

### **A Professional MLCC (Multi-Layer Ceramic Capacitor) Manufacturer**

In the post-PC 21st century, all information and communication technology products will be closely connected with our daily lives. In a colorful communication world, DARFON's Multi-layer Ceramic Capacitor is significant. This product addresses the market's application needs by combining technology from materials engineering, chemical engineering, electronic engineering, and mechanical engineering.

A Multi-layer Ceramic Capacitor with different functions is always the goal of DARFON's R&D, with R&D taking the direction of multi-levels and small scale. As far as the technical aspect is concerned, the company has surpassed other domestic companies in Taiwan by being first to develop the BME process and 0201 ultra miniature MLCC. This product's ultra thin thickness is top notch.

Through automated equipment with high efficient management systems, DARFON can guarantee the quality of each end product.

### **DARFON Quality Policy**

**“ To deliver Defect-free, Competitive Products  
and Services to our Customers on time. “**

### **MLCC Introduction**

Multi-layer ceramic capacitors (MLCC) are manufactured by suspending ceramic powders in liquid and casting into a thin green sheet from 20 um in thickness to 5 um or thinner.

Metal electrodes are sieved printed onto green sheets, which are later stacked to form a laminated structure. The metal electrodes are arranged so that the termination alternates from one edge to another of the capacitor.

Upon sintering at high temperature the part becomes a monolithic block, which can provide an extremely high capacitance in small mechanical volumes.

Finally, the termination electrodes are formed by composite of outer metal-glass electrode and followed by a barrier layer and pure-tin plating to permit MLCC to be soldered directly onto printed circuit board.

|                                                   |    |
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Darfon's series of Multilayer Ceramic Chip Capacitors are designed to meet a wide variety of needs. We offer a complete range of products for both general and specialized applications in the industry. We suggest your selection of capacitors based on consideration of the following items:

### 1. DIELECTRIC TYPE

The choice of dielectric is usually determined by the required capacitance-temperature stability. Darfon offers four types, NP0, X7R, X5R and Y5V for your choice. The features and applications of these four types are specified as follows:

| Dielectric   | NP0                                                                                                                                                                                                    | X7R/X5R                                                                                                                                                                                                               | Y5V                                                                                                                                                    |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Features     | <ol style="list-style-type: none"> <li>1. Ultra-stable</li> <li>2. Tight tolerance available</li> <li>3. Low ESR</li> <li>4. Good frequency performance</li> <li>5. No aging of capacitance</li> </ol> | <ol style="list-style-type: none"> <li>1. Semi-stable and High K</li> <li>2. High volumetric efficiency</li> <li>3. Highly reliable in high temperature application</li> <li>4. High insulation resistance</li> </ol> | <ol style="list-style-type: none"> <li>1. High volumetric efficiency</li> <li>2. Non-polar construction</li> <li>3. General purpose, High K</li> </ol> |
| Applications | <ol style="list-style-type: none"> <li>1. LC and RC tuned circuit</li> <li>2. Filtering</li> <li>3. Timing</li> </ol>                                                                                  | <ol style="list-style-type: none"> <li>1. Blocking</li> <li>2. Coupling</li> <li>3. Timing</li> <li>4. Bypassing</li> <li>5. Frequency discriminating</li> <li>6. Filtering</li> </ol>                                | <ol style="list-style-type: none"> <li>1. Bypassing</li> <li>2. De-coupling</li> <li>3. Filtering</li> </ol>                                           |

### 2. CAPACITANCE AND TOLERANCE

Capacitance and its tolerance are determined by circuit requirement and cost consideration.

#### ■ E Standard Number

|            |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>E 3</b> | 1.0 |     |     |     | 2.2 |     |     |     | 4.7 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>E 6</b> | 1.0 |     | 1.5 |     | 2.2 |     | 3.3 |     | 4.7 |     | 6.8 |     |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>E12</b> | 1.0 | 1.2 | 1.5 | 1.8 | 2.2 | 2.7 | 3.3 | 3.9 | 4.7 | 5.6 | 6.8 | 8.2 |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>E24</b> | 1.0 | 1.1 | 1.2 | 1.3 | 1.5 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.7 | 3.0 | 3.3 | 3.6 | 3.9 | 4.3 | 4.7 | 5.1 | 5.6 | 6.2 | 6.8 | 7.5 | 8.2 | 9.1 |

\* Non-standard capacitance is available on request.

## ■ Available Tolerance

| T. C.      | Capacitance *    | Standard Tolerance          | Available Tolerance on Request |
|------------|------------------|-----------------------------|--------------------------------|
| NP0 (C0G)  | Cap < 5pF        | C = ± 0.25pF<br>D = ± 0.5pF | B = ± 0.1pF                    |
|            | 5pF ≤ Cap < 10pF | D = ± 0.5pF                 | B = ± 0.1pF<br>C = ± 0.25pF    |
|            | Cap ≥ 10pF       | J = ± 5%<br>K = ± 10%       | F = ± 1%<br>G = ± 2%           |
| X5R<br>X7R | All              | K = ± 10%<br>M = ± 20%      | J = ± 5%                       |
| Y5V        | All              | Z = -20% to +80%            | M = ± 20%                      |

\* Non-standard capacitance or tolerance is available on request.

## 3. RATED VOLTAGE

Rated voltage is determined by circuit requirement.

## 4. PACKAGING

Specify the packaging of capacitors as bulk or tape and reeled.

## 5. PRODUCT RANGE AND SIZE

### ● NP0 (Class I)

| Type           |      | Size         |                  |              |              |              |
|----------------|------|--------------|------------------|--------------|--------------|--------------|
| T.C.           | RV   | 0603 (0201)  | 1005 (0402)      | 1608 (0603)  | 2012 (0805)  | 3216 (1206)  |
| NP0<br>Class I | 16V  |              |                  | 2.7nF~3.3nF  |              | 12nF~39nF    |
|                | 25V  | 0.20pF~100pF | 0.20pF~22pF      |              |              |              |
|                | 50V  | 0.20pF~18pF  | 0.20pF~470pF/1nF | 0.20pF~2.2nF | 0.50pF~10nF  | 1.50pF~10nF  |
|                | 100V |              | 0.20pF~220pF     | 0.20pF~1nF   | 0.50pF~3.3nF | 1.50pF~4.7nF |

- **X7R (Class II)**

| Type            |      | Size             |             |             |                        |             |             |
|-----------------|------|------------------|-------------|-------------|------------------------|-------------|-------------|
| T.C.            | RV   | 0603 (0201)      | 1005 (0402) | 1608 (0603) | 2012 (0805)            | 3216 (1206) | 3225 (1210) |
| X7R<br>Class II | 6.3V |                  |             |             | 4.7uF~10uF             |             |             |
|                 | 10V  | 3.3nF/4.7nF/10nF | 100pF~100nF | 100pF~1uF   | 1uF/2.2uF/4.7uF/10uF   | 2.2uF       |             |
|                 | 16V  |                  | 100pF~100nF | 100pF~1uF   | 330nF/470nF/1uF/ 2.2uF | 470nF~10uF  | 10uF        |
|                 | 25V  | 100pF~2.2nF      | 100pF~22nF  | 100pF~1uF   | 1nF~1uF                | 220nF~4.7uF | 4.7uF/10uF  |
|                 | 50V  | 100pF~2.2nF      | 100pF~10nF  | 100pF~100nF | 150pF~470nF            | 1nF~1uF     |             |
|                 | 100V |                  |             | 100pF~10nF  | 150pF~22nF             | 1nF~100nF   |             |

- **X5R (Class II)**

| Type            |      | Size        |             |                   |             |             |             |
|-----------------|------|-------------|-------------|-------------------|-------------|-------------|-------------|
| T.C.            | RV   | 0603 (0201) | 1005 (0402) | 1608 (0603)       | 2012 (0805) | 3216 (1206) | 3225 (1210) |
| X5R<br>Class II | 6.3V | 2.2nF~220nF | 470nF~4.7uF | 2.2uF/ 4.7uF/10uF | 4.7uF~22uF  | 22uF/47uF   | 47uF/100uF  |
|                 | 10V  | 2.2nF~100nF | 15nF~1uF    | 220nF~4.7uF       | 2.2uF~10uF  | 2.2uF~10uF  | 22uF        |
|                 | 16V  |             | 15nF~1uF    | 220nF~2.2uF       | 1uF~10uF    | 2.2uF~10uF  | 4.7uF~22uF  |
|                 | 25V  |             | 100nF       | 220nF/1uF         | 1uF~4.7uF   | 2.2uF~10uF  | 4.7uF/ 10uF |

- **Y5V (Class II)**

| Type            |      | Size        |             |             |              |
|-----------------|------|-------------|-------------|-------------|--------------|
| T.C.            | RV   | 0603 (0201) | 1005 (0402) | 1608 (0603) | 2012 (0805)  |
| Y5V<br>Class II | 6.3V | 22nF~100nF  | 10nF~1uF    | 10nF~2.2uF  |              |
|                 | 10V  |             | 10nF~1uF    | 10nF~2.2uF  |              |
|                 | 16V  |             | 10nF~220nF  | 10nF~2.2uF  | 100nF~2.2uF  |
|                 | 25V  |             | 10nF~100nF  | 10nF~330nF  | 100nF ~2.2uF |
|                 | 50V  |             | 10nF~33nF   | 10nF~220nF  | 100nF~1uF    |

Note : (1) Other size, capacitance, and voltage are available upon customer's request.

(2) Product range might be extended due to technology improvement or new product released : for up-to-date information, please contact our sales.

(3) Part of Y5V product will be phased out.

### DARFON Part Number

**C 1005 NP0 101 J G T S**

#### PRODUCT CODE

C = Capacitor SMD

#### SIZE in mm (EIA CODE, in inch)

|             |            |             |             |             |
|-------------|------------|-------------|-------------|-------------|
| 0402(01005) | 0603(0201) | 1005 (0402) | 1608 (0603) | 2012 (0805) |
| 3216 (1206) | 3225(1210) | 4520 (1808) | 4532 (1812) |             |

#### T. C.

|                                          |                 |
|------------------------------------------|-----------------|
| NP0: $0 \pm 30\text{ppm}/^\circ\text{C}$ | -55°C to +125°C |
| X7R: $\pm 15\%$                          | -55°C to +125°C |
| X5R: $\pm 15\%$                          | -55°C to +85°C  |
| Y5V: $+22\%/-82\%$                       | -30°C to +85°C  |

#### CAPACITANCE CODE

Expressed in pico-farads and identified by a three-digit number.  
 First two digits represent significant figures.  
 Last digit specifies the number of zeros.  
 (Use 9 for 1.0 through 9.9pF ; Use 8 for 0.2 through 0.99pF)  
 (Example: 2.2pF=229 or 0.47pF=478)

#### TOLERANCE CODE

|                        |                       |                        |                       |              |              |
|------------------------|-----------------------|------------------------|-----------------------|--------------|--------------|
| A: $\pm 0.05\text{pF}$ | B: $\pm 0.1\text{pF}$ | C: $\pm 0.25\text{pF}$ | D: $\pm 0.5\text{pF}$ | F: $\pm 1\%$ | G: $\pm 2\%$ |
| J: $\pm 5\%$           | K: $\pm 10\%$         | M: $\pm 20\%$          | Z: $+80/-20\%$        |              |              |

#### VOLTAGE CODE

|         |         |         |         |        |        |        |         |
|---------|---------|---------|---------|--------|--------|--------|---------|
| B: 4V   | C: 6.3V | D: 10V  | E: 16V  | F: 25V | N: 35V | G: 50V | H: 100V |
| J: 200V | K: 250V | L: 500V | M: 630V | P: 1KV | Q: 2KV | R: 3KV | S: 4KV  |

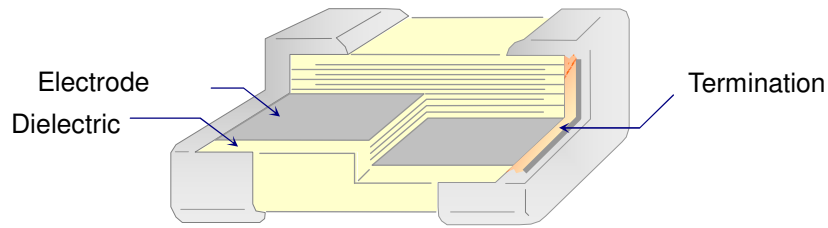
#### PACKAGING CODE

|                                                     |                                                        |
|-----------------------------------------------------|--------------------------------------------------------|
| T: Paper tape reel $\varnothing 180\text{mm}$ (7")  | P: Embossed tape reel $\varnothing 180\text{mm}$ (7")  |
| N: Paper tape reel $\varnothing 250\text{mm}$ (10") | D: Embossed tape reel $\varnothing 250\text{mm}$ (10") |
| A: Paper tape reel $\varnothing 330\text{mm}$ (13") | E: Embossed tape reel $\varnothing 330\text{mm}$ (13") |
| B: Bulk, loosed in bag                              | C: Bulk cassette                                       |
| W: Special Packing                                  |                                                        |

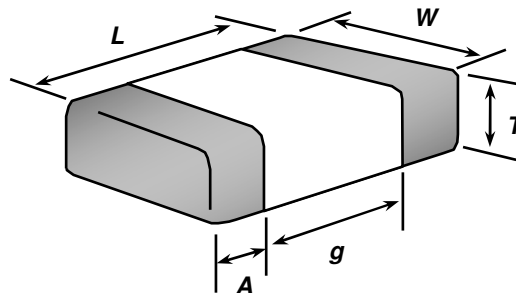
#### Product Type

S: Standard Ceramic Capacitor  
 Q: High Q/Low ESR

## MLCC STRUCTURE



## DIMENSIONS



## TYPICAL TOLERANCE

| SIZE CODE<br>(EIA) | L<br>(Length)                     | W<br>(Width)                       | T<br>(Max Thickness) | g<br>(Min)      | A<br>(Termination Min/Max)     | UNIT         |
|--------------------|-----------------------------------|------------------------------------|----------------------|-----------------|--------------------------------|--------------|
| 0603<br>(0201)     | 0.6+/-0.03<br>(0.024+/-0.001)     | 0.3+/-0.03<br>(0.012+/-0.001)      | 0.33<br>(0.013)      | 0.15<br>(0.006) | 0.10/0.20<br>(0.004/0.008)     | mm<br>(inch) |
| 1005<br>(0402)     | 1.0 +/- 0.05<br>(0.040 +/- 0.002) | 0.5 +/- 0.05<br>(0.020 +/- 0.002)  | 0.55<br>(0.022)      | 0.30<br>(0.012) | 0.10 / 0.30<br>(0.004 / 0.012) | mm<br>(inch) |
| 1608<br>(0603)     | 1.6 +/- 0.10<br>(0.063 +/- 0.004) | 0.8 +/- 0.10<br>(0.031 +/- 0.004)  | 0.90<br>(0.035)      | 0.50<br>(0.020) | 0.25 / 0.65<br>(0.010 / 0.026) | mm<br>(inch) |
| 2012<br>(0805)     | 2.0 +/- 0.15<br>(0.079 +/- 0.006) | 1.25 +/- 0.20<br>(0.049 +/- 0.008) | 1.45<br>(0.057)      | 0.70<br>(0.028) | 0.25 / 0.75<br>(0.010 / 0.030) | mm<br>(inch) |
| 3216<br>(1206)     | 3.2 +/- 0.15<br>(0.126 +/- 0.006) | 1.6 +/- 0.20<br>(0.063 +/- 0.008)  | 1.80<br>(0.069)      | 1.50<br>(0.060) | 0.25 / 0.75<br>(0.010 / 0.030) | mm<br>(inch) |
| 3225<br>(1210)     | 3.2 +/- 0.20<br>(0.126 +/- 0.008) | 2.5 +/- 0.20<br>(0.098 +/- 0.008)  | 2.70<br>(0.106)      | 1.50<br>(0.060) | 0.25 / 0.75<br>(0.010 / 0.030) | mm<br>(inch) |

## SPECIAL TOLERANCE

| SIZE CODE<br>(EIA) | L<br>(Length)                             | W<br>(Width)                               | T<br>(Max Thickness) | g<br>(Min)      | A<br>(Termination Min/Max)     | UNIT         |
|--------------------|-------------------------------------------|--------------------------------------------|----------------------|-----------------|--------------------------------|--------------|
| 1005*<br>(0402)    | 1.0 +/- 0.15<br>(0.040 +/- 0.006)         | 0.5 +/- 0.15<br>(0.020 +/- 0.006)          | 0.65<br>(0.026)      | 0.30<br>(0.012) | 0.10 / 0.30<br>(0.004 / 0.012) | mm<br>(inch) |
| 1608*<br>(0603)    | 1.6 + 0.15/-0.1<br>(0.063 +0.006/- 0.004) | 0.8 + 0.15/-0.1<br>(0.031 +0.006/-0.004)   | 0.95<br>(0.037)      | 0.50<br>(0.020) | 0.25 / 0.65<br>(0.010 / 0.026) | mm<br>(inch) |
| 2012*<br>(0805)    | 2.0 +/- 0.20<br>(0.079 +/- 0.008)         | 1.25 +0.30/-0.20<br>(0.049 +0.012/ -0.008) | 1.55<br>(0.061)      | 0.70<br>(0.028) | 0.25 / 0.75<br>(0.010 / 0.030) | mm<br>(inch) |
| 3216*<br>(1206)    | 3.2 +/- 0.20<br>(0.126 +/- 0.008)         | 1.6 +0.30/-0.20<br>(0.063 +0.012/ -0.008)  | 1.90<br>(0.075)      | 1.50<br>(0.060) | 0.25 / 0.75<br>(0.010 / 0.030) | mm<br>(inch) |
| 3225*<br>(1210)    | 3.2 +/- 0.30<br>(0.126 +/- 0.012)         | 2.5 +/- 0.30<br>(0.098 +/- 0.012)          | 2.80<br>(0.11)       | 1.50<br>(0.060) | 0.25 / 0.75<br>(0.010 / 0.030) | mm<br>(inch) |

## NP0 - General Purpose

| CLASS  | Class I   |     |      |      |      |     |      |      |      |      |     |      |
|--------|-----------|-----|------|------|------|-----|------|------|------|------|-----|------|
| TYPE   | Standard  |     |      |      |      |     |      |      |      |      |     |      |
| T.C.   | COG (NP0) |     |      |      |      |     |      |      |      |      |     |      |
| SIZE   | 0603      |     | 1005 |      | 1608 |     |      | 2012 |      | 3216 |     |      |
| (EIA)  | 0201      |     | 0402 |      | 0603 |     |      | 0805 |      | 1206 |     |      |
| RV     | 25V       | 50V | 50V  | 100V | 16V  | 50V | 100V | 50V  | 100V | 16V  | 50V | 100V |
| 0.20 p |           |     | B    | B    |      | D   | D    |      |      |      |     |      |
| 0.50 p | A         | A   | B    | B    |      | D   | D    | C    | C    |      |     |      |
| 0.75 p | A         | A   | B    | B    |      | D   | D    | C    | C    |      |     |      |
| 1.0 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      |     |      |
| 1.2 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      |     |      |
| 1.5 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 1.8 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 2.2 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 2.7 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 3.3 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 3.9 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 4.7 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 5.6 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 6.8 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 8.2 p  | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 10 p   | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 12 p   | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 15 p   | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 18 p   | A         | A   | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 22 p   | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 27 p   | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 33 p   | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 39 p   | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 47 p   | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 56 p   | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 68 p   | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 82 p   | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 100 p  | A         |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 120 p  |           |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 150 p  |           |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 180 p  |           |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 220 p  |           |     | B    | B    |      | D   | D    | C    | C    |      | E   | E    |
| 270 p  |           |     | B    |      |      | D   | D    | C    | C    |      | E   | E    |
| 330 p  |           |     | B    |      |      | D   | D    | C    | C    |      | E   | E    |
| 390 p  |           |     | B    |      |      | D   | D    | C    | E    |      | E   | E    |
| 470 p  |           |     | B    |      |      | D   | D    | C    | E    |      | E   | E    |
| 560 p  |           |     |      |      |      | D   | D    | C    | E    |      | E   | E    |
| 680 p  |           |     |      |      |      | D   | D    | C    | E    |      | E   | E    |
| 820 p  |           |     |      |      |      | D   | D    | C    | E    |      | E   | E    |
| 1.0 n  |           |     | B    |      |      | D   | D    | C    | E    |      | E   | E    |
| 1.2 n  |           |     |      |      |      | D*  |      | E    | E    |      | E   | E    |
| 1.5 n  |           |     |      |      |      | D*  |      | E    | E    |      | E   | E    |
| 1.8 n  |           |     |      |      |      | D*  |      | E    | E    |      | E   | E    |
| 2.2 n  |           |     |      |      |      | D*  |      | E    | E    |      | E   | E    |
| 2.7 n  |           |     |      |      |      | D*  |      | G    | G    |      | E   | E    |
| 3.3 n  |           |     |      |      |      | D*  |      | G    | G    |      | E   | E    |
| 3.9 n  |           |     |      |      |      |     |      | G    |      |      | E   | E    |
| 4.7 n  |           |     |      |      |      |     |      | G    |      |      | E   | E    |
| 5.6 n  |           |     |      |      |      |     |      | G    |      |      | E   |      |
| 6.8 n  |           |     |      |      |      |     |      | G    |      |      | F   |      |
| 8.2 n  |           |     |      |      |      |     |      | G    |      |      | F   |      |
| 10 n   |           |     |      |      |      |     |      | G    |      |      | G   |      |
| 12 n   |           |     |      |      |      |     |      |      |      | G    |     |      |
| 15 n   |           |     |      |      |      |     |      |      |      | G    |     |      |
| 18 n   |           |     |      |      |      |     |      |      |      | G    |     |      |
| 22 n   |           |     |      |      |      |     |      |      |      | G    |     |      |
| 27 n   |           |     |      |      |      |     |      |      |      | G    |     |      |
| 33 n   |           |     |      |      |      |     |      |      |      | G    |     |      |
| 39 n   |           |     |      |      |      |     |      |      |      | L    |     |      |

Note : Thickness might be changed due to technology improvement.



### NP0 – Low ESR/ High Q (Q Series)

| CLASS    | Class I        |     |      |     |      |     |
|----------|----------------|-----|------|-----|------|-----|
| TYPE     | Low ESR/High Q |     |      |     |      |     |
| T.C.     | NP0(C0G)       |     |      |     |      |     |
| SIZE     | 0603           |     | 1005 |     | 1608 |     |
| (EIA)    | 0201           |     | 0402 |     | 0603 |     |
| RV       | 25V            | 50V | 25V  | 50V | 25V  | 50V |
| * 0.20 p | A              | A   | B    | B   | D    | D   |
| * 0.50 p | A              | A   | B    | B   | D    | D   |
| * 0.75 p | A              | A   | B    | B   | D    | D   |
| 1.0 p    | A              | A   | B    | B   | D    | D   |
| 1.2 p    | A              | A   | B    | B   | D    | D   |
| 1.5 p    | A              | A   | B    | B   | D    | D   |
| 1.8 p    | A              | A   | B    | B   | D    | D   |
| 2.2 p    | A              | A   | B    | B   | D    | D   |
| 2.7 p    | A              | A   | B    | B   | D    | D   |
| 3.3 p    | A              | A   | B    | B   | D    | D   |
| 3.9 p    | A              | A   | B    | B   | D    | D   |
| 4.7 p    | A              | A   | B    | B   | D    | D   |
| 5.6 p    | A              | A   | B    | B   | D    | D   |
| 6.8 p    | A              | A   | B    | B   | D    | D   |
| 8.2 p    | A              | A   | B    | B   | D    | D   |
| 10 p     | A              | A   | B    | B   | D    | D   |
| 12 p     | A              | A   | B    | B   | D    | D   |
| 15 p     | A              | A   | B    | B   | D    | D   |
| 18 p     | A              | A   | B    | B   | D    | D   |
| 22 p     |                |     | B    | B   | D    | D   |
| 27 p     |                |     |      |     |      |     |
| 33 p     |                |     |      |     |      |     |
| 39 p     |                |     |      |     |      |     |
| 47 p     |                |     |      |     |      |     |
| 56 p     |                |     |      |     |      |     |
| 68 p     |                |     |      |     |      |     |
| 82 p     |                |     |      |     |      |     |
| 100 p    |                |     |      |     |      |     |
| 120 p    |                |     |      |     |      |     |
| 150 p    |                |     |      |     |      |     |
| 180 p    |                |     |      |     |      |     |
| 220 p    |                |     |      |     |      |     |
| 270 p    |                |     |      |     |      |     |
| 330 p    |                |     |      |     |      |     |

Note : Thickness might be changed due to technology improvement.

#### Thickness Tolerance

| Thickness (mm) |             | Thickness (mm) |               | Thickness (mm) |             | Thickness (mm) |                | Thickness (mm) |                | Thickness (mm) |             |
|----------------|-------------|----------------|---------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|-------------|
| Code           | Class       | Code           | Class         | Code           | Class       | Code           | Class          | Code           | Code           | Code           | Code        |
| A              | 0.30+/-0.03 | C              | 0.60+/-0.15   | E              | 0.85+/-0.15 | G              | 1.25+0.3/-0.20 | L              | 1.60+0.3/-0.20 | P              | 2.50+/-0.20 |
| B              | 0.50+/-0.05 | D              | 0.80+/-0.10   | F              | 1.15+/-0.20 | I              | 0.95+/-0.15    | N              | 2.00+/-0.20    | Q              | 0.45+/-0.05 |
| B              | 0.50+/-0.15 | D              | 0.8+0.15/-0.1 | G              | 1.25+/-0.20 | L              | 1.60+/-0.20    | N              | 2.00+/-0.30    |                |             |

#### Special Length/Width Tolerance

| Size Code(EIA) | 1005(0402) | 1608(0603) | 2012(0805)  | 3216(1206) | 3225(1210) |
|----------------|------------|------------|-------------|------------|------------|
| Length(mm)     | 1.0 ± 0.15 | 1.6 ± 0.15 | 2.0 ± 0.20  | 3.2 ± 0.20 | 3.2 ± 0.30 |
| Width(mm)      | 0.5 ± 0.15 | 0.8 ± 0.15 | 1.25 ± 0.30 | 1.6 ± 0.30 | 2.5 ± 0.30 |

## X5R – General Purpose

| CLAS  | Class II |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
|-------|----------|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|---|---|---|
| TYPE  | Standard |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| T.C.  | X5R      |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| SIZE  | 0603     |     | 1005 |     |     |     | 1608 |     |     |     | 2012 |     |     |     | 3216 |     |     |     | 3225 |     |     |     |   |   |   |
| (EIA) | 0201     |     | 0402 |     |     |     | 0603 |     |     |     | 0805 |     |     |     | 1206 |     |     |     | 1210 |     |     |     |   |   |   |
| RV    | 6.3V     | 10V | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V |   |   |   |
| 2.2 n | A        | A   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 3.3 n | A        | A   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 4.7 n | A        | A   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 5.6 n | A        | A   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 6.8 n | A        | A   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 8.2 n | A        | A   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 10 n  | A        | A   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 15 n  |          |     |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 22 n  | A        | A   |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 33 n  |          |     |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 47 n  | A        | A   |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 56 n  |          |     |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 68 n  |          |     |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 82 n  |          |     |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 100 n | A        | A   |      | B   | B   | B   |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 120 n |          |     |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 150 n |          |     |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 180 n |          |     |      | B   | B   |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 220 n | A        |     |      | B   | B   |     |      | D   | D   | D   |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 270 n |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 330 n |          |     |      |     |     |     |      | D   | D   |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 390 n |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 470 n |          |     | B    | B   |     |     |      | D   | D   |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 560 n |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 680 n |          |     |      |     |     |     |      | D   | D   |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 820 n |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 1.0 u |          |     | B    | B   | B   |     |      | Q   | D   | Q   | D    | Q   | D   |     |      | E   | G   | E   | G    |     |     |     |   |   |   |
| 1.5 u |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 1.8 u |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 2.2 u |          |     | B    |     |     |     |      | D   | D   | D   |      |     |     |     |      | E   | G   | G   |      | L   | L   | L   |   |   |   |
| 2.7 u |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 3.3 u |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 3.9 u |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 4.7 u |          |     | B*   |     |     |     |      | D   | D   |     |      |     | G   | G   | G    | G   |     |     | L    | L   | L   | N   | N |   |   |
| 6.8 u |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |
| 10 u  |          |     |      |     |     |     |      | D*  |     |     |      |     | G   | G   | G    |     |     |     | L    | L   | L   | N   | N |   |   |
| 22 u  |          |     |      |     |     |     |      |     |     |     |      |     | G   |     |      |     |     |     | L    | L   | L   | N   | P | N | P |
| 47 u  |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     | L    |     |     | P   |   |   |   |
| 100 u |          |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     | P   |   |   |   |

- Non-standard capacitance or thickness is available on request
- \* Special length/width tolerance
- The thickness might be changed due to technology improvement.

### Thickness Tolerance

| Thickness (mm) | Thickness (mm) | Thickness (mm) | Thickness (mm) | Thickness (mm) | Thickness (mm) |
|----------------|----------------|----------------|----------------|----------------|----------------|
| Code           | Class          | Code           | Class          | Code           | Class          |
| A              | 0.30+/-0.03    | C              | 0.60+/-0.15    | E              | 0.85+/-0.15    |
| B              | 0.50+/-0.05    | D              | 0.80+/-0.10    | F              | 1.15+/-0.20    |
| B              | 0.50+/-0.15    | D              | 0.8+0.15/-0.1  | G              | 1.25+/-0.20    |
|                |                |                |                | L              | 1.60+/-0.20    |
|                |                |                |                | N              | 2.00+/-0.20    |
|                |                |                |                | N              | 2.00+/-0.30    |
|                |                |                |                | P              | 2.50+/-0.20    |
|                |                |                |                | Q              | 0.45+/-0.05    |

### Special Length/Width Tolerance

| Size Code(EIA) | 1005(0402) | 1608(0603) | 2012(0805)  | 3216(1206) | 3225(1210) |
|----------------|------------|------------|-------------|------------|------------|
| Length(mm)     | 1.0 ± 0.15 | 1.6 ± 0.15 | 2.0 ± 0.20  | 3.2 ± 0.20 | 3.2 ± 0.30 |
| Width(mm)      | 0.5 ± 0.15 | 0.8 ± 0.15 | 1.25 ± 0.30 | 1.6 ± 0.30 | 2.5 ± 0.30 |

| CLASS      | Class II |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
|------------|----------|-----|-----|------|-----|------|-----|------|-----|------|-----|------|------|-----|------|-----|-----|------|-----|------|-----|-----|------|-----|------|--|
| TYPE       | Standard |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| T.C.       | X7R      |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| SIZE (EIA) | 0603     |     |     |      |     | 1005 |     |      |     | 1608 |     |      |      |     | 2012 |     |     |      |     | 3216 |     |     |      |     | 3225 |  |
|            | 0201     |     |     | 0402 |     |      |     | 0603 |     |      |     |      | 0805 |     |      |     |     | 1206 |     |      |     |     | 1210 |     |      |  |
| RV         | 10V      | 25V | 50V | 10V  | 16V | 25V  | 50V | 10V  | 16V | 25V  | 50V | 100V | 6.3V | 10V | 16V  | 25V | 50V | 100V | 10V | 16V  | 25V | 50V | 100V | 16V | 25V  |  |
| 100 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 120 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 150 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 180 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 220 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 270 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 330 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 390 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 470 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 560 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 680 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 820 p      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      |     |     |      |     |      | C   | E   | E    |     |      |  |
| 1.0 n      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 1.2 n      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 1.5 n      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 1.8 n      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 2.2 n      | A        | A   | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 2.7 n      |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 3.3 n      | A        |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 3.9 n      |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 4.7 n      | A        |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 5.6 n      |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 6.8 n      |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 8.2 n      |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 10 n       | A        |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 12 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 15 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 18 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 22 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 27 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D    |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 33 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D*   |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 39 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D*   |      |     |      | C   | E   | C    | E   | E    |     |     | E    | E   |      |  |
| 47 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D*   |      |     |      | E   | E   | E    | E   | E    |     |     | E    | E   |      |  |
| 56 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D*   |      |     |      | E   | E   | E    | E   | E    |     |     | E    | E   |      |  |
| 68 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D*   |      |     |      | E   | E   | E    | E   | E    |     |     | E    | E   |      |  |
| 82 n       |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D*   |      |     |      | E   | E   | E    | E   | E    |     |     | E    | E   |      |  |
| 100 n      |          |     | B   | B    | B   | B    | B   | D    | D   | D    | D   | D*   |      |     |      | E   | E   | E    | E   | E    |     |     | E    | E   |      |  |
| 120 n      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      | E   | E   | E    | E   | E    |     |     |      |     |      |  |
| 150 n      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      | E   | E   | E    | E   | E    |     |     |      |     |      |  |
| 180 n      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      | E   | E   | E    | E   | E    |     |     |      |     |      |  |
| 220 n      |          |     |     |      |     |      |     | D    | D   | D*   |     |      |      |     |      | E   | E   | E    | E   | E    |     | I   | I    |     |      |  |
| 270 n      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 330 n      |          |     |     |      |     |      |     | D*   | D*  |      |     |      |      |     | G    | G   | G   |      |     |      |     | I   | G    |     |      |  |
| 390 n      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 470 n      |          |     |     |      |     |      |     | D*   | D*  |      |     |      |      |     | G    | G   | G   |      |     |      |     | G   | G    | L   |      |  |
| 560 n      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 680 n      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 820 n      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 1.0 u      |          |     |     |      |     |      |     | D*   | D*  | D*   |     |      |      | G   | G    | G   |     |      |     |      |     | G   | G    | G   | L    |  |
| 1.2 u      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 1.5 u      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 1.8 u      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 2.2 u      |          |     |     |      |     |      |     |      |     |      |     |      |      | G   | G    |     |     |      |     |      |     | L   | L    | L   |      |  |
| 2.7 u      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 3.3 u      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 3.9 u      |          |     |     |      |     |      |     |      |     |      |     |      |      |     |      |     |     |      |     |      |     |     |      |     |      |  |
| 4.7 u      |          |     |     |      |     |      |     |      |     |      |     |      |      | G   | G    |     |     |      |     |      |     | L   | L    |     |      |  |
| 10 u       |          |     |     |      |     |      |     |      |     |      |     |      |      | G   |      |     |     |      |     |      |     | L   | L    |     |      |  |

- Non-standard capacitance or thickness is available on request
- \* Special length/width tolerance
- The thickness might be changed due to technology improvement.

