

# DATA SHEET

## SURFACE MOUNT MULTILAYER CERAMIC CAPACITORS

Automotive grade

NP0/X7R

6.3 V TO 630 V

0.2 pF to 680nF

RoHS compliant & Halogen Free



## SCOPE

This specification describes Automotive grade NP0/X7R series chip capacitors with lead-free terminations and used for automotive equipments.

## APPLICATIONS

All general purpose applications  
Entertainment applications  
Comfort / security applications  
Information applications

## FEATURES

- AEC-Q200 qualified
- MSL class: MSL I
- 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

B =  $\pm 0.1$  pF

C =  $\pm 0.25$  pF

D =  $\pm 0.5$  pF

F =  $\pm 1\%$

G =  $\pm 2\%$

J =  $\pm 5\%$

K =  $\pm 10\%$

M =  $\pm 20\%$

#### (3) PACKING STYLE (SEE FIG. 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

6 = 10 V

7 = 16 V

8 = 25 V

9 = 50 V

0 = 100 V

A = 200 V

Y = 250 V

B = 500 V

Z = 630 V

#### (6) PROCESS

N = NPO

B = Class 2 MLCC

#### (7) CAPACITANCE VALUE

2 significant digits+number of zeros

The 3rd digit signifies the multiplying factor, and letter R is decimal point

Example: 121 =  $12 \times 10^1 = 120$  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.

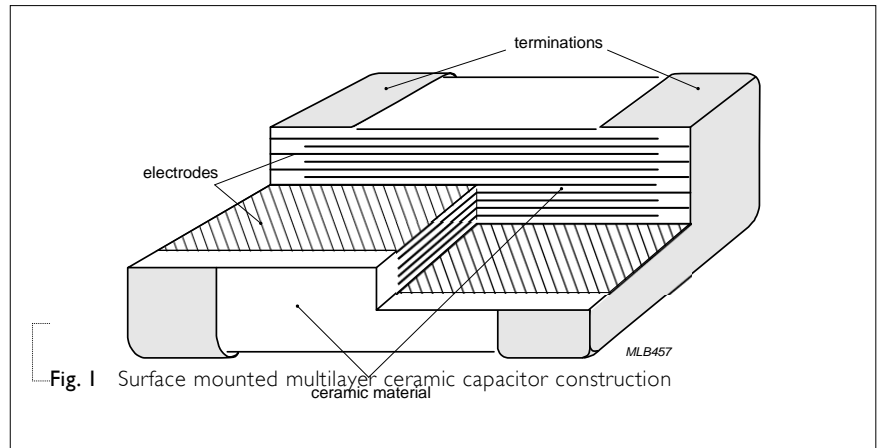


Fig. 1 Surface mounted multilayer ceramic capacitor construction

**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 | 0.40                |
| 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                |
|      |                     |            | 0.85 ±0.10 |                                      |      |                     |
| 1206 | 3.2 ±0.15           | 1.6 ±0.15  | 0.6 ±0.10  | 0.25                                 | 0.75 | 1.40                |
|      |                     |            | 0.85 ±0.10 |                                      |      |                     |
|      |                     |            | 1.25 ±0.20 |                                      |      |                     |
| 1210 | 3.2 ±0.20           | 2.5 ±0.20  | 1.6 ±0.20  | 0.25                                 | 0.75 | 1.40                |
|      |                     |            | 2.0 ±0.20  |                                      |      |                     |
|      |                     |            | 2.5 ±0.20  |                                      |      |                     |
| 1808 | 4.5 ±0.40           | 2.0 ±0.30  | 1.25 ±0.20 | 0.25                                 | 0.75 | 2.20                |
|      |                     |            | 0.85 ±0.10 |                                      |      |                     |
| 1812 | 4.5 ±0.40           | 3.2 ±0.30  | 1.25 ±0.20 | 0.25                                 | 0.75 | 2.20                |
|      |                     |            | 1.60 ±0.20 |                                      |      |                     |
| 2020 | 5.7 ±0.40           | 5.0 ±0.30  | 2.0 ±0.20  | 0.25                                 | 0.75 | 3.40                |

**OUTLINES**

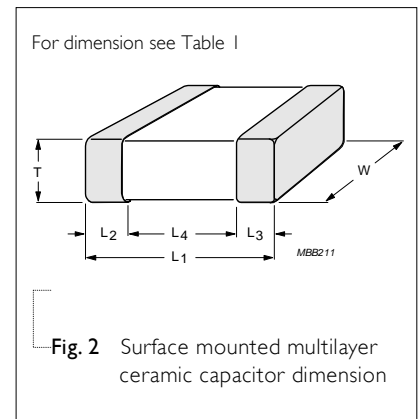


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

**CAPACITANCE RANGE & THICKNESS FOR NP0**

**Table 2** Sizes from 0201 to 0805

| CAP.    | 0201        |          | 0603    |         |         | 0805    |         |         |
|---------|-------------|----------|---------|---------|---------|---------|---------|---------|
|         | 25 V / 50 V | 50 V     | 50 V    | 100 V   | 250 V   | 50 V    | 100 V   | 250V    |
| 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 & THICKNESS FOR NP0**

**Table 3** Sizes from 0402 to 0805 (continued)

| CAP.   | 0402     | 0603    |         |         | 0805     |          |          |
|--------|----------|---------|---------|---------|----------|----------|----------|
|        | 50 V     | 50 V    | 100 V   | 250 V   | 50 V     | 100 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 |          |         |         |         | 1.25±0.2 | 1.25±0.2 |          |
| 3.3 nF |          |         |         |         | 1.25±0.2 | 1.25±0.2 |          |
| 3.9 nF |          |         |         |         | 1.25±0.2 | 1.25±0.2 |          |
| 4.7 nF |          |         |         |         | 1.25±0.2 | 1.25±0.2 |          |
| 5.6 nF |          |         |         |         | 1.25±0.2 | 1.25±0.2 |          |
| 6.8 nF |          |         |         |         | 1.25±0.2 | 1.25±0.2 |          |
| 8.2 nF |          |         |         |         | 1.25±0.2 | 1.25±0.2 |          |
| 10 nF  |          |         |         |         | 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 NP0**

**Table 4** Sizes from 1206 to 1210

| CAP.   | 1206    |         |          |          |          | 1210     |          |          |          |
|--------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
|        | 50 V    | 100 V   | 250 V    | 500 V    | 630 V    | 50 V     | 100 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 |          |          |          |          |
| 12 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1  | 0.6±0.1  | 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 |          |          |          |          |
| 18 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1  | 0.6±0.1  | 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 |          |          |          |          |
| 27 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1  | 0.6±0.1  | 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 |          |          |          |          |
| 39 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1  | 0.6±0.1  | 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 |          |          |          |          |
| 56 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1  | 0.6±0.1  | 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 |          |          |          |          |
| 82 pF  | 0.6±0.1 | 0.6±0.1 | 0.6±0.1  | 0.6±0.1  | 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 |          |          |          |          |
| 120 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1  | 0.6±0.1  | 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 |          |          |          |          |
| 180 pF | 0.6±0.1 | 0.6±0.1 | 0.6±0.1  | 0.6±0.1  | 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 |          |          |          |          |
| 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 & 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    | 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 | 0.85±0.1 |
| 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 | 0.85±0.1 |
| 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 | 0.85±0.1 |
| 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 | 0.85±0.1 |
| 33 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 0.85±0.1 | 0.85±0.1 |
| 47 nF  | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 0.85±0.1 | 0.85±0.1 |
| 68 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 | 0.85±0.1 |
| 100 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 | 0.85±0.1 |
| 150 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 |
| 220 nF | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 | 1.25±0.2 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 |
| 330 nF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 0.85±0.1 | 0.85±0.1 | 0.85±0.1 |
| 470 nF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 0.85±0.1 | 0.85±0.1 |
| 680 nF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 0.85±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 7** Size 1206

| CAP.   | 1206     |          |          |          |          |          |          |          |          |
|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|        | 6.3 V    | 10V      | 16V      | 25V      | 50 V     | 100 V    | 250 V    | 500 V    | 630 V    |
| 1 nF   | -        | -        | -        | -        | -        | -        | -        | 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    | 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 |
| <b>0201</b> | 0.3 ±0.03 mm             | R            | P       | 8 mm       | 15,000            | ---     | 50,000            | ---     |
| <b>0402</b> | 0.5 ±0.05 mm             | R            | P       | 8 mm       | 10,000            | ---     | 50,000            | ---     |
| <b>0603</b> | 0.8 ±0.1 mm              | R            | P       | 8 mm       | 4,000             | ---     | 15,000            | ---     |
| <b>0805</b> | 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  |
| <b>1206</b> | 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  |
| <b>1210</b> | 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   | ---               | ---     |
| <b>1812</b> | 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**

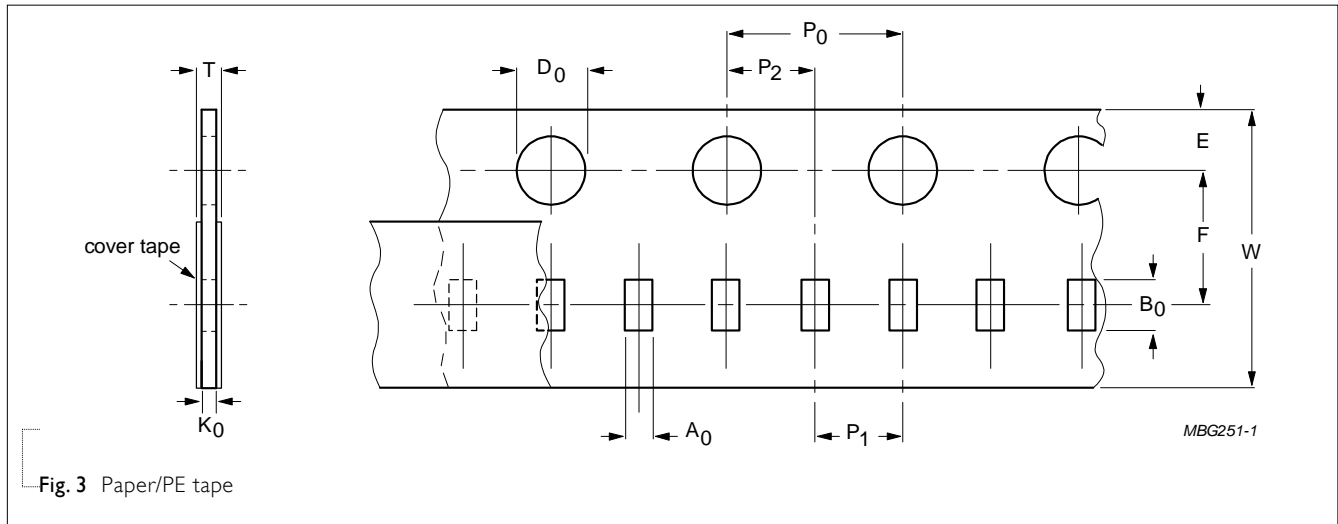


Table 10 Dimensions of paper/PE tape for relevant chip size; see Fig.3

| SIZE<br>CODE | SYMBOL         |                | Unit: mm   |            |             |                               |                |                |                 |                           |                           |  |
|--------------|----------------|----------------|------------|------------|-------------|-------------------------------|----------------|----------------|-----------------|---------------------------|---------------------------|--|
|              | 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

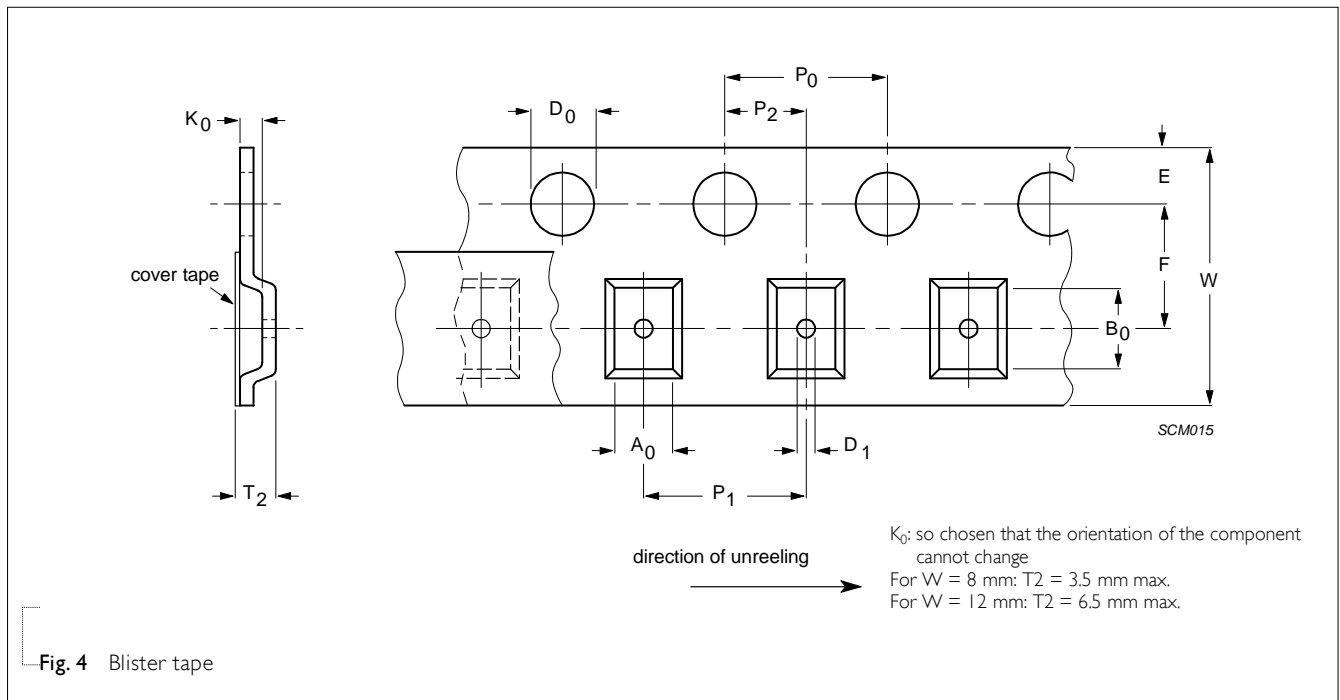


Fig. 4 Blister tape

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

| SIZE 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> | T <sub>2</sub> |      |
|           | Min.           | Max. | Min.           | Max. | Min.           | Max. |            |           |           |                 |                 |                               |                |                | 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<sub>0</sub> pitch tolerance over any 10 pitches is ±0.2 mm

**REEL SPECIFICATION**

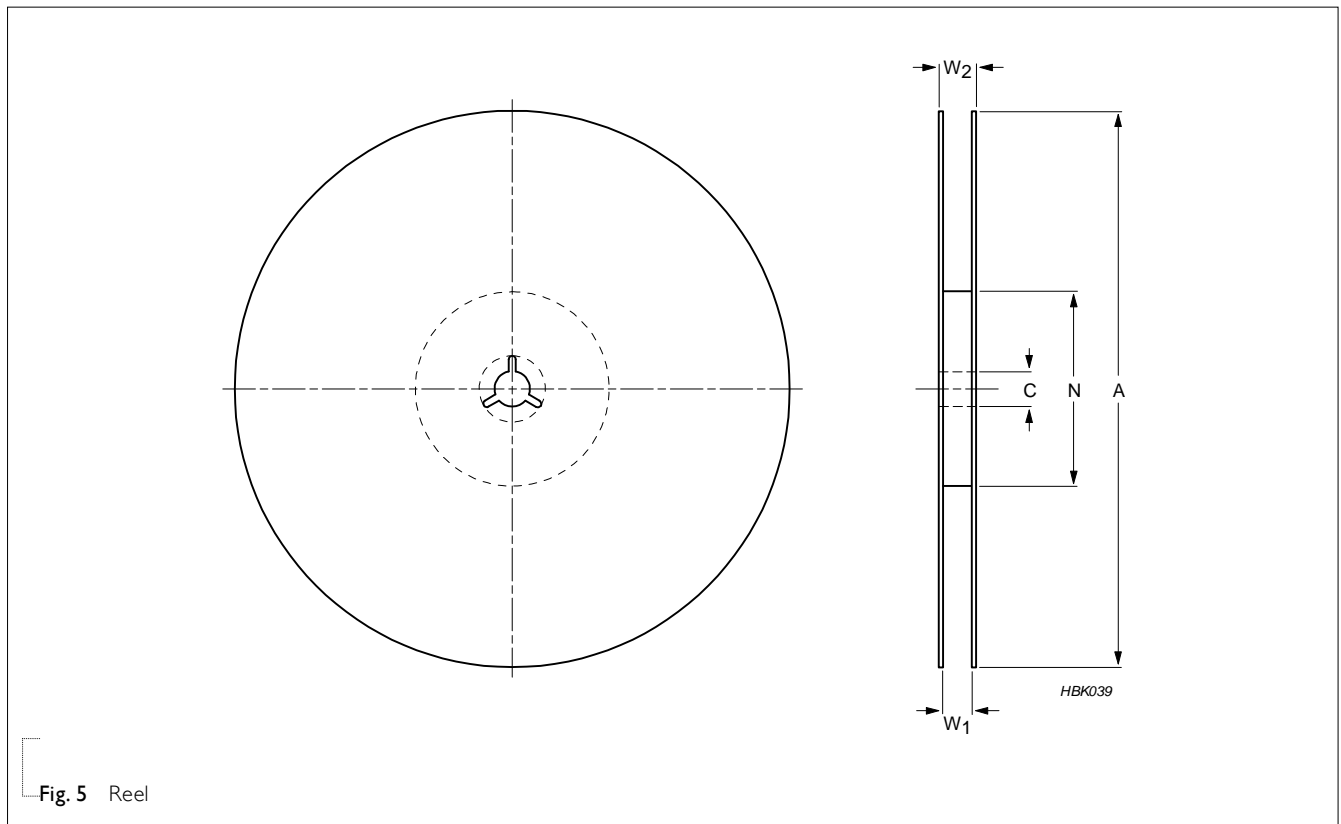


Fig. 5 Reel

Table 12 Reel dimensions; see Fig.5

| TAPE WIDTH      | SYMBOL   |          |                |           |             | Unit: mm |
|-----------------|----------|----------|----------------|-----------|-------------|----------|
|                 | A        | N        | C              | $W_1$     | $W_{2max.}$ |          |
| 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:  $<10^{10} \text{ } \Omega/\text{sq.}$

**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                |                |                |   |                |                |                                   |
| Capacitance tolerance                                       |                |                                 |                |                |   |                |                |                                   |
| NP0   | C < 10 pF      | ±0.1 pF, ±0.25 pF, ±0.5 pF      |                |                |   |                |                |                                   |
|   | C ≥ 10 pF      | ±1%, ±2%, ±5%                   |                |                |   |                |                |                                   |
| X7R   |                | ±5% <sup>(1)</sup> , ±10%, ±20% |                |                |   |                |                |                                   |
| Dissipation factor (D.F.)                                   |                |                                 |                |                |   |                |                |                                   |
| NP0   | C < 30 pF      | ≤ 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%<br>≤ 10%                     |
| 16V   |                | 220pF to 22nF                   | 1nF to 220nF   | 1nF to 470nF   | 22nF to 680nF   | 100nF to 680nF |                | ≤ 3.5%<br>≤ 5%                    |
|   |                | 27nF to 100nF                   | 470nF to 680nF | 680nF          | 680nF   |                |                |                                   |
| 25V   | 100pF to 470pF | 220pF to 10nF                   | 1nF to 39nF    | 1nF to 180nF   | 22nF to 680nF   | 100nF to 680nF |                | ≤ 2.5%<br>≤ 3.5%<br>≤ 5%          |
|   |                | 12nF to 27nF                    | 47nF to 220nF  | 220nF to 470nF | 680nF   |                |                |                                   |
|   |                | 560pF to 10nF                   | 33nF to 100nF  | 330nF to 680nF | 330nF to 680nF  | 680nF          |                |                                   |
| 50V   | 100pF to 470nF | 220pF to 10nF                   | 1nF to 39nF    | 1nF to 180nF   | 22nF to 470nF   | 100nF to 680nF | 470nF to 680nF | ≤ 2.5%<br>≤ 3.5%<br>≤ 5%<br>≤ 10% |
|   |                | 560pF to 1nF                    | 47nF to 220nF  | 220nF to 470nF | 680nF   |                |                |                                   |
|   |                | 12nF to 100nF                   |                | 680nF          | 680nF   |                |                |                                   |
| 100V  |                | 220pF to 1.5nF                  | 1nF to 10nF    | 1nF to 100nF   | 22nF to 470nF   | 100nF to 270nF | 470nF to 680nF | ≤ 2.5%<br>≤ 5%                    |
|   |                |                                 | 12nF to 100nF  |                | 560nF to 680nF  | 330nF to 680nF |                |                                   |
| 250V  |                |                                 |                | 1nF to 22nF    | 22nF to 100nF   | 100nF          |                | ≤ 2.5%                            |
| 500V  |                |                                 |                | 1nF to 4.7nF   | 1nF to 10nF   |                |                | ≤ 2.5%                            |
| 630V  |                |                                 |                |                | 1nF to 10nF   |                |                | ≤ 2.5%                            |
| Insulation resistance after 1 minute at U <sub>r</sub> (DC) |                |                                 |                |                | I.R. ≥ 10 GΩ or I.R. × C ≥ 500 seconds whichever is less<br>I.R. × C ≥ 100 seconds <sup>(2)</sup> |                |                |                                   |
| Operating temperature range:                                |                |                                 |                |                |   |                |                |                                   |
| NP0/X7R   |                | -55 °C to +125 °C               |                |                |   |                |                |                                   |

