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# Multilayer Ceramic Capacitor

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## ■ INTRODUCTION

MLCC(Multilayer Ceramic Capacitor) is SMD(Surface Mounted Device) type capacitor that is used in wide ranges of capacitance. MLCC is paid more attentions than other capacitors due to the better frequency characteristics, higher reliability, higher withstanding voltage and so on.

MLCC is made of many layers of ceramic and inner electrodes like sandwich. Pd was used for inner electrodes. But the price of Pd was skyrocketed and Pd was replaced by the BME(Base Metal Electrode), which reduced the total cost of MLCC.

This inner electrode is connected to outer termination for surface mounting, which is composed of three layers, Cu or Ag layer, Ni plating layer, and SnPb or Sn plating layer. Most of MLCCs become Pb free by the environmental issue at present.

MLCC is divided into two classes. Class I(COG, etc) is the temperature compensating type. It has a small TCC(Temperature Coefficient of Capacitance) and a better frequency performance. Therefore, it is used in RF applications such as cellular phone, tuner, and so on. Class II(X7R, X5R, Y5V, etc) is the high dielectric constant type, which is used in general electronic circuit. Especially high capacitance MLCC is replacing other capacitors (Tantalum and Aluminum capacitor) due to the low ESR(Equivalent Series Resistance) value.

## ■ FEATURE AND APPLICATION

### ● Feature

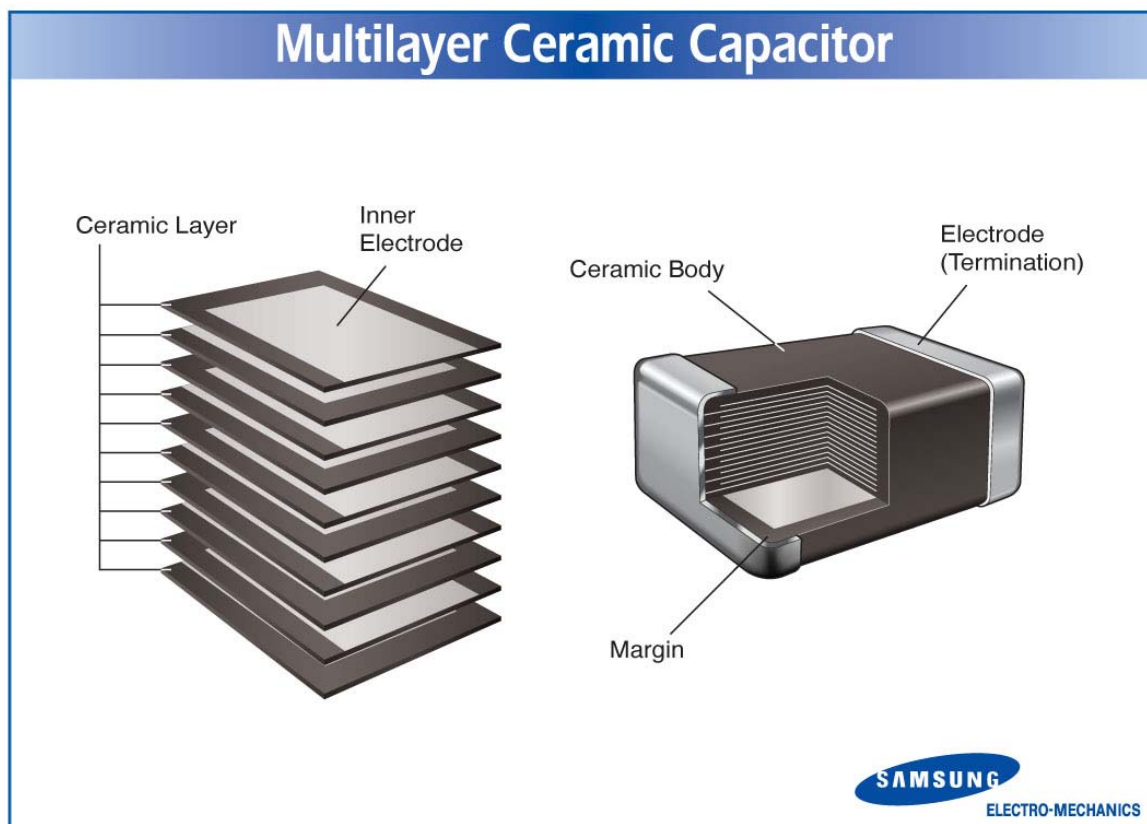
- Miniature Size
- Wide Capacitance and Voltage Range
- Highly Reliable Performance
- Tape & Reel for Surface Mount Assembly
- Low ESR
- High Q at High Frequencies
- Stable Temperature Dependence of Capacitance

### ● Application

- High Frequency Circuit(Tuner, VCO, PAM etc)
- General Power Supply Circuit(SMPS etc)
- DC-DC Converter
- General Electronic Circuit

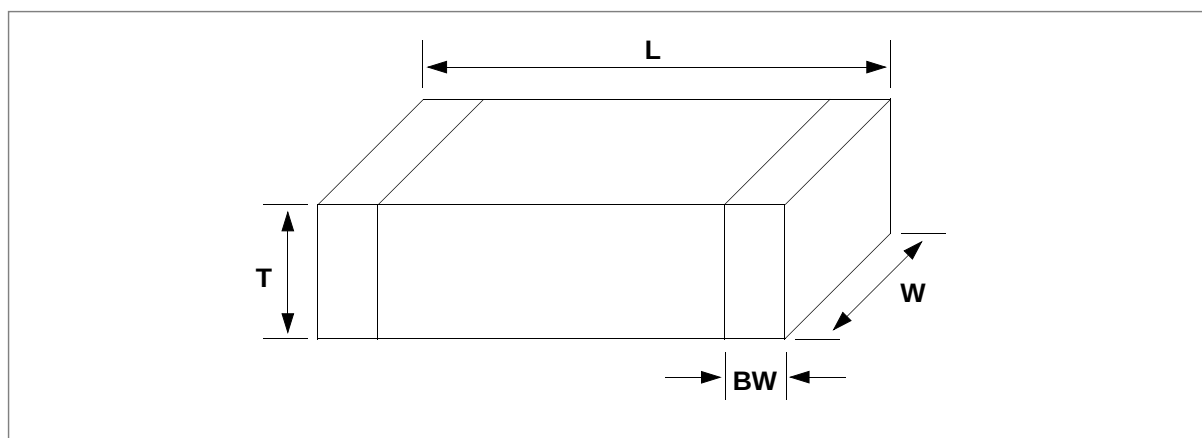
# Multilayer Ceramic Capacitor

## ■ STRUCTURE



# Multilayer Ceramic Capacitor

## ■ APPEARANCE AND DIMENSION



| CODE | EIA CODE | DIMENSION ( mm ) |                |                |                      |
|------|----------|------------------|----------------|----------------|----------------------|
|      |          | L                | W              | T (MAX)        | BW                   |
| 03   | 0201     | $0.6 \pm 0.03$   | $0.3 \pm 0.03$ | $0.3 \pm 0.03$ | $0.15 \pm 0.05$      |
| 05   | 0402     | $1.0 \pm 0.05$   | $0.5 \pm 0.05$ | $0.5 \pm 0.05$ | $0.2 + 0.15 / - 0.1$ |
| 10   | 0603     | $1.6 \pm 0.1$    | $0.8 \pm 0.1$  | $0.8 \pm 0.1$  | $0.3 \pm 0.2$        |
| 21   | 0805     | $2.0 \pm 0.1$    | $1.25 \pm 0.1$ | $1.25 \pm 0.1$ | $0.5 + 0.2 / - 0.3$  |
| 31   | 1206     | $3.2 \pm 0.2$    | $1.6 \pm 0.2$  | $1.6 \pm 0.2$  | $0.5 + 0.2 / - 0.3$  |
| 32   | 1210     | $3.2 \pm 0.3$    | $2.5 \pm 0.2$  | $2.5 \pm 0.2$  | $0.6 \pm 0.3$        |
| 43   | 1812     | $4.5 \pm 0.4$    | $3.2 \pm 0.3$  | $3.2 \pm 0.3$  | $0.8 \pm 0.3$        |
| 55   | 2220     | $5.7 \pm 0.4$    | $5.0 \pm 0.4$  | $3.2 \pm 0.3$  | $1.0 \pm 0.3$        |

# Multilayer Ceramic Capacitor

## PREVIOUS PART NUMBERING

|           |           |          |            |          |          |          |          |
|-----------|-----------|----------|------------|----------|----------|----------|----------|
| <u>CL</u> | <u>10</u> | <u>C</u> | <u>101</u> | <u>J</u> | <u>B</u> | <u>N</u> | <u>C</u> |
| ①         | ②         | ③        | ④          | ⑤        | ⑥        | ⑦        | ⑧        |

- ① SAMSUNG Multilayer Ceramic Capacitor
- ② Type(Size)
- ③ Capacitance Temperature Characteristics
- ④ Nominal Capacitance
- ⑤ Capacitance Tolerance
- ⑥ Rated Voltage
- ⑦ Thickness Option
- ⑧ Packaging Type

## ③ CAPACITANCE TEMPERATURE CHARACTERISTICS

### ► CLASS I (Temperature Compensation)

| Symbol | EIA Code | Temperature Coefficient(PPM/°C) | ※ Temperature Characteristics | Operation Temperature Range |
|--------|----------|---------------------------------|-------------------------------|-----------------------------|
| C      | C0G(CH)  | 0 ± 30                          | CΔ                            | -55 ~ +125°C                |
| P      | P2H      | -150 ± 60                       | PΔ                            |                             |
| R      | R2H      | -220 ± 60                       | RΔ                            |                             |
| S      | S2H      | -330 ± 60                       | SΔ                            |                             |
| T      | T2H      | -470 ± 60                       | TΔ                            |                             |
| U      | U2J      | -750 ± 120                      | UΔ                            |                             |
| L      | S2L      | +350 ~ -1000                    | SL                            |                             |

### ※ Temperature Characteristics

| Temperature Characteristics | below 2.0pF | 2.2 ~ 3.9pF | above 4.0pF | above 10pF |                   |
|-----------------------------|-------------|-------------|-------------|------------|-------------------|
| CΔ                          | C0G         | C0G         | C0G         | C0G        |                   |
| PΔ                          | -           | P2J         | P2H         | P2H        |                   |
| RΔ                          | -           | R2J         | R2H         | R2H        | ☞ K : ±250 PPM/°C |
| SΔ                          | -           | S2J         | S2H         | S2H        | J : ±120 PPM/°C   |
| TΔ                          | -           | T2J         | T2H         | T2H        | H : ±60 PPM/°C    |
| UΔ                          | -           | U2J         | U2J         | U2J        | G : ±30 PPM/°C    |

### ► CLASS II (High Dielectric Constant)

| Symbol | EIA Code | Capacitance Change (ΔC : %) | Operation Temperature Range |
|--------|----------|-----------------------------|-----------------------------|
| A      | X5R      | ± 15                        | -55 ~ +85°C                 |
| B      | X7R      | ± 15                        | -55 ~ +125°C                |
| F      | Y5V      | +22 ~ -82                   | -30 ~ +85°C                 |

# Multilayer Ceramic Capacitor

## ④ NOMINAL CAPACITANCE

The nominal capacitance value is expressed in pico-Farad(pF) and identified by three-digit number, first two digits represent significant figures and last digit specifies the number of zeros to follow. For values below 1pF, the letter "R" is used as the decimal point and the last digit becomes significant.

example)

|     |   |     |   |                 |   |        |
|-----|---|-----|---|-----------------|---|--------|
| 100 | : | 10  | × | 10 <sup>0</sup> | = | 10pF   |
| 102 | : | 10  | × | 10 <sup>2</sup> | = | 1000pF |
| 020 | : | 2   | × | 10 <sup>0</sup> | = | 2pF    |
| 1R5 | : | 1.5 |   |                 | = | 1.5pF  |

## ⑤ CAPACITANCE TOLERANCE

| Temperature Characteristics  | Symbol | Tolerance   | Applicable Capacitance & Range |
|------------------------------|--------|-------------|--------------------------------|
| C0G(NPO)<br>or<br>T.C Series | B      | ± 0.1pF     | 0.5 ~ 3pF                      |
|                              | C      | ± 0.25pF    | 0.5 ~ 10pF                     |
|                              | D      | ± 0.5pF     |                                |
|                              | F      | ± 1pF       | 6 ~ 10pF                       |
|                              | G      | ± 2%        | E-24 Series for over 10pF      |
|                              | J      | ± 5%        |                                |
|                              | K      | ± 10%       |                                |
| A(X5R)<br>B(X7R)             | J      | ± 5%        | E-12 Series                    |
|                              | K      | ± 10%       |                                |
|                              | M      | ± 20%       |                                |
| F(Y5V)                       | Z      | -20% ~ +80% | E-6 Series                     |

※ Please consult us for special tolerances.