### Thickness Tolerance

| Thickness (mm) |             | Thickness (mm) |               | Thickness (mm) |             | Thickness (mm) |                | Thickness (mm) |                | Thickness (mm) |             |
|----------------|-------------|----------------|---------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|-------------|
| Code           | Class       | Code           | Class         | Code           | Class       | Code           | Class          | Code           | Class          | Code           | Class       |
| A              | 0.30+/-0.03 | C              | 0.60+/-0.15   | E              | 0.85+/-0.15 | G              | 1.25+0.3/-0.20 | L              | 1.60+0.3/-0.20 | P              | 2.50+/-0.20 |
| B              | 0.50+/-0.05 | D              | 0.80+/-0.10   | F              | 1.15+/-0.20 | I              | 0.95+/-0.15    | N              | 2.00+/-0.20    | Q              | 0.45+/-0.05 |
| B              | 0.50+/-0.15 | D              | 0.8+0.15/-0.1 | G              | 1.25+/-0.20 | L              | 1.60+/-0.20    | N              | 2.00+/-0.30    |                |             |

### Special Length/Width Tolerance

| Size Code(EIA) | 1005(0402) | 1608(0603) | 2012(0805)  | 3216(1206) | 3225(1210) |
|----------------|------------|------------|-------------|------------|------------|
| Length(mm)     | 1.0 ± 0.15 | 1.6 ± 0.15 | 2.0 ± 0.20  | 3.2 ± 0.20 | 3.2 ± 0.30 |
| Width(mm)      | 0.5 ± 0.15 | 0.8 ± 0.15 | 1.25 ± 0.30 | 1.6 ± 0.30 | 2.5 ± 0.30 |

### Y5V – General Purpose

| CLASS | Class II |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
|-------|----------|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-----|------|-----|-----|
| TYPE  | Standard |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| T.C.  | Y5V      |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| SIZE  | 0603     |     | 1005 |     |     |     |     | 1608 |     |     |     |     | 2012 |     |     |
| (EIA) | 0201     |     | 0402 |     |     |     |     | 0603 |     |     |     |     | 0805 |     |     |
| RV    | 6.3V     | 10V | 6.3V | 10V | 16V | 25V | 50V | 6.3V | 10V | 16V | 25V | 50V | 16V  | 25V | 50V |
| 10 n  |          |     | B    | B   | B   | B   | B   | D    | D   | D   | D   | D   |      |     |     |
| 12 n  |          |     | B    | B   | B   | B   | B   | D    | D   | D   | D   | D   |      |     |     |
| 15 n  |          |     | B    | B   | B   | B   | B   | D    | D   | D   | D   | D   |      |     |     |
| 18 n  |          |     | B    | B   | B   | B   | B   | D    | D   | D   | D   | D   |      |     |     |
| 22 n  | A        | A   | B    | B   | B   | B   | B   | D    | D   | D   | D   | D   |      |     |     |
| 27 n  |          |     | B    | B   | B   | B   | B   | D    | D   | D   | D   | D   |      |     |     |
| 33 n  | A        | A   | B    | B   | B   | B   | B   | D    | D   | D   | D   | D   |      |     |     |
| 39 n  |          |     | B    | B   | B   | B   |     | D    | D   | D   | D   | D   |      |     |     |
| 47 n  | A        | A   | B    | B   | B   | B   |     | D    | D   | D   | D   | D   |      |     |     |
| 56 n  |          |     | B    | B   | B   |     |     | D    | D   | D   | D   | D   |      |     |     |
| 68 n  |          |     | B    | B   | B   |     |     | D    | D   | D   | D   | D   |      |     |     |
| 82 n  |          |     | B    | B   | B   |     |     | D    | D   | D   | D   | D   |      |     |     |
| 100 n | A        | A   | B    | B   | B   | B   |     | D    | D   | D   | D   | D   | C    | C   | C   |
| 120 n |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 150 n |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 180 n |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 220 n |          |     | B    | B   | B   |     |     | D    | D   | D   | D   | D   | E    | E   | E   |
| 270 n |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 330 n |          |     | B    | B   |     |     |     | D    | D   | D   | D   |     |      |     |     |
| 390 n |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 470 n |          |     | B    | B   |     |     |     | D    | D   | D   |     |     | E    | E   | E   |
| 560 n |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 680 n |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 820 n |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 1.0 u |          |     | B    | B   |     |     |     | D*   | D*  | D*  |     |     | E    | G   | G   |
| 1.2 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 1.5 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 1.8 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 2.2 u |          |     |      |     |     |     |     | D    | D   | D   |     |     | E    | G   |     |
| 2.7 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 3.3 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 3.9 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 4.7 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 5.6 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 6.8 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 8.2 u |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |
| 10 u  |          |     |      |     |     |     |     |      |     |     |     |     |      |     |     |

- Non-standard capacitance or thickness is available on request
- \* Special length/width tolerance
- The thickness might be changed due to technology improvement.
- Part of Y5V product will be phased out.

#### Thickness Tolerance

| Thickness (mm) |             | Thickness (mm) |               | Thickness (mm) |             | Thickness (mm) |                | Thickness (mm) |                | Thickness (mm) |             |
|----------------|-------------|----------------|---------------|----------------|-------------|----------------|----------------|----------------|----------------|----------------|-------------|
| Code           | Class       | Code           | Class         | Code           | Class       | Code           | Class          | Code           | Code           | Code           | Code        |
| A              | 0.30+/-0.03 | C              | 0.60+/-0.15   | E              | 0.85+/-0.15 | G              | 1.25+0.3/-0.20 | L              | 1.60+0.3/-0.20 | P              | 2.50+/-0.20 |
| B              | 0.50+/-0.05 | D              | 0.80+/-0.10   | F              | 1.15+/-0.20 | I              | 0.95+/-0.15    | N              | 2.00+/-0.20    | Q              | 0.45+/-0.05 |
| <u>B</u>       | 0.50+/-0.15 | <u>D</u>       | 0.8+0.15/-0.1 | G              | 1.25+/-0.20 | L              | 1.60+/-0.20    | N              | 2.00+/-0.30    |                |             |

#### Special Length/Width Tolerance

| Size Code(EIA) | 1005(0402) | 1608(0603) | 2012(0805)  | 3216(1206) | 3225(1210) |
|----------------|------------|------------|-------------|------------|------------|
| Length(mm)     | 1.0 ± 0.15 | 1.6 ± 0.15 | 2.0 ± 0.20  | 3.2 ± 0.20 | 3.2 ± 0.30 |
| Width(mm)      | 0.5 ± 0.15 | 0.8 ± 0.15 | 1.25 ± 0.30 | 1.6 ± 0.30 | 2.5 ± 0.30 |

## General Purpose

| Item                                      | Specification                                                                                                                                                                            |                                                                                | Test Method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------|----------------------|-----------|------------|------------|---------|-------------|-------------|------|----------------------|----------------------|----------------------|-----------|------------|------------|------------|---------|-------------|-------------|-------------|------|-----------|-----|------|-----|------|--------|------|------|-----|------|--------|-----|---------|-----|------|--------|-----|---------|-----|
|                                           | Temp. compensating type                                                                                                                                                                  | High dielectric constant type                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 1 Operating Temperature Range             | NP0: -55 to 125 degree C                                                                                                                                                                 | X7R: -55 to 125 degree C<br>X5R: -55 to 85 degree C<br>Y5V: -30 to 85 degree C | ---                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 2 Rated Voltage                           | 4VDC, 6.3VDC, 10VDC, 16VDC, 25VDC, 35VDC, 50VDC, 100VDC, 200VDC, 250VDC, 500VDC, 630VDC, 1000VDC, 2000VDC, 3000VDC                                                                       |                                                                                | The rated voltage is defined as the maximum voltage, which may be applied continuously to the capacitor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 3 Appearance                              | No defects or abnormalities.                                                                                                                                                             |                                                                                | Visual inspection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 4 Dimensions                              | Within the specified dimension.                                                                                                                                                          |                                                                                | Using calipers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 5 Dielectric Strength                     | No defects or abnormalities.                                                                                                                                                             |                                                                                | No failure shall be observed when 250%* of the rated voltage ( 150% for 500V, 120% for above 1KV ) is applied between the terminations for 1 to 5 seconds. The charge and discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 6 Insulation Resistance ( I.R.)           | Rated Voltage: <500V<br>Rated Voltage: ≥500V                                                                                                                                             | To apply rated voltage.<br>To apply 500V.                                      | I.R. ≥ 10G or R <sub>i</sub> C <sub>0</sub> ≥ 500Ω·F (whichever is smaller)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 7 Capacitance                             | Within the specified tolerance<br>* X7R, X5R and Y5V at 1000 hours                                                                                                                       |                                                                                | The capacitance / D.F. shall be measured at 25°C at the frequency and voltage shown in the tables.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 8 Q/Dissipation Factor ( D.F.)            | NP0:<br>If C ≤ 30pF, DF ≤ 1/(400+20C), C in pF<br>If C > 30pF, DF ≤ 0.1%.                                                                                                                | I. X5R, X7R:<br>See X5R,X7R DF table<br>II. Y5V:<br>See Y5V DF table.          | <table border="1"> <thead> <tr> <th>Item</th> <th>Class I<br/>C ≤ 1,000pF</th> <th>Class I<br/>&gt; 1,000pF</th> </tr> </thead> <tbody> <tr> <td>Frequency</td> <td>1.0±0.2MHz</td> <td>1.0±0.2kHz</td> </tr> <tr> <td>Voltage</td> <td>1.0±0.2Vrms</td> <td>1.0±0.2Vrms</td> </tr> </tbody> </table><br><table border="1"> <thead> <tr> <th>Item</th> <th>ClassII<br/>(≤ 10 uF)</th> <th>ClassII<br/>(&gt; 10 uF)</th> <th>* For item in Table1</th> </tr> </thead> <tbody> <tr> <td>Frequency</td> <td>1.0±0.2kHz</td> <td>120Hz±24Hz</td> <td>1.0±0.2kHz</td> </tr> <tr> <td>Voltage</td> <td>1.0±0.2Vrms</td> <td>0.5±0.1Vrms</td> <td>0.5±0.1Vrms</td> </tr> </tbody> </table><br><table border="1"> <caption>Table 1</caption> <thead> <tr> <th>Size</th> <th>Thickness</th> <th>TC</th> <th>RV</th> <th>Cap</th> </tr> </thead> <tbody> <tr> <td>0603</td> <td>0.3 mm</td> <td>X5R</td> <td>6.3V</td> <td>104</td> </tr> <tr> <td>1005</td> <td>0.5 mm</td> <td>X5R</td> <td>4V/6.3V</td> <td>475</td> </tr> <tr> <td>1608</td> <td>0.8 mm</td> <td>X5R</td> <td>4V/6.3V</td> <td>106</td> </tr> </tbody> </table> | Item | Class I<br>C ≤ 1,000pF | Class I<br>> 1,000pF | Frequency | 1.0±0.2MHz | 1.0±0.2kHz | Voltage | 1.0±0.2Vrms | 1.0±0.2Vrms | Item | ClassII<br>(≤ 10 uF) | ClassII<br>(> 10 uF) | * For item in Table1 | Frequency | 1.0±0.2kHz | 120Hz±24Hz | 1.0±0.2kHz | Voltage | 1.0±0.2Vrms | 0.5±0.1Vrms | 0.5±0.1Vrms | Size | Thickness | TC  | RV   | Cap | 0603 | 0.3 mm | X5R  | 6.3V | 104 | 1005 | 0.5 mm | X5R | 4V/6.3V | 475 | 1608 | 0.8 mm | X5R | 4V/6.3V | 106 |
| Item                                      | Class I<br>C ≤ 1,000pF                                                                                                                                                                   | Class I<br>> 1,000pF                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| Frequency                                 | 1.0±0.2MHz                                                                                                                                                                               | 1.0±0.2kHz                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| Voltage                                   | 1.0±0.2Vrms                                                                                                                                                                              | 1.0±0.2Vrms                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| Item                                      | ClassII<br>(≤ 10 uF)                                                                                                                                                                     | ClassII<br>(> 10 uF)                                                           | * For item in Table1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| Frequency                                 | 1.0±0.2kHz                                                                                                                                                                               | 120Hz±24Hz                                                                     | 1.0±0.2kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| Voltage                                   | 1.0±0.2Vrms                                                                                                                                                                              | 0.5±0.1Vrms                                                                    | 0.5±0.1Vrms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| Size                                      | Thickness                                                                                                                                                                                | TC                                                                             | RV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Cap  |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 0603                                      | 0.3 mm                                                                                                                                                                                   | X5R                                                                            | 6.3V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 104  |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 1005                                      | 0.5 mm                                                                                                                                                                                   | X5R                                                                            | 4V/6.3V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 475  |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 1608                                      | 0.8 mm                                                                                                                                                                                   | X5R                                                                            | 4V/6.3V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 106  |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 9 Capacitance Temperature Characteristics | Capacitance change<br>NP0 within 0±30ppm/°C under operating temperature range.                                                                                                           | Capacitance change<br>X7R/X5R within ±15%<br>Y5V: -82 to + 22%                 | <p>1. Temperature compensating type:<br/>The capacitance value at 25°C and 85°C shall be measured and calculated from the formula given below.<br/>T.C.=(C<sub>85</sub>-C<sub>25</sub>)/C<sub>25</sub>* Δ T*10<sup>6</sup>(PPM/°C)</p> <p>2. High dielectric constant type:<br/>The ranges of capacitance change compared with the 25°C value over the temperature ranges shall be within the specified ranges.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 10 Termination Strength                   | No removal of the terminations or marking defect.                                                                                                                                        |                                                                                | Apply a parallel force of 5N to a PCB mounted sample for 10±1sec. *2N for 0603 (EIA 0201).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 11 Deflection (Bending Strength)          | No cracking or marking defects shall occur at 1mm deflection.<br>Capacitance change:<br>NP0: within ±5% or ± 0.5pF. (whichever is larger)<br>X7R, X5R: within ±12.5%<br>Y5V: within ±20% | (Unit in mm)                                                                   | <p>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.a using a SAC305(Sn96.5Ag3.0Cu0.5) solder (then let sit for 48±4 hours for X7R X5R and Y5V).</p> <p>Then apply a force in the direction shown in Fig.b. The soldering shall be done with the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.</p> <table border="1"> <thead> <tr> <th>Size</th> <th>a</th> <th>b</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>0603</td> <td>0.3</td> <td>0.9</td> <td>0.3</td> </tr> <tr> <td>1005</td> <td>0.4</td> <td>1.5</td> <td>0.5</td> </tr> <tr> <td>1608</td> <td>1.0</td> <td>3.0</td> <td>1.2</td> </tr> <tr> <td>2012</td> <td>1.2</td> <td>4.0</td> <td>1.65</td> </tr> <tr> <td>3216</td> <td>2.2</td> <td>5.0</td> <td>2.0</td> </tr> <tr> <td>4520</td> <td>3.5</td> <td>7.0</td> <td>2.5</td> </tr> <tr> <td>4532</td> <td>3.5</td> <td>7.0</td> <td>3.7</td> </tr> </tbody> </table>                                                                                                                               | Size | a                      | b                    | C         | 0603       | 0.3        | 0.9     | 0.3         | 1005        | 0.4  | 1.5                  | 0.5                  | 1608                 | 1.0       | 3.0        | 1.2        | 2012       | 1.2     | 4.0         | 1.65        | 3216        | 2.2  | 5.0       | 2.0 | 4520 | 3.5 | 7.0  | 2.5    | 4532 | 3.5  | 7.0 | 3.7  |        |     |         |     |      |        |     |         |     |
| Size                                      | a                                                                                                                                                                                        | b                                                                              | C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 0603                                      | 0.3                                                                                                                                                                                      | 0.9                                                                            | 0.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 1005                                      | 0.4                                                                                                                                                                                      | 1.5                                                                            | 0.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 1608                                      | 1.0                                                                                                                                                                                      | 3.0                                                                            | 1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 2012                                      | 1.2                                                                                                                                                                                      | 4.0                                                                            | 1.65                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 3216                                      | 2.2                                                                                                                                                                                      | 5.0                                                                            | 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 4520                                      | 3.5                                                                                                                                                                                      | 7.0                                                                            | 2.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 4532                                      | 3.5                                                                                                                                                                                      | 7.0                                                                            | 3.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |
| 12 Solderability of Termination           | 90% of the terminations are to be soldered evenly and continuously.                                                                                                                      |                                                                                | Immerse the test capacitor into a methanol solution containing rosin for 3 to 5 seconds, preheat it 150 to 180°C for 2 to 3 minutes and immerse it into SAC305(Sn96.5Ag3.0Cu0.5) solder of 245 ± 5°C for 3±1seconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                        |                      |           |            |            |         |             |             |      |                      |                      |                      |           |            |            |            |         |             |             |             |      |           |     |      |     |      |        |      |      |     |      |        |     |         |     |      |        |     |         |     |

|    | Item                              | Specification           |                                                                                                          | Test Method                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|----|-----------------------------------|-------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    |                                   | Temp. compensating type | High dielectric constant type                                                                            |                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 13 | Resistance to Soldering Heat      | Appearance              | No marking defects                                                                                       |                                                                                                                                                  | *Preheat the capacitor at 120 to 150°C for 1 minute.<br>Immerse the capacitor in a SAC305(Sn96.5Ag3.0Cu0.5) solder solution at 270±5°C for 10±1 seconds. Let sit at room temperature for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type), then measure.<br><br>* Preheat 150 to 200°C for size ≥3216.<br><br>*High dielectric constant type: Initial measurement : perform a heat treatment at 150+/-10°C for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.                                                                                                                                                                                                                              |  |
|    |                                   | Cap. Change             | NP0 within ±2.5% or 0.25pF ( whichever is larger )                                                       | X7R/X5R within ±7.5%<br>Y5V within ±20%                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|    |                                   | Q/D.F.                  | If C ≤30pF, DF ≤1/(400+20C)<br>If C >30pF, DF ≤0.1%                                                      | To satisfy the specified initial spec.                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|    |                                   | I.R.                    | I.R. ≥ 10,000MΩ or R <sub>i</sub> C <sub>r</sub> ≥ 500Ω-F. (whichever is smaller)                        | I.R. ≥ 10,000MΩ or R <sub>i</sub> C <sub>r</sub> ≥ 500Ω-F. (whichever is smaller)                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 14 | Temperature cycle (Thermal shock) | Appearance              | No marking defects                                                                                       |                                                                                                                                                  | Solder the capacitor to supporting jig (glass epoxy board) and perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2hrs at room temperature, then measure.<br>Step 1: Minimum operating temperature 30±3min<br>Step 2: Room temperature 2~3 min<br>Step 3: Maximum operating temperature 30±3min<br>Step 4: Room temperature 2~3min<br><br>*High dielectric constant type: Initial measurement: perform a heat treatment at 150+/-10°C for one hour and then let sit for 48±4 hours at room temp. Perform the initial measurement.                                                                                                                                                                                         |  |
|    |                                   | Cap. Change             | NP0 within ±2.5% or 0.25pF ( whichever is larger )                                                       | X7R/X5R within ±7.5%<br>Y5V within ±20%                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|    |                                   | Q/D.F.                  | If C ≤30pF, DF ≤1/(400+20C)<br>If C >30pF, DF ≤0.1%                                                      | To satisfy the specified initial spec.                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|    |                                   | I.R.                    | I.R. ≥ 10,000MΩ or R <sub>i</sub> C <sub>r</sub> ≥ 500Ω-F. (whichever is smaller)                        | I.R. ≥ 10,000MΩ or R <sub>i</sub> C <sub>r</sub> ≥ 500Ω-F. (whichever is smaller)                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 15 | Humidity load                     | Appearance              | No marking defects                                                                                       |                                                                                                                                                  | Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.<br><br>The charge / discharge current is less than 50mA.<br><br>*High dielectric constant type: Initial measurement: perform a heat treatment at 150+/-10°C for one hour and then let sit for 48±4hours at room temperature. Perform the initial measurement.                                                                                                                                                                                                                                                                                        |  |
|    |                                   | Cap. Change             | NP0 within ±7.5% or 0.75pF ( whichever is larger )                                                       | X7R/X5R within ±12.5%<br>Y5V within ±30%                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|    |                                   | Q/D.F.                  | If C >30pF, DF ≤0.5%<br>If C ≤30pF, DF ≤1/(100+10xC/3)<br>C in pF                                        | X7R 200% max of initial spec.<br>Y5V 150% max of initial spec.<br>X5R 200% max of initial spec.                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|    |                                   | I.R.                    | I.R. ≥ 500MΩ or R <sub>i</sub> C <sub>r</sub> ≥ 25Ω-F. (whichever is smaller)                            | I.R. ≥ 500MΩ or R <sub>i</sub> C <sub>r</sub> ≥ 25Ω-F. (whichever is smaller)<br>* some of the parts are RiCr ≥ 12.5Ω-F, please refer to table 2 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 16 | High temperature load life test   | Appearance              | No marking defects                                                                                       |                                                                                                                                                  | Apply 200%(150% for ≥500V; 120% for ≥1000V) of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.<br><br>The charge/discharge current is less than 50mA.<br><br>*High dielectric constant type: Initial measurement: perform a heat treatment at 150+/-10°C for one hour and then let sit for 48±4hours at room temperature. Perform the initial measurement.<br><br>P.S.: Please refer to table 1 for items applying 150% voltage.<br><br>* 150% for high dielectric constant type ≥500V.<br>* 120% for voltage ≥ 1000V.<br>* some of the parts are applicable in rated voltage *1.5. please refer to table 2 |  |
|    |                                   | Cap. Change             | NP0 within ±7.5% or 0.75pF ( whichever is larger )                                                       | X7R/X5R within ±12.5%<br>Y5V within ±30%                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|    |                                   | Q/D.F.                  | If C >30pF, DF ≤0.3%<br>If 10pF < C ≤ 30pF, DF ≤ 1/(275+5xC/2)<br>If C ≤ 10pF, DF ≤ 1/(200+10C), C in pF | X7R 200% max of initial value<br>Y5V 150% max of initial value<br>X5R 200% max of initial value                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|    |                                   | I.R.                    | More than 1GΩ or R <sub>i</sub> C <sub>r</sub> ≥ 50Ω-F (whichever is less.)                              | More than 1GΩ or R <sub>i</sub> C <sub>r</sub> ≥ 50Ω-F (whichever is less.)<br>* some of the parts are RiCr ≥ 25Ω-F, please refer to table 2     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |

Table 2

| TC  | Product Range                |
|-----|------------------------------|
| X5R | 0603 (EIA 0201): C > 10 nF   |
|     | 1005 (EIA 0402): C > 0.1 uF  |
|     | 1608 (EIA 0603): C ≥ 1.0 uF  |
|     | 2012 (EIA 0805): C ≥ 2.2 uF  |
|     | 3216 (EIA 1206): C ≥ 10 uF   |
|     | 3225 (EIA 1210): C ≥ 22 uF   |
| Y5V | 1005 (EIA 0402): C > 0.47 uF |
|     | 1608 (EIA 0603): C > 1.0 uF  |
|     | 2012 (EIA 0805): C > 4.7 uF  |
|     | 3216 (EIA 1206): C > 10 uF   |
|     | 3225 (EIA 1210): C > 22 uF   |

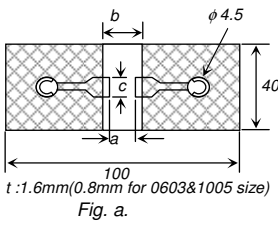
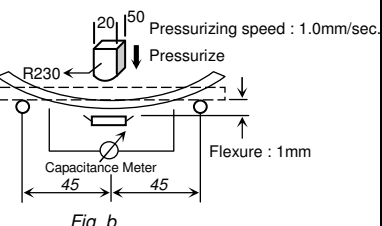
## ■ X5R/X7R DF (tan δ) Table

| Rated Voltage | Size              | Capacitance         | D.F Max. |       |
|---------------|-------------------|---------------------|----------|-------|
|               |                   |                     | X5R      | X7R   |
| 4V            | All               | All                 | 15.0%    |       |
| 6.3V          | All               | cap ≤1.0uF          | 10.0%    | 7.5%  |
|               | All               | 1.0uF < cap < 4.7uF | 10.0%    | 10.0% |
|               | All               | 4.7uF ≤ cap ≤ 100uF | 15.0%    | 15.0% |
| 10V           | 0603/3216/3225    | All                 | 7.5%     | 5.0%  |
|               | 0603              | 100nF ≤ cap         | 10.0%    |       |
|               |                   | cap ≤ 100nF         | 7.5%     | 5.0%  |
|               | 1005              | 100nF < cap < 330nF | 7.5%     |       |
|               |                   | 330nF ≤ cap         | 10.0%    |       |
|               |                   | cap ≤ 1.0uF         | 7.5%     | 5.0%  |
|               | 1608              | 1.0uF < cap < 2.2uF | 7.5%     |       |
|               |                   | 2.2uF ≤ cap         | 10.0%    |       |
|               |                   | cap < 2.2uF         | 7.5%     | 5.0%  |
|               | 2012              | 2.2uF ≤ cap         | 10.0%    |       |
| 3216          | 10uF              | 10.0%               | 10.0%    |       |
| 3225          | 10uF < cap ≤ 22uF | 10.0%               | 10.0%    |       |
| 16V           | 0603/3216/3225    | All                 | 5.0%     | 5.0%  |
|               | 1005              | cap ≤ 100nF         | 5.0%     | 5.0%  |
|               |                   | 100nF < cap ≤ 220nF | 7.5%     |       |
|               | 1608              | cap ≤ 470nF         | 5.0%     | 5.0%  |
|               |                   | 470nF < cap < 1.0uF | 7.5%     | 5.0%  |
|               |                   | 1.0uF ≤ cap         | 10.0%    | 10.0% |
|               | 2012              | cap ≤ 2.2uF         | 5.0%     | 5.0%  |
|               |                   | 2.2uF < cap ≤ 4.7uF | 7.5%     |       |
|               |                   | 4.7uF < cap ≤ 10uF  | 10.0%    |       |
|               | 3216              | 4.7uF < cap         | 10.0%    | 10.0% |
| 3225          | 10uF < cap ≤ 22uF | 15.0%               |          |       |
| 25V           | All               | All                 | 5.0%     | 3.5%  |
|               | 1608              | 1.0uF ≤ cap         | 10.0%    |       |
|               |                   | 470nF               |          | 10.0% |
|               | 3216              | 1.0uF < cap ≤ 4.7u  | 5.0%     | 5.0%  |
|               |                   | 4.7uF < cap         | 10.0%    |       |
| 3225          | 4.7uF < cap ≤ 10u | 10.0%               |          |       |
| ≥ 50V         | All               | All but below       | 2.5%     | 3.0%  |
|               | 3216/3225         | cap ≤ 1.0uF         | 3.5%     | 3.5%  |

## ■ Y5V DF (tan δ) Table

| T.C  | Rated Voltage | Size        | Capacitance | D.F Max |
|------|---------------|-------------|-------------|---------|
| Y5V  | 4V            | 0603        | ALL         | 16.0%   |
|      |               | 1005        | ALL         | 20.0%   |
|      | 6.3V          | 0603        | ALL         | 16.0%   |
|      |               |             | cap ≤ 220nF | 12.5%   |
|      |               | 1005        | 220nF < cap | 16.0%   |
|      |               |             | ALL         | 12.5%   |
|      | 1608          | ALL         | 16.0%       |         |
|      |               | 2012        | ALL         | 16.0%   |
|      | 10V           | 1005/1608   | ALL         | 12.5%   |
|      |               | 1005        | 220nF < cap | 16.0%   |
|      |               |             | cap < 10uF  | 12.5%   |
|      |               | 2012        | 10uF        | 20.0%   |
|      | 16V           | 1005        | cap ≤ 220nF | 9.0%    |
|      |               |             | 220nF < cap | 12.5%   |
|      |               |             | cap ≤ 100nF | 7.0%    |
|      |               |             | cap ≤ 220nF | 9.0%    |
|      |               | 1608        | 100nF < cap | 12.5%   |
|      |               |             | 220nF < cap | 9.0%    |
|      |               |             | cap < 2.2uF | 9.0%    |
|      |               |             | 2.2uF ≤ cap | 12.5%   |
|      | 25V/50V       | 1005        | cap ≤ 100nF | 9.0%    |
|      |               |             | cap < 100nF | 5.0%    |
|      |               |             | 100nF       | 7.0%    |
|      |               |             | 100nF < cap | 9.0%    |
| 1608 |               | cap < 330nF | 5.0%        |         |
|      |               | 330nF       | 7.0%        |         |
|      |               | 330nF < cap | 9.0%        |         |
|      |               | cap         | 9.0%        |         |

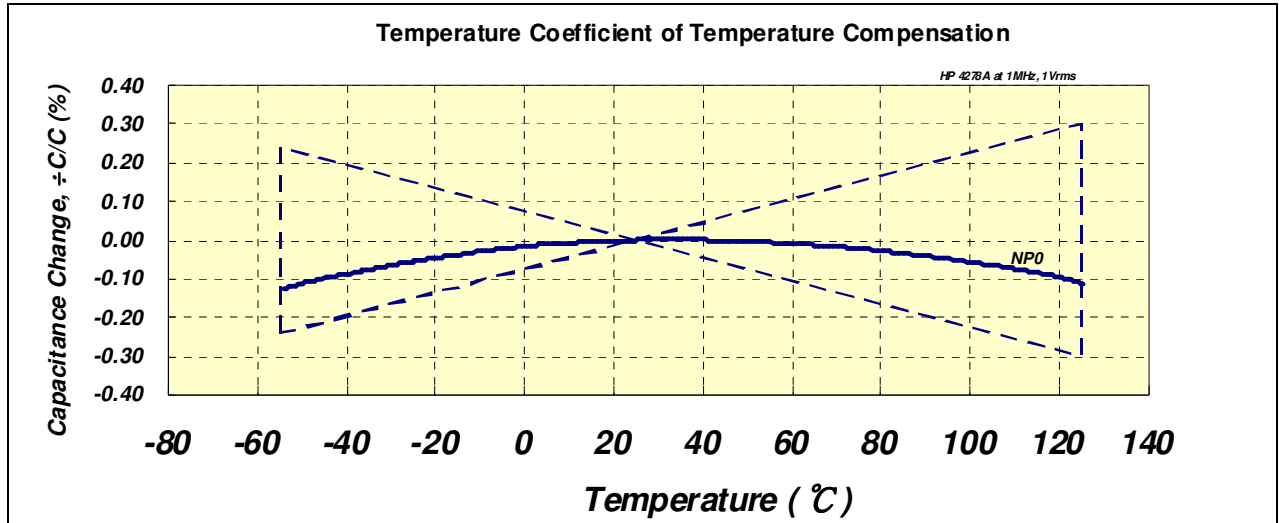
## NP0 High Frequency Type (Q Series)

| Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Specification                                                                                                                                                                            | Test Method                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------|-------------|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Operating Temperature Range</b><br>NP0: -55 to 125 degree C                                                                                                                           | ---                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Rated Voltage</b><br>16VDC, 25VDC, and 50VDC                                                                                                                                          | The rated voltage is defined as the maximum voltage, which may be applied continuously to the capacitor.                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Appearance</b><br>No defects or abnormalities.                                                                                                                                        | Visual inspection                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Dimensions</b><br>Within the specified dimension.                                                                                                                                     | Using calipers                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Dielectric Strength (Flash)</b><br>No defects or abnormalities.                                                                                                                       | No failure shall be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds. The charge and discharge current is less than 50mA.                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Insulation Resistance ( I.R.)</b><br>I.R. $\geq 10G\Omega$                                                                                                                            | The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25°C and 75%RH max, and within 1 minute of charging.                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Capacitance</b><br>Within the specified tolerance                                                                                                                                     | The capacitance / D.F. shall be measured at 25°C at the frequency and voltage shown in the tables.                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Quality Factor ( Q )</b><br>30pF min.: $Q \geq 1000$<br>30pF max.: $Q \geq 400+20C$<br>C: Nominal Capacitance (pF)                                                                    | <table border="1"> <tr> <td>Frequency</td> <td>1.0±0.2MHz</td> </tr> <tr> <td>Voltage</td> <td>1.0±0.2Vrms</td> </tr> </table>                                                                                                                                                                                                            | Frequency                                                                                                                                                                                                                                                                                                                                                                                   | 1.0±0.2MHz | Voltage | 1.0±0.2Vrms |      |     |     |     |      |     |     |     |      |     |     |     |
| Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0±0.2MHz                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1.0±0.2Vrms                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Capacitance Temperature Characteristics</b><br>Capacitance change within 0±30ppm/°C under operating temperature range.                                                                | The capacitance value at 25°C and 85°C shall be measured and calculated from the formula given below.<br>$T.C. = (C_{85} - C_{25}) / C_{25} * \Delta T * 10^6 (PPM/°C)$                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Termination Strength</b><br>No removal of the terminations or marking defect.                                                                                                         | Apply a parallel force of 5N to a PCB mounted sample for 10±1sec. *2N for 0603 (EIA 0201).                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Deflection (Bending Strength)</b><br>Appearance: No cracking or marking defects shall occur at 1mm deflection.<br>Capacitance change: within ±2.5% or ± 0.25pF. (whichever is larger) | Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.a. Using a SAC305(Sn96.5Ag3.0Cu0.5) solder.<br>Then apply a force in the direction shown in Fig.b.<br>The soldering shall be done with the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock. |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|  <table border="1" data-bbox="829 1108 1037 1220"> <thead> <tr> <th>Size</th> <th>a</th> <th>b</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>0603</td> <td>0.3</td> <td>0.9</td> <td>0.3</td> </tr> <tr> <td>1005</td> <td>0.4</td> <td>1.5</td> <td>0.5</td> </tr> <tr> <td>1608</td> <td>1.0</td> <td>3.0</td> <td>1.2</td> </tr> </tbody> </table>  |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                           | Size                                                                                                                                                                                                                                                                                                                                                                                        | a          | b       | C           | 0603 | 0.3 | 0.9 | 0.3 | 1005 | 0.4 | 1.5 | 0.5 | 1608 | 1.0 | 3.0 | 1.2 |
| Size                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | a                                                                                                                                                                                        | b                                                                                                                                                                                                                                                                                                                                         | C                                                                                                                                                                                                                                                                                                                                                                                           |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 0603                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.3                                                                                                                                                                                      | 0.9                                                                                                                                                                                                                                                                                                                                       | 0.3                                                                                                                                                                                                                                                                                                                                                                                         |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 1005                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.4                                                                                                                                                                                      | 1.5                                                                                                                                                                                                                                                                                                                                       | 0.5                                                                                                                                                                                                                                                                                                                                                                                         |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 1608                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1.0                                                                                                                                                                                      | 3.0                                                                                                                                                                                                                                                                                                                                       | 1.2                                                                                                                                                                                                                                                                                                                                                                                         |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Solderability of Termination</b>                                                                                                                                                      | 90% of the terminations are to be soldered evenly and continuously.                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Resistance to Soldering Heat</b>                                                                                                                                                      | <b>Appearance</b><br>No marking defects                                                                                                                                                                                                                                                                                                   | Immerse the capacitor into a methanol solution containing rosin for 3 to 5 seconds, preheat it 150 to 180°C for 2 to 3 minutes and immerse it into SAC305(Sn96.5Ag3.0Cu0.5) solder of 245 ± 5°C for 3±1seconds.                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>Cap. Change</b><br>NP0 within ±2.5% or ±0.25pF ( whichever is larger )                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>Q</b><br>Initial spec.                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>I.R.</b><br>Initial spec.                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Temperature cycle (Thermal shock)</b>                                                                                                                                                 | <b>Appearance</b><br>No marking defects                                                                                                                                                                                                                                                                                                   | Solder the capacitor to supporting jig (glass epoxy board) and perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2hrs at room temperature, then measure.<br>Step 1: Minimum operating temperature 30±3min<br>Step 2: Room temperature 2~3 min<br>Step 3: Maximum operating temperature 30±3min<br>Step 4: Room temperature 2~3min |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>Cap. Change</b><br>NP0 within ±2.5% or 0.25pF ( whichever is larger )                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>Q</b><br>Initial spec.                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>I.R.</b><br>Initial spec.                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Humidity load</b>                                                                                                                                                                     | <b>Appearance</b><br>No marking defects                                                                                                                                                                                                                                                                                                   | Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure.<br>The charge / discharge current is less than 50mA.                                                                                                                                                                                        |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>Cap. Change</b><br>NP0 within ±5% or ±0.5pF ( whichever is larger )                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>Q</b><br>200 min.                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>I.R.</b><br>I.R. $\geq 500M\Omega$                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>High temperature load life test</b>                                                                                                                                                   | <b>Appearance</b><br>No marking defects                                                                                                                                                                                                                                                                                                   | Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ± 3°C. Let sit for 24± 2 hours at room temperature, then measure.<br>The charge/discharge current is less than 50mA.                                                                                                                                                                                 |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>Cap. Change</b><br>NP0 within ±5% or ±0.5pF ( whichever is larger )                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>Q</b><br>350 min.                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>I.R.</b><br>I.R. $\geq 1G\Omega$                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
| 17                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>RF Characteristics</b>                                                                                                                                                                | <b>Q</b><br>See RF Characteristics of NP0 Q series P:19~21                                                                                                                                                                                                                                                                                | Measurements performed on a HP4287A with fixture 16196 and represent the typical capacitor performance.                                                                                                                                                                                                                                                                                     |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                          | <b>ESR</b>                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                             |            |         |             |      |     |     |     |      |     |     |     |      |     |     |     |

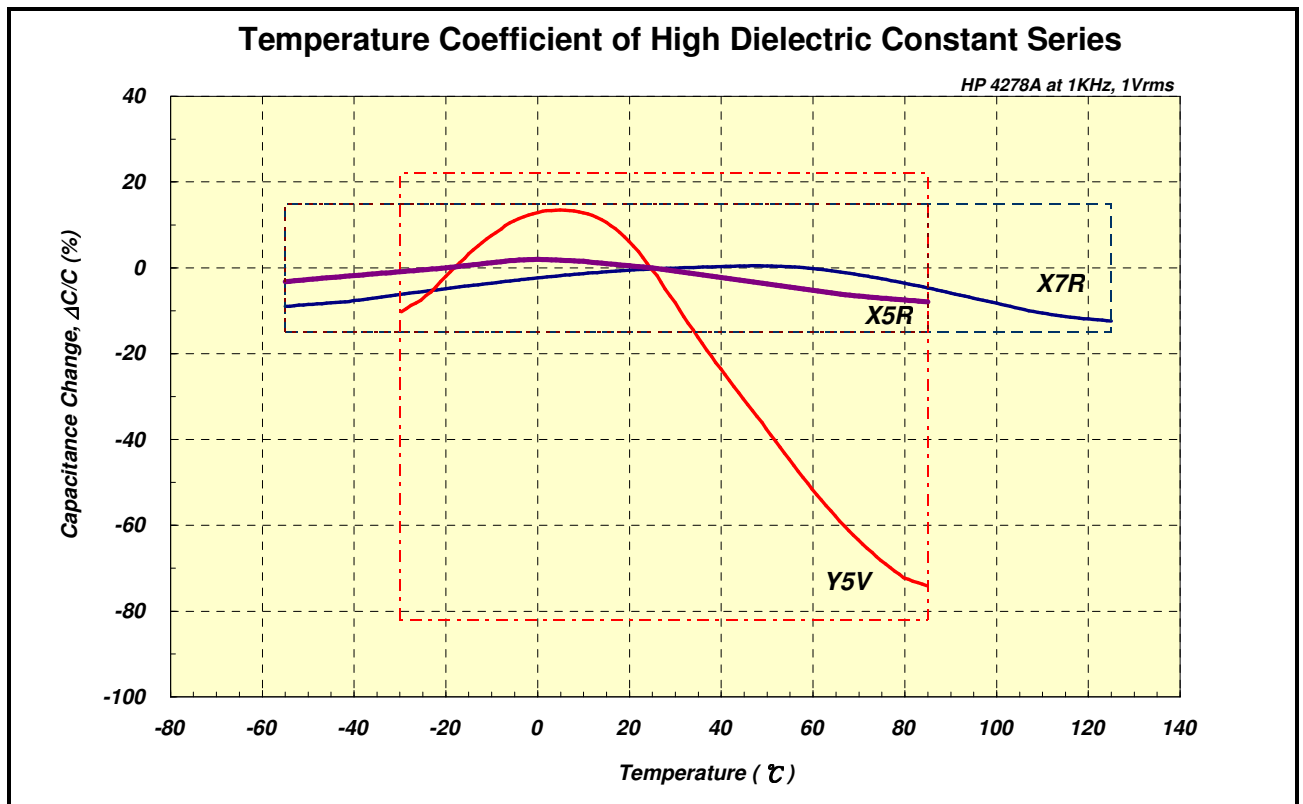


## TEMPERATURE COEFFICIENT

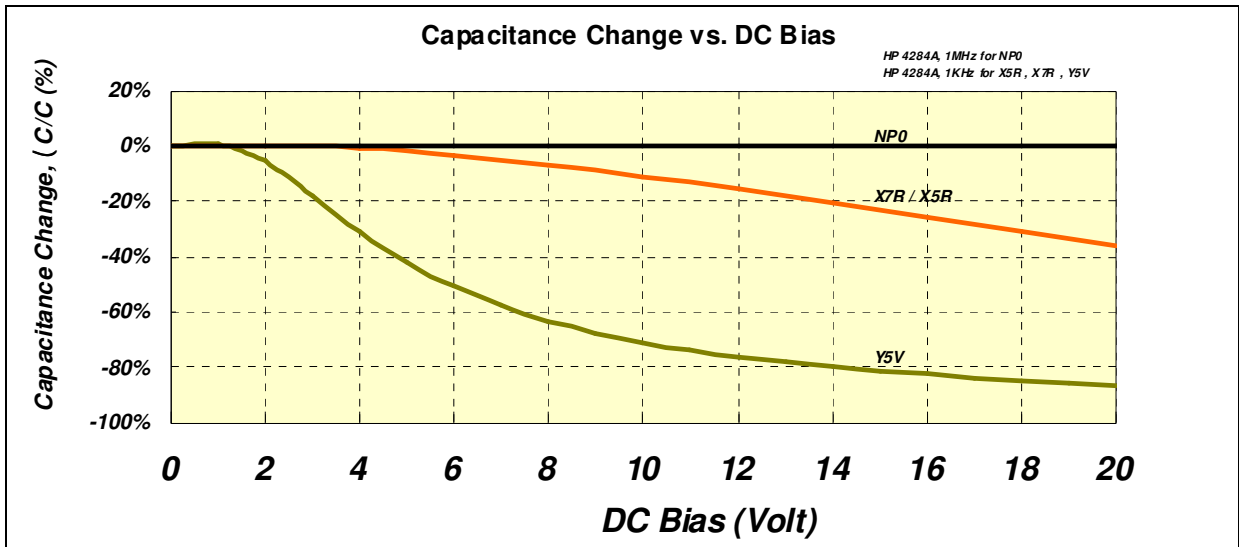
- Class 1 (Temperature Compensation series)



- Class 2 (High Dielectric Constant Series)

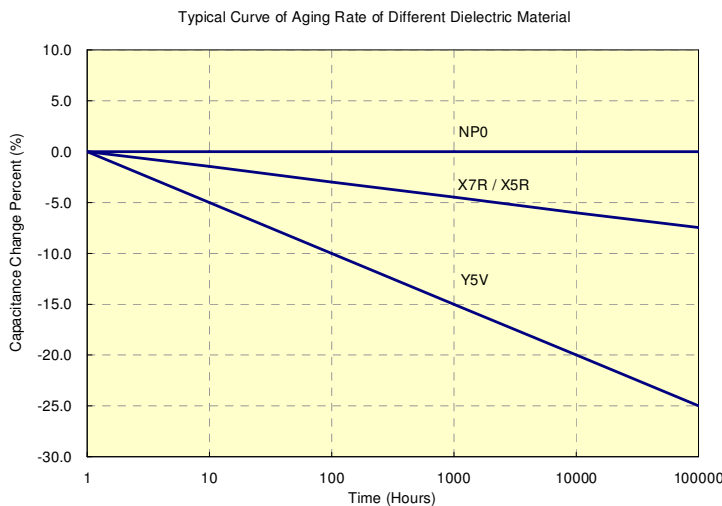


**DC VOLTAGE COEFFICIENT**



**AGING RATE**

The capacitance and dissipation factor of class 2 capacitors decreases with time. It is known as ‘aging’ that follows a logarithmic law and expressed in terms of an aging constant. Aging is caused by a gradual re-alignment of the crystalline structure of the ceramic. The aging constant is defined as the percentage loss of capacitance at a ‘time decade’. The law of capacitance aging is expressed as following equation:



$$C_{t2} = C_{t1} \times (1 - k \times \log_{10}(t_2/t_1))$$

$C_{t1}$ : Capacitance after  $t_1$  hours of start aging.

$C_{t2}$ : Capacitance after  $t_2$  hours of start aging.

$k$ : aging constant (capacitance decrease per decade)

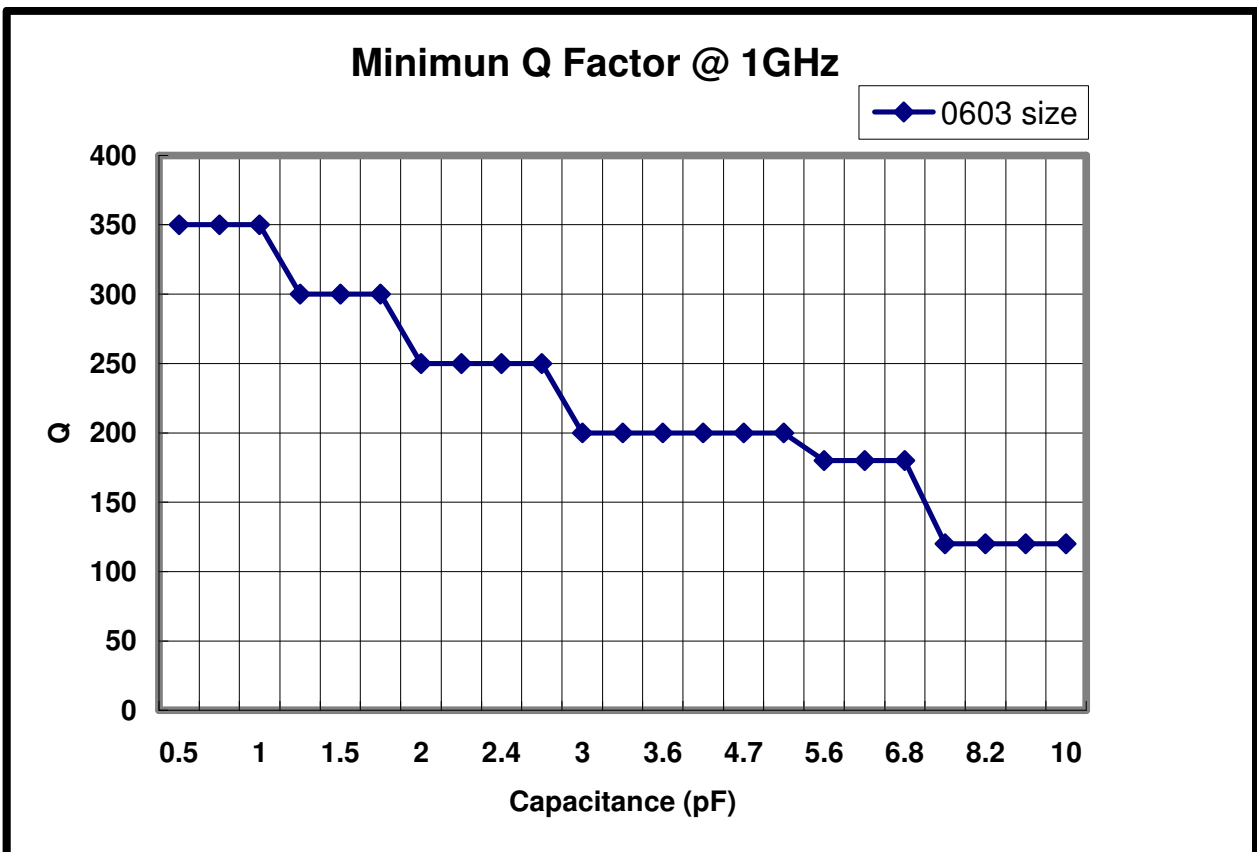
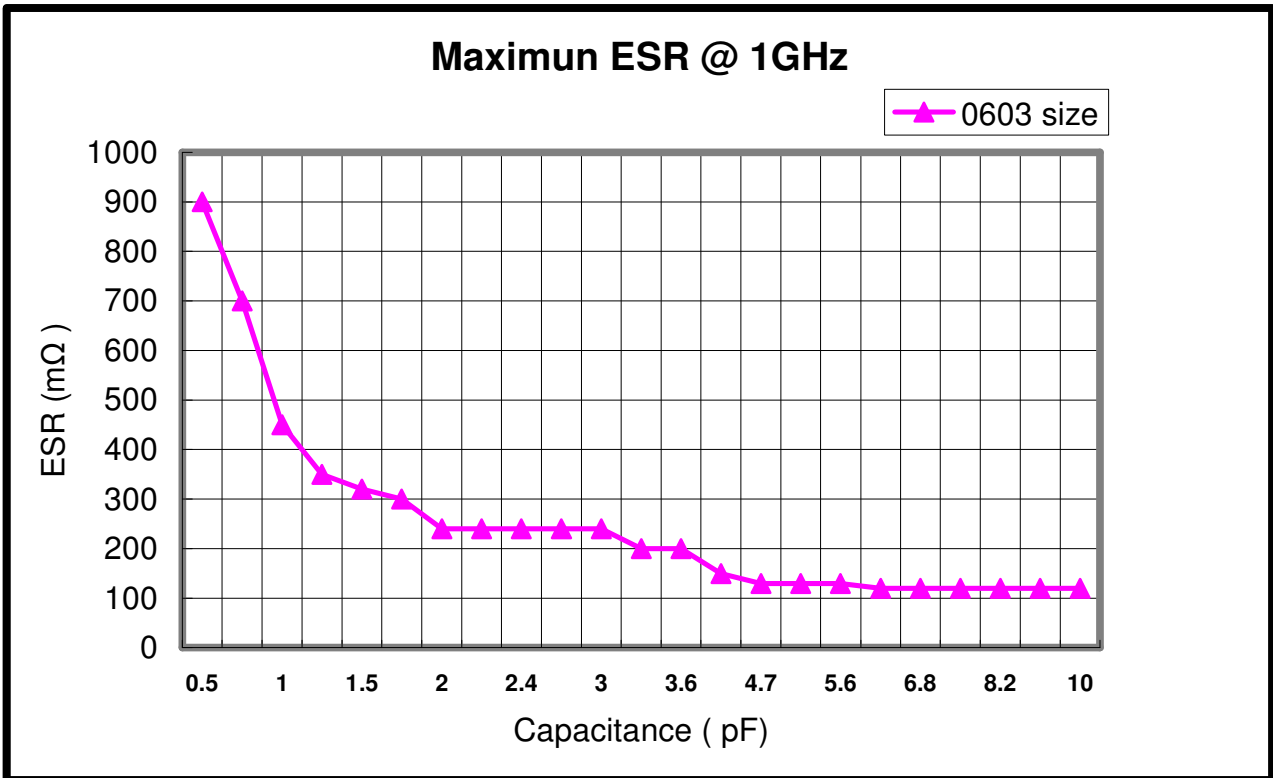
$t_1, t_2$ : time in hours from start of aging.

A typical curve of aging rate is shown in following figure.

When heating the capacitors above Curie temperature ( $130^{\circ}\text{C} \sim 150^{\circ}\text{C}$ ) the capacitance can be re-new. So capacitance of class 2 capacitors will be complete de-aged by soldering process; subsequently a new aging process begins.

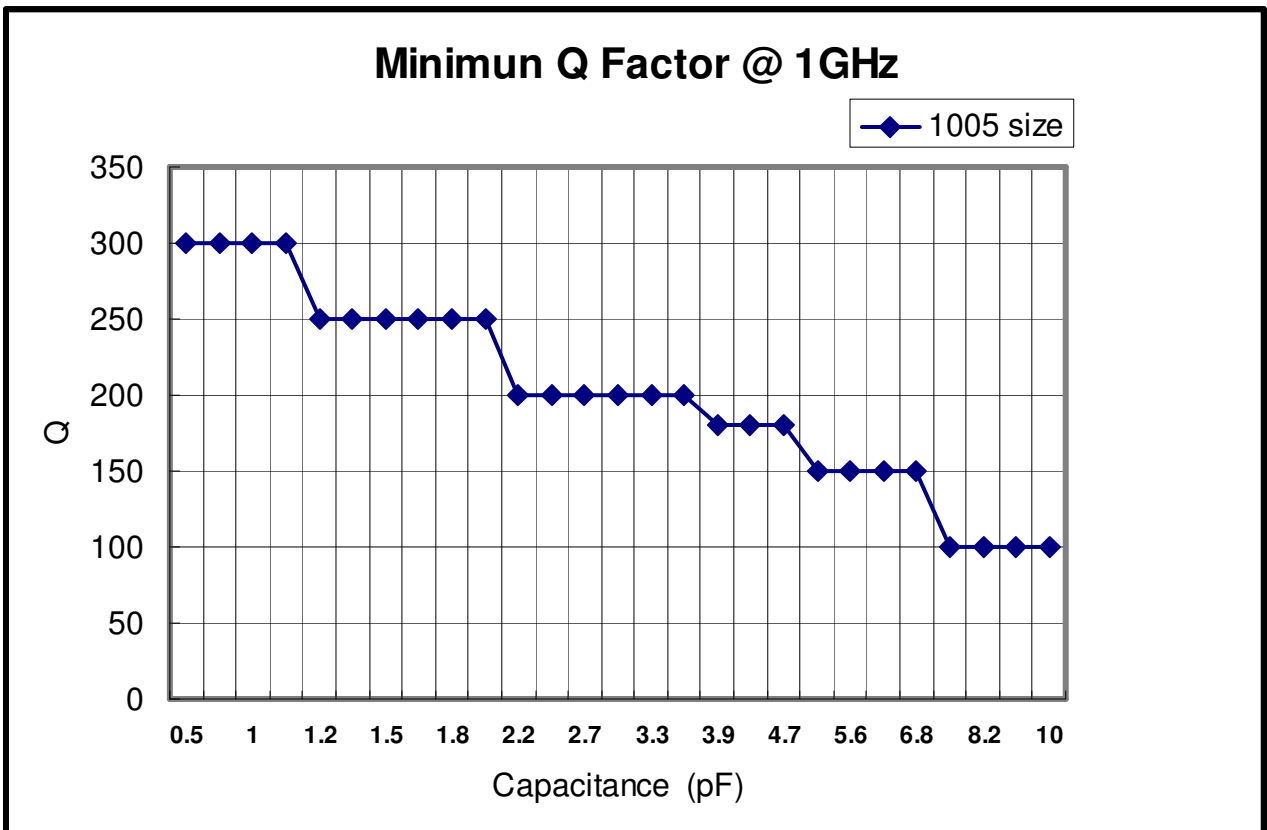
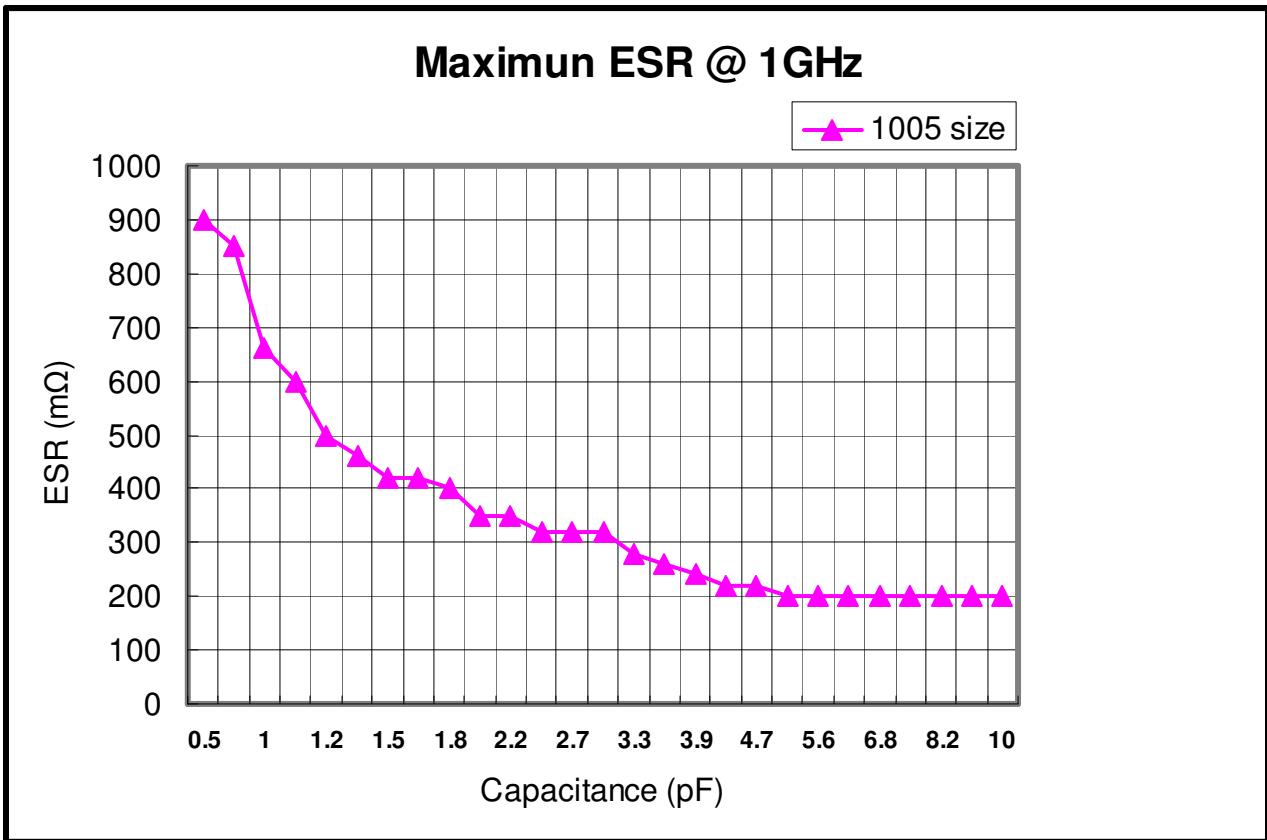
Because of aging, it is specified an age for measurement to meet the prescribed tolerance for class 2 capacitors. Normally, 1000 hours ( $t_2=1000$  hrs) is defined.

- Typical RF Characteristics for High Frequency NPO (C0G) 0603 (EIA 0201) at 1GHz.



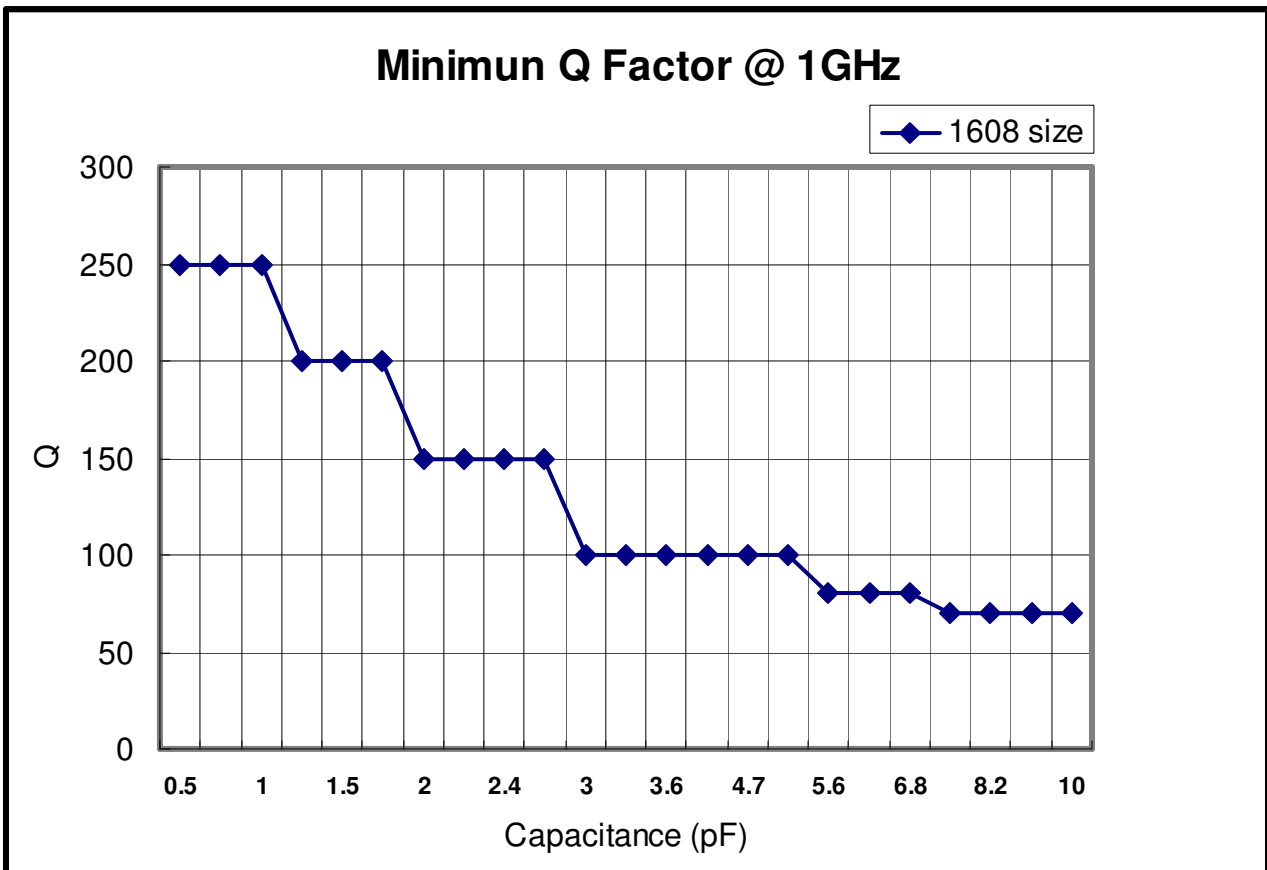
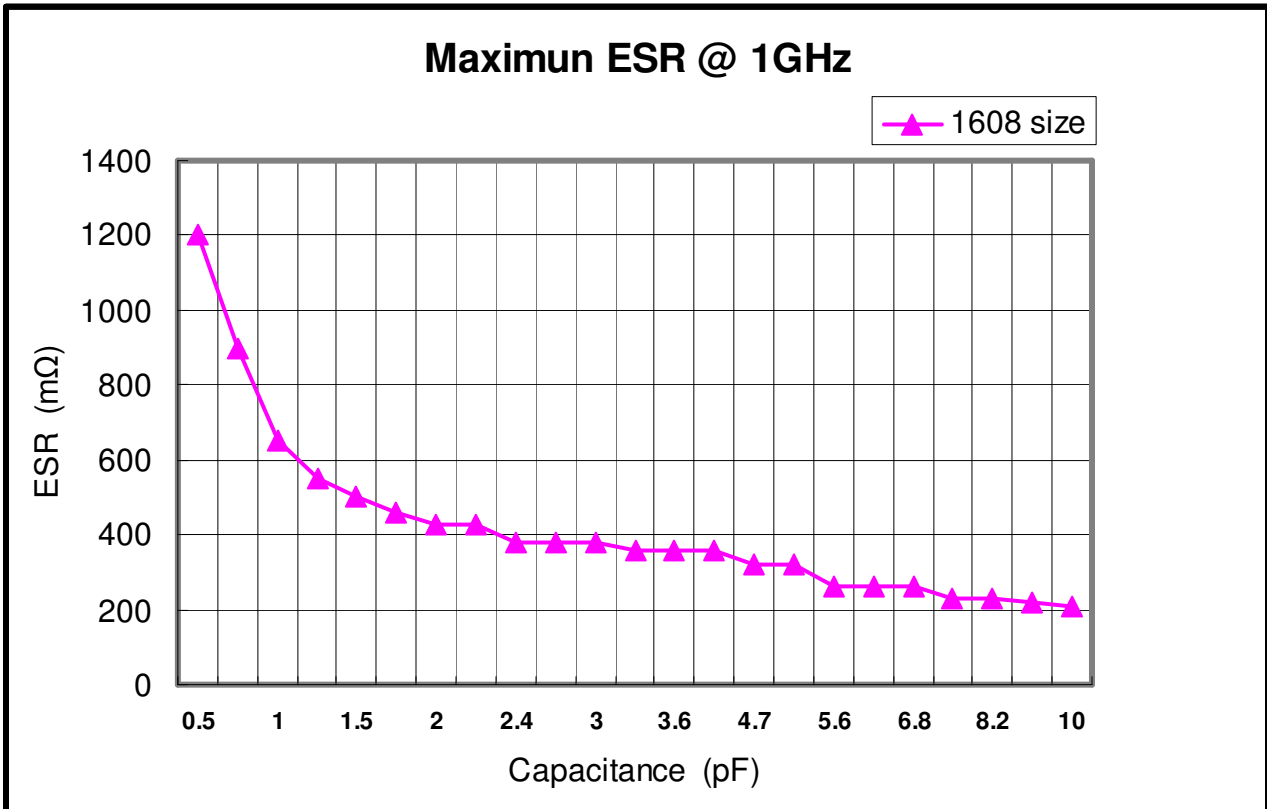
Measurements performed on a HP4287A with fixture 16196C and represent the typical capacitor performance.

■ Typical RF Characteristics for High Frequency NP0 (C0G) 1005 (EIA 0402) at 1GHz.



Measurements performed on a HP4287A with fixture 16196B and represent the typical capacitor performance.

- Typical RF Characteristics for High Frequency NP0 (COG) 1608 (EIA 0603) at 1GHz.



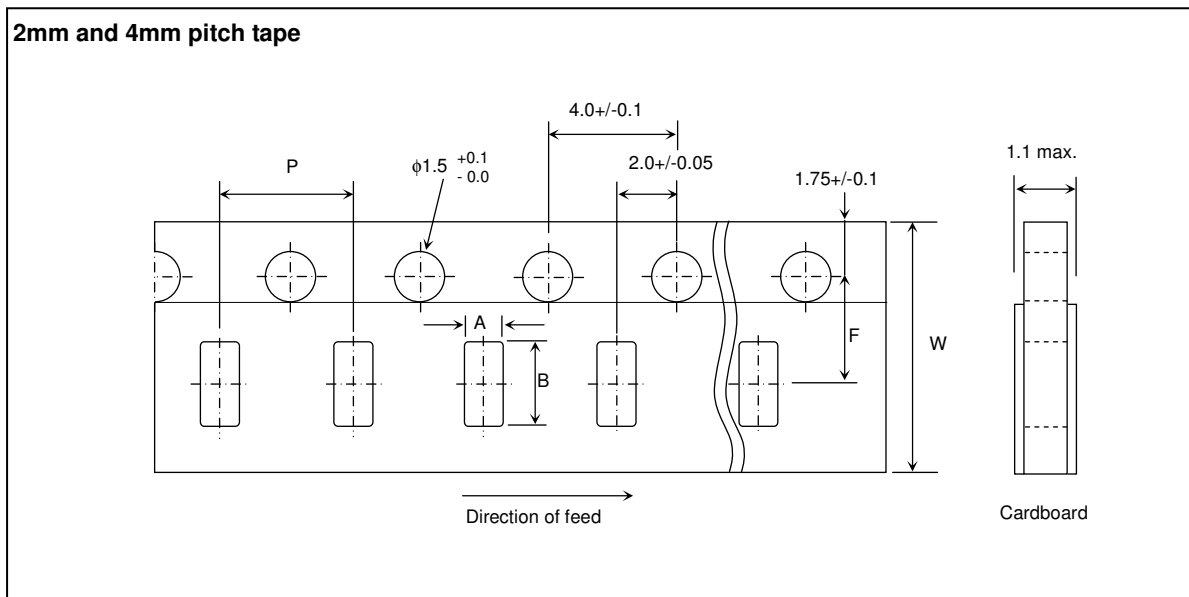
Measurements performed on a HP4287A with fixture 16196A and represent the typical capacitor performance.

## ■ Packing

### ● Tape and reel packaging

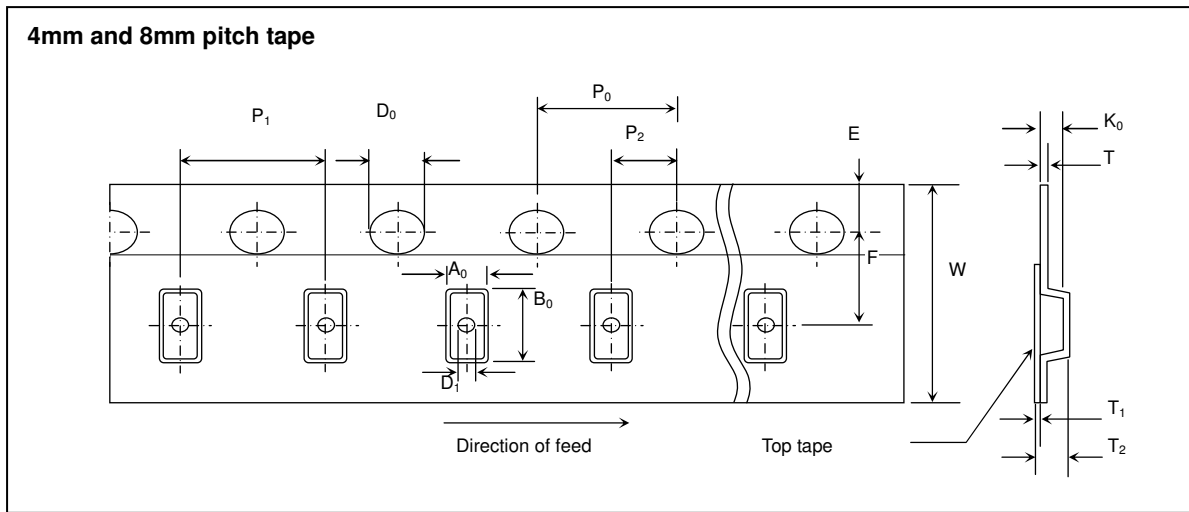
Tape and reel packaging is currently the most promising system for high-speed production. A typical 180mm (7 inch) diameter reel contains 1,500 to 15,000 capacitors, 250mm (10 inch) contains 10,000 capacitors, and 330mm(13 inch) contains 10,000 to 50,000 capacitors. Three standard sizes are available in taped and reeled package either with paper carrier tapes or embossed tapes.

### ● Paper tape specifications



| SYMBOL | PRODUCT SIZE CODE |          |            |          |            |          |            |          |            |          | UNIT |
|--------|-------------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|------|
|        | 0603(0201)        |          | 1005(0402) |          | 1608(0603) |          | 2012(0805) |          | 3216(1206) |          |      |
|        | SIZE              | TOL.     | SIZE       | TOL.     | SIZE       | TOL.     | SIZE       | TOL.     | SIZE       | TOL.     |      |
| A      | 0.38              | +/- 0.04 | 0.60       | +/- 0.04 | 1.0        | +/- 0.2  | 1.5        | +/- 0.2  | 1.9        | +/- 0.2  | mm   |
| B      | 0.68              | +/- 0.04 | 1.12       | +/- 0.04 | 1.8        | +/- 0.2  | 2.3        | +/- 0.2  | 3.6        | +/- 0.2  | mm   |
| F      | 3.50              | +/- 0.05 | 3.50       | +/- 0.05 | 3.5        | +/- 0.05 | 3.5        | +/- 0.05 | 3.5        | +/- 0.05 | mm   |
| P      | 2.00              | +/- 0.10 | 2.00       | +/- 0.10 | 4.0        | +/- 0.1  | 4.0        | +/- 0.1  | 4.0        | +/- 0.1  | mm   |
| W      | 8.00              | +/- 0.20 | 8.00       | +/- 0.20 | 8.0        | +/- 0.2  | 8.0        | +/- 0.2  | 8.0        | +/- 0.2  | mm   |

- Embossed tape specifications



$k_0$ : so chosen that the orientation of the component cannot change.

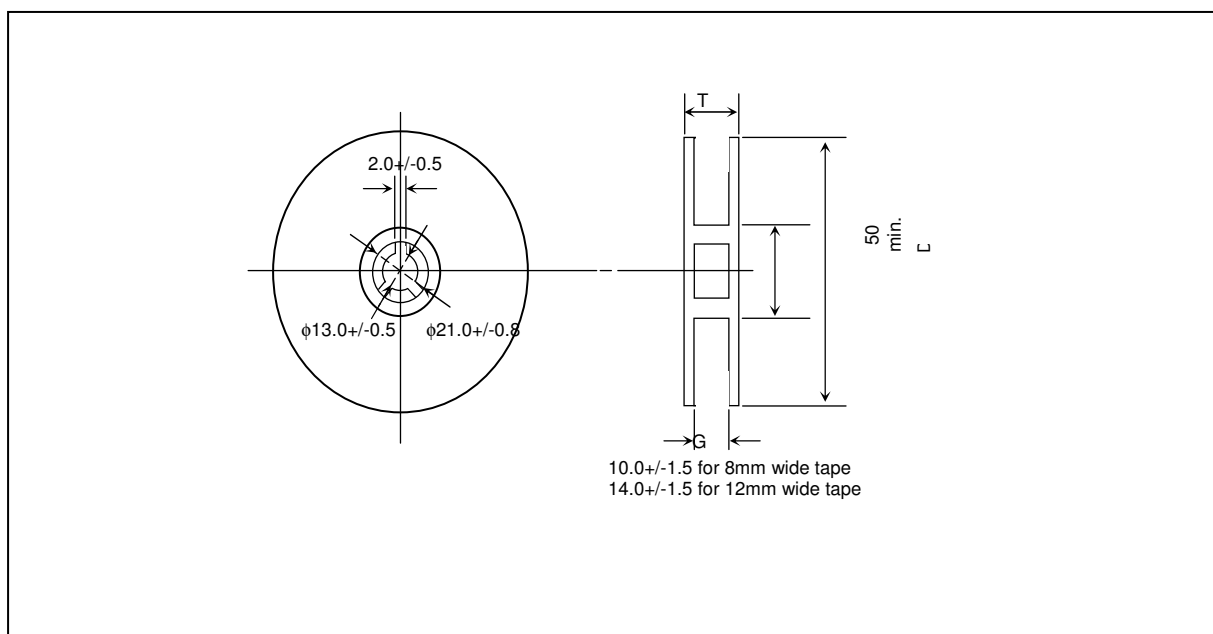
For  $W = 8\text{mm}$ :  $T_2 = 2.5\text{mm max.}$

For  $W = 12\text{mm}$ :  $T_2 = 4.5\text{mm}$

| DIMENSION<br>(mm)        | PRODUCT SIZE CODE |             |             |             |             | TOLERANCE<br>(mm) |
|--------------------------|-------------------|-------------|-------------|-------------|-------------|-------------------|
|                          | 4 mm tape         |             |             | 8 mm tape   |             |                   |
|                          | 2012 (0805)       | 3216 (1206) | 3225 (1210) | 4520 (1808) | 4532 (1812) |                   |
| $P_1$                    | 4                 | 4           | 4           | 8           | 8           | +/- 0.10          |
| $P_0$                    | 4                 | 4           | 4           | 4           | 4           | +/- 0.10          |
| $P_2$                    | 2                 | 2           | 2           | 2           | 2           | +/- 0.05          |
| $A_0$ nominal clearance* | 0.2               | 0.3         | 0.3         | 0.4         | 0.4         | -                 |
| $B_0$ nominal clearance* | 0.2               | 0.3         | 0.3         | 0.4         | 0.4         | -                 |
| $K_0$ minimum clearance* | 0.05              | 0.05        | 0.05        | 0.05        | 0.05        | -                 |
| $W$                      | 8.0               | 8.0         | 8.0         | 12.0        | 12.0        | +/- 0.20          |
| $E$                      | 1.75              | 1.75        | 1.75        | 1.75        | 1.75        | +/- 0.10          |
| $F$                      | 3.5               | 3.5         | 3.5         | 5.5         | 5.5         | +/- 0.05          |
| $D_0$                    | 1.5               | 1.5         | 1.5         | 1.5         | 1.5         | +0.1/-0.0         |
| $D_1$                    | 1 min             | 1 min       | 1 min       | 1.5 min     | 1.5 min     | +0.1/-0.0         |
| $T$                      | 0.25              | 0.25        | 0.25        | 0.25        | 0.25        | +/- 0.10          |
| $T_1$                    | 0.05              | 0.05        | 0.05        | 0.05        | 0.05        | +/- 0.01          |
| $T_2$                    | 2.5 max.          | 2.5 max.    | 2.5 max.    | 4.5         | 4.5         | -                 |

\* Typical capacitors displace in pocket.

- Reel specifications



| TAPE WIDTH (mm) | G (mm)       | T max. (mm) | D (mm) |
|-----------------|--------------|-------------|--------|
| 8               | 10.0 +/- 1.5 | 14.5        | 180    |
| 8               | 10.0 +/- 1.5 | 14.5        | 250    |
| 8               | 10.0 +/- 1.5 | 14.5        | 330    |
| 12              | 14.0 +/- 1.5 | 18.5        | 180    |



■ Thickness and Packing Amount

| Thickness |                  |             | Amount per reel |           |              |          |              |          |
|-----------|------------------|-------------|-----------------|-----------|--------------|----------|--------------|----------|
|           |                  |             | 180 mm (7")     |           | 250 mm (10") |          | 330 mm (13") |          |
| Code      | Spec             | Size(EIA)   | Paper           | Embossed  | Paper        | Embossed | Paper        | Embossed |
| A         | 0.30+/-0.03      | 0603 (0201) | 15K             |           |              |          |              |          |
| B         | 0.50+/-0.05      | 1005 (0402) | 10K             |           |              |          | 50K          |          |
| <u>B</u>  | 0.50+/-0.15      | 1005 (0402) | 10K             |           |              |          | 50K          |          |
| Q         | 0.45+/-0.05      | 1005 (0402) | 10K             |           |              |          | 50K          |          |
| C         | 0.60+/-0.15      | 2012 (0805) | 4K              |           | 10K          |          | 15K          |          |
|           |                  | 3216(1206)  | 4K              |           | 10K          |          | 15K          |          |
| Q         | 0.45+/-0.05      | 1608(0603)  | 4K              |           | 10K          |          | 15K          |          |
| D         | 0.80+/-0.10      | 1608(0603)  | 4K              |           | 10K          |          | 15K          |          |
| <u>D</u>  | 0.80+0.15/ -0.10 | 1608 (0603) | 4K              |           | 10K          |          | 15K          |          |
| E         | 0.85+/-0.15      | 2012 (0805) | 4K              |           | 10K          |          | 15K          |          |
|           |                  | 3216 (1206) | 4K              |           | 10K          |          | 15K          |          |
|           |                  | 3225 (1210) |                 | 3K        |              |          |              | 10K      |
|           |                  | 4532 (1812) |                 | 1K        |              |          |              |          |
| I         | 0.95+/-0.15      | 2012(0805)  |                 | 3K        |              |          |              |          |
|           |                  | 3216(1206)  |                 | 3K        |              |          |              |          |
| F         | 1.15+/-0.20      | 3216 (1206) |                 | 3K        |              |          |              | 10K      |
|           |                  | 4520 (1808) |                 | 3K        |              |          |              |          |
| G         | 1.25 +/-0.20     | 2012 (0805) |                 | 2K/3K     |              |          |              | 10K      |
|           |                  | 3216 (1206) |                 | 3K        |              |          |              | 10K      |
|           |                  | 3225 (1210) |                 | 3K        |              |          |              |          |
|           |                  | 4520(1808)  |                 | 3K        |              |          |              |          |
|           |                  | 4532(1812)  |                 | 1K        |              |          |              |          |
| <u>G</u>  | 1.25+0.3/-0.2    | 2012(0805)  |                 | 2K/3K     |              |          |              | 10K      |
|           |                  | 3216(1206)  |                 | 3K        |              |          |              | 10K      |
|           |                  | 3225(1210)  |                 | 3K        |              |          |              |          |
| L         | 1.60+/-0.20      | 3216(1206)  |                 | 2K        |              |          |              |          |
|           |                  | 3225(1210)  |                 | 2K        |              |          |              |          |
|           |                  | 4520(1808)  |                 | 2K        |              |          |              |          |
|           |                  | 4532(1812)  |                 | 1K        |              |          |              |          |
|           |                  |             |                 |           |              |          |              |          |
| <u>L</u>  | 1.60+0.30/-0.20  | 3216(1206)  |                 | 2K        |              |          |              |          |
|           |                  | 3225(1210)  |                 | 2K        |              |          |              |          |
|           |                  | 4520(1808)  |                 | 2K        |              |          |              |          |
|           |                  | 45321812)   |                 | 1K        |              |          |              |          |
| N         | 2.00+/-0.20      | 3216 (1206) |                 | 2K/3K     |              |          |              |          |
|           |                  | 3225 (1210) |                 | 2K        |              |          |              |          |
|           |                  | 4520 (1808) |                 | 1K        |              |          |              |          |
|           |                  | 4532(1812)  |                 | 1K        |              |          |              |          |
| <u>N</u>  | 2.00+/-0.30      | 3225 (1210) |                 | 2K        |              |          |              |          |
| P         | 2.50+/-0.20      | 3225(1210)  |                 | 500pcs/1K |              |          |              |          |
| <u>P</u>  | 2.50+/-0.30      | 3225(1210)  |                 | 500pcs/1K |              |          |              |          |

## Storage

1. The chip capacitors shall be packaged in carrier tapes or bulk cases.
2. Keep storage place temperatures from +5°C to +35°C, humidity from 45 to 70% RH.
3. The storage atmosphere must be free of gas containing sulfur and chlorine. Also, avoid exposing the product to saline moisture. If the product is exposed to such atmospheres, the terminations will oxidize and solderability will be affected.
4. The solderability is assured for 12 months from our final inspection date if the above storage condition is followed.

## Circuit Design

1. Once application and assembly environments have been checked, the capacitor may be used in conformance with the rating and performance, which are provided in both the catalog and the specifications. Exceeding the specifications listed may result in inferior performance. It may also cause a short, open, smoking, or flaming to occur, etc.
2. Please use the capacitors in conformance with the operating temperature provided in both the catalog and the specifications. Be especially cautious not to exceed the maximum temperature. In the situation the maximum temperature set forth in both the catalog and specifications is exceeded, the capacitor's insulation resistance may deteriorate, power may suddenly surge and short-circuit may occur. The loss of capacitance will occur, and may self-heat due to equivalent series resistance when alternating electric current is passed through. As this effect becomes critical in high frequency circuits, please exercise with caution. When using the capacitor in a (self-heating) circuit, please make sure the surface of the capacitor remains under the maximum temperature for usage. Also, please make certain temperature rise remain below 20°C.
3. Please keep voltage under the rated voltage, which is applied to the capacitor. Also, please make certain the peak voltage remains below the rated voltage when AC voltage is super-imposed to the DC voltage. In the situation where AC or pulse voltage is employed, ensure average peak voltage does not exceed the rated voltage. Exceeding the rated voltage provided in both catalog and specifications may lead to defective withstanding voltage or, in worse case situations, may cause the capacitor to burn out.
4. It's is a common phenomenon of high-dielectric products to have a deteriorated amount of static electricity due to the application of DC voltage.

### Handling

Chip capacitors should be handled with care to avoid contamination or damage. The use of vacuum pick-up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

### Flux

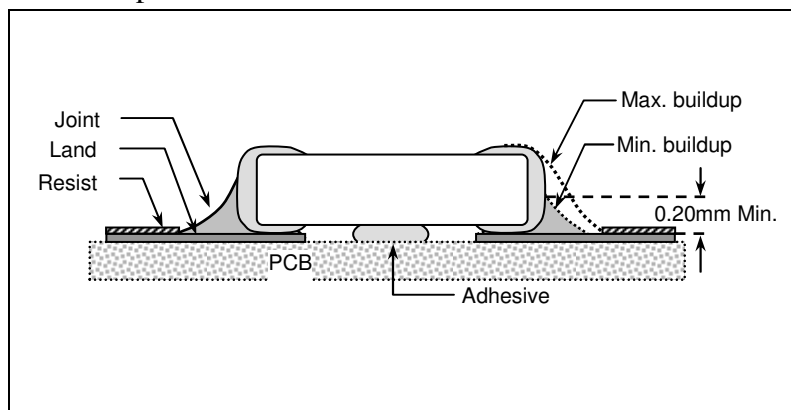
1. An excessive amount of flux or too rapid temperature rise can causes solvent burst, solder can generate a large quantity of gas. The gas can spreads small solder particles to cause solder balling effect or bridging problem.
2. Flux containing too high of a percentage of halide may cause corrosion of termination unless sufficient cleaning is applied.
3. Use rosin-type flux. Highly acidic flux (halide content less than 0.2wt%) is not recommended.
4. The water soluble flux causes deteriorated insulation resistance between outer terminations unless sufficiently cleaned.

### Component Spacing

For wave soldering components, the spacing must be sufficient far apart to prevent bridging or shadowing. This is not so important for reflow process but enough space for rework should be considered. The suggested spacing for reflow soldering and wave soldering is 0.5mm and 1.0mm, respectively.

### Solder Fillet

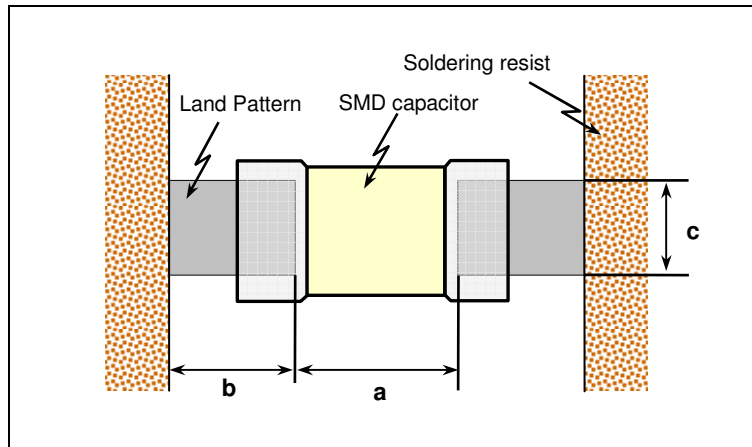
Too much solder amount may increase solder stress and cause crack risk. Insufficient solder amount may reduce adhesive strength and cause parts falling off PCB. When soldering, confirm that the solder is placed over 0.2mm of the surface of the terminations.



## Recommended Land Pattern Dimensions

When mounting the capacitor to substrate, it's important to consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1. The greater the amount of solder, the greater the stress to the elements, as this may cause the substrate to break or crack.
2. In the situation where two or more devices are mounted onto a common land, separate the device into exclusive pads by using soldering resist.
3. Land width equal to or less than component. It is permissible to reduce land width to 80% of component width.



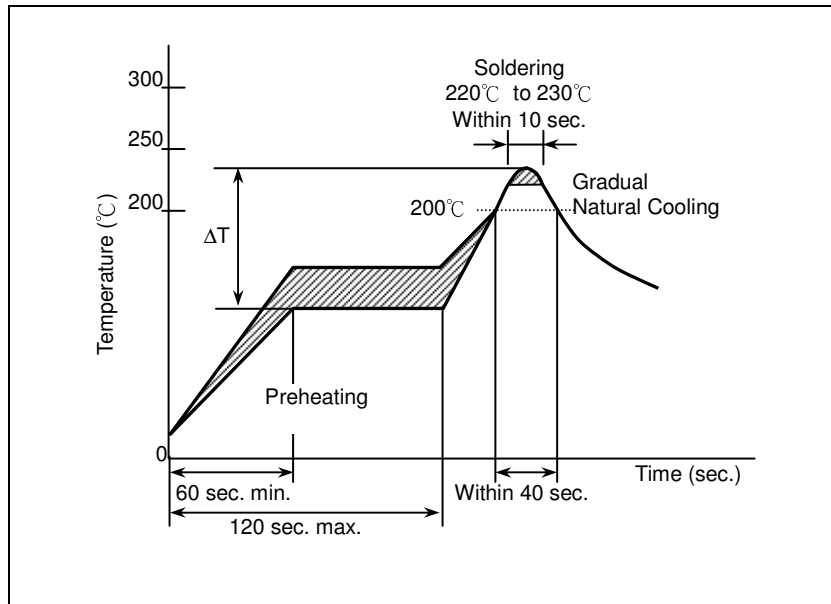
| Size mm (EIA) | L x W (mm) | a (mm)       | b (mm)       | c (mm)      |
|---------------|------------|--------------|--------------|-------------|
| 0603 (0201)   | 0.6*0.3    | 0.15 to 0.35 | 0.2 to 0.3   | 0.25 to 0.3 |
| 1005 (0402)   | 1.0*0.5    | 0.3 to 0.5   | 0.35 to 0.45 | 0.4 to 0.5  |
| 1608 (0603)   | 1.6*0.8    | 0.7 to 1.0   | 0.6 to 0.8   | 0.7 to 0.8  |
| 2012 (0805)   | 2.0*1.25   | 1.0 to 1.3   | 0.7 to 0.9   | 1.0 to 1.2  |
| 3216 (1206)   | 3.2*1.6    | 2.1 to 2.5   | 1.0 to 1.2   | 1.3 to 1.6  |
| 3225 (1210)   | 3.2*2.5    | 2.1 to 2.5   | 1.0 to 1.2   | 2.0 to 2.5  |
| 4520 (1808)   | 4.5*2.0    | 3.2 to 3.8   | 1.2 to 1.4   | 1.7 to 2.0  |
| 4532 (1812)   | 4.5*3.2    | 3.2 to 3.8   | 1.2 to 1.4   | 2.7 to 3.2  |

### Resin Mold

If a large amount of resin is used for molding the chip, cracks may occur due to contraction stress during curing. To avoid such cracks, use a low shrinkage resin. The insulation resistance of the chip will degrade due to moisture absorption. Use a low moisture absorption resin. Check carefully that the resin does not generate a decomposition gas or reaction gas during the curing process or during normal storage. Such gases may crack the chip capacitor or damage the device itself.

### Soldering Profile for SMT Process with SnPb Solder Paste

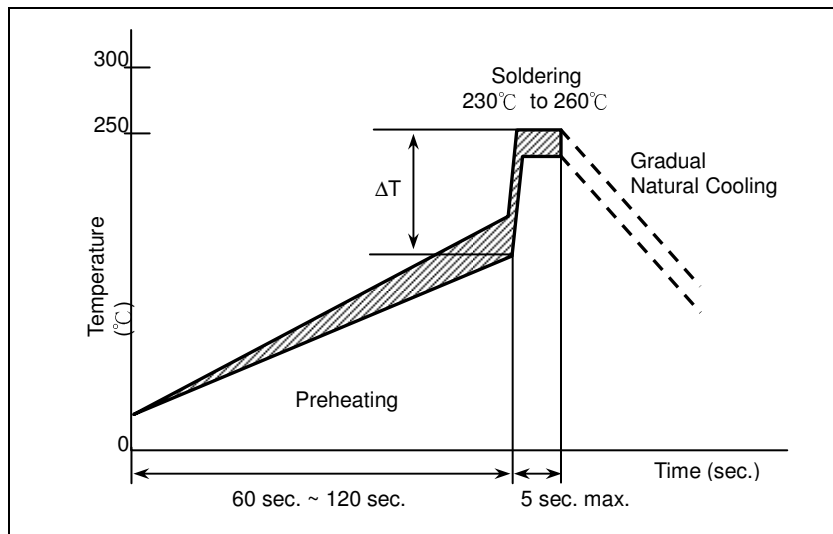
- Reflow Soldering



The difference between solder and chip surface should be controlled as following table. The rate of preheat should not exceed 4°C/sec and a target of 2°C/sec is preferred.

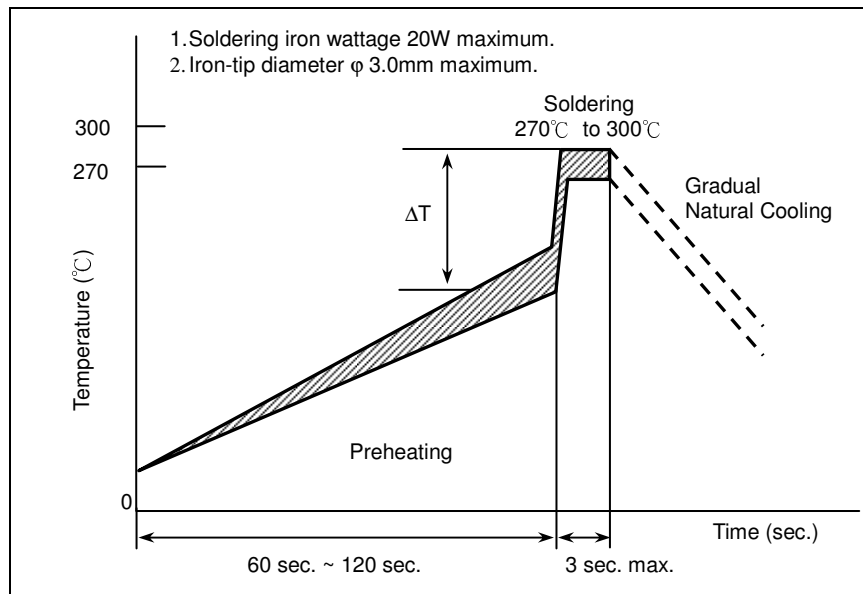
| Chip Size  | 3216 and smaller                  | 3225 and above                    |
|------------|-----------------------------------|-----------------------------------|
| Preheating | $\Delta T \leq 150^\circ\text{C}$ | $\Delta T \leq 130^\circ\text{C}$ |

- Wave Soldering



| Chip Size  | 3216 and smaller                  | 3225 and above |
|------------|-----------------------------------|----------------|
| Preheating | $\Delta T \leq 150^\circ\text{C}$ | -              |

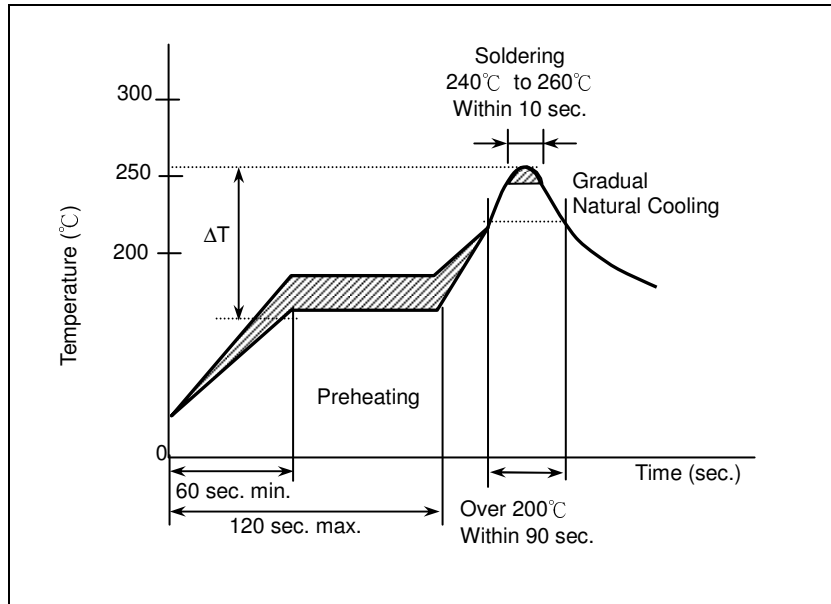
- Soldering Iron



| Chip Size  | 3216 and smaller                  | 3225 and above                    |
|------------|-----------------------------------|-----------------------------------|
| Preheating | $\Delta T \leq 190^\circ\text{C}$ | $\Delta T \leq 130^\circ\text{C}$ |

## Soldering

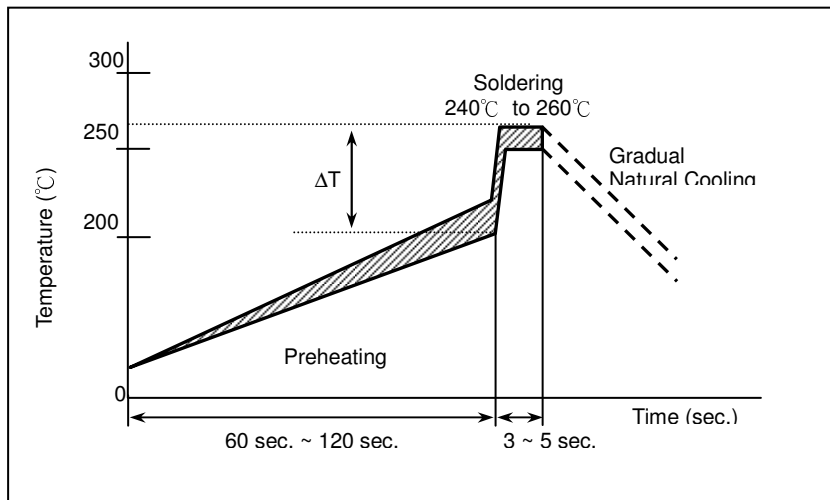
- Reflow Soldering for Lead free Termination



The difference between solder and chip surface should be controlled as following table. The rate of preheat should not exceed 4°C/sec and a target of 2°C/sec is preferred.

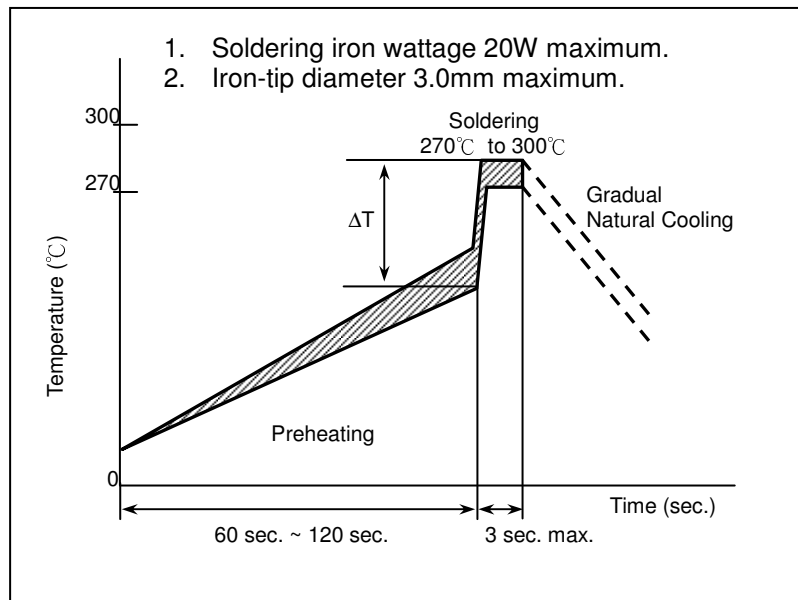
| Chip Size  | 3216 and smaller                  | 3225 and above                    |
|------------|-----------------------------------|-----------------------------------|
| Preheating | $\Delta T \leq 150^\circ\text{C}$ | $\Delta T \leq 130^\circ\text{C}$ |

- Flow Soldering for Lead free Termination



| Chip Size  | 3216 and smaller                  | 3225 and above |
|------------|-----------------------------------|----------------|
| Preheating | $\Delta T \leq 150^\circ\text{C}$ | -              |

- Soldering Iron

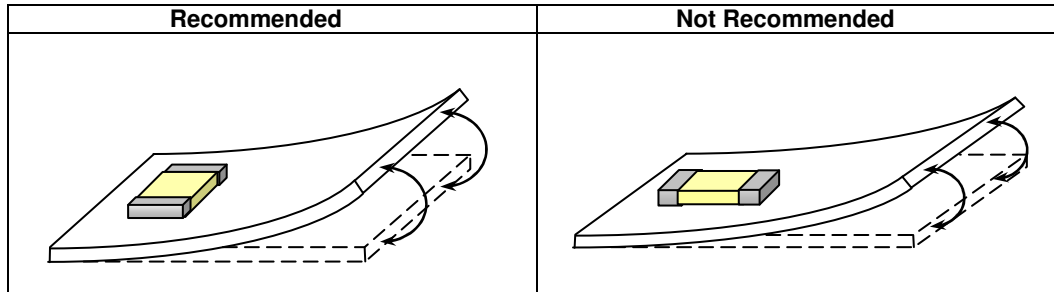


| Chip Size  | 3216 and smaller                  | 3225 and above                    |
|------------|-----------------------------------|-----------------------------------|
| Preheating | $\Delta T \leq 190^\circ\text{C}$ | $\Delta T \leq 130^\circ\text{C}$ |

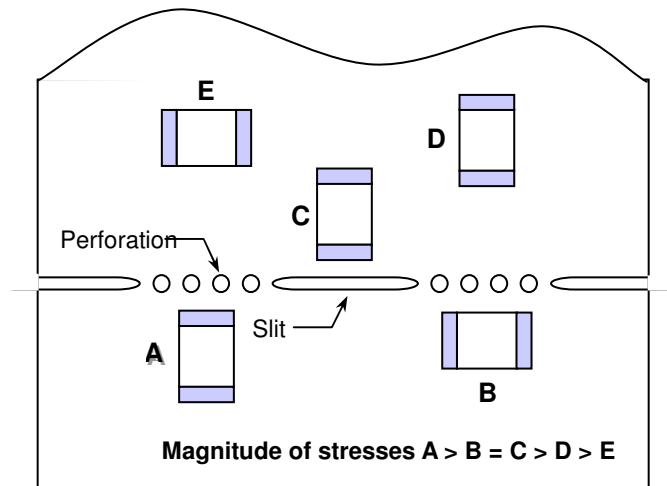


## Chip Layout and Breaking PCB

1. To layout the SMD capacitors for reducing bend stress from board deflection of PCB. The following are examples of good and bad layout.



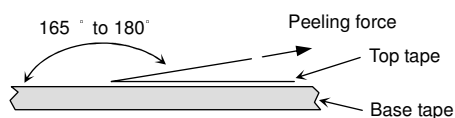
2. When breaking PCB, the layout should be noted that the mechanical stresses are depending on the position of capacitors. The following example shows recommendation for better design.



## Peeling Off Force

Peeling off force: 0.1N to 1.0N in the direction shown below.

The peeling speed: 300+/-10 mm/min



1. The taped tape on reel is wound clockwise. The sprocket holes are to the right as the tape is pulled toward the user.
2. There are minimum 150 mm as the leader and minimum 40 mm empty tape as the tail is attached to the end of the tape.

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An audit was performed, Report No. : 2.5-8619/2010

Proof has been furnished that the requirements according to

**OHSAS 18001 : 2007**

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The certificate is valid until 27 January 2013

Certificate Registration No: 2010001



Taipei, 28.01.2010

Certification Body  
TUV Asia Pacific Ltd.





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Expiration: 11/22/2010

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[C1608X7R1E334K](#) [C2012C0G2A472J](#) [2220J2K00562KXT](#) [1812J2K00332KXT](#) [CDR31BX103AKWR](#) [CDR33BX104AKUR](#)  
[CDR33BX683AKUS](#) [CGA2B2C0G1H010C](#) [CGA2B2C0G1H040C](#) [CGA2B2C0G1H050C](#) [CGA2B2C0G1H060D](#) [CGA2B2C0G1H070D](#)  
[CGA2B2C0G1H120J](#) [CGA2B2C0G1H151J](#) [CGA2B2C0G1H181JT0Y0F](#) [CGA2B2C0G1H1R5C](#) [CGA2B2C0G1H2R2C](#)  
[CGA2B2C0G1H390J](#) [CGA2B2C0G1H391J](#) [CGA2B2C0G1H3R3C](#) [CGA2B2C0G1H680J](#) [CGA2B2C0G1H6R8D](#)