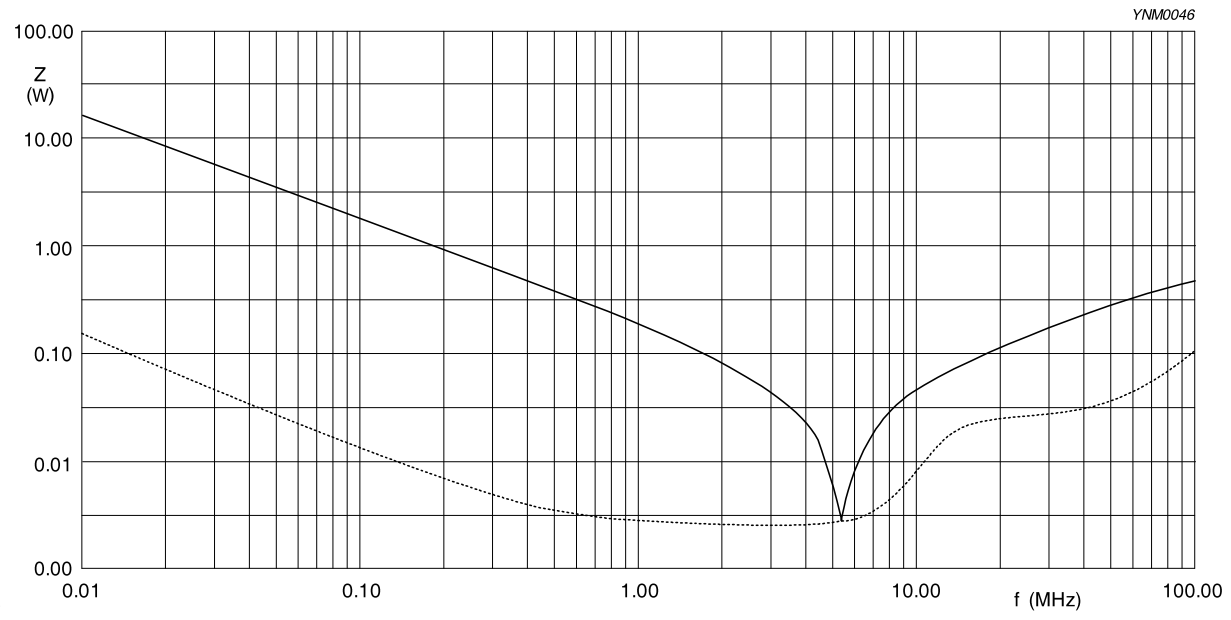



**Fig. 7** Impedance ESR vs. frequency characteristics for multilayer chip capacitors

Size 1206 1 µF / 25 V
Solid lines: Impedance / Dotted lines: ESR

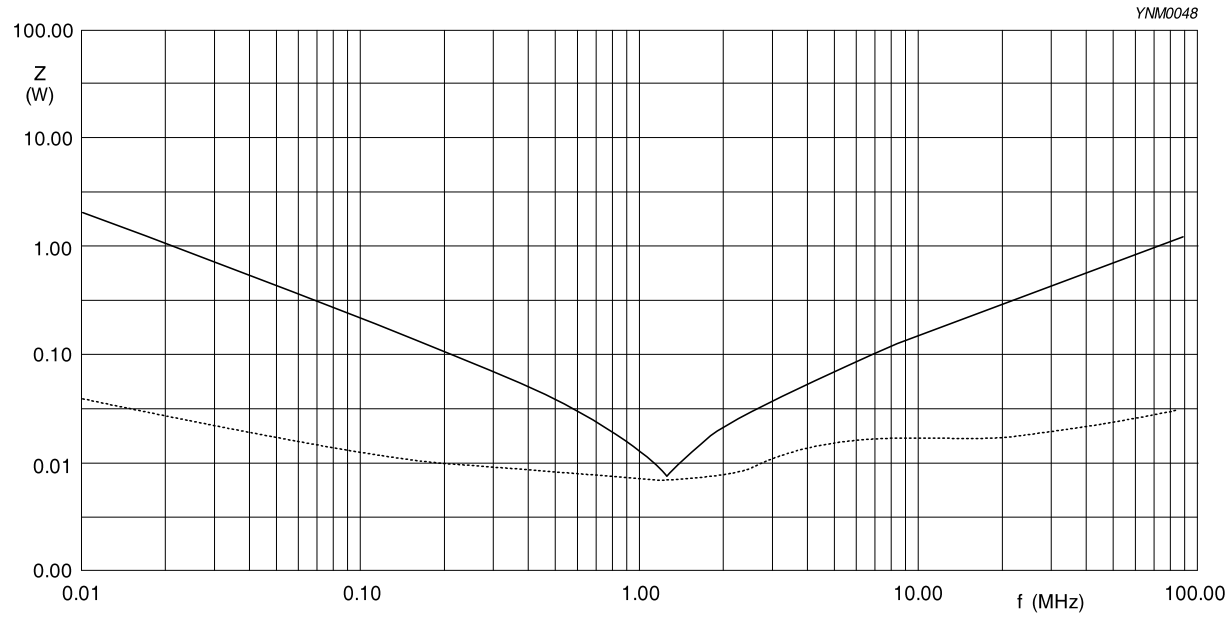



**Fig. 8** Impedance ESR vs. frequency characteristics for multilayer chip capacitors

Size 1206 10 µF / 10 V
Solid lines: Impedance / Dotted lines: ESR