## ⑥ RATED VOLTAGE

| Symbol | Rated Voltage(Vdc) | Symbol | Rated Voltage(Vdc) |
|--------|--------------------|--------|--------------------|
| Q      | 6.3V               | D      | 200V               |
| P      | 10V                | G      | 500V               |
| O      | 16V                | I      | 1000V              |
| A      | 25V                | J      | 2000V              |
| B      | 50V                | K      | 3000V              |
| C      | 100V               |        |                    |

# Multilayer Ceramic Capacitor

## ⑦ THICKNESS OPTION

| Symbol | Description of the Code                                                    |
|--------|----------------------------------------------------------------------------|
| N      | Standard thickness (please refer to standard thickness table on next page) |
| A      | Thinner than standard thickness                                            |
| B      | Thicker than standard thickness                                            |
| C      | Standard Thickness High Q ( Low ` D.F ` )                                  |
| D      | Sn-100% (High-Q)                                                           |
| E      | Sn-100% (General)                                                          |

※ Please Consult us for other termination type.

## ⑧ PACKAGING TYPE

| Symbol | Packaging              | Symbol | Packaging               |
|--------|------------------------|--------|-------------------------|
| B      | Bulk                   | F      | Embossed Tape, 13" Reel |
| P      | Cassette               | L      | Paper 13" Reel          |
| C      | Paper Tape, 7" Reel    | O      | Paper 10" Reel          |
| D      | Paper Tape, 13" Reel   | S      | Embossed Tape, 10" Reel |
| E      | Embossed Tape, 7" Reel |        |                         |

## ► STANDARD CAPACITANCE STEP

| Series | Capacitance Step |     |     |     |     |     |     |     |     |     |     |     |
|--------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| E- 3   | 1.0              |     |     |     | 2.2 |     |     |     | 4.7 |     |     |     |
| E- 6   | 1.0              | 1.5 |     | 2.2 | 3.3 |     | 4.7 | 6.8 |     |     |     |     |
| E-12   | 1.0              | 1.2 | 1.5 | 1.8 | 2.2 | 2.7 | 3.3 | 3.9 | 4.7 | 5.6 | 6.8 | 8.2 |
| E-24   | 1.0              | 1.2 | 1.5 | 1.8 | 2.2 | 2.7 | 3.3 | 3.9 | 4.7 | 5.6 | 6.8 | 8.2 |
|        | 1.1              | 1.3 | 1.6 | 2.0 | 2.4 | 3.0 | 3.6 | 4.3 | 5.1 | 6.2 | 7.5 | 9.1 |

※ Standard Capacitance is " Each step  $\times 10^n$  "

# Multilayer Ceramic Capacitor

## ■ NEW PART NUMBERING

|           |           |          |            |          |          |          |          |          |          |          |
|-----------|-----------|----------|------------|----------|----------|----------|----------|----------|----------|----------|
| <b>CL</b> | <b>10</b> | <b>C</b> | <b>101</b> | <b>J</b> | <b>B</b> | <b>8</b> | <b>N</b> | <b>N</b> | <b>N</b> | <b>C</b> |
| <b>①</b>  | <b>②</b>  | <b>③</b> | <b>④</b>   | <b>⑤</b> | <b>⑥</b> | <b>⑦</b> | <b>⑧</b> | <b>⑨</b> | <b>⑩</b> | <b>⑪</b> |

- ① SAMSUNG Multilayer Ceramic Capacitor
- ② Size(mm)
- ③ Capacitance Temperature Characteristic
- ④ Nominal Capacitance
- ⑤ Capacitance Tolerance
- ⑥ Rated Voltage
- ⑦ Thickness Option
- ⑧ Product & Plating Method
- ⑨ Samsung Control Code
- ⑩ Reserved For Future Use
- ⑪ Packaging Type

### ① PRODUCT ABBREVIATION

| Symbol | Product Abbreviation                 |
|--------|--------------------------------------|
| CL     | SAMSUNG Multilayer Ceramic Capacitor |

### ② SIZE(mm)

| Symbol | Size(mm) |       |
|--------|----------|-------|
|        | Length   | Width |
| 03     | 0.6      | 0.3   |
| 05     | 1.0      | 0.5   |
| 10     | 1.6      | 0.8   |
| 21     | 2.0      | 1.2   |
| 31     | 3.2      | 1.6   |
| 32     | 3.2      | 2.5   |
| 43     | 4.5      | 3.2   |
| 55     | 5.7      | 5.0   |

# Multilayer Ceramic Capacitor

## ③ CAPACITANCE TEMPERATURE CHARACTERISTIC

| Symbol | Temperature Characteristics |     |     |                                         | Temperature Range               |
|--------|-----------------------------|-----|-----|-----------------------------------------|---------------------------------|
| C      | Class I                     | COG | C△  | $0 \pm 30(\text{ppm}/^{\circ}\text{C})$ | $-55 \sim +125^{\circ}\text{C}$ |
| P      |                             | P2H | P△  | $-150 \pm 60$                           |                                 |
| R      |                             | R2H | R△  | $-220 \pm 60$                           |                                 |
| S      |                             | S2H | S△  | $-330 \pm 60$                           |                                 |
| T      |                             | T2H | T△  | $-470 \pm 60$                           |                                 |
| U      |                             | U2J | U△  | $-750 \pm 60$                           |                                 |
| L      |                             | S2L | S△  | $+350 \sim -1000$                       |                                 |
| A      | Class II                    | X5R | X5R | $\pm 15\%$                              | $-55 \sim +85^{\circ}\text{C}$  |
| B      |                             | X7R | X7R | $\pm 15\%$                              | $-55 \sim +125^{\circ}\text{C}$ |
| F      |                             | Y5V | Y5V | $+22 \sim -82\%$                        | $-30 \sim +85^{\circ}\text{C}$  |

### ※ Temperature Characteristic

| Temperature Characteristics | Below 2.0pF | 2.2 ~ 3.9pF | Above 4.0pF | Above 10pF |
|-----------------------------|-------------|-------------|-------------|------------|
| C△                          | COG         | COG         | COG         | COG        |
| P△                          | -           | P2J         | P2H         | P2H        |
| R△                          | -           | R2J         | R2H         | R2H        |
| S△                          | -           | S2J         | S2H         | S2H        |
| T△                          | -           | T2J         | T2H         | T2H        |
| U△                          | -           | U2J         | U2J         | U2J        |

J :  $\pm 120\text{PPM}/^{\circ}\text{C}$ , H :  $\pm 60\text{PPM}/^{\circ}\text{C}$ , G :  $\pm 30\text{PPM}/^{\circ}\text{C}$

## ④ NOMINAL CAPACITANCE

Nominal capacitance is identified by 3 digits.

The first and second digits identify the first and second significant figures of the capacitance.

The third digit identifies the multiplier. 'R' identifies a decimal point.

### ● Example

| Symbol | Nominal Capacitance                 |
|--------|-------------------------------------|
| 1R5    | 1.5pF                               |
| 103    | 10,000pF, 10nF, 0.01 $\mu\text{F}$  |
| 104    | 100,000pF, 100nF, 0.1 $\mu\text{F}$ |

## Multilayer Ceramic Capacitor

### ⑤ CAPACITANCE TOLERANCE

| Symbol | Tolerance           | Nominal Capacitance                |
|--------|---------------------|------------------------------------|
| A      | $\pm 0.05\text{pF}$ | Less than 10pF<br>(Including 10pF) |
| B      | $\pm 0.1\text{pF}$  |                                    |
| C      | $\pm 0.25\text{pF}$ |                                    |
| D      | $\pm 0.5\text{pF}$  |                                    |
| F      | $\pm 1\text{pF}$    |                                    |
| F      | $\pm 1\%$           | More than 10pF                     |
| G      | $\pm 2\%$           |                                    |
| J      | $\pm 5\%$           |                                    |
| K      | $\pm 10\%$          |                                    |
| M      | $\pm 20\%$          |                                    |
| Z      | +80, -20%           |                                    |

### ⑥ RATED VOLTAGE

| Symbol | Rated Voltage | Symbol | Rated Voltage |
|--------|---------------|--------|---------------|
| Q      | 6.3V          | E      | 250V          |
| P      | 10V           | G      | 500V          |
| O      | 16V           | H      | 630V          |
| A      | 25V           | I      | 1,000V        |
| B      | 50V           | J      | 2,000V        |
| C      | 100V          | K      | 3,000V        |
| D      | 200V          |        |               |

## Multilayer Ceramic Capacitor

### ⑦ THICKNESS OPTION

| Type | Symbol | Thickness(T) | Spec  |
|------|--------|--------------|-------|
| 0603 | 3      | 0.30         | ±0.03 |
| 1005 | 5      | 0.50         | ±0.05 |
| 1608 | 8      | 0.80         | ±0.10 |
| 2012 | A      | 0.65         | ±0.10 |
|      | C      | 0.85         |       |
|      | F      | 1.25         | ±0.10 |
| 3216 | C      | 0.85         | ±0.15 |
|      | F      | 1.25         | ±0.15 |
|      | H      | 1.6          | ±0.20 |
| 3225 | F      | 1.25         | ±0.20 |
|      | H      | 1.6          |       |
|      | I      | 2.0          |       |
|      | J      | 2.5          |       |
| 4532 | F      | 1.25         | ±0.20 |
|      | H      | 1.6          |       |
|      | I      | 2.0          |       |
|      | J      | 2.5          |       |
|      | L      | 3.2          | ±0.30 |
| 5750 | F      | 1.25         | ±0.20 |
|      | H      | 1.6          |       |
|      | I      | 2.0          |       |
|      | J      | 2.5          |       |
|      | L      | 3.2          | ±0.30 |

## Multilayer Ceramic Capacitor

### ⑧ PRODUCT & PLATING METHOD

| Symbol | Electrode | Termination | Plating Type |
|--------|-----------|-------------|--------------|
| A      | Pd        | Ag          | Sn_100%      |
| N      | Ni        | Cu          | Sn_100%      |
| G      | Cu        | Cu          | Sn_100%      |

### ⑨ SAMSUNG CONTROL CODE

| Symbol | Description of the code | Symbol | Description of the code |
|--------|-------------------------|--------|-------------------------|
| A      | Array (2-element)       | N      | Normal                  |
| B      | Array (4-element)       | P      | Automotive              |
| C      | High - Q                | W      | 3 Terminal EMI Filter   |
| L      | LICC                    |        |                         |

### ⑩ RESERVED FOR FUTURE USE

| Symbol | Description of the code |
|--------|-------------------------|
| N      | Reserved for future use |

### ⑪ PACKAGING TYPE

| Symbol | Packaging Type       | Symbol | Packaging Type           |
|--------|----------------------|--------|--------------------------|
| B      | Bulk                 | F      | Embossing 13" (10,000EA) |
| P      | Bulk Case            | L      | Paper 13" (15,000EA)     |
| C      | Paper 7"             | O      | Paper 10"                |
| D      | Paper 13" (10,000EA) | S      | Embossing 10"            |
| E      | Embossing 7"         |        |                          |

# Multilayer Ceramic Capacitor

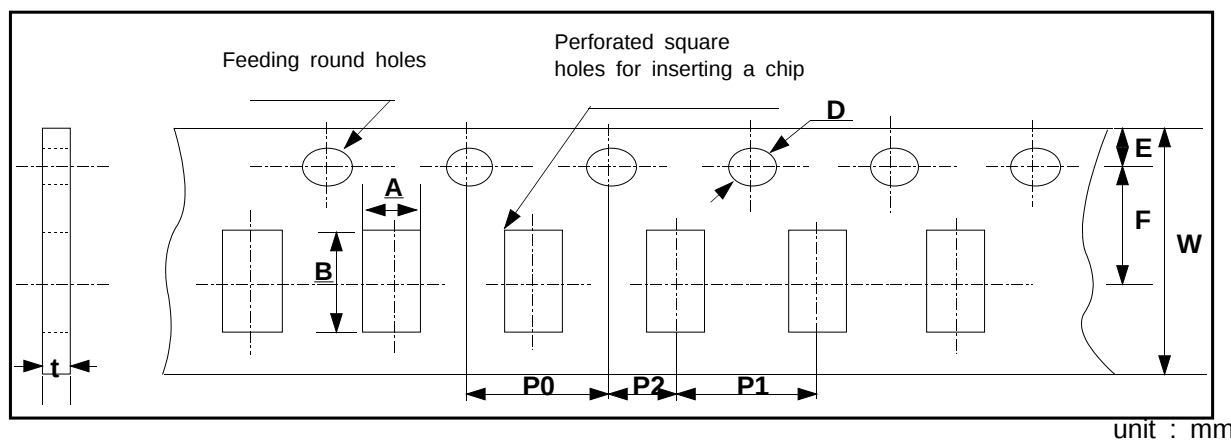
## ► CAPACITANCE vs CHIP THICKNESS STANDARD

| Description               |                            | 0603<br>(0201) | 1005<br>(0402) | 1608<br>(0603) | 2012 Type<br>(0805) |               |                | 3216 Type<br>(1206) |               |               | 3225 Type<br>(1210) |               |                  |                 | 4532 Type<br>(1812) |                |                 |                 | 5750 Type<br>(2220) |             |             |               |
|---------------------------|----------------------------|----------------|----------------|----------------|---------------------|---------------|----------------|---------------------|---------------|---------------|---------------------|---------------|------------------|-----------------|---------------------|----------------|-----------------|-----------------|---------------------|-------------|-------------|---------------|
| Dimension<br>(mm)         |                            | L              | 0.6<br>±0.03   | 1.0<br>±0.05   | 1.6<br>±0.1         | 2.0±0.1       |                |                     | 3.2±0.15      |               | 3.2<br>±0.2         | 3.2±0.3       |                  |                 |                     | 4.5±0.4        |                 |                 |                     | 5.7±0.4     |             |               |
|                           |                            | W              | 0.3<br>±0.03   | 0.5<br>±0.05   | 0.8<br>±0.1         | 1.25±0.1      |                |                     | 1.6±0.15      |               | 1.6<br>±0.2         | 2.5±0.2       |                  |                 |                     | 3.2±0.3        |                 |                 |                     | 5.0±0.4     |             |               |
|                           |                            | T              | 0.3<br>±0.03   | 0.5~<br>±0.05  | 0.8<br>±0.1         | 0.65<br>±0.1  | 0.85<br>±0.1   | 1.25<br>±0.1        | 0.85<br>±0.15 | 1.25<br>±0.15 | 1.6<br>±0.2         | 1.25<br>±0.2  | 1.6<br>±0.2      | 2.0<br>±0.2     | 2.5<br>±0.2         | 1.25<br>±0.2   | 1.6<br>±0.2     | 2.0<br>±0.2     | 2.5<br>±0.2         | 1.6<br>±0.2 | 2.0<br>±0.2 | 2.5<br>±0.2   |
| CAPACITANCE<br>(pF)       | SL                         | 50V            | -              | 0.5~<br>240    | 0.5 ~<br>1000       | 0.5 ~<br>1000 | 1100 ~<br>1500 | 1600~<br>2700       | 0.5 ~<br>2700 | 3000~<br>5600 | 6200~<br>8200       | -             | -                | -               | -                   | -              | -               | -               | -                   | -           | -           |               |
|                           | C, TC<br>(Except<br>SL,UJ) | 25V            | 0.5~<br>47     | 0.5~<br>220    | 0.5 ~<br>1000       | -             | -              | 3300~<br>8200       | 1500~<br>3600 | 3900~<br>6800 | 7500~<br>10000      | -             | -                | -               | -                   | -              | 100000          | -               | -                   | -           | -           |               |
|                           |                            | 50V            | -              | 0.5 ~<br>180   | 0.5 ~<br>1000       | 0.5 ~<br>560  | 620~<br>1000   | 1100~<br>3300       | 0.5 ~<br>2200 | 2400~<br>4700 | -                   | 560~<br>10000 | 11000 ~<br>22000 | 24000~<br>47000 | -                   | 1000~<br>13000 | 15000~<br>22000 | 24000~<br>47000 | 62000~<br>68000     | 43000       | 93000       | 130000        |
| CAPACITANCE RANGE<br>(nF) | A<br>(X5R)                 | 6.3V           | 10             | 220            | 2200                | -             | -              | 10000               | -             | -             | 10000               | -             | -                | -               | 22000               | -              | -               | -               | 47000               | -           | -           | 47000         |
|                           |                            | 10V            | 10             | 100            | 1000                | -             | -              | 2200                | -             | -             | 4700~<br>10000      | -             | -                | -               | 22000               | -              | -               | -               | -                   | -           | -           | 47000         |
|                           |                            | 16V            | -              | 47             | 330~<br>470         | -             | -              | 1000                | -             | -             | 4700                | -             | -                | -               | 6800~<br>10000      | -              | -               | -               | -                   | -           | -           | -             |
|                           |                            | 25V            | -              | -              | -                   | -             | -              | -                   | -             | -             | -                   | -             | -                | -               | -                   | -              | -               | -               | -                   | -           | -           |               |
|                           |                            | 50V            | -              | 6.8~<br>10     | -                   | -             | -              | -                   | -             | -             | -                   | -             | -                | -               | -                   | -              | -               | -               | -                   | -           | -           |               |
|                           | B<br>(X7R)                 | 6.3V           | 0.1~<br>10     | 47~<br>100     | 470~<br>1000        | -             | -              | 1000                | -             | -             | 6800~<br>10000      | -             | -                | -               | 22000               | -              | -               | -               | -                   | -           | -           | -             |
|                           |                            | 10V            | 0.1~<br>10     | 33~<br>100     | 220~<br>470         | 220~<br>270   | 330~<br>470    | 560~<br>1000        | -             | 1000~<br>3300 | 4700                | 1500~<br>2200 | 3300             | 3900~<br>4700   | -                   | -              | -               | -               | 22000               | -           | -           | -             |
|                           |                            | 16V            | 0.1~<br>1      | 10~<br>33      | 100~<br>220         | 68~<br>200    | 220~<br>330    | 390~<br>1000        | 330~<br>680   | 1000~<br>1500 | 2200~<br>3300       | 1500~<br>2200 | 3300             | 3900~<br>4700   | -                   | -              | -               | 2200            | -                   | -           | -           |               |
|                           |                            | 25V            | -              | 4.7~<br>10     | 47~<br>100          | 39~<br>68     | 82~<br>100     | 150~<br>470         | 100~<br>330   | 470~<br>620   | 680~<br>1000        | 680~<br>1500  | 1800             | 2200            | -                   | -              | -               | 1000            | -                   | -           | -           | 10000         |
|                           |                            | 50V            | -              | 0.22~<br>4.7   | 0.22~<br>100        | 0.22~<br>39   | 47~<br>100     | 220                 | 1~<br>150     | 220           | 390~<br>1000        | 2.2~<br>680   | 820~<br>1000     | -               | -                   | 10~<br>1000    | -               | -               | -                   | -           | -           | 3300~<br>4700 |
|                           | F<br>(Y5V)                 | 6.3V           | 10~<br>100     | -              | 2200                | -             | -              | 10000               | -             | -             | -                   | -             | -                | 47000           | -                   | -              | -               | -               | -                   | -           | -           | -             |
|                           |                            | 10V            | -              | 220~<br>330    | 100~<br>1000        | -             | -              | 4700                | -             | 4700          | 10000~<br>22000     | -             | -                | -               | 22000               | -              | -               | -               | -                   | -           | -           | 10000         |
|                           |                            | 16V            | -              | 10~<br>220     | 100~<br>1000        | 10~<br>680    | 820~<br>1000   | 1200~<br>2200       | 1000~<br>2200 | 2700~<br>4700 | 10000               | 3300~<br>6800 | 10000            | 15000           | -                   | -              | -               | 22000           | -                   | -           | -           | -             |
|                           |                            | 25V            | -              | 10~<br>33      | 22~<br>330          | 10~<br>220    | 270~<br>470    | 560~<br>1000        | 470~<br>1000  | 1200~<br>2200 | 2700~<br>3300       | 1000~<br>3300 | 4700~<br>10000   | -               | -                   | -              | -               | -               | 10000               | -           | -           | -             |
|                           |                            | 50V            | -              | 2.2~<br>10     | 2.2~<br>100         | 2.2~<br>68    | 82~<br>150     | 180~<br>1000        | 10~<br>470    | 560~<br>1000  | -                   | 100~<br>1000  | -                | -               | -                   | -              | -               | -               | 10000               | -           | -           | -             |

# Multilayer Ceramic Capacitor

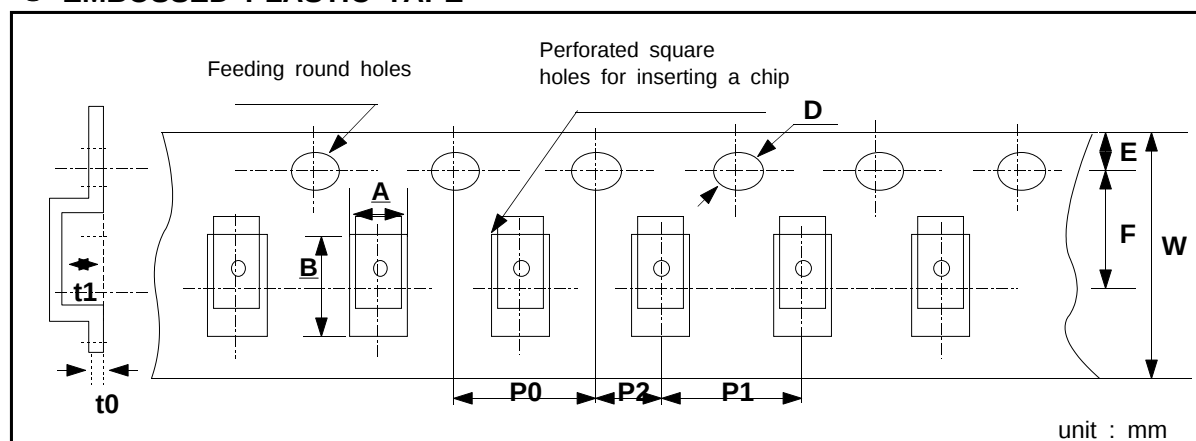
## PACKAGING

### ● CARDBOARD PAPER TAPE



| Symbol Type |    | W           | F            | E            | P1           | P2           | P0          | D               | t             | A                  | B                  |
|-------------|----|-------------|--------------|--------------|--------------|--------------|-------------|-----------------|---------------|--------------------|--------------------|
| Dimension   | 03 |             |              |              | 2.0<br>±0.05 |              |             |                 | 0.37<br>±0.03 | 0.38<br>±0.03      | 0.68<br>±0.03      |
|             | 05 |             |              |              |              |              |             |                 | 0.6<br>±0.05  | 0.65<br>+0.05/-0.1 | 1.15<br>+0.05/-0.1 |
|             | 10 | 8.0<br>±0.3 | 3.5<br>±0.05 | 1.75<br>±0.1 |              | 2.0<br>±0.05 | 4.0<br>±0.1 | Φ1.5<br>+0.1/-0 | 1.1<br>MAX    | 1.1<br>±0.2        | 1.9<br>±0.2        |
|             | 21 |             |              |              | 4.0<br>±0.1  |              |             |                 |               | 1.6<br>±0.2        | 2.4<br>±0.2        |
|             | 31 |             |              |              |              |              |             |                 |               | 2.0<br>±0.2        | 3.6<br>±0.2        |

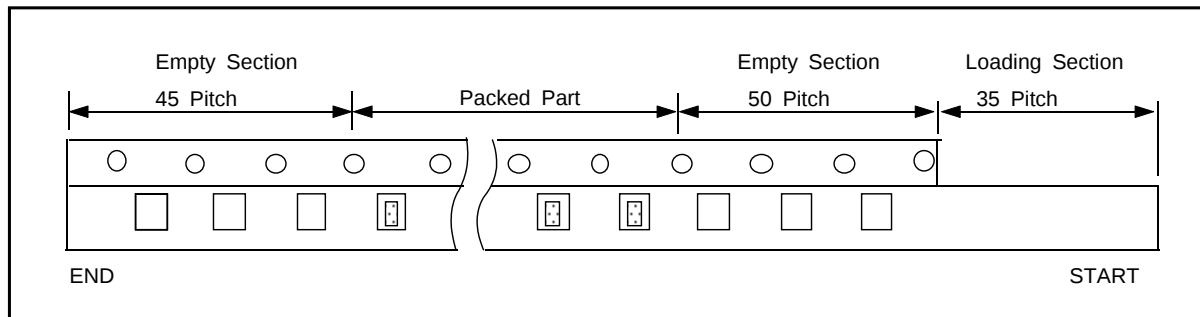
### ● EMBOSSED PLASTIC TAPE



| Symbol Type |    | W           | F            | E            | P1          | P2           | P0          | D               | t0         | t1         | A            | B           |
|-------------|----|-------------|--------------|--------------|-------------|--------------|-------------|-----------------|------------|------------|--------------|-------------|
| Dimension   | 21 |             |              |              |             |              |             |                 |            |            | 1.45<br>±0.2 | 2.3<br>±0.2 |
|             | 31 |             |              |              |             |              |             |                 |            |            | 2.0<br>±0.2  | 3.6<br>±0.2 |
|             | 32 | 8.0<br>±0.3 | 3.5<br>±0.05 | 1.75<br>±0.1 | 4.0<br>±0.1 | 2.0<br>±0.05 | 4.0<br>±0.1 | Φ1.5<br>+0.1/-0 | 0.6<br>max | 2.5<br>max | 2.9<br>±0.2  | 3.6<br>±0.2 |
|             | 43 |             |              |              |             |              |             |                 |            |            | 3.6<br>±0.2  | 4.9<br>±0.2 |
|             | 55 |             |              |              |             |              |             |                 |            |            | 5.4<br>±0.2  | 6.0<br>±0.2 |

# Multilayer Ceramic Capacitor

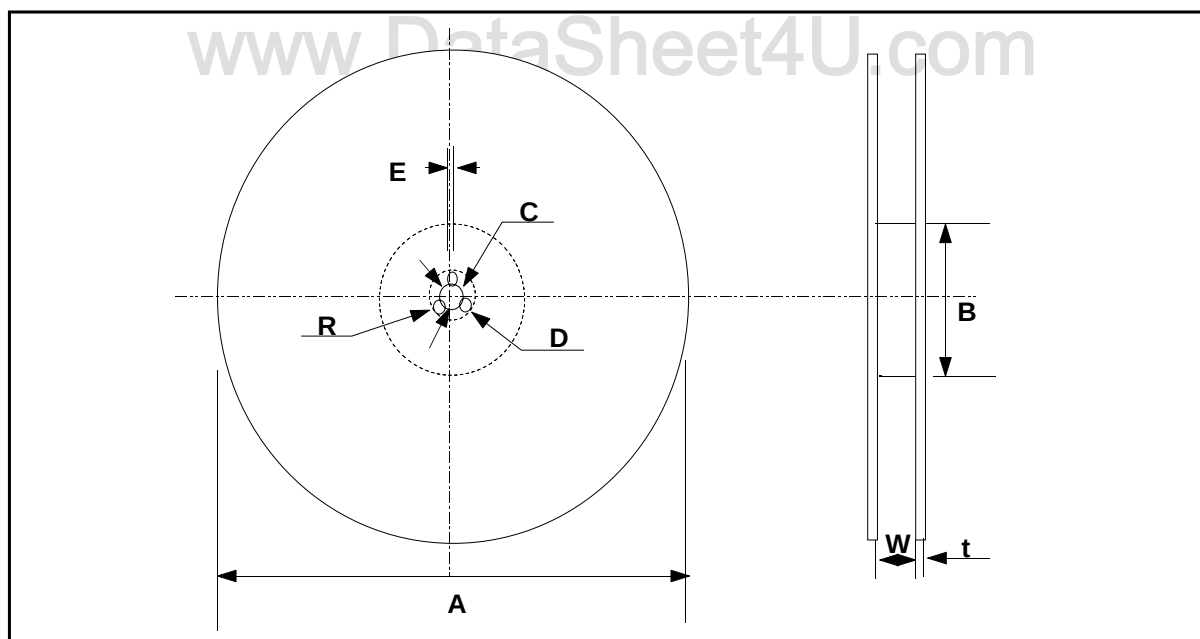
## ● TAPING SIZE



unit : pcs

| Symbol   | Cardboard Paper Tape | Embossed Plastic Tape |
|----------|----------------------|-----------------------|
| 7" Reel  | 4000                 | 2000                  |
| 13" Reel | 15000                | -                     |

## ● REEL DIMENSION



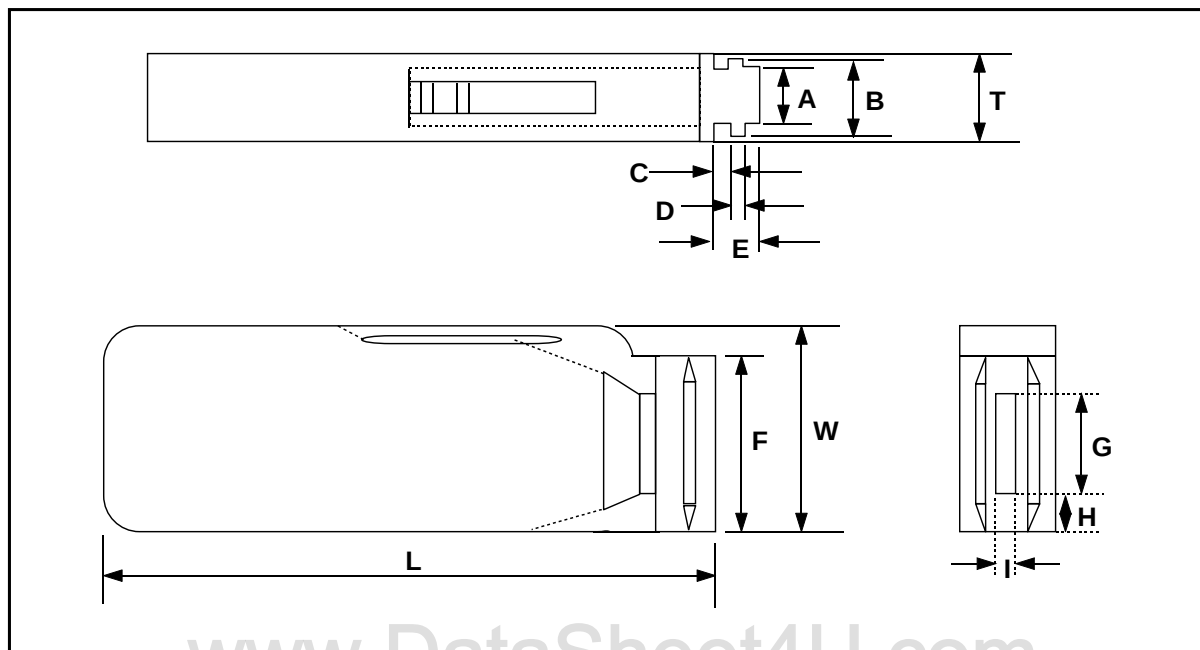
unit : mm

| Symbol   | A                  | B              | C                 | D            | E             | W            | t             | R   |
|----------|--------------------|----------------|-------------------|--------------|---------------|--------------|---------------|-----|
| 7" Reel  | $\phi 178 \pm 2.0$ | min. $\phi 50$ | $\phi 13 \pm 0.5$ | $21 \pm 0.8$ | $2.0 \pm 0.5$ | $10 \pm 1.5$ | $0.8 \pm 0.2$ | 1.0 |
| 13" Reel | $\phi 330 \pm 2.0$ | min. $\phi 70$ |                   |              |               |              |               |     |

# Multilayer Ceramic Capacitor

## ● BULK CASE PACKAGING

- Bulk case packaging can reduce the stock space and transportation costs.
- The bulk feeding system can increase the productivity.
- It can eliminate the components loss.



| Symbol    | A             | B             | T            | C                 | D               | E             |
|-----------|---------------|---------------|--------------|-------------------|-----------------|---------------|
| Dimension | $6.8 \pm 0.1$ | $8.8 \pm 0.1$ | $12 \pm 0.1$ | $1.5 + 0.1 / - 0$ | $2 + 0 / - 0.1$ | $4.7 \pm 0.1$ |

| Symbol    | F                  | W                | G             | H            | L             | I            |
|-----------|--------------------|------------------|---------------|--------------|---------------|--------------|
| Dimension | $31.5 + 0.2 / - 0$ | $36 + 0 / - 0.2$ | $19 \pm 0.35$ | $7 \pm 0.35$ | $110 \pm 0.7$ | $5 \pm 0.35$ |

## ● QUANTITY

| Size     | 05(0402) | 10(0603)       | 21(0805)               |                       |
|----------|----------|----------------|------------------------|-----------------------|
|          |          |                | $T \leq 0.85\text{mm}$ | $T \geq 1.0\text{mm}$ |
| Quantity | 50,000   | 10,000~15,000* | 10,000                 | 5,000                 |

\* Option

# Multilayer Ceramic Capacitor

## ■ CHARACTERISTIC MAP

### ● CLASS I

| Temperature Characteristics | Size         | Voltage | Capacitance Range (pF) |    |     |      |       |        |         |          |
|-----------------------------|--------------|---------|------------------------|----|-----|------|-------|--------|---------|----------|
|                             |              |         | 0.5                    | 10 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000 |
| SL,UJ                       | 05<br>(0402) | 50V     | 240                    |    |     |      |       |        |         |          |
|                             | 10<br>(0603) | 50V     | 1000                   |    |     |      |       |        |         |          |
|                             | 21<br>(0805) | 50V     | 2700                   |    |     |      |       |        |         |          |
|                             | 31<br>(1206) | 50V     | 8200                   |    |     |      |       |        |         |          |
| C(COG) & TC Series          | 03<br>(0201) | 25V     | 47                     |    |     |      |       |        |         |          |
|                             | 05<br>(0402) | 25V     | 220                    |    |     |      |       |        |         |          |
|                             |              | 50V     | 180                    |    |     |      |       |        |         |          |
|                             | 10<br>(0603) | 25V     | 1000                   |    |     |      |       |        |         |          |
|                             |              | 50V     | 1000                   |    |     |      |       |        |         |          |
|                             | 21<br>(0805) | 25V     | 3300 8200              |    |     |      |       |        |         |          |
|                             |              | 50V     | 3300                   |    |     |      |       |        |         |          |
|                             | 31<br>(1206) | 25V     | 1500 10000             |    |     |      |       |        |         |          |
|                             |              | 50V     | 4700                   |    |     |      |       |        |         |          |
|                             | 32<br>(1210) | 50V     | 560 47000              |    |     |      |       |        |         |          |
|                             |              | 100V    | 4700 18000             |    |     |      |       |        |         |          |
|                             | 43<br>(1812) | 25V     | 100000                 |    |     |      |       |        |         |          |
|                             |              | 50V     | 1000 68000             |    |     |      |       |        |         |          |
|                             | 55<br>(2220) | 50V     | 43000 130000           |    |     |      |       |        |         |          |

# Multilayer Ceramic Capacitor

## ● CLASS II , A(X5R)

| Temperature Characteristics | Size           | Voltage | Capacitance Range (pF) |     |      |         |          |            |            |           |
|-----------------------------|----------------|---------|------------------------|-----|------|---------|----------|------------|------------|-----------|
|                             |                |         | 10                     | 100 | 1000 | 10000   | 100000   | 1000000    | 10000000   | 100000000 |
| A(X5R)                      | 0603<br>(0201) | 6.3V    |                        |     |      | ■ 10000 |          |            |            |           |
|                             |                | 10V     |                        |     |      | ■ 10000 |          |            |            |           |
|                             | 1005<br>(0402) | 6.3V    |                        |     |      |         | ■ 220000 |            |            |           |
|                             |                | 10V     |                        |     |      |         | ■ 100000 |            |            |           |
|                             |                | 16V     |                        |     |      | ■ 47000 |          |            |            |           |
|                             |                | 50V     |                        |     | 6800 | ■ 10000 |          |            |            |           |
|                             | 1608<br>(0603) | 6.3V    |                        |     |      |         |          | ■ 2200000  |            |           |
|                             |                | 10V     |                        |     |      |         |          | ■ 1000000  |            |           |
|                             |                | 16V     |                        |     |      | 330000  | ■ 470000 |            |            |           |
|                             | 2012<br>(0805) | 6.3V    |                        |     |      |         |          |            | ■ 10000000 |           |
|                             |                | 10V     |                        |     |      |         |          | ■ 2200000  |            |           |
|                             |                | 16V     |                        |     |      |         |          | ■ 1000000  |            |           |
|                             | 3216<br>(1206) | 6.3V    |                        |     |      |         |          |            | ■ 10000000 |           |
|                             |                | 10V     |                        |     |      |         | 4700000  | ■ 10000000 |            |           |
|                             |                | 16V     |                        |     |      |         |          | ■ 4700000  |            |           |
|                             | 3225<br>(1210) | 6.3V    |                        |     |      |         |          |            | ■ 22000000 |           |
|                             |                | 10V     |                        |     |      |         |          |            | ■ 22000000 |           |
|                             |                | 16V     |                        |     |      |         | 6800000  | ■ 10000000 |            |           |
|                             | 4532<br>(1812) | 6.3V    |                        |     |      |         |          |            | ■ 47000000 |           |
|                             | 5750<br>(2220) | 6.3V    |                        |     |      |         |          |            | ■ 47000000 |           |
|                             |                | 10V     |                        |     |      |         |          |            | ■ 47000000 |           |

# Multilayer Ceramic Capacitor

## ● CLASS II , B(X7R)

| Temperature Characteristics | Size         | Voltage | Capacitance Range (pF) |     |       |        |         |         |          |           |
|-----------------------------|--------------|---------|------------------------|-----|-------|--------|---------|---------|----------|-----------|
|                             |              |         | 10                     | 100 | 1000  | 10000  | 100000  | 1000000 | 10000000 | 100000000 |
| B(X7R)                      | 03<br>(0201) | 6.3V    |                        | 100 |       | 10000  |         |         |          |           |
|                             |              | 10V     |                        | 100 |       | 10000  |         |         |          |           |
|                             |              | 16V     |                        | 100 | 1000  |        |         |         |          |           |
|                             | 05<br>(0402) | 6.3V    |                        |     |       | 47000  | 100000  |         |          |           |
|                             |              | 10V     |                        |     |       | 33000  | 100000  |         |          |           |
|                             |              | 16V     |                        |     | 10000 | 33000  |         |         |          |           |
|                             |              | 25V     |                        |     | 4700  | 10000  |         |         |          |           |
|                             |              | 50V     |                        | 220 | 4700  |        |         |         |          |           |
|                             | 10<br>(0603) | 6.3V    |                        |     |       |        | 470000  | 1000000 |          |           |
|                             |              | 10V     |                        |     |       |        | 220000  | 470000  |          |           |
|                             |              | 16V     |                        |     |       | 100000 | 220000  |         |          |           |
|                             |              | 25V     |                        |     |       | 47000  | 100000  |         |          |           |
|                             |              | 50V     |                        | 220 |       |        | 100000  |         |          |           |
|                             | 21<br>(0805) | 6.3V    |                        |     |       |        |         | 1000000 |          |           |
|                             |              | 10V     |                        |     |       |        | 220000  | 1000000 |          |           |
|                             |              | 16V     |                        |     |       | 68000  | 1000000 |         |          |           |
|                             |              | 25V     |                        |     |       | 39000  | 470000  |         |          |           |
|                             |              | 50V     |                        | 220 |       |        | 220000  |         |          |           |
|                             | 31<br>(1206) | 6.3V    |                        |     |       |        |         | 6800000 | 10000000 |           |
|                             |              | 10V     |                        |     |       |        | 1000000 | 4700000 |          |           |
|                             |              | 16V     |                        |     |       |        | 330000  | 3300000 |          |           |
|                             |              | 25V     |                        |     |       | 100000 | 1000000 |         |          |           |
|                             |              | 50V     |                        |     | 1000  |        |         | 1000000 |          |           |

# Multilayer Ceramic Capacitor

## ● CLASS II , B(X7R)

| Temperature Characteristics | Size         | Voltage | Capacitance Range (pF) |     |       |       |         |            |            |           |
|-----------------------------|--------------|---------|------------------------|-----|-------|-------|---------|------------|------------|-----------|
|                             |              |         | 10                     | 100 | 1000  | 10000 | 100000  | 1000000    | 10000000   | 100000000 |
| B(X7R)                      | 32<br>(1210) | 6.3V    |                        |     |       |       |         |            | ■ 22000000 |           |
|                             |              | 10V     |                        |     |       |       | 1500000 | ■ 4700000  |            |           |
|                             |              | 16V     |                        |     |       |       | 1500000 | ■ 4700000  |            |           |
|                             |              | 25V     |                        |     |       |       | 680000  | ■ 2200000  |            |           |
|                             |              | 50V     |                        |     | 2200  | ■     | 1000000 |            |            |           |
|                             | 43<br>(1812) | 10V     |                        |     |       |       |         | ■ 22000000 |            |           |
|                             |              | 16V     |                        |     |       |       |         | ■ 2200000  |            |           |
|                             |              | 25V     |                        |     |       |       |         | ■ 1000000  |            |           |
|                             |              | 50V     |                        |     | 10000 | ■     | 1000000 |            |            |           |
|                             | 55<br>(2220) | 25V     |                        |     |       |       |         | ■ 10000000 |            |           |
|                             |              | 50V     |                        |     |       |       | 3300000 | ■ 4700000  |            |           |

# Multilayer Ceramic Capacitor

## ● CLASS II , F(Y5V)

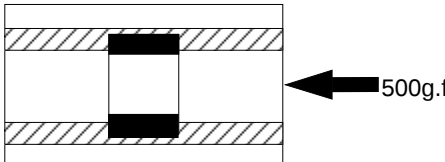
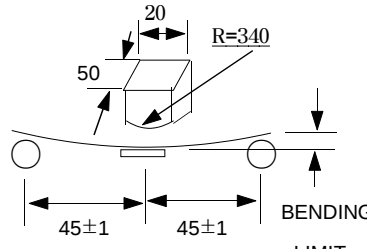
| Temperature Characteristics | Size         | Voltage | Capacitance Range (pF) |     |      |         |         |          |           |           |
|-----------------------------|--------------|---------|------------------------|-----|------|---------|---------|----------|-----------|-----------|
|                             |              |         | 10                     | 100 | 1000 | 10000   | 100000  | 1000000  | 10000000  | 100000000 |
| F(Y5V)                      | 03<br>(0201) | 6.3V    |                        |     |      | 10000   | 100000  |          |           |           |
|                             | 05<br>(0402) | 10 V    |                        |     |      |         | 220000  | 330000   |           |           |
|                             |              | 16 V    |                        |     |      | 10000   | 220000  |          |           |           |
|                             |              | 25 V    |                        |     |      | 10000   | 33000   |          |           |           |
|                             |              | 50 V    |                        |     | 2200 | 10000   |         |          |           |           |
|                             | 10<br>(0603) | 6.3V    |                        |     |      |         |         | 2200000  |           |           |
|                             |              | 10 V    |                        |     |      | 100000  | 1000000 |          |           |           |
|                             |              | 16 V    |                        |     |      | 100000  | 1000000 |          |           |           |
|                             |              | 25 V    |                        |     |      | 22000   | 330000  |          |           |           |
|                             |              | 50 V    |                        |     | 2200 | 100000  |         |          |           |           |
|                             | 21<br>(0805) | 6.3V    |                        |     |      |         |         | 10000000 |           |           |
|                             |              | 10 V    |                        |     |      |         |         | 4700000  |           |           |
|                             |              | 16 V    |                        |     |      | 10000   | 2200000 |          |           |           |
|                             |              | 25 V    |                        |     |      | 10000   | 1000000 |          |           |           |
|                             |              | 50 V    |                        |     | 2200 | 1000000 |         |          |           |           |
|                             | 31<br>(1206) | 10 V    |                        |     |      |         | 470000  | 22000000 |           |           |
|                             |              | 16 V    |                        |     |      |         | 1000000 | 10000000 |           |           |
|                             |              | 25 V    |                        |     |      |         | 470000  | 3300000  |           |           |
|                             |              | 50 V    |                        |     |      | 10000   | 1000000 |          |           |           |
|                             | 32<br>(1210) | 6.3V    |                        |     |      |         |         | 47000000 |           |           |
|                             |              | 10 V    |                        |     |      |         |         | 22000000 |           |           |
|                             |              | 16 V    |                        |     |      |         | 3300000 | 15000000 |           |           |
|                             |              | 25 V    |                        |     |      |         | 1000000 | 10000000 |           |           |
|                             |              | 50 V    |                        |     |      | 100000  | 1000000 |          |           |           |
|                             | 43<br>(1812) | 16V     |                        |     |      |         |         | 22000000 |           |           |
|                             |              | 25 V    |                        |     |      |         |         | 10000000 |           |           |
|                             |              | 50 V    |                        |     |      |         |         | 10000000 |           |           |
|                             | 55<br>(2220) | 10 V    |                        |     |      |         |         |          | 100000000 |           |

# Multilayer Ceramic Capacitor

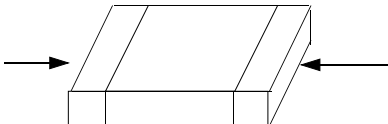
## RELIABILITY TEST DATA

| NO | ITEM                  |          | PERFORMANCE                                                                                                                                                                                                                                                                     | TEST CONDITION                                                                                                                             |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|----|-----------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------|----------|-----|----------|-----|-----------|-----|-----------|--------|-----------|-------------|-----------|---------|
| 1  | APPEARANCE            |          | NO ABNORMAL EXTERIOR APPEARANCE                                                                                                                                                                                                                                                 | THROUGH MICROSCOPE(×10)                                                                                                                    |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
| 2  | INSULATION RESISTANCE |          | 10,000MΩ OR 500MΩ·μF PRODUCT WHICHEVER IS SMALLER<br>(RATED VOLTAGE IS BELOW 16V : 10,000MΩ OR 100MΩ·μF)                                                                                                                                                                        | RATED VOLTAGE SHALL BE APPLIED.<br>MEASUREMENT TIME IS 60 ~ 120 RATED VOLTAGE TIME 60 SEC.                                                 |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
| 3  | WITHSTANDING VOLTAGE  |          | NO DIELECTRIC BREAKDOWN OR MECHANICAL BREAKDOWN                                                                                                                                                                                                                                 | CLASS I : 300% OF THE RATED VOLTAGE FOR 1-5 SEC,<br>CLASS II :250% OF THE RATED VOLTAGE FOR 1-5 SEC IS APPLIED WITH LESS THAN 50mA CURRENT |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
| 4  | CAPACITANCE           | CLASS I  | WITHIN THE SPECIFIED TOLERANCE                                                                                                                                                                                                                                                  | CAPACITANCE                                                                                                                                | FREQUENCY | VOLTAGE      |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 1,000pF AND BELOW                                                                                                                          | 1kHz±10%  | 0.5 ~ 5 Vrms |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | MORE THAN 1,000pF                                                                                                                          | 1kHz±10%  |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       | CLASS II | WITHIN THE SPECIFIED TOLERANCE                                                                                                                                                                                                                                                  | CAPACITANCE                                                                                                                                | FREQUENCY | VOLTAGE      |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 10μF AND BELOW                                                                                                                             | 1kHz±10%  | 1.0±0.2Vrms  |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | MORE THAN 10μF                                                                                                                             | 120Hz±20% | 0.5±0.1Vrms  |          |     |          |     |           |     |           |        |           |             |           |         |
| 5  | Q                     | CLASS I  | OVER 30pF : Q ≥1,000<br>LESS THAN 30pF: Q ≥400 +20C<br>( C : CAPACITANCE )                                                                                                                                                                                                      | CAPACITANCE                                                                                                                                | FREQUENCY | VOLTAGE      |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 1,000pF AND BELOW                                                                                                                          | 1kHz±10%  | 0.5 ~ 5 Vrms |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | MORE THAN 1,000pF                                                                                                                          | 1kHz±10%  |              |          |     |          |     |           |     |           |        |           |             |           |         |
| 6  | Tanδ                  | CLASS II | 1. CHAR : B <table><tr><td>RATED VOLTAGE</td><td>DF SPEC</td></tr><tr><td>6.3V</td><td>0.05 max</td></tr><tr><td>10V</td><td>0.05 max</td></tr><tr><td>16V</td><td>0.035 max</td></tr><tr><td>25V</td><td>0.025 max</td></tr><tr><td>50V 이상</td><td>0.025 max</td></tr></table> | RATED VOLTAGE                                                                                                                              | DF SPEC   | 6.3V         | 0.05 max | 10V | 0.05 max | 16V | 0.035 max | 25V | 0.025 max | 50V 이상 | 0.025 max | CAPACITANCE | FREQUENCY | VOLTAGE |
|    |                       |          |                                                                                                                                                                                                                                                                                 | RATED VOLTAGE                                                                                                                              | DF SPEC   |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 6.3V                                                                                                                                       | 0.05 max  |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 10V                                                                                                                                        | 0.05 max  |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 16V                                                                                                                                        | 0.035 max |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 25V                                                                                                                                        | 0.025 max |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 50V 이상                                                                                                                                     | 0.025 max |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | 10μF AND BELOW                                                                                                                             | 1kHz±10%  | 1.0±0.2Vrms  |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 | MORE THAN 10μF                                                                                                                             | 120Hz±20% | 0.5±0.1Vrms  |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
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|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |
|    |                       |          |                                                                                                                                                                                                                                                                                 |                                                                                                                                            |           |              |          |     |          |     |           |     |           |        |           |             |           |         |

# Multilayer Ceramic Capacitor

| NO       | ITEM                                      |                                                                       | PERFORMANCE                          |                                                                                                                                                               | TEST CONDITION                                                                                                                                                                                                                                                                                                                                                               |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|----------|-------------------------------------------|-----------------------------------------------------------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------------|------------|--------|---|--------------------|---|--------|---|--------------------|---|--------|
| 7        | CAPACITANCE<br>TEMPERATURE<br>COEFFICIENT | CLASS<br>I                                                            |                                      |                                                                                                                                                               | THESE SYMMETRICAL TOLERANCE APPLY TO<br>2 POINT MEASUREMENT OF TEMPERATURE<br>COEFFICIENT: ONE AT 25℃ AND AT 85℃ <table><tr><th>STEP</th><th>TEMPERATURE</th></tr><tr><td>1</td><td>25 ± 2</td></tr><tr><td>2</td><td>MIN RATED TEMP ± 2</td></tr><tr><td>3</td><td>25 ± 2</td></tr><tr><td>4</td><td>MAX RATED TEMP ± 2</td></tr><tr><td>5</td><td>25 ± 2</td></tr></table> | STEP                         | TEMPERATURE | 1          | 25 ± 2 | 2 | MIN RATED TEMP ± 2 | 3 | 25 ± 2 | 4 | MAX RATED TEMP ± 2 | 5 | 25 ± 2 |
|          |                                           |                                                                       | STEP                                 | TEMPERATURE                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | 1                                    | 25 ± 2                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | 2                                    | MIN RATED TEMP ± 2                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | 3                                    | 25 ± 2                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | 4                                    | MAX RATED TEMP ± 2                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | 5                                    | 25 ± 2                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | CHARACTERISTIC                       |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              | TEMP. COEFFICIENT<br>(PPM/℃) |             |            |        |   |                    |   |        |   |                    |   |        |
| C0G      | 0 ± 30                                    |                                                                       |                                      |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| PH       | -150 ± 60                                 |                                                                       |                                      |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| RH       | -220 ± 60                                 |                                                                       |                                      |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| SH       | -330 ± 60                                 |                                                                       |                                      |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| TH       | -470 ± 60                                 |                                                                       |                                      |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| UL       | -750 ± 120                                |                                                                       |                                      |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| SL       | +350 ~ -1000                              |                                                                       |                                      |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| 8        | TEMPERATURE<br>CHARACTERISTIC<br>S        | CLASS<br>II                                                           | CAPACITANCE CHANGE                   |                                                                                                                                                               | The change of capacitance should be got from<br>the capacitance at 25℃.<br>After capacitance measured from Min. Temp. to<br>Max. Temp.,<br>it should be calculated from the formula below.<br>$\frac{C2 - C1}{C1} \times 100 \%$<br>C1 : CAPACITANCE AT STANDARD<br>TEMPERATURE(25℃)<br>C2 : CAPACITANCE AT EACH<br>TEMPERATURE                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | CHAR. CAP. CHANGE(%)                 |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | A,B                                  | ±15%                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | F                                    | +22% ~ -82%                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| 9        | ADHESIVE STRENGTH<br>OF TERMINATION       | NO INDICATION OF PEELING SHALL<br>OCCUR ON THE TERMINAL<br>ELECTRODE. |                                      | A 500g.f PRESSURE SHALL BE<br>APPLIED FOR 10±1 SECOND.<br><br>SEE (FIG.1) |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       |                                      |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
| 10       | BENDING<br>STRENGTH                       | APPEARANCE                                                            | NO MECHANICAL DAMAGE SHALL<br>OCCUR. |                                                                                                                                                               | BENDING SHALL BE APPLIED TO<br>THE LIMIT(1mm) WITH 0.3mm/SEC.<br>KEEP THE TEST BOARD AT THE LIMIT POINT<br>IN 5 SEC., THEN MEASURE CAPACITANCE. <table><tr><th>CHARACTER</th><th>LIMIT</th></tr><tr><td>C, A, B, F</td><td>1mm</td></tr></table> <br>SEE (FIG.2)                         | CHARACTER                    | LIMIT       | C, A, B, F | 1mm    |   |                    |   |        |   |                    |   |        |
|          |                                           | CHARACTER                                                             | LIMIT                                |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           | C, A, B, F                                                            | 1mm                                  |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           | CAPACITANCE                                                           | CHARACTER                            | CHANGE OF<br>CAPACITANCE                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       | CLASS I                              | WITHIN ±5%<br>OR ± 0.5 pF<br>WHICHEVER IS<br>LARGER                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |
|          |                                           |                                                                       |                                      | A,B                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                              | WITHIN ±12.5%                |             |            |        |   |                    |   |        |   |                    |   |        |
| CLASS II | F                                         |                                                                       | WITHIN ±30%                          |                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                              |                              |             |            |        |   |                    |   |        |   |                    |   |        |

# Multilayer Ceramic Capacitor

| NO      | ITEM                         |                       | PERFORMANCE                                                                                                                                                                                                                                                                                                   |                                             |                                                                                                      | TEST CONDITION                                                                                                                                                                                                                                                                                                                         |                |                 |             |                    |        |    |   |         |    |
|---------|------------------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|-------------|--------------------|--------|----|---|---------|----|
| 11      | SOLDERABILITY                |                       | <div>MORE THAN 75% OF THE TERMINAL SURFACE IS TO BE SOLDERED NEWLY, SO METAL PART DOES NOT COME OUT OR DISSOLVE</div> <div></div> <div>IN PB--FREE PART, MORE THAN 95% OF THE TERMINAL SURFACE IS TO BE SOLDERED NEWLY</div> |                                             |                                                                                                      | <div>SOLDER TEMPERATURE : 230±5℃</div> <div>DIP TIME : 3±1 Sec</div> <div>SOLDER : H63A</div> <div>FLUX : RMA TYPE</div> <div>*PB-FREE</div> <div>SOLDER TEMPERATURE : 260±5℃</div> <div>SOLDER : Sn96.5-3Ag-0.5Cu</div> <div>Flux : RMA TYPE</div> <div>DIP TIME : 3±0.1Sec</div> <div>* PRE-HEATING : AT 80~120℃ FOR 10~30SEC.</div> |                |                 |             |                    |        |    |   |         |    |
| 12      | RESISTANCE TO SOLDERING HEAT | APPEARANCE            | NO MECHANICAL DAMAGE SHALL OCCUR                                                                                                                                                                                                                                                                              |                                             |                                                                                                      | DIP : SOLDER TEMPERATURE OF 270±5℃                                                                                                                                                                                                                                                                                                     |                |                 |             |                    |        |    |   |         |    |
|         |                              | CAPACITANCE           | CHARACTERISTIC                                                                                                                                                                                                                                                                                                | CAP. CHANGE                                 |                                                                                                      | DIP TIME :10±1 SEC.                                                                                                                                                                                                                                                                                                                    |                |                 |             |                    |        |    |   |         |    |
|         |                              |                       | CLASS I                                                                                                                                                                                                                                                                                                       | WITHIN ±2.5% OR ±0.25pF WHICHEVER IS LARGER |                                                                                                      | EACH TERMINATION SHALL BE FULLY IMMERSED AND PREHEATED AS FOLLOWING:                                                                                                                                                                                                                                                                   |                |                 |             |                    |        |    |   |         |    |
|         |                              |                       | CLASS II                                                                                                                                                                                                                                                                                                      | A,B                                         | WITHIN ±7.5%                                                                                         |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
|         |                              |                       | F                                                                                                                                                                                                                                                                                                             | WITHIN ±20%                                 |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
|         |                              | Q CLASS I             | 30pF AND OVER : Q≥ 1000<br>LESS THAN 30pF : Q≥ 400+20×C                                                                                                                                                                                                                                                       |                                             |                                                                                                      | <table><tr><th>STEP</th><th>TEMP.(℃)</th><th>TIME (SEC.)</th></tr><tr><td>1</td><td>80~100</td><td>60</td></tr><tr><td>2</td><td>150~180</td><td>60</td></tr></table>                                                                                                                                                                  | STEP           | TEMP.(℃)        | TIME (SEC.) | 1                  | 80~100 | 60 | 2 | 150~180 | 60 |
| STEP    | TEMP.(℃)                     | TIME (SEC.)           |                                                                                                                                                                                                                                                                                                               |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
| 1       | 80~100                       | 60                    |                                                                                                                                                                                                                                                                                                               |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
| 2       | 150~180                      | 60                    |                                                                                                                                                                                                                                                                                                               |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
|         |                              | Tanδ CLASS II         | TO SATISFY THE SPECIFIED INITIAL VALUE                                                                                                                                                                                                                                                                        |                                             |                                                                                                      | MEASURE AT ROOM TEMP. AFTER COOLING FOR                                                                                                                                                                                                                                                                                                |                |                 |             |                    |        |    |   |         |    |
|         |                              | INSULATION RESISTANCE | TO SATISFY THE SPECIFIED INITIAL VALUE                                                                                                                                                                                                                                                                        |                                             |                                                                                                      | CLASS I : 24 ± 2 HOURS<br>CLASS II : 48 ± 4 HOURS                                                                                                                                                                                                                                                                                      |                |                 |             |                    |        |    |   |         |    |
|         |                              | WITHSTANDING VOLTAGE  | TO SATISFY THE SPECIFIED INITIAL VALUE                                                                                                                                                                                                                                                                        |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
| 13      | VIBRATION TEST               | APPEARANCE            | NO MECHANICAL DAMAGE SHALL OCCUR.                                                                                                                                                                                                                                                                             |                                             |                                                                                                      | BENDING SHALL BE APPLIED TO THE LIMIT(1mm) WITH 0.3mm/SEC.                                                                                                                                                                                                                                                                             |                |                 |             |                    |        |    |   |         |    |
|         |                              | CAPACITANCE           | CHARACTERISTIC                                                                                                                                                                                                                                                                                                | CAP. CHANGE                                 |                                                                                                      | KEEP THE TEST BOARD AT THE LIMIT POINT IN 5 SEC., THEN MEASURE CAPACITANCE.                                                                                                                                                                                                                                                            |                |                 |             |                    |        |    |   |         |    |
|         |                              |                       | CLASS I                                                                                                                                                                                                                                                                                                       | WITHIN ±2.5% OR ±0.25pF WHICHEVER IS LARGER |                                                                                                      | <table><tr><th>CHAR.</th><th>FREQUENCY RANGE</th></tr><tr><td>A,B,C,F</td><td>10Hz → 55Hz → 10Hz</td></tr></table>                                                                                                                                                                                                                     | CHAR.          | FREQUENCY RANGE | A,B,C,F     | 10Hz → 55Hz → 10Hz |        |    |   |         |    |
| CHAR.   | FREQUENCY RANGE              |                       |                                                                                                                                                                                                                                                                                                               |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
| A,B,C,F | 10Hz → 55Hz → 10Hz           |                       |                                                                                                                                                                                                                                                                                                               |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
|         |                              | CLASS II              | A,B                                                                                                                                                                                                                                                                                                           | WITHIN ±5%                                  |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
|         |                              |                       | F                                                                                                                                                                                                                                                                                                             | WITHIN ±20%                                 | <table><tr><th>CHAR.</th><th>TRAVERSED TIME</th></tr><tr><td>A,B,C,F</td><td>1 min</td></tr></table> | CHAR.                                                                                                                                                                                                                                                                                                                                  | TRAVERSED TIME | A,B,C,F         | 1 min       |                    |        |    |   |         |    |
| CHAR.   | TRAVERSED TIME               |                       |                                                                                                                                                                                                                                                                                                               |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
| A,B,C,F | 1 min                        |                       |                                                                                                                                                                                                                                                                                                               |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
|         |                              | Q CLASS I             | 30pF AND OVER : Q≥ 1000<br>LESS THAN 30pF : Q≥ 400+20×C                                                                                                                                                                                                                                                       |                                             |                                                                                                      | THE ENTIRE FREQUENCY RANGE, FROM 10 TO 55Hz AND RETURN TO 10Hz, SHALL BE TRAVERSED IN 1 MINUTE.                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
|         |                              | Tanδ CLASS II         | TO SATISFY THE SPECIFIED INITIAL VALUE                                                                                                                                                                                                                                                                        |                                             |                                                                                                      |                                                                                                                                                                                                                                                                                                                                        |                |                 |             |                    |        |    |   |         |    |
|         |                              | INSULATION RESISTANCE | TO SATISFY THE SPECIFIED INITIAL VALUE                                                                                                                                                                                                                                                                        |                                             |                                                                                                      | THIS CYCLE SHALL BE PERFORMED 2 HOURS IN EACH THERE MUTUALLY PERPENDICULAR DIRECTION, FOR TOTAL PERIOD OF 6 HOURS.                                                                                                                                                                                                                     |                |                 |             |                    |        |    |   |         |    |

\* THE INITIAL VALUE OF HIGH DIELECTRIC CONSTANT SERIES SHALL BE MEASURED

AFTER THE HEAT TREATMENT OF  $150 \pm 0/10^{\circ}\text{C}$ , 1hr AND SITTING OF  $48\pm 4$ hr AT ROOM TEMPERATURE & ROOM HUMIDITY.

# Multilayer Ceramic Capacitor

| NO                       | ITEM                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                   | PERFORMANCE                                                                           |              |                                                   |  |       |                                                                                                                                         | TEST CONDITION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------------------|--------------|---------------------------------------------------|--|-------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|----|-----|-------------|-------------|-------------|--------------|------------|---|--------------|---------------------------------------------------|-------------|--------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------|----------------------|-------------------|----------------|---------------|---------------|----------------|----------------|----------------|-----------------|
| 14                       | HUMIDITY<br>(STEADY<br>STATE)                                                                                                                                                                                                                                                                                                                                                                                          | APPEARANCE                                        | NO MECHANICAL DAMAGE SHALL OCCUR                                                      |              |                                                   |  |       |                                                                                                                                         | TEMPERATURE : 40±2 ℃<br>RELATIVE HUMIDITY:90~95 %RH<br>TEST TIME : 500 +12/-0 Hr.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        | CAPACITANCE                                       | CHARACTERISTIC                                                                        |              | CAPACITANCE CHANGE                                |  |       |                                                                                                                                         | MEASURE AT ROOM TEMPERATURE<br>AFTER COOLING FOR<br>CLASS I : 24±2 Hr.<br>CLASS II : 48±4 Hr.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   | CLASS I                                                                               |              | WITHIN ±5% OR<br>±0.5pF WHICHEVER<br>IS LARGER    |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   | CLASS II                                                                              | A,B          | WITHIN ±12.5%                                     |  |       | WITHIN ±30%                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        | F                                                 |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        | Q<br>CLASS I                                      | 30pF AND OVER : Q≥ 350<br>10 ~30pF : Q≥ 275 + 2.5×C<br>LESS THAN 10pF : Q≥ 200 + 10×C |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| Tanδ<br>CLASS II         | <table><tr><td>CHAR.</td><td>25V<br/>AND<br/>OVER</td><td>16V</td><td>10V</td><td>6.3V</td><td>4V</td></tr><tr><td>A,B</td><td>0.05</td><td>0.05 MAX</td><td>0.05<br/>MAX</td><td>0.075<br/>MAX</td><td>0.1<br/>MAX</td></tr><tr><td>F</td><td>0.075<br/>MAX</td><td>0.1MAX<br/>(C &lt;1.0μF)<br/>0.125<br/>MAX<br/>(C≥1.0μF)</td><td>0.15<br/>MAX</td><td>0.195<br/>MAX</td><td>0.25<br/>MAX</td></tr></table>        |                                                   |                                                                                       |              |                                                   |  | CHAR. | 25V<br>AND<br>OVER                                                                                                                      | 16V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 10V | 6.3V | 4V | A,B | 0.05        | 0.05 MAX    | 0.05<br>MAX | 0.075<br>MAX | 0.1<br>MAX | F | 0.075<br>MAX | 0.1MAX<br>(C <1.0μF)<br>0.125<br>MAX<br>(C≥1.0μF) | 0.15<br>MAX | 0.195<br>MAX | 0.25<br>MAX | <table><tr><td>6.3V<br/>Tanδ</td><td>0.125 MAX *Condition</td></tr><tr><td rowspan="6">CLASS II<br/>(A,B)</td><td>1005 C ≥0.22μF</td></tr><tr><td>1608 C ≥2.2μF</td></tr><tr><td>2012 C ≥4.7μF</td></tr><tr><td>3216 C ≥10.0μF</td></tr><tr><td>3225 C ≥22.0μF</td></tr><tr><td>4532 C ≥47.0μF</td></tr><tr><td>5750 C ≥100.0μF</td></tr></table> |  | 6.3V<br>Tanδ | 0.125 MAX *Condition | CLASS II<br>(A,B) | 1005 C ≥0.22μF | 1608 C ≥2.2μF | 2012 C ≥4.7μF | 3216 C ≥10.0μF | 3225 C ≥22.0μF | 4532 C ≥47.0μF | 5750 C ≥100.0μF |
| CHAR.                    | 25V<br>AND<br>OVER                                                                                                                                                                                                                                                                                                                                                                                                     | 16V                                               | 10V                                                                                   | 6.3V         | 4V                                                |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| A,B                      | 0.05                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.05 MAX                                          | 0.05<br>MAX                                                                           | 0.075<br>MAX | 0.1<br>MAX                                        |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| F                        | 0.075<br>MAX                                                                                                                                                                                                                                                                                                                                                                                                           | 0.1MAX<br>(C <1.0μF)<br>0.125<br>MAX<br>(C≥1.0μF) | 0.15<br>MAX                                                                           | 0.195<br>MAX | 0.25<br>MAX                                       |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| 6.3V<br>Tanδ             | 0.125 MAX *Condition                                                                                                                                                                                                                                                                                                                                                                                                   |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| CLASS II<br>(A,B)        | 1005 C ≥0.22μF                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 1608 C ≥2.2μF                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 2012 C ≥4.7μF                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 3216 C ≥10.0μF                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 3225 C ≥22.0μF                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 4532 C ≥47.0μF                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| 5750 C ≥100.0μF          |                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| INSULATION<br>RESISTANCE | MINIMUM INSULATION RESISTANCE:<br>1,000 MΩ OR 50MΩ·μF PRODUCT WHICHEVER IS<br>SMALLER                                                                                                                                                                                                                                                                                                                                  |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| 15                       | MOISTURE<br>RESISTANCE                                                                                                                                                                                                                                                                                                                                                                                                 | APPEARANCE                                        | NO MECHANICAL DAMAGE SHALL OCCUR                                                      |              |                                                   |  |       |                                                                                                                                         | APPLIED VOLTAGE :<br>RATED VOLTAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        | CAPACITANCE                                       | CHARACTERISTIC                                                                        |              | CAPACITANCE CHANGE                                |  |       |                                                                                                                                         | TEMPERATURE : 40±2 ℃<br>RELATIVE HUMIDITY:90~95%RH<br>TEST TIME : 500 +12/-0 Hr.<br>CURRENT APPLIED : 50mA MAX.<br><INITIAL MEASUREMENT><br>CLASS II SHOULD BE MEASURED<br>INITIAL VALUE AFTER BE HEAT-TREATED<br>FOR 1 HR IN 150℃+0/-10℃ AND BE LEFT<br>FOR 48±4HR AT ROOM TEMPERATURE.<br><LATTER MEASUREMENT><br>CLASS I SHOULD BE MEASURED AFTER<br>LEFT FOR 24±2 HRS IN ROOM<br>TEMPERATURE AND HUMIDITY.<br>CLASS II SHOULD BE MEASURED<br>LATTER VALUE AFTER BE<br>HEAT-TREATED FOR 1 HR IN 150℃+0/-10<br>℃ AND BE LEFT FOR 48±4HR AT ROOM<br>TEMPERATURE. |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   | CLASS I                                                                               |              | WITHIN ±7.5% OR<br>±0.75pF WHICHEVER<br>IS LARGER |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   | CLASS II                                                                              | A,B          | WITHIN ±12.5%                                     |  |       | WITHIN ±30%<br><br>WITHIN +30~- 40%<br>1005 C>0.47μF<br>1608 C>1.0μF<br>2012 C>4.7μF<br>3216 C>10.0μF<br>3225 C>22.0μF<br>4532 C>47.0μF |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   |                                                                                       | F            |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| Q<br>CLASS I             | 30pF AND OVER : Q≥ 200<br>30pF AND BELOW : Q≥ 100 + 10/3×C                                                                                                                                                                                                                                                                                                                                                             |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| Tanδ<br>CLASS II         | <table><tr><td>CHAR.</td><td>25V<br/>AND<br/>OVER</td><td>16V</td><td>10V</td><td>6.3V</td><td>4V</td></tr><tr><td>A,B</td><td>0.05<br/>MAX</td><td>0.05<br/>MAX</td><td>0.05<br/>MAX</td><td>0.075<br/>MAX</td><td>0.1<br/>MAX</td></tr><tr><td>F</td><td>0.075<br/>MAX</td><td>0.1MAX<br/>(C &lt;1.0μF)<br/>0.125MAX<br/>(C≥1.0μF)</td><td>0.15<br/>MAX</td><td>0.195<br/>MAX</td><td>0.25<br/>MAX</td></tr></table> |                                                   |                                                                                       |              |                                                   |  | CHAR. | 25V<br>AND<br>OVER                                                                                                                      | 16V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 10V | 6.3V | 4V | A,B | 0.05<br>MAX | 0.05<br>MAX | 0.05<br>MAX | 0.075<br>MAX | 0.1<br>MAX | F | 0.075<br>MAX | 0.1MAX<br>(C <1.0μF)<br>0.125MAX<br>(C≥1.0μF)     | 0.15<br>MAX | 0.195<br>MAX | 0.25<br>MAX | <table><tr><td>6.3V Tanδ</td><td>0.125 MAX *Condition</td></tr><tr><td rowspan="6">CLASS II<br/>(A,B)</td><td>1005 C ≥0.22μF</td></tr><tr><td>1608 C ≥2.2μF</td></tr><tr><td>2012 C ≥4.7μF</td></tr><tr><td>3216 C ≥10.0μF</td></tr><tr><td>3225 C ≥22.0μF</td></tr><tr><td>4532 C ≥47.0μF</td></tr><tr><td>5750 C ≥100.0μF</td></tr></table>     |  | 6.3V Tanδ    | 0.125 MAX *Condition | CLASS II<br>(A,B) | 1005 C ≥0.22μF | 1608 C ≥2.2μF | 2012 C ≥4.7μF | 3216 C ≥10.0μF | 3225 C ≥22.0μF | 4532 C ≥47.0μF | 5750 C ≥100.0μF |
| CHAR.                    | 25V<br>AND<br>OVER                                                                                                                                                                                                                                                                                                                                                                                                     | 16V                                               | 10V                                                                                   | 6.3V         | 4V                                                |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| A,B                      | 0.05<br>MAX                                                                                                                                                                                                                                                                                                                                                                                                            | 0.05<br>MAX                                       | 0.05<br>MAX                                                                           | 0.075<br>MAX | 0.1<br>MAX                                        |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| F                        | 0.075<br>MAX                                                                                                                                                                                                                                                                                                                                                                                                           | 0.1MAX<br>(C <1.0μF)<br>0.125MAX<br>(C≥1.0μF)     | 0.15<br>MAX                                                                           | 0.195<br>MAX | 0.25<br>MAX                                       |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| 6.3V Tanδ                | 0.125 MAX *Condition                                                                                                                                                                                                                                                                                                                                                                                                   |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| CLASS II<br>(A,B)        | 1005 C ≥0.22μF                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 1608 C ≥2.2μF                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 2012 C ≥4.7μF                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 3216 C ≥10.0μF                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 3225 C ≥22.0μF                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
|                          | 4532 C ≥47.0μF                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| 5750 C ≥100.0μF          |                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |
| INSULATION<br>RESISTANCE | MINIMUM INSULATION RESISTANCE:<br>500 MΩ OR 25MΩ·μF PRODUCT,<br>WHICHEVER IS SMALLER.                                                                                                                                                                                                                                                                                                                                  |                                                   |                                                                                       |              |                                                   |  |       |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |      |    |     |             |             |             |              |            |   |              |                                                   |             |              |             |                                                                                                                                                                                                                                                                                                                                                   |  |              |                      |                   |                |               |               |                |                |                |                 |

## Multilayer Ceramic Capacitor

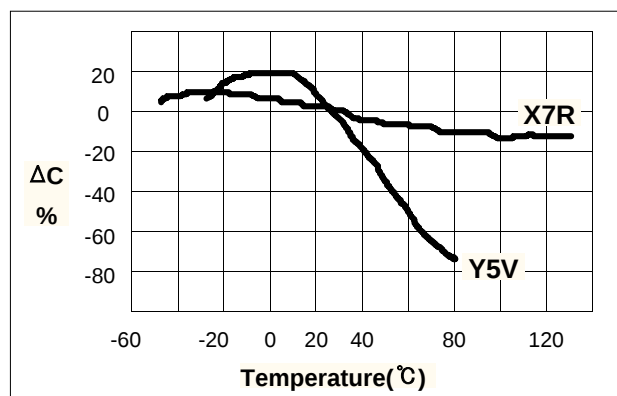
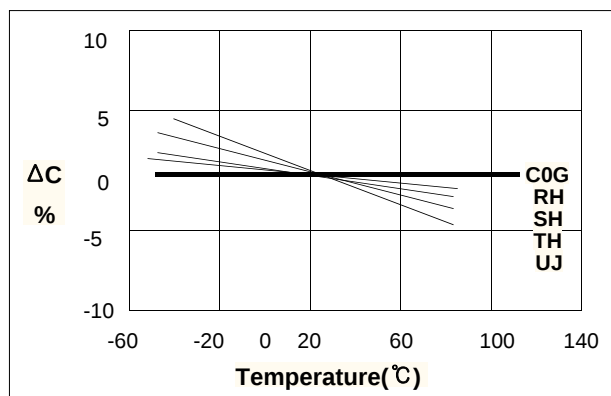
| NO                    | ITEM                                                                                                                                                                                                                                                                                                                                                              |                                        | PERFORMANCE                                                                                                                      |           |          |  |       |              | TEST CONDITION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|-----------|----------|--|-------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|----------|-----------|----------|----------------------|----------|-----------|---------|----------|-----------|----------------------------------------|----------|-----------|-----------|-----|---|----------|--|
| 16                    | HIGH TEMPERATURE RESISTANCE                                                                                                                                                                                                                                                                                                                                       | APPEARANCE                             | NO MECHANICAL DAMAGE SHALL OCCUR                                                                                                 |           |          |  |       |              | <div>APPLIED VOLTAGE :<br/>150%, 200% OF RATED VOLTAGE<br/>TEST TIME : 1000 +48/-0 Hr.<br/>CURRENT APPLIED : 50mA MAX.</div> <table><tr><td colspan="2">CHAR.</td><td colspan="2">TEMP.</td></tr><tr><td colspan="2">CLASS I</td><td colspan="2">125 ±3 °C</td></tr><tr><td rowspan="3">CLASS II</td><td>A</td><td colspan="2">85 ±3 °C</td></tr><tr><td>B</td><td colspan="2">125 ±3 °C</td></tr><tr><td>F</td><td colspan="2">85 ±3 °C</td></tr></table> <div>&lt;INITIAL MEASUREMENT&gt;<br/>CLASS II SHOULD BE MEASURED INITIAL VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150℃+0/-10℃ AND BE LEFT FOR 48±4HR AT ROOM TEMPERATURE.<br/>&lt;LATTER MEASUREMENT&gt;<br/>CLASS I SHOULD BE MEASURED AFTER LEFT FOR 24±2 HRS IN ROOM TEMPERATURE AND HUMIDITY.<br/>CLASS II SHOULD BE MEASURED LATTER VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150℃+0/-10℃ AND BE LEFT FOR 48±4HR AT ROOM TEMPERATURE.</div> |     | CHAR. |          | TEMP.     |          | CLASS I              |          | 125 ±3 °C |         | CLASS II | A         | 85 ±3 °C                               |          | B         | 125 ±3 °C |     | F | 85 ±3 °C |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | CHAR.                                  |                                                                                                                                  | TEMP.     |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | CLASS I                                |                                                                                                                                  | 125 ±3 °C |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | CLASS II                               | A                                                                                                                                | 85 ±3 °C  |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   |                                        | B                                                                                                                                | 125 ±3 °C |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   |                                        | F                                                                                                                                | 85 ±3 °C  |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| CAPACITANCE           | CHARACTERISTIC                                                                                                                                                                                                                                                                                                                                                    |                                        | CAP. CHANGE                                                                                                                      |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       | CLASS I                                                                                                                                                                                                                                                                                                                                                           |                                        | WITHIN ±3% OR ±0.3pF, WHICHEVER IS LARGER                                                                                        |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | A,B                                    | WITHIN ±12.5%                                                                                                                    |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | F                                      | WITHIN ±30%<br>WITHIN+30~40%<br>1005 C>0.47µF<br>1608 C>1.0µF<br>2012 C>4.7µF<br>3216 C>10.0µF<br>3225 C>22.0µF<br>4532 C>47.0µF |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| Q<br>CLASS I          | 30pF AND OVER : Q ≥ 350<br>10 ~ 30 pF : Q ≥ 275 + 2.5×C<br>LESS THAN 10pF :Q ≥200 + 10×C                                                                                                                                                                                                                                                                          |                                        |                                                                                                                                  |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| Tanδ<br>CLASS II      | <table><tr><td>CHAR.</td><td>25V AND OVER</td><td>16V</td><td>10V</td><td>6.3V</td><td>4V</td></tr><tr><td>A,B</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.05 MAX</td><td>0.075 MAX</td><td>0.1 MAX</td></tr><tr><td>F</td><td>0.075 MAX</td><td>0.1MAX (C&lt;1.0µF)<br/>0.125MAX (C≥1.0µF)</td><td>0.15 MAX</td><td>0.195 MAX</td><td>0.25 MAX</td></tr></table> |                                        |                                                                                                                                  |           |          |  | CHAR. | 25V AND OVER | 16V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 10V | 6.3V  | 4V       | A,B       | 0.05 MAX | 0.05 MAX             | 0.05 MAX | 0.075 MAX | 0.1 MAX | F        | 0.075 MAX | 0.1MAX (C<1.0µF)<br>0.125MAX (C≥1.0µF) | 0.15 MAX | 0.195 MAX | 0.25 MAX  |     |   |          |  |
| CHAR.                 | 25V AND OVER                                                                                                                                                                                                                                                                                                                                                      | 16V                                    | 10V                                                                                                                              | 6.3V      | 4V       |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| A,B                   | 0.05 MAX                                                                                                                                                                                                                                                                                                                                                          | 0.05 MAX                               | 0.05 MAX                                                                                                                         | 0.075 MAX | 0.1 MAX  |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| F                     | 0.075 MAX                                                                                                                                                                                                                                                                                                                                                         | 0.1MAX (C<1.0µF)<br>0.125MAX (C≥1.0µF) | 0.15 MAX                                                                                                                         | 0.195 MAX | 0.25 MAX |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| INSULATION RESISTANCE | MINIMUM INSULATION RESISTANCE:<br>1,000 MΩ OR 50MΩ·µF PRODUCT<br>WHICHEVER IS SMALLER                                                                                                                                                                                                                                                                             |                                        |                                                                                                                                  |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| 17                    | TEMPERATURE CYCLE                                                                                                                                                                                                                                                                                                                                                 | APPEARANCE                             | NO MECHANICAL DAMAGE SHALL OCCUR                                                                                                 |           |          |  |       |              | <div>CAPACITORS SHALL BE SUBJECTED TO FIVE CYCLES OF THE TEMPERATURE CYCLE AS FOLLOWING</div> <table><tr><td>STEP</td><td>TEMP.(℃)</td><td>TIME(MIN)</td></tr><tr><td>1</td><td>MIN.RATED TEMP.+0/-3</td><td>30</td></tr><tr><td>2</td><td>25</td><td>2~3</td></tr><tr><td>3</td><td>MAX.RATED TEMP.+3/-0</td><td>30</td></tr><tr><td>4</td><td>25</td><td>2~3</td></tr></table> <div>MEASURE AT ROOM TEMPERATURE<br/>AFTER COOLING FOR<br/>CLASS I : 24±2 Hr.<br/>CLASS II : 48±4 Hr.</div>                                                                                                                                                                                                                                                                                                                                                                                                             |     | STEP  | TEMP.(℃) | TIME(MIN) | 1        | MIN.RATED TEMP.+0/-3 | 30       | 2         | 25      | 2~3      | 3         | MAX.RATED TEMP.+3/-0                   | 30       | 4         | 25        | 2~3 |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | STEP                                   | TEMP.(℃)                                                                                                                         | TIME(MIN) |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | 1                                      | MIN.RATED TEMP.+0/-3                                                                                                             | 30        |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | 2                                      | 25                                                                                                                               | 2~3       |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | 3                                      | MAX.RATED TEMP.+3/-0                                                                                                             | 30        |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | 4                                      | 25                                                                                                                               | 2~3       |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| CAPACITANCE           | CHARACTERISTIC                                                                                                                                                                                                                                                                                                                                                    |                                        | CAP. CHANGE                                                                                                                      |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       | CLASS I                                                                                                                                                                                                                                                                                                                                                           |                                        | WITHIN ±2.5%<br>OR ±0.25pF WHICHEVER IS LARGER                                                                                   |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       | CLASS II                                                                                                                                                                                                                                                                                                                                                          | A,B                                    | WITHIN ±7.5%                                                                                                                     |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
|                       |                                                                                                                                                                                                                                                                                                                                                                   | F                                      | WITHIN ±20%                                                                                                                      |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| Q<br>CLASS I          | 30 pF AND OVER : Q ≥ 1000<br>LESS THAN 30pF:Q ≥400 +20×C                                                                                                                                                                                                                                                                                                          |                                        |                                                                                                                                  |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| Tanδ<br>CLASS II      | TO SATISFY THE SPECIFIED INITIAL VALUE                                                                                                                                                                                                                                                                                                                            |                                        |                                                                                                                                  |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |
| INSULATION RESISTANCE | TO SATISFY THE SPECIFIED INITIAL VALUE                                                                                                                                                                                                                                                                                                                            |                                        |                                                                                                                                  |           |          |  |       |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |       |          |           |          |                      |          |           |         |          |           |                                        |          |           |           |     |   |          |  |

# Multilayer Ceramic Capacitor

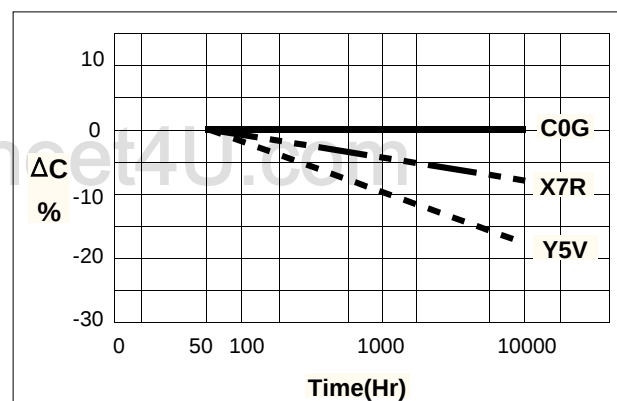
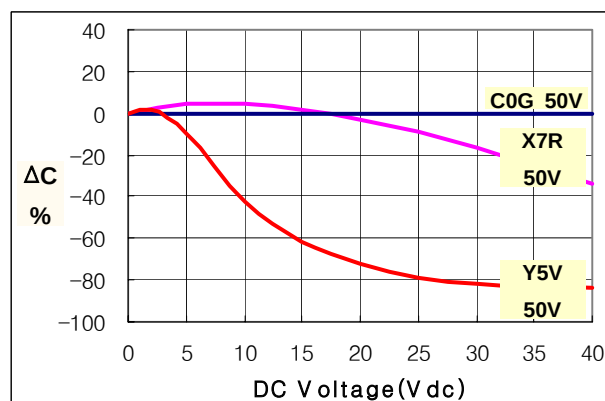
## ■ CHARACTERISTIC GRAPH

### ● ELECTRICAL CHARACTERISTICS

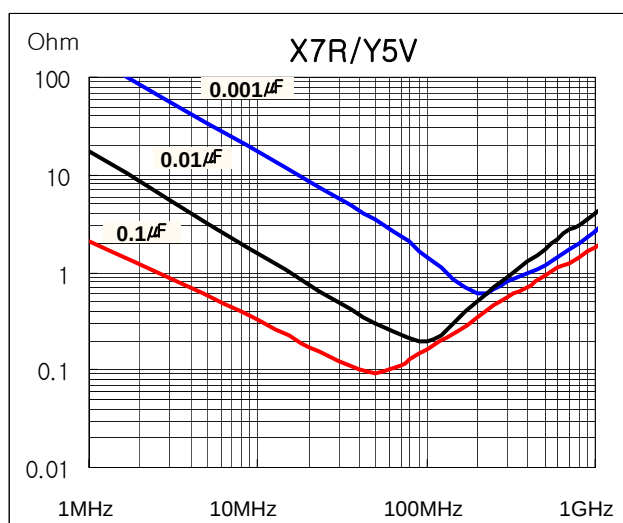
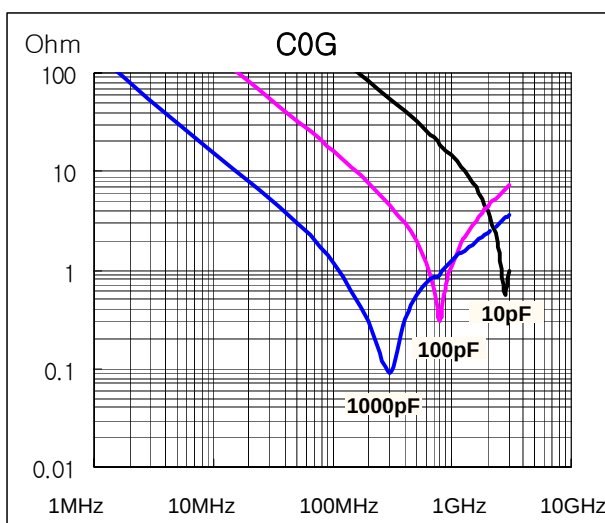
#### ► CAPACITANCE - TEMPERATURE CHARACTERISTICS



#### ► CAPACITANCE - DC VOLTAGE CHARACTERISTICS ► CAPACITANCE CHANGE - AGING



#### ► IMPEDANCE - FREQUENCY CHARACTERISTICS



# Multilayer Ceramic Capacitor

## ■ APPLICATION MANUAL

### ● Storage Condition

#### ▶ Storage Environment

The electrical characteristics of MLCCs were degraded by the environment of high temperature or humidity. Therefore, the MLCCs shall be stored in the ambient temperature and the relative humidity of less than 40℃ and 70%, respectively. Guaranteed storage period is within 6 months from the outgoing date of delivery.

#### ▶ Corrosive Gases

Since the solderability of the end termination in MLCC was degraded by a chemical atmosphere such as chlorine, acid or sulfide gases, MLCCs must be avoid from these gases.

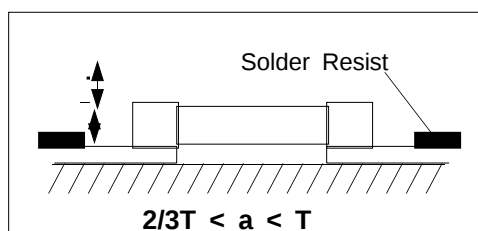
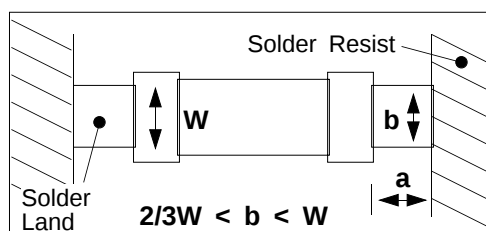
#### ▶ Temperature Fluctuations

Since dew condensation may occur by the differences in temperature when the MLCCs are taken out of storage, it is important to maintain the temperature-controlled environment.

### ● Design of Land Pattern

When designing printed circuit boards, the shape and size of the lands must allow for the proper amount of solder on the capacitor. The amount of solder at the end terminations has a direct effect on the crack. The crack in MLCC will be easily occurred by the tensile stress which was due to too much amount of solder. In contrast, if too little solder is applied, the termination strength will be insufficiently. Use the following illustrations as guidelines for proper land design.

Recommendation of Land Shape and Size



### ● Adhesives

When flow soldering the MLCCs, apply the adhesive in accordance with the following conditions.

#### ▶ Requirements for Adhesives

They must have enough adhesion, so that, the chips will not fall off or move during the handling of the circuit board.

They must maintain their adhesive strength when exposed to soldering temperature.

They should not spread or run when applied to the circuit board.

They should harden quickly.

They should not corrode the circuit board or chip material.

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## Multilayer Ceramic Capacitor

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They should be a good insulator.

They should be non-toxic, and not produce harmful gases, nor be harmful when touched.

### ► Application Method

It is important to use the proper amount of adhesive. Too little and much adhesive will cause poor adhesion and overflow into the land, respectively.

### ► Adhesive hardening Characteristics

To prevent oxidation of the terminations, the adhesive must harden at 160°C or less, within 2 minutes or less.

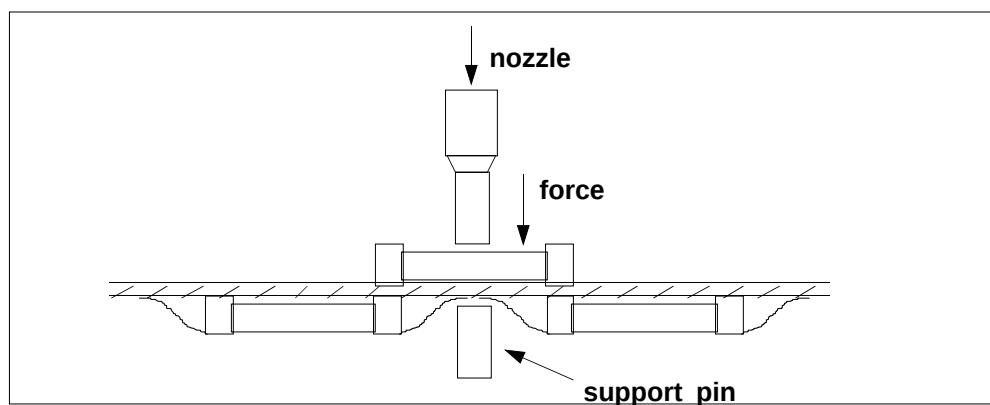
## ● Mounting

### ► Mounting Head Pressure

Excessive pressure will cause crack to MLCCs. The pressure of nozzle will be 300g maximum during mounting.

### ► Bending Stress

When double-sided circuit boards are used, MLCCs first are mounted and soldered onto one side of the board. When the MLCCs are mounted onto the other side, it is important to support the board as shown in the illustration. If the circuit board is not supported, the crack occur to the ready-installed MLCCs by the bending stress.



## ● