

# DATA SHEET

## SURFACE MOUNT MULTILAYER CERAMIC CAPACITORS

Automotive grade

NP0/X7R

6.3 V TO 2000 V

0.2 pF to 680nF

RoHS compliant & Halogen Free



## SCOPE

This specification describes Automotive grade chip capacitors with lead-free terminations and used for automotive equipments.

## APPLICATIONS

All general purpose applications under normal operation and usage conditions for automotive equipments.

## FEATURES

- AEC-Q200 qualified
- MSL class: MSL 1
- AC series soldering is compliant with J-STD-020D
- High component and equipment reliability
- The capacitors are 100% performed by automatic optical inspection prior to taping.

## ORDERING INFORMATION - GLOBAL PART NUMBER

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

### GLOBAL PART NUMBER

**AC** xxxx x x xxx x **B** x xxx  
(1) (2) (3) (4) (5) (6) (7)

#### (1) SIZE – INCH BASED (METRIC)

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

#### (2) TOLERANCE

|              |              |          |
|--------------|--------------|----------|
| NPO(< 10 pF) | NPO(≥ 10 pF) | X7R      |
| B = ±0.1 pF  | F = ±1%      | J = ±5%  |
| C = ±0.25 pF | G = ±2%      | K = ±10% |
| D = ±0.5 pF  | J = ±5%      | M = ±20% |

**Note:** Capacitance tolerance ±5% doesn't available for full X7R range, please contact local sale before order.

#### (3) PACKING STYLE (SEE TABLE. 9 FOR DETAIL)

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) TC MATERIAL

NPO  
X7R

#### (5) RATED VOLTAGE

|           |            |
|-----------|------------|
| 5 = 6.3 V | B = 500 V  |
| 6 = 10 V  | Z = 630 V  |
| 7 = 16 V  | C = 1000 V |
| 8 = 25 V  | D = 2000 V |
| 9 = 50 V  |            |
| 0 = 100 V |            |
| A = 200 V |            |
| Y = 250 V |            |

#### 6) PROCESS

N = NPO  
B = X7R

#### (7) CAPACITANCE VALUE

2 significant digits+number of zeros  
The 3rd digit signifies the multiplying factor, and letter R is decimal point  
Example: 121 =  $12 \times 10^1 = 120 \text{ pF}$

## 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 (Matte Sn). The terminations are lead-free. A cross section of the structure is shown in Fig.1.

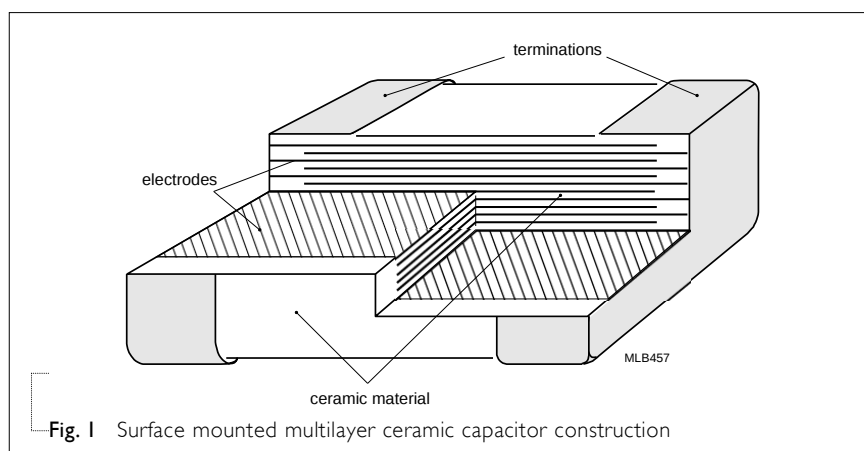


Fig. 1 Surface mounted multilayer ceramic capacitor construction

## DIMENSION

Table I For outlines see fig. 2

| TYPE | L <sub>1</sub> (mm) | W (mm)    | T (MM)                | L <sub>2</sub> / L <sub>3</sub> (mm) |      | L <sub>4</sub> (mm) |
|------|---------------------|-----------|-----------------------|--------------------------------------|------|---------------------|
|      |                     |           |                       | min.                                 | max. | min.                |
| 0201 | 0.6±0.03            | 0.3±0.03  | 0.3±0.03              | 0.10                                 | 0.20 | 0.20                |
| 0402 | 1.0±0.05            | 0.5 ±0.05 | 0.5±0.05              | 0.15                                 | 0.35 | 0.30                |
| 0603 | 1.6±0.10            | 0.8±0.10  | 0.8±0.10              | 0.20                                 | 0.60 | 0.40                |
| 0805 | 2.0±0.10            | 1.25±0.10 | 0.6±0.10              | 0.25                                 | 0.75 | 0.70                |
|      | 2.0±0.20            | 1.25±0.20 | 1.25±0.20             |                                      |      |                     |
|      | 3.2±0.15            | 1.6±0.15  | 0.6±0.10<br>0.85±0.10 |                                      |      |                     |
| 1206 | 3.2±0.30            | 1.6±0.20  | 1.00±0.10             | 0.25                                 | 0.75 | 1.40                |
|      |                     |           | 1.15± 0.10            |                                      |      |                     |
|      |                     |           | 1.25±0.20             |                                      |      |                     |
|      | 3.2±0.30            | 1.6±0.30  | 1.6±0.30              |                                      |      |                     |
| 1210 | 3.2±0.20            | 2.5±0.20  | 0.85±0.10             | 0.25                                 | 0.75 | 1.40                |
|      |                     |           | 1.25±0.20             |                                      |      |                     |
|      |                     |           | 1.6±0.20              |                                      |      |                     |
|      | 3.2±0.40            | 2.5±0.30  | 2.5±0.20              |                                      |      |                     |
| 1808 | 4.5±0.40            | 2.0±0.30  | 1.25±0.20             | 0.25                                 | 0.75 | 2.20                |
| 1812 | 4.5±0.40            | 3.2±0.30  | 0.85±0.10             | 0.25                                 | 0.75 | 2.20                |
|      |                     |           | 1.25±0.20             |                                      |      |                     |
|      |                     |           | 1.60±0.20             |                                      |      |                     |
| 2020 | 5.7±0.40            | 5.0±0.30  | 2.0±0.20              | 0.25                                 | 0.75 | 3.40                |

## OUTLINES

For dimension see Table I

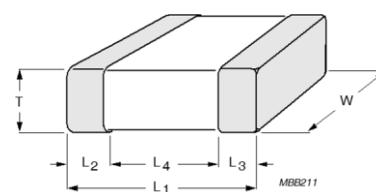


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

## CAPACITANCE RANGE &amp; THICKNESS FOR NPO

Table 2 Sizes from 0201 to 0805

| CAP.    | 0201        | 0402        | 0603        | 0805    |               |         |         |               |
|---------|-------------|-------------|-------------|---------|---------------|---------|---------|---------------|
|         | 25 V / 50 V | 25 V / 50 V | 25 V / 50 V | 100 V   | 200 V / 250 V | 50 V    | 100 V   | 200 V / 250 V |
| 0.2 pF  | 0.3±0.03    |             |             |         |               |         |         |               |
| 0.47 pF | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 0.56 pF | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 0.68 pF | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 0.82 pF | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 1.0 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 1.2 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 1.5 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 1.8 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 2.2 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 2.7 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 3.3 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 3.9 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 4.7 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 5.6 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 6.8 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 8.2 pF  | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 10 pF   | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 12 pF   | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 15 pF   | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 18 pF   | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 22 pF   | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 27 pF   | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 33 pF   | 0.3±0.03    | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 39 pF   |             | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 47 pF   |             | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 56 pF   |             | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 68 pF   |             | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 82 pF   |             | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |
| 100 pF  |             | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       |

## NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request

## CAPACITANCE RANGE &amp; THICKNESS FOR NPO

Table 3 Sizes from 0402 to 0805 (continued)

| CAP.   | 0402        | 0603        | 0805    |               |          |          |               |
|--------|-------------|-------------|---------|---------------|----------|----------|---------------|
|        | 25 V / 50 V | 25 V / 50 V | 100 V   | 200 V / 250 V | 50 V     | 100 V    | 200 V / 250 V |
| 120 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.6±0.1  | 0.6±0.1       |
| 150 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.6±0.1  | 0.6±0.1       |
| 180 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.6±0.1  | 0.6±0.1       |
| 220 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.6±0.1  | 0.85±0.1      |
| 270 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.6±0.1  | 0.85±0.1      |
| 330 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.6±0.1  | 0.85±0.1      |
| 390 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.6±0.1  | 0.85±0.1      |
| 470 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.6±0.1  | 0.85±0.1      |
| 560 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.85±0.1 | 0.85±0.1      |
| 680 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 | 0.8±0.1       | 0.6±0.1  | 0.85±0.1 | 0.85±0.1      |
| 820 pF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 |               | 0.6±0.1  | 0.85±0.1 | 0.85±0.1      |
| 1.0 nF | 0.5±0.05    | 0.8±0.1     | 0.8±0.1 |               | 0.6±0.1  | 0.85±0.1 | 0.85±0.1      |
| 1.2 nF |             | 0.8±0.1     | 0.8±0.1 |               | 0.85±0.1 | 0.85±0.1 |               |
| 1.5 nF |             | 0.8±0.1     | 0.8±0.1 |               | 0.85±0.1 | 0.85±0.1 |               |
| 1.8 nF |             | 0.8±0.1     | 0.8±0.1 |               | 0.85±0.1 | 0.85±0.1 |               |
| 2.2 nF |             | 0.8±0.1     | 0.8±0.1 |               | 1.25±0.2 | 1.25±0.2 |               |
| 2.7 nF |             | 0.8±0.1     |         |               | 1.25±0.2 | 1.25±0.2 |               |
| 3.3 nF |             | 0.8±0.1     |         |               | 1.25±0.2 | 1.25±0.2 |               |
| 3.9 nF |             | 0.8±0.1     |         |               | 1.25±0.2 | 1.25±0.2 |               |
| 4.7 nF |             | 0.8±0.1     |         |               | 1.25±0.2 | 1.25±0.2 |               |
| 5.6 nF |             | 0.8±0.1     |         |               | 1.25±0.2 | 1.25±0.2 |               |
| 6.8 nF |             | 0.8±0.1     |         |               | 1.25±0.2 | 1.25±0.2 |               |
| 8.2 nF |             | 0.8±0.1     |         |               | 1.25±0.2 | 1.25±0.2 |               |
| 10 nF  |             | 0.8±0.1     |         |               | 1.25±0.2 | 1.25±0.2 |               |

## NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request

**CAPACITANCE RANGE & THICKNESS FOR NPO****Table 4** Sizes from 1206 to 1210

| CAP.   | 1206    |         |               |          |          |          |          | 1210     |          |               |          |
|--------|---------|---------|---------------|----------|----------|----------|----------|----------|----------|---------------|----------|
|        | 50 V    | 100 V   | 200 V / 250 V | 500 V    | 630 V    | 1000 V   | 2000 V   | 50 V     | 100 V    | 200 V / 250 V | 500 V    |
| 10 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 12 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 15 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 18 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 22 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 27 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 33 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 39 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 47 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |          |          |               |          |
| 56 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 |          |          |          |               |          |
| 68 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 |          |          |          |               |          |
| 82 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 |          |          |          |               |          |
| 100 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 |          |          |          |               |          |
| 120 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 |          |          |          |               |          |
| 150 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 |          |          |          |               |          |
| 180 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 |          |          |          |               |          |
| 220 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 | 1.25±0.2 |          |          |          |               |          |
| 270 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 |          |          |          |          |               |          |
| 330 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 |          |          |          |          |               |          |
| 390 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 |          |          |          |          |               |          |
| 470 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 |          |          |          |          |               |          |
| 560 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 |          |          |          |          |               |          |
| 680 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1       | 0.6±0.1  | 1.25±0.2 |          |          |          |          |               |          |
| 820 pF | 0.6±0.1 | 0.6±0.1 | 0.85±0.1      | 0.85±0.1 | 1.25±0.2 |          |          |          |          |               |          |
| 1.0 nF | 0.6±0.1 | 0.6±0.1 | 0.85±0.1      | 0.85±0.1 | 1.25±0.2 |          |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2      | 1.25±0.2 |
| 1.2 nF | 0.6±0.1 | 0.6±0.1 | 0.85±0.1      |          |          |          |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2      | 1.25±0.2 |
| 1.5 nF | 0.6±0.1 | 0.6±0.1 | 0.85±0.1      |          |          |          |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2      | 1.25±0.2 |
| 1.8 nF | 0.6±0.1 | 0.6±0.1 |               |          |          |          |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2      | 1.25±0.2 |
| 2.2 nF | 0.6±0.1 | 0.6±0.1 |               |          |          |          |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2      |          |
| 2.7 nF | 0.6±0.1 | 0.6±0.1 |               |          |          |          |          | 1.25±0.2 | 1.25±0.2 | 1.25±0.2      |          |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request

## CAPACITANCE RANGE &amp; THICKNESS FOR X7R

Table 5 Sizes from 0201 to 0603

| CAP.   | 0201     |          | 0402     |          |          |          |          | 0603    |         |         |         |         |
|--------|----------|----------|----------|----------|----------|----------|----------|---------|---------|---------|---------|---------|
|        | 25V      | 50 V     | 10V      | 16 V     | 25 V     | 50 V     | 100 V    | 10V     | 16 V    | 25 V    | 50 V    | 100 V   |
| 100 pF | 0.3±0.03 | 0.3±0.03 |          |          |          |          |          |         |         |         |         |         |
| 150 pF | 0.3±0.03 | 0.3±0.03 |          |          |          |          |          |         |         |         |         |         |
| 220 pF | 0.3±0.03 | 0.3±0.03 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |         |         |         |         |         |
| 330 pF | 0.3±0.03 | 0.3±0.03 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |         |         |         |         |         |
| 470 pF | 0.3±0.03 | 0.3±0.03 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |         |         |         |         |         |
| 680 pF | 0.3±0.03 | 0.3±0.03 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |         |         |         |         |         |
| 1.0 nF | 0.3±0.03 | 0.3±0.03 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 1.5 nF | 0.3±0.03 |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 2.2 nF | 0.3±0.03 |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 3.3 nF | 0.3±0.03 |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 4.7 nF | 0.3±0.03 |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 6.8 nF | 0.3±0.03 |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 10 nF  | 0.3±0.03 |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 15 nF  |          |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 22 nF  |          |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 33 nF  |          |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 47 nF  |          |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 68 nF  |          |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 100 nF |          |          | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |
| 150 nF |          |          |          |          |          |          |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |         |
| 220 nF |          |          |          |          |          |          |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |         |
| 330 nF |          |          |          |          |          |          |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |         |         |
| 470 nF |          |          |          |          |          |          |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |         |         |
| 680 nF |          |          |          |          |          |          |          | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 |         |         |

## NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request

CAPACITANCE RANGE & THICKNESS FOR X7R

Table 6 Size 0805

| CAP.   | 0805     |          |          |                      |          |               |          |
|--------|----------|----------|----------|----------------------|----------|---------------|----------|
|        | 10 V     | 16 V     | 25 V     | 50 V                 | 100 V    | 200 V / 250 V | 500 V    |
| 1.0 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 0.85±0.1      | 0.85±0.1 |
| 1.5 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 0.85±0.1      | 0.85±0.1 |
| 2.2 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 0.85±0.1      | 0.85±0.1 |
| 3.3 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 0.85±0.1      | 0.85±0.1 |
| 4.7 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 0.85±0.1      | 0.85±0.1 |
| 6.8 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 1.25±0.2      |          |
| 10 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 1.25±0.2      |          |
| 15 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 1.25±0.2      |          |
| 22 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 0.85±0.1 | 1.25±0.2      |          |
| 33 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 1.25±0.2 |               |          |
| 47 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1             | 1.25±0.2 |               |          |
| 68 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1<br>1.25±0.2 | 1.25±0.2 |               |          |
| 100 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1<br>1.25±0.2 | 1.25±0.2 |               |          |
| 150 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2             |          |               |          |
| 220 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2             |          |               |          |
| 330 nF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2             |          |               |          |
| 470 nF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2             |          |               |          |
| 680 nF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2             |          |               |          |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request

**CAPACITANCE RANGE & THICKNESS FOR X7R**

Table 7 Size 1206

| CAP.   | 1206     |          |          |          |          |          |               |          |          |          |
|--------|----------|----------|----------|----------|----------|----------|---------------|----------|----------|----------|
|        | 6.3 V    | 10V      | 16V      | 25V      | 50 V     | 100 V    | 200 V / 250 V | 500 V    | 630 V    | 1000 V   |
| 220 pF |          |          |          |          |          |          |               | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 330 pF |          |          |          |          |          |          |               | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 470 pF |          |          |          |          |          |          |               | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 680 pF |          |          |          |          |          |          |               | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 1 nF   |          |          |          |          |          |          |               | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 |
| 2.2 nF |          |          |          |          |          |          |               | 1.25±0.2 | 1.25±0.2 |          |
| 4.7 nF |          |          |          |          |          |          |               | 1.25±0.2 | 1.25±0.2 |          |
| 10 nF  |          |          |          |          |          |          |               | 1.25±0.2 | 1.25±0.2 |          |
| 22 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2      |          |          |          |
| 33 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.60±0.2      |          |          |          |
| 47 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.60±0.2      |          |          |          |
| 68 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 1.60±0.2      |          |          |          |
| 100 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 1.60±0.2      |          |          |          |
| 150 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 |               |          |          |          |
| 220 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 |               |          |          |          |
| 330 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.60±0.2 | 1.60±0.2 |               |          |          |          |
| 470 nF | 1.00±0.1 | 1.00±0.1 | 1.00±0.1 | 1.00±0.1 | 1.60±0.2 | 1.60±0.2 |               |          |          |          |
| 680 nF | 1.15±0.1 | 1.15±0.1 | 1.15±0.1 | 1.60±0.2 | 1.60±0.2 | 1.60±0.2 |               |          |          |          |

Table 8 Size 1210

| CAP.   | 1210     |          |          |          |          |          |               | 1812     |          |
|--------|----------|----------|----------|----------|----------|----------|---------------|----------|----------|
|        | 6.3V     | 10 V     | 16 V     | 25 V     | 50V      | 100 V    | 200 V / 250 V | 50V      | 100V     |
| 100 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2      |          |          |
| 150 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 |               |          |          |
| 220 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 1.25±0.2 |               |          |          |
| 330 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 2.0±0.2  |               |          |          |
| 470 nF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 2.0±0.2  |               | 1.60±0.2 | 1.60±0.2 |
| 680 nF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 2.0±0.2  |               | 1.60±0.2 | 1.60±0.2 |

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request

## THICKNESS CLASSES AND PACKING QUANTITY

Table 9

| SIZE CODE | THICKNESS CLASSIFICATION | PACKING CODE |         | TAPE WIDTH | QUANTITY PER REEL |         |                   |         |
|-----------|--------------------------|--------------|---------|------------|-------------------|---------|-------------------|---------|
|           |                          | 7 INCH       | 13 INCH |            | Ø180 MM / 7 INCH  |         | Ø330 MM / 13 INCH |         |
|           |                          |              |         |            | Paper             | Blister | Paper             | Blister |
| 0201      | 0.3 ±0.03 mm             | R            | P       | 8 mm       | 15,000            | ---     | 50,000            | ---     |
| 0402      | 0.5 ±0.05 mm             | R            | P       | 8 mm       | 10,000            | ---     | 50,000            | ---     |
| 0603      | 0.8 ±0.1 mm              | R            | P       | 8 mm       | 4,000             | ---     | 15,000            | ---     |
| 0805      | 0.6 ±0.1 mm              | R            | P       | 8 mm       | 4,000             | ---     | 20,000            | ---     |
|           | 0.85 ±0.1 mm             | R            | P       | 8 mm       | 4,000             | ---     | 15,000            | ---     |
|           | 1.25 ±0.2 mm             | K            | F       | 8 mm       | ---               | 3,000   | ---               | 10,000  |
| 1206      | 0.6 ±0.1 mm              | R            | P       | 8 mm       | 4,000             | ---     | 20,000            | ---     |
|           | 0.85 ±0.1 mm             | R            | P       | 8 mm       | 4,000             | ---     | 15,000            | ---     |
|           | 1.0/1.15 ±0.1 mm         | K            | F       | 8 mm       | ---               | 3,000   | ---               | 10,000  |
|           | 1.25 ±0.2 mm             | K            | F       | 8 mm       | ---               | 3,000   | ---               | 10,000  |
|           | 1.60 ±0.2 mm             | K            | F       | 8 mm       | ---               | 2,000   | ---               | 8,000   |
| 1210      | 0.85 ±0.1 mm             | K            | F       | 8 mm       | ---               | 4,000   | ---               | 10,000  |
|           | 1.15 ±0.1 mm             | K            | F       | 8 mm       | ---               | 3,000   | ---               | 10,000  |
|           | 1.25 ±0.2 mm             | K            | F       | 8 mm       | ---               | 3,000   | ---               | 10,000  |
|           | 2.0 ±0.2 mm              | K            |         | 8 mm       | ---               | 2,000   | ---               | ---     |
|           | 2.5 ±0.2 mm              | K            |         | 8 mm       | ---               | 1,000   | ---               | ---     |
| 1812      | 0.6 / 0.85±0.1 mm        | K            |         | 12 mm      | ---               | 2,000   | ---               | ---     |
|           | 1.15±0.1 mm              | K            |         | 12 mm      | ---               | 1,000   | ---               | ---     |
|           | 1.25±0.2 mm              | K            |         | 12 mm      | ---               | 1,000   | ---               | ---     |
|           | 1.6 ±0.2 mm              | K            |         | 12 mm      | ---               | 2,000   | ---               | ---     |

## PAPER/PE TAPE SPECIFICATION

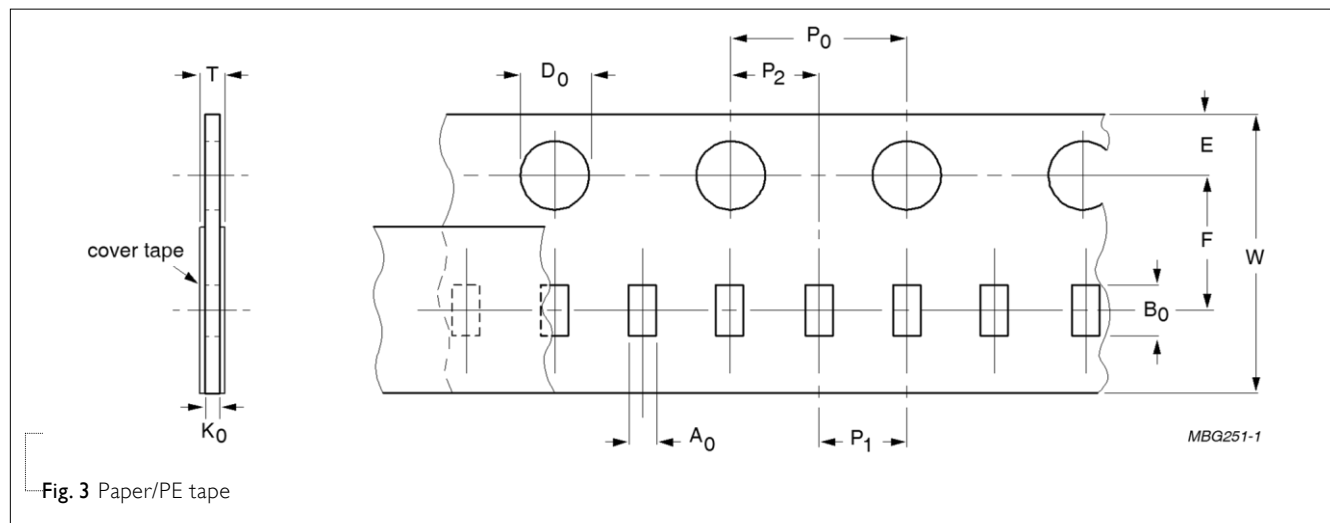


Table 10 Dimensions of paper/PE tape for relevant chip size; see Fig.3

| SIZE | SYMBOL         |                |            |            |             |                               |                |                |                 |                             | Unit: mm                    |
|------|----------------|----------------|------------|------------|-------------|-------------------------------|----------------|----------------|-----------------|-----------------------------|-----------------------------|
| CODE | A <sub>0</sub> | B <sub>0</sub> | W          | E          | F           | P <sub>0</sub> <sup>(1)</sup> | P <sub>1</sub> | P <sub>2</sub> | ØD <sub>0</sub> | K <sub>0</sub>              | T                           |
| 0201 | 0.39 ± 0.06    | 0.70 ± 0.06    | 8.0 ± 0.20 | 1.75 ± 0.1 | 3.50 ± 0.05 | 4.0 ± 0.05                    | 2.0 ± 0.05     | 2.0 ± 0.05     | 1.55 ± 0.03     | 0.38 ± 0.05                 | (0.47 / 0.55) ± 0.10        |
| 0402 | 0.70 ± 0.15    | 1.21 ± 0.12    | 8.0 ± 0.20 | 1.75 ± 0.1 | 3.50 ± 0.05 | 4.0 ± 0.05                    | 2.0 ± 0.05     | 2.0 ± 0.05     | 1.50 +0.1 / -0  | (0.75 / 0.60) ± 0.10        | (0.85 / 0.70) ± 0.10        |
| 0603 | 1.05 ± 0.14    | 1.86 ± 0.13    | 8.0 ± 0.20 | 1.75 ± 0.1 | 3.50 ± 0.05 | 4.0 ± 0.10                    | 4.0 ± 0.10     | 2.0 ± 0.05     | 1.50 +0.1 / -0  | (1.05 / 0.95 / 0.75) ± 0.10 | (1.15 / 1.05 / 0.85) ± 0.10 |
| 0805 | 1.50 ± 0.15    | 2.26 ± 0.20    | 8.0 ± 0.20 | 1.75 ± 0.1 | 3.50 ± 0.05 | 4.0 ± 0.10                    | 4.0 ± 0.10     | 2.0 ± 0.05     | 1.50 +0.1 / -0  | (1.05 / 0.95 / 0.75) ± 0.10 | (1.15 / 1.05 / 0.85) ± 0.10 |
| 1206 | 1.90 ± 0.15    | 3.50 ± 0.20    | 8.0 ± 0.20 | 1.75 ± 0.1 | 3.50 ± 0.05 | 4.0 ± 0.10                    | 4.0 ± 0.10     | 2.0 ± 0.05     | 1.50 +0.1 / -0  | (0.95 / 0.75) ± 0.10        | (1.05 / 0.85) ± 0.10        |

## NOTE

I. P<sub>0</sub> pitch tolerance over any 10 pitches is ±0.2 mm

## BLISTER TAPE SPECIFICATION

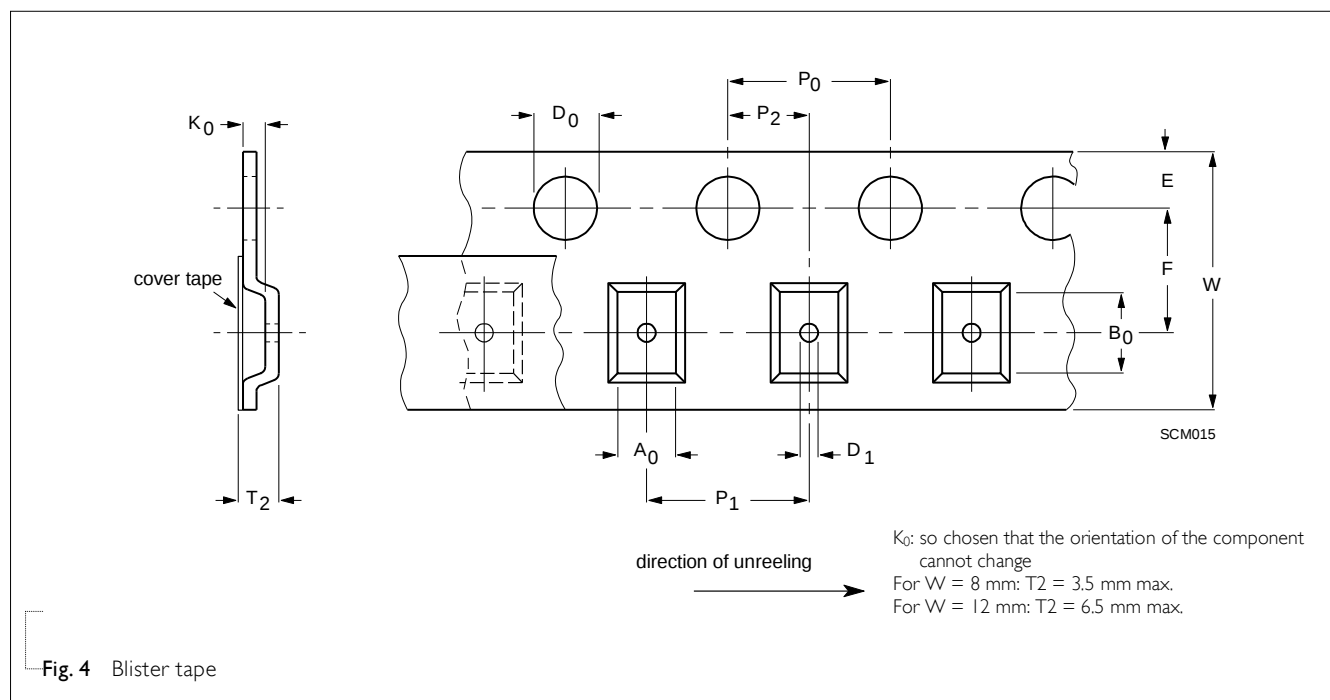


Table I I Dimensions of blister tape for relevant chip size; see Fig.4

| SIZE<br>CODE | SYMBOL         |      |                |      |                |      |            |           |           |                 |                 |                               |                |                | Unit: mm |      |
|--------------|----------------|------|----------------|------|----------------|------|------------|-----------|-----------|-----------------|-----------------|-------------------------------|----------------|----------------|----------|------|
|              | A <sub>0</sub> |      | B <sub>0</sub> |      | K <sub>0</sub> |      | W          | E         | F         | ØD <sub>0</sub> | ØD <sub>1</sub> | P <sub>0</sub> <sup>(2)</sup> | P <sub>1</sub> | P <sub>2</sub> | T2       |      |
|              | Min.           | Max. | Min.           | Max. | Min.           | Max. |            |           |           |                 | Min.            |                               |                |                | Min.     | Max. |
| 0805         | 1.29           | 1.65 | 2.09           | 2.60 | 1.25           | 1.62 | 8.1 ±0.20  | 1.75 ±0.1 | 3.5 ±0.05 | 1.5 +0.1/-0.0   | 1 +0.1/-0.0     | 4.0 ±0.10                     | 4.0 ±0.10      | 2.0 ±0.05      | 1.30     | 1.67 |
| 1206         | 1.65           | 2.12 | 3.30           | 3.75 | 1.22           | 2.15 | 8.1 ±0.20  | 1.75 ±0.1 | 3.5 ±0.05 | 1.5 +0.1/-0.0   | 1 +0.1/-0.0     | 4.0 ±0.10                     | 4.0 ±0.10      | 2.0 ±0.05      | 1.27     | 2.20 |
| 1210         | 2.55           | 3.02 | 3.31           | 3.88 | 0.97           | 2.92 | 8.1 ±0.20  | 1.75 ±0.1 | 3.5 ±0.05 | 1.5 +0.1/-0.0   | 1 +0.1/-0.0     | 4.0 ±0.10                     | 4.0 ±0.10      | 2.0 ±0.05      | 1.02     | 2.97 |
| 1808         | 2.05           | 2.55 | 4.80           | 5.45 | 1.30           | 2.45 | 12.1 ±0.20 | 1.75 ±0.1 | 5.5 ±0.05 | 1.5 +0.1/-0.0   | 1.5 +0.1/-0.0   | 4.0 ±0.10                     | 4.0 ±0.10      | 2.0 ±0.05      | 1.35     | 2.50 |
| 1812         | 3.35           | 3.75 | 4.70           | 5.33 | 0.70           | 2.40 | 12.1 ±0.20 | 1.75 ±0.1 | 5.5 ±0.05 | 1.5 +0.1/-0.0   | 1.5 +0.1/-0.0   | 4.0 ±0.10                     | 8.0 ±0.10      | 2.0 ±0.05      | 0.75     | 2.45 |

## NOTE

1. Typical capacitor displacement in pocket
2.  $P_0$  pitch tolerance over any 10 pitches is  $\pm 0.2 \text{ mm}$

## REEL SPECIFICATION

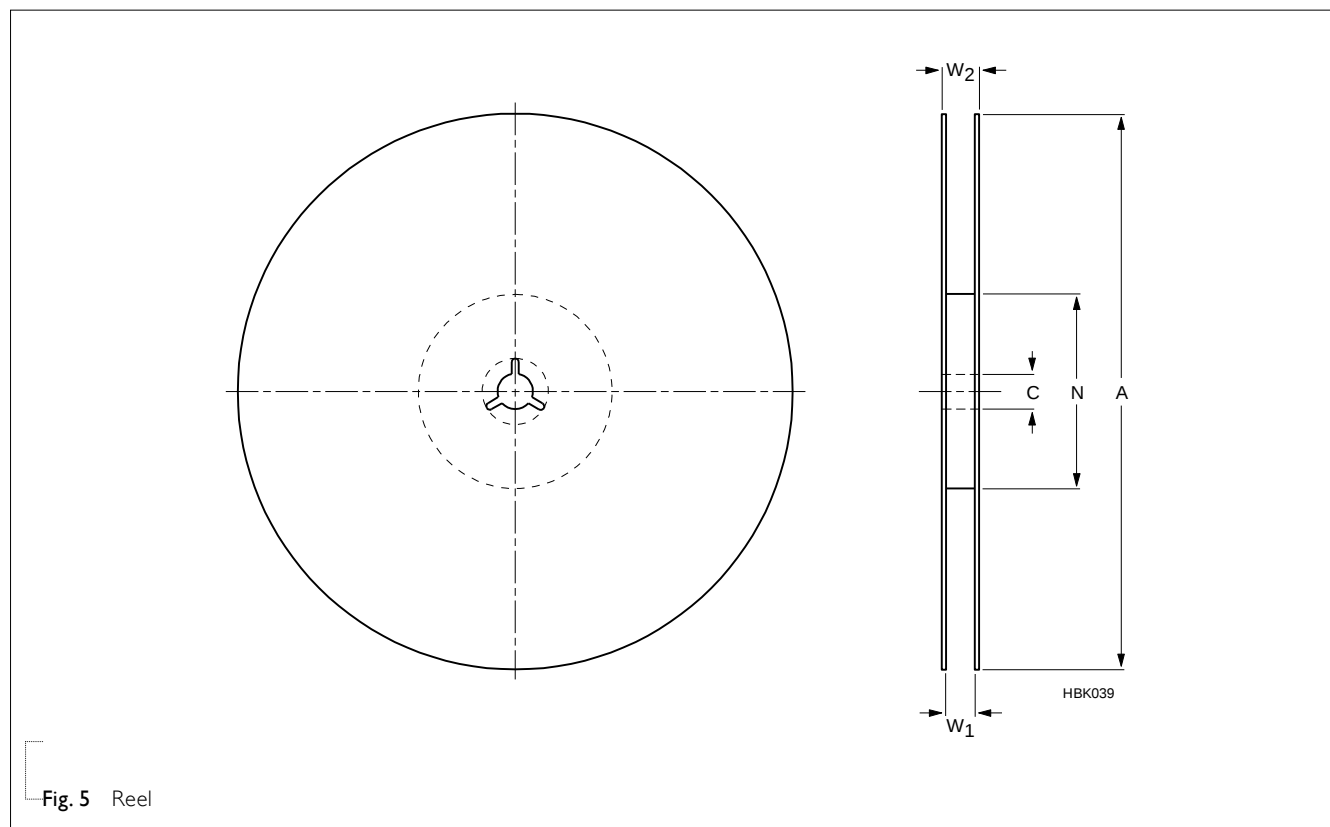


Table 12 Reel dimensions; see Fig.5

| TAPE WIDTH      | SYMBOL   |          |                | Unit: mm       |                    |
|-----------------|----------|----------|----------------|----------------|--------------------|
|                 | A        | N        | C              | W <sub>1</sub> | W <sub>2max.</sub> |
| 8 (Ø178 mm/7")  | 178 ±1.0 | 60 ±1.0  | 13 +0.50/-0.20 | 9.4 ±1.5       | 14.4               |
| 8 (Ø330 mm/13") | 330 ±1.0 | 100 ±1.0 | 13 +0.50/-0.20 | 9.0 ±0.2       | 14.4               |
| 12 (Ø178 mm/7") | 178 ±1.0 | 60 ±1.0  | 13 +0.50/-0.20 | 13.4 ±1.5      | 18.4               |

## PROPERTIES OF REEL

Material: polystyrene

Surface resistance: <10<sup>10</sup> X/sq.

## ELECTRICAL CHARACTERISTICS

## NP0/X7R DIELECTRIC CAPACITORS; NI/SIN 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 13

| DESCRIPTION                                        |                |                |                |                |                                                                                           |                |                | VALUE                  |
|----------------------------------------------------|----------------|----------------|----------------|----------------|-------------------------------------------------------------------------------------------|----------------|----------------|------------------------|
| Capacitance range                                  |                |                |                |                |                                                                                           |                |                | 0.2 pF to 680 nF       |
| Dissipation factor (D.F.)                          |                |                |                |                |                                                                                           |                |                |                        |
| NP0                                                |                | C < 30 pF      |                |                |                                                                                           |                |                | $\leq 1 / (400 + 20C)$ |
|                                                    |                | C ≥ 30 pF      |                |                |                                                                                           |                |                | ≤ 0.1 %                |
| X7R                                                | 0201           | 0402           | 0603           | 0805           | 1206                                                                                      | 1210           | 1812           |                        |
| ≤10V                                               |                | 220pF to 100nF | 1nF to 680nF   | 1nF to 680nF   | 22nF to 680nF                                                                             | 100nF to 680nF |                | ≤ 5%                   |
| 16V                                                |                | 220pF to 22nF  | 1nF to 220nF   | 1nF to 470nF   | 22nF to 680nF                                                                             | 100nF to 680nF |                | ≤ 3.5%                 |
|                                                    |                | 27nF to 100nF  | 470nF to 680nF | 680nF          |                                                                                           |                |                | ≤ 5%                   |
| 25V                                                | 100pF to 470pF | 220pF to 10nF  | 1nF to 39nF    | 1nF to 180nF   | 22nF to 680nF                                                                             | 100nF to 680nF |                | ≤ 2.5%                 |
|                                                    |                | 12nF to 27nF   | 47nF to 220nF  | 220nF          |                                                                                           |                |                | ≤ 3.5%                 |
|                                                    | 560pF to 10nF  | 33nF to 100nF  | 330nF to 680nF | 330nF to 680nF |                                                                                           |                |                | ≤ 5%                   |
| 50V                                                | 100pF to 470nF | 220pF to 10nF  | 1nF to 39nF    | 1nF to 180nF   | 22nF to 470nF                                                                             | 100nF to 680nF | 470nF to 680nF | ≤ 2.5%                 |
|                                                    | 560pF to 1nF   |                | 47nF to 220nF  | 220nF to 470nF |                                                                                           |                |                | ≤ 3.5%                 |
|                                                    |                | 12nF to 100nF  |                | 680nF          | 680nF                                                                                     |                |                | ≤ 5%                   |
| 100V                                               |                | 220pF to 1.5nF | 1nF to 10nF    | 1nF to 100nF   | 22nF to 470nF                                                                             | 100nF to 270nF | 470nF to 680nF | ≤ 2.5%                 |
|                                                    |                |                | 12nF to 100nF  |                | 560nF to 680nF                                                                            | 330nF to 680nF |                | ≤ 5%                   |
| 250V                                               |                |                |                | 1nF to 22nF    | 22nF to 100nF                                                                             | 100nF          |                | ≤ 2.5%                 |
| 500V                                               |                |                |                | 1nF to 4.7nF   | 220pF to 10nF                                                                             |                |                | ≤ 2.5%                 |
| 630V                                               |                |                |                |                | 220pF to 10nF                                                                             |                |                | ≤ 2.5%                 |
| 1KV                                                |                |                |                |                | 220pF to 1nF                                                                              |                |                | ≤ 2.5%                 |
| Insulation resistance after 1 minute at $U_r$ (DC) |                |                |                |                |                                                                                           |                |                |                        |
| General (NP0)                                      |                |                |                |                | $I.R. \geq 100 \text{ G}\Omega$ or $I.R. \times C \geq 1000 \Omega.F$ , whichever is less |                |                |                        |
| General (X7R)                                      |                |                |                |                | $I.R. \geq 10 \text{ G}\Omega$ or $I.R. \times C \geq 500 \Omega.F$ , whichever is less   |                |                |                        |
| 0603 / 25V/ 330nF to 680nF                         |                |                |                |                | $I.R. \times C \geq 100 \Omega.F$                                                         |                |                |                        |
| Operating temperature range:                       |                |                |                |                |                                                                                           |                |                |                        |
| NP0/X7R                                            |                |                |                |                |                                                                                           |                |                | -55 °C to +125 °C      |

**SOLDERING RECOMMENDATION**

Table 14

| SOLDERING METHOD | SIZE 0201   | 0402          | 0603          | 0805          | 1206          | ≥ 1210      |
|------------------|-------------|---------------|---------------|---------------|---------------|-------------|
| Reflow           | Reflow only | ≥ 0.1 $\mu$ F | ≥ 1.0 $\mu$ F | ≥ 2.2 $\mu$ F | ≥ 4.7 $\mu$ F | Reflow only |
| Reflow/Wave      |             | < 0.1 $\mu$ F | < 1.0 $\mu$ F | < 2.2 $\mu$ F | < 4.7 $\mu$ F | ---         |

**SOLDERING CONDITIONS**

The lead free MLCCs are able to stand the reflow soldering conditions as below:

- Temperature: above 220 °C
- Endurance: 95 to 120 seconds
- Cycles: 3 times

The test of "soldering heat resistance" is carried out in accordance with the schedule of "MIL-STD-202G-method 210F", "The robust construction of chip capacitors allows them to be completely immersed in a solder bath of 260 °C for 10 seconds". Therefore, it is possible to mount MLCCs on one side of a PCB and other discrete components on the reverse (mixed PCBs). Surface Mount Capacitors are tested for solderability at 245 °C during 2 seconds. The test condition for no leaching is 260°C for 30 seconds.

**TESTS AND REQUIREMENTS**

Table 15 Test procedures and requirements

| NO | AEC-Q200 TEST                 | TEST METHOD                                                                                                                                                                                                                                                                 | REQUIREMENTS                                                                                       |
|----|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| 1  | High Temperature Exposure     | Unpowered ; 1000hours @ T=150 °C<br>Measurement at 24±2 hours after test conclusion.                                                                                                                                                                                        | No visual damage                                                                                   |
|    |                               |                                                                                                                                                                                                                                                                             | $\Delta C/C$<br>NPO: Within $\pm 2.5\%$ or 0.25 pF, whichever is greater<br>X7R: Within $\pm 10\%$ |
|    |                               |                                                                                                                                                                                                                                                                             | D.F.:<br>within initial specified value                                                            |
|    |                               |                                                                                                                                                                                                                                                                             | IR:<br>within initial specified value                                                              |
| 2  | Temperature Cycling           | Preconditioning:<br>150 +0/-10 °C for 1 hour, then keep for<br>24 $\pm$ 1 hours at room temperature<br><br>1000 cycles with following detail:<br>30 minutes at lower category temperature<br>30 minutes at upper category temperature<br><br>Recovery time 24 $\pm$ 2 hours | No visual damage                                                                                   |
|    |                               |                                                                                                                                                                                                                                                                             | $\Delta C/C$<br>NPO: Within $\pm 2.5\%$ or 0.25 pF, whichever is greater<br>X7R: $\pm 10\%$        |
|    |                               |                                                                                                                                                                                                                                                                             | D.F. meet initial specified value                                                                  |
|    |                               |                                                                                                                                                                                                                                                                             | IR meet initial specified value                                                                    |
| 3  | Destructive Physical Analysis | Electrical test not required.                                                                                                                                                                                                                                               |                                                                                                    |

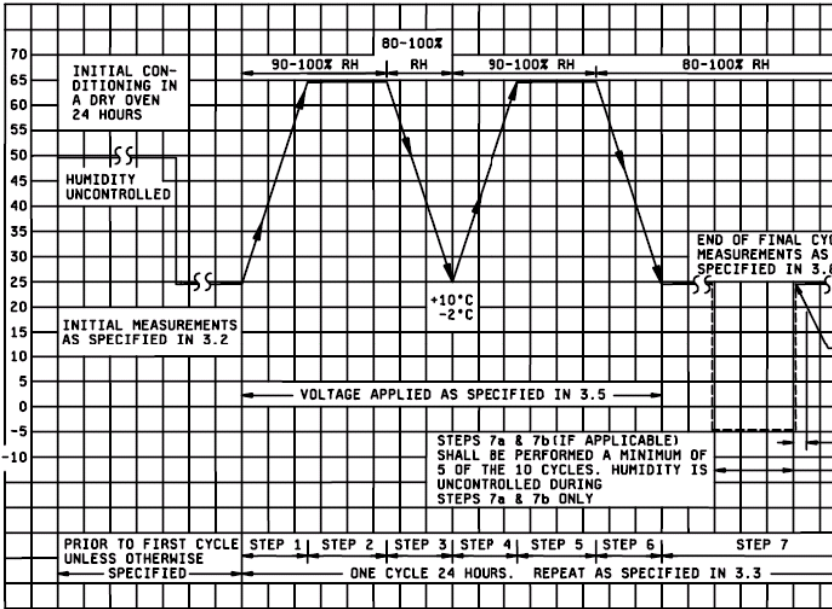
| NO | AEC-Q200 TEST       | TEST METHOD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4  | Moisture Resistance | <p>T=24 hrs/per cycle; 10 continuous cycles unpowered.<br/>Measurement at 24 ±2 hours after test condition.</p>                                                                                                                                                                                                                                                                                                                                                                                         | <p>No visual damage</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|    |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p><math>\Delta C/C</math><br/>NPO: Within <math>\pm 3\%</math> or 3 pF, whichever is greater<br/>X7R: <math>\pm 15\%</math></p> <p>D.F.<br/>Within initial specified value</p> <p>I.R.<br/>Meet initial specified value</p>                                                                                                                                                                                                                                                                        |
| 5  | Biased Humidity     | <ol style="list-style-type: none"> <li>Preconditioning, class 2 only:<br/>150 <math>\pm 0/-10</math> °C /1 hour, then keep for 24 <math>\pm 1</math> hour at room temp</li> <li>Initial measure:<br/>Spec. refer to initial spec. C. D. I.R.<br/>Note: Series with 100 K<math>\Omega</math></li> <li>Test condition:<br/>85 °C, 85% R.H. connected with 100 K<math>\Omega</math> resistor, applied 1.5V/<math>U_r</math> (no more than 630V) for 1,000 hours.</li> <li>Recovery:<br/>NPO: 6 to 24 hours<br/>X7R: 24 <math>\pm 2</math> hours</li> <li>Final measure: C. D. I.R.</li> </ol> | <p>No visual damage after recovery</p> <p><math>\Delta C/C</math><br/>NPO: Within <math>\pm 2\%</math> or 1 pF, whichever is greater<br/>X7R: <math>\pm 15\%</math></p> <p>D.F.<br/>NPO: <math>\leq 2 \times</math> specified value.<br/>X7R:<br/>(1) <math>\leq 16V: \leq 7\%</math> or specified value whichever is greater<br/>(2) <math>\geq 25V: \leq 5\%</math> or specified value whichever is greater</p> <p>I.R.<br/>The insulation resistance shall greater than 10% of initial spec.</p> |

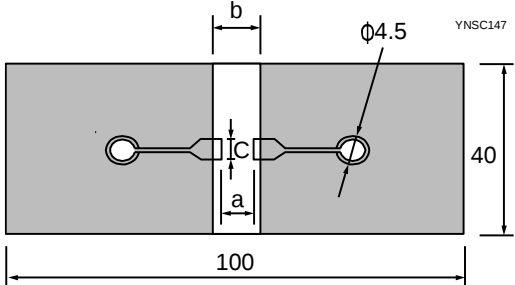
Fig. 6 Moisture resistant

| NO | AEC-Q200 TEST                     | TEST METHOD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | REQUIREMENTS                                                                                                                                                                                                                                       |
|----|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6  | High Temperature Operational Life | 1. Preconditioning, class 2 only:<br>150 +0/-10 °C /1 hour, then keep for<br>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: 125 °C<br>Specified stress voltage applied for 1,000 hours:<br>Applied 2.0 × Ur for general products *<br>High voltage series follows with below<br>stress condition:<br>Applied 1.5 × Ur for 200V, 250V series<br>Applied 1.3 × Ur for 500V, 630V series<br>Applied 1.2 × Ur for 1KV, 2KV, 3KV series<br>Recovery time: 24 ±2 hours<br>Final measure: C, D, IR<br><br>Note: If the capacitance value is less than the minimum value<br>permitted, then after the other measurements have been<br>made the capacitor shall be preconditioned according to "IEC<br>60384 4.1" and then the requirement shall be met.<br>* Applied 1.5 × Ur<br>0402/X7R/50V/>10nF<br>0603/X7R/25V/>220nF; 0603/X7R/50V/220nF<br>0603/X7R/100V/≥100nF<br>0805/X7R/100V/≥ 470nF | No visual damage                                                                                                                                                                                                                                   |
|    |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | $\Delta C/C$<br>NPO: Within $\pm 2\%$ or 1 pF,<br>whichever is greater<br>X7R: $\pm 15\%$                                                                                                                                                          |
|    |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | D.F.<br>NPO: $\leq 2 \times$ specified value.<br>X7R:<br>(1) $\leq 16V: \leq 7\%$ or specified<br>value whichever is greater<br>(2) $\geq 25V: \leq 5\%$ or specified<br>value whichever is greater                                                |
|    |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | IR<br>NPO: $\geq 4,000 M\Omega$ or $IR \times C_r \geq$<br>40 $\Omega$ .F. whichever is less<br>X7R: $\geq 1,000 M\Omega$ or $IR \times C_r \geq$<br>50 $\Omega$ .F. whichever is less *<br>* $IR \times C_r \geq 10\Omega$ .F.<br>0603/25V/>220nF |
| 7  | External Visual                   | Any applicable method using $\times 10$ magnification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | In accordance with specification                                                                                                                                                                                                                   |
| 8  | Physical Dimension                | Verify physical dimensions to the applicable device specification.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | In accordance with specification                                                                                                                                                                                                                   |
| 9  | Mechanical Shock                  | Three shocks in each direction shall be applied along the three<br>mutually perpendicular axes of the test specimen<br>(18 shocks)<br>Peak value: 1,500 g's<br>Duration: 0.5 ms<br>Velocity change: 15.4 ft/s<br>Waveform: Half-sin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | $\Delta C/C$<br>NPO: Within $\pm 0.5\%$ or 0.5 pF,<br>whichever is greater<br>X7R: $\pm 10\%$                                                                                                                                                      |
|    |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | D.F.<br>Within initial specified value                                                                                                                                                                                                             |
|    |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | IR<br>Within initial specified value                                                                                                                                                                                                               |
| 10 | Vibration                         | 5 g's for 20 minutes, 12 cycles each of 3 orientations.<br>Test from 10-2000 Hz.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | $\Delta C/C$<br>NPO: Within $\pm 0.5\%$ or 0.5 pF,<br>whichever is greater<br>X7R: $\pm 10\%$                                                                                                                                                      |
|    |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | D.F: meet initial specified value                                                                                                                                                                                                                  |
|    |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | IR meet initial specified value                                                                                                                                                                                                                    |

| NO | AEC-Q200 TEST                | TEST METHOD                                                                                                                                                                                                                                                                                                                                                                          | REQUIREMENTS                                                                                                                                                                                                                                                          |
|----|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | Resistance to Soldering Heat | 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<br><br>$\Delta C/C$<br>NPO: Within ±1% or 0.5 pF, whichever is greater.<br>X7R: ±10%<br><br>D.F. within initial specified value<br><br>IR within initial specified value |
| 12 | Thermal Shock                | 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. Rapid change of temperature test:<br>-55 °C to +125 °C; 300 cycles<br>15 minutes at -55°C;<br>15 minutes at 125 °C<br>4. Recovery time:<br>NPO: 6 to 24 hours<br>X7R: 24±2 hours<br>5. Final measure: C, D, IR | No visual damage<br><br>$\Delta C/C$<br>NPO: Within ±1% or 1 pF, whichever is greater<br><br>X7R: ±15%<br><br>D.F: meet initial specified value<br><br>IR meet initial specified value                                                                                |
| 13 | ESD                          | Per AEC-Q200-002<br><br><p>Note: Classify the components according to the highest ESD voltage level survived during ESD testing.</p> <p><b>Fig. 7</b> Passive component HBM ESD test flow diagram<br/>           (DC = Direct Contact Discharge, AD = Air Discharge)</p>                                                                                                             | A component passes a voltage level if all components stressed at that voltage level pass.                                                                                                                                                                             |

| NO | AEC-Q200 TEST               |                              | TEST METHOD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | REQUIREMENTS                                                               |
|----|-----------------------------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| 14 | Solderability               |                              | <p>1. Preheat at 155°C for 4 hours. After preheating, immerse the capacitor in a solution of ethanol and rosin (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.</p> <p>2. Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol and rosin (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.</p> <p>3. Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of Ethanol and rosin (25% rosin in weight proportion). Immerse in eutectic solder solution for 120±5 seconds at 260±5°C.</p> | The solder should cover over 95% of the critical area of each termination. |
| 15 | Electrical Characterization | Capacitance                  | <p><b>NPO:</b><br/> <math>f = 1 \text{ MHz}</math> for <math>C \leq 1 \text{ nF}</math>, measuring at voltage <math>1 V_{\text{rms}}</math> at 25 °C<br/> <math>f = 1 \text{ KHz}</math> for <math>C &gt; 1 \text{ nF}</math>, measuring at voltage <math>1 V_{\text{rms}}</math> at 25 °C</p> <p><b>X7R:</b><br/>           At 25 °C, 24 hours after annealing<br/> <math>f = 1 \text{ KHz}</math>, measuring at voltage <math>1 V_{\text{rms}}</math> at 25 °C</p>                                                                                                                                                                                                                                                               | Within specified tolerance                                                 |
|    |                             | Dissipation Factor (D.F.)    | <p><b>NPO:</b><br/> <math>f = 1 \text{ MHz}</math> for <math>C \leq 1 \text{ nF}</math>, measuring at voltage <math>1 V_{\text{rms}}</math> at 25 °C<br/> <math>f = 1 \text{ KHz}</math> for <math>C &gt; 1 \text{ nF}</math>, measuring at voltage <math>1 V_{\text{rms}}</math> at 25 °C</p> <p><b>X7R:</b><br/>           At 25 °C, 24 hours after annealing<br/> <math>f = 1 \text{ KHz}</math>, measuring at voltage <math>1 V_{\text{rms}}</math> at 25 °C</p>                                                                                                                                                                                                                                                               | In accordance with specification on Table 13                               |
|    |                             | Insulation Resistance (I.R.) | At $U_r$ (DC) for 1 minute                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | In accordance with specification on Table 13                               |

| NO            | AEC-Q200 TEST                                                                                                                                                                                                                                                                                                                  |                           | TEST METHOD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | REQUIREMENTS |                 |   |      |   |                       |   |      |   |                       |   |      |                                                  |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------|---|------|---|-----------------------|---|------|---|-----------------------|---|------|--------------------------------------------------|
| 15            | Electrical Characterization                                                                                                                                                                                                                                                                                                    | Temperature coefficient   | <p>Capacitance shall be measured by the steps shown in the following table.</p> <p>The capacitance change should be measured after 5 min at each specified temperature stage.</p> <table><tr><td>Step</td><td>Temperature(°C)</td></tr><tr><td>a</td><td>25±2</td></tr><tr><td>b</td><td>Lower temperature±3°C</td></tr><tr><td>c</td><td>25±2</td></tr><tr><td>d</td><td>Upper Temperature±2°C</td></tr><tr><td>e</td><td>25±2</td></tr></table> <p>(1) NPO</p> <p>Temperature Coefficient shall be calculated from the formula as below</p> $\text{Temp, Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}$ <p>C1: Capacitance at step c<br/>C2: Capacitance at 125°C<br/>ΔT: 100°C (=125°C -25°C)</p> <p>(2) X7R</p> <p>Capacitance Change shall be calculated from the formula as below</p> $\Delta C = \frac{C2 - C1}{C1} \times 100\%$ <p>C1: Capacitance at step c<br/>C2: Capacitance at step b or d</p> | Step         | Temperature(°C) | a | 25±2 | b | Lower temperature±3°C | c | 25±2 | d | Upper Temperature±2°C | e | 25±2 | <p>ΔC/C<br/>NPO: ±30ppm /°C</p> <p>X7R: ±15%</p> |
|               |                                                                                                                                                                                                                                                                                                                                | Step                      | Temperature(°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                 |   |      |   |                       |   |      |   |                       |   |      |                                                  |
| a             | 25±2                                                                                                                                                                                                                                                                                                                           |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                 |   |      |   |                       |   |      |   |                       |   |      |                                                  |
| b             | Lower temperature±3°C                                                                                                                                                                                                                                                                                                          |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                 |   |      |   |                       |   |      |   |                       |   |      |                                                  |
| c             | 25±2                                                                                                                                                                                                                                                                                                                           |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                 |   |      |   |                       |   |      |   |                       |   |      |                                                  |
| d             | Upper Temperature±2°C                                                                                                                                                                                                                                                                                                          |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                 |   |      |   |                       |   |      |   |                       |   |      |                                                  |
| e             | 25±2                                                                                                                                                                                                                                                                                                                           |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                 |   |      |   |                       |   |      |   |                       |   |      |                                                  |
| Voltage Proof | <p>1. Specified stress voltage applied for 1~5 seconds<br/>2. Ur ≤ 100 V: series applied 2.5 Ur<br/>3. 100 V &lt; Ur ≤ 200 V series applied (1.5 Ur + 100)<br/>4. 200 V &lt; Ur ≤ 500 V series applied (1.3 Ur + 100)<br/>5. Ur ≥ 500 V: 1.3 Ur<br/>6. Ur ≥ 1000 V: 1.2 Ur<br/>Charge/Discharge current is less than 50 mA</p> | No breakdown or flashover |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                 |   |      |   |                       |   |      |   |                       |   |      |                                                  |

| NO   | AEC-Q200 TEST     | TEST METHOD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |               |  |  |      |   |   |   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |      |      |     |     |      |      |     |     |     |      |     |     |     |
|------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------|--|--|------|---|---|---|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|------|------|-----|-----|------|------|-----|-----|-----|------|-----|-----|-----|
| 16   | Board Flex        | <p>Part mounted on a 100mm × 40mm FR4 PCB board, which is <math>1.6 \pm 0.2</math> mm thick and has a layer-thickness <math>35 \mu\text{m} \pm 10 \mu\text{m}</math>. Part should be mounted using the following soldering reflow profile.</p> <p>Conditions:</p> <p><b>NPO:</b><br/>Bending 3 mm at a rate of 1 mm/s, radius jig 340 mm</p> <p><b>X7R:</b><br/>Bending 2 mm at a rate of 1 mm/s, radius jig 340 mm</p> <p>Test Substrate:</p>  <p>unit: mm</p> | <p><math>\Delta C/C</math></p> <p>NPO: Within <math>\pm 1\%</math> or 0.5 pF, whichever is greater</p> <p>X7R: <math>\pm 10\%</math></p> <table border="1"> <thead> <tr> <th></th><th colspan="3">Dimension(mm)</th></tr> <tr> <th>Type</th><th>a</th><th>b</th><th>c</th></tr> </thead> <tbody> <tr> <td>0201</td><td>0.3</td><td>0.9</td><td>0.3</td></tr> <tr> <td>0402</td><td>0.4</td><td>1.5</td><td>0.5</td></tr> <tr> <td>0603</td><td>1.0</td><td>3.0</td><td>1.2</td></tr> <tr> <td>0805</td><td>1.2</td><td>4.0</td><td>1.65</td></tr> <tr> <td>1206</td><td>2.2</td><td>5.0</td><td>1.65</td></tr> <tr> <td>1210</td><td>2.2</td><td>5.0</td><td>2.0</td></tr> <tr> <td>1808</td><td>3.5</td><td>7.0</td><td>3.7</td></tr> </tbody> </table> |  | 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 |
|      | 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |               |  |  |      |   |   |   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |      |      |     |     |      |      |     |     |     |      |     |     |     |
| 17   | Terminal Strength | <p>With the component mounted on a PCB obtained with the device to be tested, apply a 17.7N (1.8Kg) force to the side of a device being tested.</p> <p>This force shall be applied for 60+ 1 seconds.</p> <p>Also the force shall be applied gradually as not to apply a shock to the component being tested.</p> <p>* Apply 2N force for 0402 size.</p> <p>* Apply 1N force for 0201 size.</p>                                                                                                                                                    | <p>Magnification of 20X or greater may be employed for inspection of the mechanical integrity of the device body, terminals and body/terminal junction.</p> <p>Before, during and after the test, the device shall comply with all electrical requirements stated in this specification.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |               |  |  |      |   |   |   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |      |      |     |     |      |      |     |     |     |      |     |     |     |
| 18   | Beam Load Test    | <p>Place the part in the beam load fixture. Apply a force until the part breaks or the minimum acceptable force level required in the user specification(s) is attained.</p>                                                                                                                                                                                                                                                                                                                                                                       | <p><math>\leq 0805</math></p> <p>Thickness &gt; 0.5mm: 20N</p> <p>Thickness <math>\leq 0.5</math>mm: 8N</p> <p><math>\geq 1206</math></p> <p>Thickness <math>\geq 1.25</math> mm: 54N</p> <p>Thickness &lt; 1.25 mm: 15N</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |               |  |  |      |   |   |   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |      |      |     |     |      |      |     |     |     |      |     |     |     |

## REVISION HISTORY

| REVISION   | DATE          | CHANGE NOTIFICATION | DESCRIPTION                                                                                                                                                                                                                      |
|------------|---------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Version 17 | Jan. 14, 2022 | -                   | - Add 1206/NPO/2000V/10pF to 47pF                                                                                                                                                                                                |
| Version 16 | Nov. 17, 2021 | -                   | - Add 1206/X7R/500V to 1000V/220pF to 1nF                                                                                                                                                                                        |
| Version 15 | Oct. 12, 2021 | -                   | - Add 0603/NPO/25V/50V/2.7nF to 10nF<br>- I.R. for NPO change to "I.R. $\geq 100\text{ G}\Omega$ or I.R. $\times C \geq 1000\Omega\cdot\text{F}$ , whichever is less"                                                            |
| Version 14 | Aug. 09, 2021 | -                   | - Add 1206/NPO/1kV/10pF to 220pF<br>1206/X7R/1kV/1nF                                                                                                                                                                             |
| Version 13 | Jun. 08, 2021 | -                   | - Move out "Array" and "High Cap" to individual specification<br>Add 0603 NPO 50V/100V 1.2nF to 2.2nF<br>0402 X7R 50V 15nF to 100nF<br>0603 X7R 25V 330nF to 680nF<br>0603 X7R 50V 150nF to 220nF<br>0603 X7R 100V 68nF to 100nF |
| Version 12 | Feb. 26, 2021 | -                   | - Add 0201/ X7R/ 50V / 100 pF to 1nF<br>0603/ X7R/ 16V / 680nF to 1 $\mu\text{F}$<br>0603/ X7R/ 25V / 150nF / 220nF/ 1 $\mu\text{F}$<br>1210/ X7R/ 50V / 4.7 $\mu\text{F}$                                                       |
| Version 11 | Jun. 29, 2018 | -                   | - Add 0201 NPO 25V/ 50V, 0.2pF to 33pF, Add 0402 NPO 50V 270pF to 1nF, Add 0805 X7R 25V 2.2uF                                                                                                                                    |
| Version 10 | May. 2, 2018  | -                   | - Add 0603 NPO 100V 820pF to 1nF,<br>- Add 0805 NPO 50V to 100V, 1.2nF to 10nF,<br>- Add 0805 X7R 16V 2.2uF, 50V 680nF to 1uF,<br>- Add 1206 X7R 100V 330nF to 2.2uF, 250V 33nF to 100nF                                         |
| Version 9  | Mar. 22, 2018 | -                   | - Add 0402 X7R 100nF 25~50V                                                                                                                                                                                                      |
| Version 8  | Nov. 22, 2017 | -                   | - Add X7R/0201/25V/100pF~10nF                                                                                                                                                                                                    |
| Version 7  | Jul. 7, 2017  | -                   | - Add X7R/0805/330nF to 470nF/50V, X7R/1206/10uF/6.3V                                                                                                                                                                            |
| Version 6  | Mar. 31, 2017 | -                   | - Add NPO/0603/1nF/50V, X7R/0603/1uF/10V, X7R/0603/470nF/16V, X7R/0603/220nF/25V                                                                                                                                                 |
| Version 5  | Nov. 15, 2016 | -                   | - Add Soldering Condition                                                                                                                                                                                                        |
| Version 4  | Jun. 14, 2016 | -                   | - Add X7R/0805/2.2uF/10V and NPO/1206/1.2nF to 1.5nF/250V                                                                                                                                                                        |
| Version 3  | Jul. 21, 2015 | -                   | - Tests and Requirements update                                                                                                                                                                                                  |
| Version 2  | Jul. 17, 2014 | -                   | - Tests and Requirements update                                                                                                                                                                                                  |
| Version 1  | Apr. 19, 2013 | -                   | - Capacitance range update                                                                                                                                                                                                       |
| Version 0  | Dec. 25, 2012 | -                   | - New                                                                                                                                                                                                                            |

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