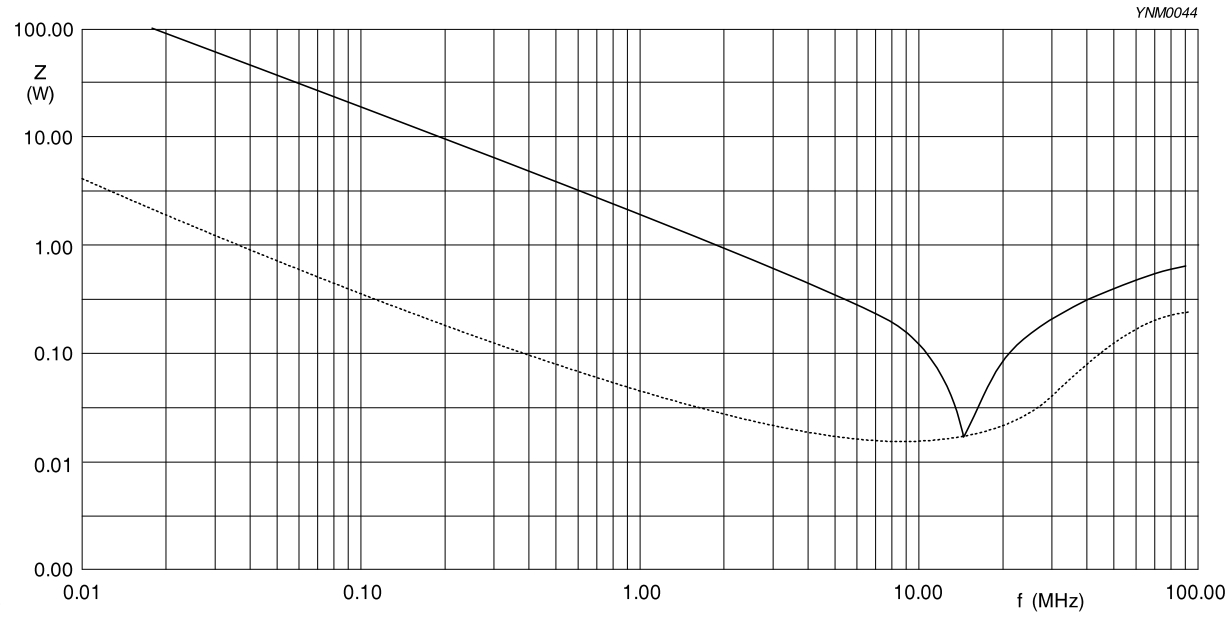



**Fig. 9** Impedance ESR vs. frequency characteristics for multilayer chip capacitors

## SOLDERING RECOMMENDATION

Table 8

| SOLDERING METHOD | SIZE 0201 | 0402 | 0603 | 0805 | 1206 | ≥ 1210 |
|---|---|---|---|---|---|---|
| Reflow | Reflow only | > 100 nF | > 1 µF | > 2.2 µF | > 4.7 µF | Reflow only |
| Reflow/Wave | | ≤ 100 nF | ≤ 1 µF | ≤ 2.2 µF | ≤ 4.7 µF | --- |

## TESTS AND REQUIREMENTS

Table 9 Test procedures and requirements

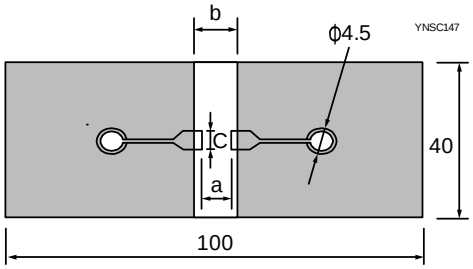
| TEST | TEST METHOD | | PROCEDURE | REQUIREMENTS |
|---|---|---|---|---|
| Mounting | IEC 60384-21/22 | 4.3 | The capacitors may be mounted on printed-circuit boards or ceramic substrates | No visible damage |
| Visual Inspection and Dimension Check | | 4.4 | Any applicable method using × 10 magnification | In accordance with specification |
| Capacitance (1) | | 4.5.1 | Class 2: | Within specified tolerance |
| Dissipation Factor (D.F.) (1) | | 4.5.2 | At 20 °C, 24 hrs after annealing<br>Cap ≤ 1 µF, f = 1 KHz, measuring at voltage 1 Vrms at 20 °C<br>Cap > 1 µF, f = 1 KHz for C ≤ 10 µF, rated voltage > 6.3 V, measuring at voltage 1 Vrms at 20 °C<br>f = 1 KHz, for C ≤ 10 µF, rated voltage ≤ 6.3 V, measuring at voltage 0.5 Vrms at 20 °C<br>f = 120 Hz for C > 10 µF, measuring at voltage 0.5 Vrms at 20 °C | |
| Insulation Resistance | | 4.5.3 | At $U_r$ (DC) for 1 minute | In accordance with specification |

**NOTE:**

1. For individual product specification, please contact local sales.

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|---|---|---|
| Temperature Characteristic | IEC 60384-21/22 4.6 | Capacitance shall be measured by the steps shown in the following table.<br>The capacitance change should be measured after 5 min at each specified temperature stage.<br>(1) Class I<br>Temperature Coefficient shall be calculated from the formula as below<br>$\text{Temp, Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6$ [ppm/℃]<br>C1: Capacitance at step c<br>C2: Capacitance at 125℃<br>ΔT: 100℃(=125℃-25℃)<br>(2) Class II<br>Capacitance Change shall be calculated from the formula as below<br>$\Delta C = \frac{C2 - C1}{C1} \times 100\%$<br>C1: Capacitance at step c<br>C2: Capacitance at step b or d | <General purpose series><br>Class1:<br>Δ C/C: ±30ppm<br>Class2:<br>X7R: Δ C/C: ±15%<br>Y5V: Δ C/C: 22~-82%<br><High Capacitance series><br>Class2:<br>X7R/X5R: Δ C/C: ±15%<br>Y5V: Δ C/C: 22~-82% |
| Adhesion | 4.7 | A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate | Force<br>size ≥ 0603: 5N<br>size = 0402: 2.5N<br>size = 0201: 1N |

| Step | Temperature(℃) |
|---|---|
| a | 25±2 |
| b | Lower temperature±3℃ |
| c | 25±2 |
| d | Upper Temperature±2℃ |
| e | 25±2 |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|---|---|---|
| Bond Strength | 4.8 | Mounting in accordance with IEC 60384-22 paragraph 4.3 | No visible damage |
| | | Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 5 mm | ΔC/C<br>Class2:<br><General purpose series><br>X5R: ±10%<br><High Capacitance series><br>X5R: ±12.5% |
| | | Test Substrate:<br>  <br><br>unit:mm | |
| Resistance to Soldering Heat | 4.9 | Precondition: 150 +0/–10 °C for 1 hour, then keep for 24 ±1 hours at room temperature<br>Preheating: for size ≤ 1206: 120 °C to 150 °C for 1 minute<br>Preheating: for size >1206: 100 °C to 120 °C for 1 minute and 170 °C to 200 °C for 1 minute<br>Solder bath temperature: 260 ±5 °C<br>Dipping time: 10 ±0.5 seconds<br>Recovery time: 24 ±2 hours | Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned |
| | | | ΔC/C<br>Class2:<br>X7R: ±10% |
| | | | D.F. within initial specified value<br>$R_{ins}$ within initial specified value |