**NOTE**

1. Capacitance tolerance ±5% doesn't available for X7R full product range, please contact local sales force before order
2. 0603/ 25 V/ 330nF to 680nF

**SOLDERING RECOMMENDATION**

Table 14

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

**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-202F-method 210F", "The robust construction of chip capacitors allows them to be completely immersed in a solder bath of 270 °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

| TEST                      | TEST METHOD     |       | PROCEDURE   | REQUIREMENTS                     |
|---------------------------|-----------------|-------|---|----------------------------------|
| Mounting                  | IEC 60384-21/22 | 4.3   | The capacitors may be mounted on printed-circuit boards or ceramic substrates   | No visible damage                |
| Capacitance               | IEC 60384-21/22 | 4.5.1 | Class 1:<br>At 20 °C, 24 hours after annealing<br>f = 1 MHz for C ≤ 1nF, measuring at voltage   V <sub>rms</sub> at 20 °C<br>f = 1 KHz for C > 1nF, measuring at voltage   V <sub>rms</sub> at 20 °C<br>Class 2:<br>At 20 °C, 24 hours after annealing<br>f = 1 KHz, measuring at voltage   V <sub>rms</sub> at 20 °C | Within specified tolerance       |
| Dissipation Factor (D.F.) | IEC 60384-21/22 | 4.5.2 | Class 1:<br>At 20 °C, 24 hours after annealing<br>f = 1 MHz for C ≤ 1nF, measuring at voltage   V <sub>rms</sub> at 20 °C<br>f = 1 KHz for C > 1nF, measuring at voltage   V <sub>rms</sub> at 20 °C<br>Class 2:<br>At 20 °C, 24 hours after annealing<br>f = 1 KHz, measuring at voltage   V <sub>rms</sub> at 20 °C | In accordance with specification |
| Insulation Resistance     | IEC 60384-21/22 | 4.5.3 | At U <sub>r</sub> (DC) for 1 minute   | In accordance with specification |

| TEST                          | TEST METHOD | PROCEDURE   | REQUIREMENTS  |
|-------------------------------|-------------|---|---|
| High Temperature Exposure     | AEC-Q200 3  | Unpowered ; 1000hours @ T=150 °C<br>Measurement at 24±2 hours after test conclusion.  | No visual damage<br>D.F.:<br>within initial specified value<br>IR:<br>within initial specified value  |
| Temperature Cycling           | AEC-Q200 4  | Preconditioning:<br>150 +0/-10 °C for 1 hour, then keep for<br>24 ±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 ±2 hours | No visual damage<br><br>D.F. meet initial specified value<br>IR meet initial specified value  |
| Destructive Physical Analysis | AEC-Q200 5  | Note: Only applies to SMD ceramics.<br>Electrical test not required.  |   |
| Moisture Resistance           | AEC-Q200 6  | T=24 hrs/per cycle; 10 continuous cycles unpowered.<br>ment at 24 ±2 hours after Measurertest condition.  | No visual damage<br><br>ΔC/C<br>NP0: Within ±3% or 3 pF,<br>whichever is greater<br>X7R: ±15%<br><br>D.F.<br>Within initial specified value<br>IR<br>NP0: ≥ 10,000 MΩ<br>X7R: Meet initial specified<br>value |

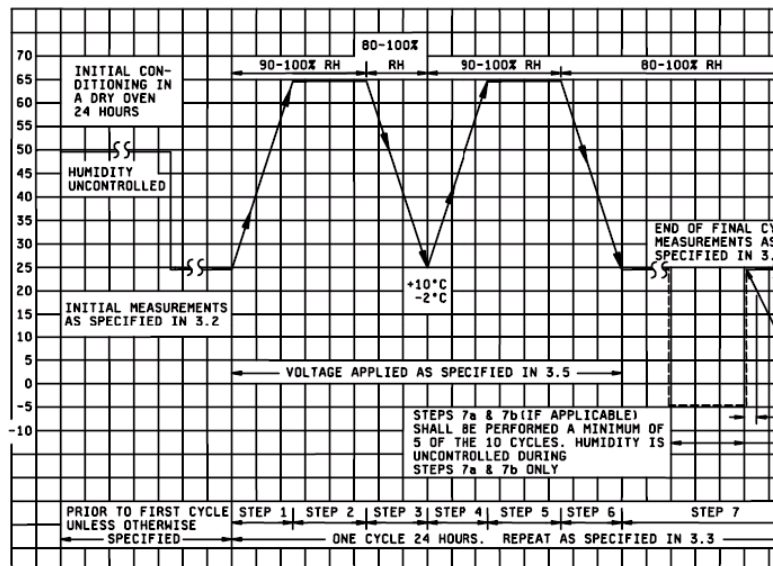


Fig. 6 Moisture resistant



| TEST            | TEST METHOD | PROCEDURE  | REQUIREMENTS  |
|-----------------|-------------|--|---|
| Biased Humidity | AEC-Q200 7  | <ol style="list-style-type: none"> <li>1. Preconditioning, class 2 only:<br/>150 +0/-10 °C /1 hour, then keep for<br/>24 ±1 hour at room temp</li> <li>2. Initial measure:<br/>Spec. refer to initial spec. C. D.<br/>I,R.<br/>Measuring voltage: 1.5V ± 0.1 VDC<br/>Note: Series with 100 KΩ</li> <li>3. Test condition:<br/>85 °C, 85% R.H. connected with 100 KΩ resistor, applied<br/>1.5V/U<sub>r</sub> for 1,000 hours.</li> <li>4. Recovery:<br/>NP0: 6 to 24 hours<br/>X7R: 24 ±2 hours</li> <li>5. Final measure: C. D. I.R.</li> </ol> | <p>No visual damage after recovery</p> <hr/> <p>ΔC/C<br/>NP0: Within ±2% or 1 pF, whichever is greater<br/>X7R: ±15%</p> <hr/> <p>D.F.<br/>NP0: ≤ 2 × specified value.<br/>X7R: ≤ 16V: ≤ 7% or specified value whichever is greater<br/>≥ 25V: ≤ 5% or specified value whichever is greater</p> <hr/> <p>I.R.<br/>Initial requirement:<br/>NP0:<br/>C ≤ 10 nF: I.R ≥ 10,000 MΩ<br/>or<br/>C &gt; 10 nF: (I.R-100 KΩ) × C ≥ 100s.<br/>X7R:<br/>C ≤ 25 nF: I.R ≥ 4,000 MΩ or<br/>C &gt; 25 nF: (I.R-100 KΩ) × C ≥ 100s.</p> <p>Final measurement:<br/>The insulation resistance shall greater than 10% of initial spec.</p> |

|                           |          |    |  |   |
|---------------------------|----------|----|--|---|
| <b>Operational Life</b>   | AEC-Q200 | 8  | <p>1. Preconditioning, class 2 only:<br/>150 +0/-10 °C /1 hour, then keep for<br/>24 ±1 hour at room temp</p> <p>2. Initial measure:<br/>Spec: refer to initial spec C, D, IR</p> <p>3. Endurance test:<br/>Temperature: X7R: 125 °C<br/>Specified stress voltage applied for 1,000 hours:<br/>Applied 2.0 × U<sub>r</sub> for general products *</p> <p>High voltage series follows with below<br/>stress condition:<br/>Applied 1.5 × U<sub>r</sub> for 200V, 250V series<br/>Applied 1.3 × U<sub>r</sub> for 500V, 630V series<br/>Applied 1.2 × U<sub>r</sub> for 1KV, 2KV, 3KV series</p> <p>4. Recovery time: 24 ±2 hours</p> <p>5. Final measure: C, D, IR</p> <p>Note: If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to "IEC 60384 4.1" and then the requirement shall be met.</p> <p>* Applied 1.5 × U<sub>r</sub><br/>0402/X7R/50V/&gt;10nF<br/>0603/X7R/25V/&gt;220nF</p> | <p>No visual damage</p> <hr/> <p>ΔC/C<br/>NP0: Within ±2% or 1 pF,<br/>whichever is greater<br/>X7R: ±15%</p> <hr/> <p>D.F.<br/>NP0: ≤ 2 × specified value.<br/>X7R: ≤ 16V: ≤ 7% or specified<br/>value whichever is greater<br/>≥ 25V: ≤ 5% or specified<br/>value whichever is greater</p> <hr/> <p>IR<br/>NP0: ≥ 4,000 MΩ or IR × C<sub>r</sub> ≥<br/>40s whichever is less<br/>X7R: ≥ 1,000 MΩ or IR× C<sub>r</sub> ≥<br/>50s whichever is less *</p> <p>* IR× C<sub>r</sub> ≥ 10s<br/>0603/25V/&gt;220nF</p> |
| <b>External Visual</b>    | AEC-Q200 | 9  | Any applicable method using × 10 magnification   | In accordance with specification  |
| <b>Physical Dimension</b> | AEC-Q200 | 10 | Verify physical dimensions to the applicable device specification.   | In accordance with specification  |
| <b>Mechanical Shock</b>   | AEC-Q200 | 13 | <p>Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen (18 shocks)</p> <p>Peak value: 1,500 g's</p> <p>Duration: 0.5 ms</p> <p>Velocity change: 15.4 ft/s</p> <p>Waveform: Half-sin</p>   | <p>ΔC/C<br/>NP0: Within ±0.5% or 0.5 pF,<br/>whichever is greater<br/>X7R: ±10%</p> <hr/> <p>D.F.<br/>Within initial specified value</p> <p>IR<br/>Within initial specified value</p>   |
| <b>Vibration</b>          | AEC-Q200 | 14 | <p>5 g's for 20 minutes, 12 cycles each of 3 orientations.<br/>Test from 10-2000 Hz.</p>   | <p>ΔC/C<br/>NP0: Within ±0.5% or 0.5 pF,<br/>whichever is greater<br/>X7R: ±10%</p> <hr/> <p>D.F: meet initial specified value<br/>IR meet initial specified value</p>  |

|                              |             |  |  |
|------------------------------|-------------|--|--|
| Resistance to Soldering Heat | AEC-Q200 15 | Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature   | Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned                     |
|                              |             | 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 |  |
|                              |             |  | <p>ΔC/C</p> <p>Class 1:<br/>NP0: Within ± 1% or 0.5 pF, whichever is greater.</p> <p>Class 2:<br/>X7R: ± 10%</p> |
|                              |             |  | <p>D.F. within initial specified value</p> <p>IR within initial specified value</p>                              |

|               |             |   |   |
|---------------|-------------|---|---|
| Thermal Shock | AEC-Q200 16 | 1. Preconditioning, class 2 only:<br>150 +0/-10 °C / 1 hour, then keep for 24 ± 1 hour at room temp   | No visual damage  |
|               |             | 2. Initial measure:<br>Spec: refer to initial spec C, D, IR   |   |
|               |             |   | <p>ΔC/C</p> <p>NP0: Within ± 1% or 1 pF, whichever is greater</p> <p>X7R: ± 15%</p> |
|               |             |   | <p>D.F. meet initial specified value</p> <p>IR meet initial specified value</p>     |
|               |             | 3. Rapid change of temperature test:<br>NP0/X7R: -55 °C to +125 °C; 300 cycles<br>15 minutes at lower category temperature; 15 minutes at upper category temperature. |   |
|               |             | 4. Recovery time:<br>Class 1: 6 to 24 hours<br>Class 2: 24 ± 2 hours  |   |
|               |             | 5. Final measure: C, D, IR  |   |

|     |             |                  |   |
|-----|-------------|------------------|---|
| ESD | AEC-Q200 17 | Per AEC-Q200-002 | A component passes a voltage level if all components stressed at that voltage level pass. |
|-----|-------------|------------------|---|

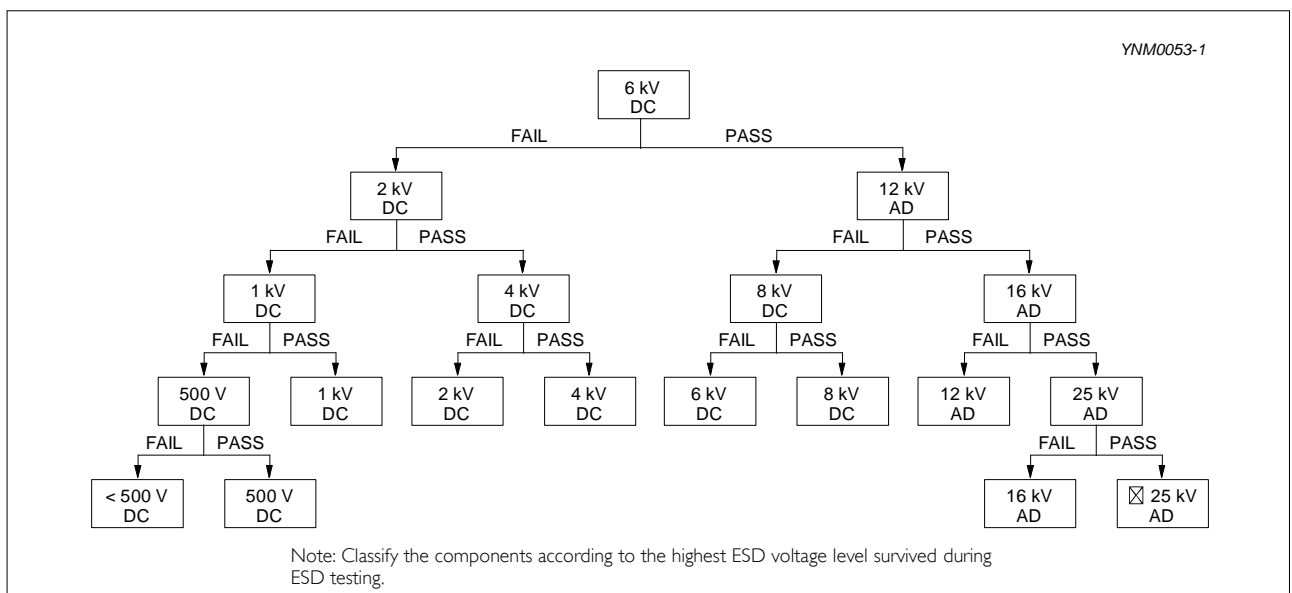


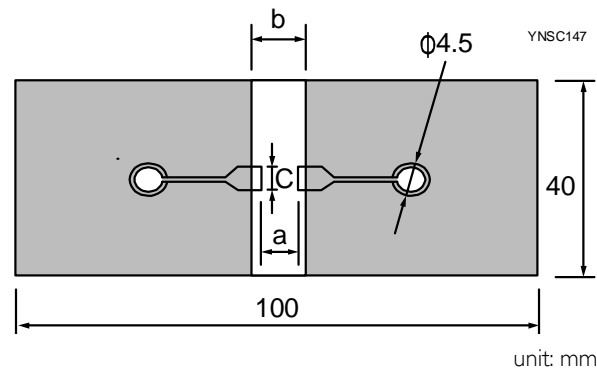
Fig. 7 Passive component HBM ESD test flow diagram (DC = Direct Contact Discharge, AD = Air Discharge)

|                      |             |   |  |
|----------------------|-------------|---|--|
| <b>Solderability</b> | AEC-Q200 18 | <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> </ol> | The solder should cover over 95% of the critical area of each termination. |
|----------------------|-------------|---|--|

|                                    |             |  |   |
|------------------------------------|-------------|--|---|
| <b>Electrical Characterization</b> | AEC-Q200 19 | <p>Parametrically test per lot and sample size requirements, summary to show Min, Max, Mean and Standard deviation at room as well as Min and Max operating temperatures.</p> <p>NP0: -55 °C to +125 °C<br/> X7R: -55 °C to +125 °C<br/> Normal temperature: 20 °C</p> | <p>ΔC/C</p> <p>NP0: ±30 ppm/°C<br/> X7R: ±15%</p> |
|------------------------------------|-------------|--|---|

|                   |             |  |   |
|-------------------|-------------|--|---|
| <b>Board Flex</b> | AEC-Q200 21 | <p>Part mounted on a 100 mm X 40 mm FR4 PCB board, which is 1.6 ±0.2 mm thick and has a layer-thickness 35 μm ± 10 μm.</p> <p>Part should be mounted using the following soldering reflow profile.</p> <p>Conditions:</p> <p>Class 1:<br/> Bending 3 mm at a rate of 1 mm/s, radius jig 340 mm</p> <p>Class2:<br/> Bending 2 mm at a rate of 1 mm/s, radius jig 340 mm</p> | <p>No visible damage</p> <p>ΔC/C</p> <p>Class 1:<br/> NP0: Within ±1% or 0.5 pF, whichever is greater</p> <p>Class2:<br/> X7R: ±10%</p> |
|-------------------|-------------|--|---|

Test Substrate:



| Type | Dimension(mm) |     |      |
|------|---------------|-----|------|
|      | 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  |

|                          |             |   |  |
|--------------------------|-------------|---|--|
| <b>Terminal Strength</b> | AEC-Q200 22 | <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>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> |
| <b>Beam Load Test</b>    | AEC-Q200 23 | <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>≤ 0805</p> <p>Thickness &gt; 0.5mm: 20N</p> <p>Thickness ≤ 0.5mm: 8N</p> <p>≥ 1206</p> <p>Thickness ≥ 1.25 mm: 54N</p> <p>Thickness &lt; 1.25 mm: 15N</p>   |
| <b>Voltage Proof</b>     |             | <ol style="list-style-type: none"> <li>1. Specified stress voltage applied for 1~5 seconds</li> <li>2. <math>U_r \leq 100\text{ V}</math>: series applied 2.5 <math>U_r</math></li> <li>3. <math>100\text{ V} &lt; U_r \leq 200\text{ V}</math> series applied (1.5 <math>U_r + 100</math>)</li> <li>4. <math>200\text{ V} &lt; U_r \leq 500\text{ V}</math> series applied (1.3 <math>U_r + 100</math>)</li> <li>5. <math>U_r &gt; 500\text{ V}</math>: 1.3 <math>U_r</math></li> <li>6. <math>U_r \geq 1000\text{ V}</math>: 1.2 <math>U_r</math></li> </ol> <p>Charge/Discharge current is less than 50 mA</p> | <p>No breakdown or flashover</p>   |

REVISION HISTORY

| REVISION   | DATE          | CHANGE NOTIFICATION | DESCRIPTION  |
|------------|---------------|---------------------|--|
| Version 13 | Jul. 05, 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 1µF<br>0603/ X7R/ 25V / 150nF / 220nF/ 1µF<br>1210/ X7R/ 50V / 4.7µF   |
| 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,<br>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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[CDR33BX683AKUS](#) [CGA2B2C0G1H010C](#) [CGA2B2C0G1H040C](#) [CGA2B2C0G1H050C](#) [CGA2B2C0G1H060D](#) [CGA2B2C0G1H070D](#)  
[CGA2B2C0G1H120J](#) [CGA2B2C0G1H151J](#) [CGA2B2C0G1H1R5C](#) [CGA2B2C0G1H2R2C](#) [CGA2B2C0G1H390J](#) [CGA2B2C0G1H391J](#)  
[CGA2B2C0G1H3R3C](#) [CGA2B2C0G1H680J](#) [CGA2B2C0G1H6R8D](#) [CGA2B2C0G1H820J](#) [CGA2B2X8R1H152K](#)