| | Dimension(mm) | | |
|---|---|---|---|
| Type | a | b | c |
| 0201 | 0.3 | 0.9 | 0.3 |
| 0402 | 0.4 | 1.5 | 0.5 |
| 0603 | 1.0 | 3.0 | 1.2 |
| 0805 | 1.2 | 4.0 | 1.65 |
| 1206 | 2.2 | 5.0 | 1.65 |
| 1210 | 2.2 | 5.0 | 2.0 |
| 1808 | 3.5 | 7.0 | 3.7 |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|---|---|---|
| Solderability | IEC 60384-21/22 4.10 | Preheated to a temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.<br><br>1. Temperature: 235±5°C / Dipping time: 2 ±0.5 s<br>2. Temperature: 245±5°C / Dipping time: 3 ±0.5 s (lead free)<br>Depth of immersion: 10mm | The solder should cover over 95% of the critical area of each termination |
| Rapid Change of Temperature | 4.11 | Preconditioning;<br>150 +0/–10 °C for 1 hour, then keep for 24 ±1 hours at room temperature<br><br>5 cycles with following detail:<br>30 minutes at lower category temperature<br>30 minutes at upper category temperature<br><br>Recovery time 24 ±2 hours | No visual damage<br><br>ΔC/C<br>Class2:<br>X7R: ±15%<br><br>D.F. meet initial specified value<br>$R_{ins}$ meet initial specified value |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|---|---|---|
| Damp Heat with $U_r$ Load | IEC 60384-21/22 4.13 | 1. Preconditioning, class 2 only:<br>150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp<br>2. Initial measure:<br>Spec: refer to initial spec C, D, IR<br>3. Damp heat test:<br>500 ±12 hours at 40 ±2 °C;<br>90 to 95% R.H. 1.0 $U_r$ applied<br>4. Recovery:<br>Class 2: 24 ±2 hours<br>5. Final measure: C, D, IR<br><br>P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to *"IEC 60384 4.1"* and then the requirement shall be met. | No visual damage after recovery<br><br><General Purpose series><br>ΔC/C<br>Class2:<br>X7R: ±15%<br>D.F.<br>Class2:<br>X7R: ≤ 16V: ≤ 7%<br>≥ 25V: ≤ 5%<br>$R_{ins}$<br>Class2:<br>X7R: ≥ 500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less<br><br><High Capacitance series(≥ 1uF) and CC0402xRX7R9BB104><br>ΔC/C<br>Class2:<br>X7R: ±20%<br>D.F.<br>Class2:<br>X7R: 2 x initial value max<br>$R_{ins}$<br>Class2:<br>X7R: 500 MΩ or $R_{ins} \times C_r \geq 5s$ whichever is less |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|---|---|---|---|
| Endurance | IEC 60384-21/22 4.14 | 1. Preconditioning, class 2 only:<br>150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp<br>2. Initial measure:<br>Spec: refer to initial spec C, D, IR<br>3. Endurance test:<br>Temperature: X7R: 125 °C<br>Specified stress voltage applied for 1,000 hours:<br>Applied 2.0 x $U_r$ for general products*<br>Applied 1.5 x $U_r$ for high cap. Products*<br>4. Recovery time: 24 ±2 hours<br>5. Final measure: C, D, IR<br><br>P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to *"IEC 60384 4.1"* and then the requirement shall be met.<br><br>* General product (Applied 2.0 x Ur):<br>0201 ≤ 10nF<br>0402 ≤ 100nF<br>0603 ≤ 470nF<br>0805, 1206, 1210 ≤ 1uF;<br>* High cap product (Applied 1.5 x Ur):<br>0201 > 10nF<br>0402 > 100nF<br>0603 > 470nF<br>0805, 1206, 1210 > 1uF; | No visual damage<br><br><General Purpose series><br>ΔC/C<br>Class2:<br>X7R: ±15%<br>D.F.<br>Class2:<br>X7R: ≤ 16V: ≤ 7%<br>≥ 25V: ≤ 5%<br>$R_{ins}$<br>Class2:<br>X7R: ≥ 1,000 MΩ or $R_{ins}$ x $C_r$ ≥ 50s whichever is less<br><br><High Capacitance series><br>ΔC/C<br>Class 2:<br>X7R: ±20%<br>D.F.<br>Class 2:<br>X7R: 2 x initial value max<br>$R_{ins}$<br>Class 2:<br>X7R: 1,000 MΩ or $R_{ins}$ x $C_r$ ≥ 10s whichever is less |
| Voltage Proof | IEC 60384-1 4.6 | Specified stress voltage applied for 1~5 seconds<br>Ur ≤ 100 V: series applied 2.5 Ur<br>Charge/Discharge current is less than 50 mA | No breakdown or flashover |

## REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|---|---|---|---|
| Version 18 | May. 11th, 2017 | | - Add 1210/10uF/50V |
| Version 17 | Mar. 7th, 2017 | - | - 0805 L4 spec updated<br>- Dimension updated |
| Version 16 | Dec. 7th, 2016 | - | - Dimension updated |
| Version 15 | Oct. 3rd, 2016 | - | - Dimension updated, Soldering recommendation updated |
| Version 14 | May 31st, 2016 | - | - Dimension updated |
| Version 13 | Dec. 30, 2015 | - | - Dimension on 0603 and 1206 case size updated |
| Version 12 | May 26, 2015 | - | - 1210, 25V dissipation factor updated |
| Version 11 | Jan. 06, 2015 | - | - 0402, 100nF, 50V Dissipation factor (D.F.) updated. |
| Version 10 | Jul. 08, 2014 | - | - Dimension updated |
| Version 9 | Aug. 19, 2013 | - | - Dimension updated |
| Version 8 | Oct. 13, 2011 | - | - Dimension updated<br>- 50V Dissipation factor(D.F) updated |
| Version 7 | Jan. 13, 2011 | - | - Dimension updated |
| Version 6 | Oct. 13, 2010 | - | - Rated voltage of 0201 extend to 50 V<br>- Capacitance range of 0201 X7R 6.3V to 16V extend to 100 pF<br>- Capacitance range of 0805 X7R 10V extend to 10 µF<br>- Capacitance range of 0805 X7R 50V extend to 1 µF<br>- Capacitance range of 1210 X7R 10V extend to 22 µF<br>- Figures of impedance ESR updated |
| Version 5 | Jul 27, 2010 | - | - Dimension on 0603 and 1206 case size updated<br>- 16V to 25V Dissipation factor(D.F) updated |
| Version 4 | Apr 21, 2010 | - | - The statement of "Halogen Free" on the cover added<br>- Dimension updated |
| Version 3 | Oct 26, 2009 | - | - Capacitance range of 0402 X7R 25 V extend to 100 nF<br>- 16V Dissipation factor updated |
| Version 2 | May 11, 2009 | - | - Product range updated |
| Version 1 | Apr 24, 2009 | - | - Ordering code updated |
| Version 0 | Apr 15, 2009 | - | - New datasheet for general purpose and high capacitance X7R series with RoHS compliant<br>- Replace the "6.3V to 50V" part of pdf files: X7R_10V_9, X7R_16V-to-100V_9, X7R_16-to-500V_9, UP-X5R_X7R_HighCaps_6.3-to-25V_11, UY-X5R_X7R_HighCaps_6.3-to-25V_11<br>- Combine 0201 from pdf files: UP-NP0X5RX7RY5V_0201_6.3-to-50V_2 and UY-NPOX5RX7RY5V_0201_6.3-to-50V_2<br>- Define global part number<br>- Description of "Halogen Free compliant" added<br>- Test method and procedure updated |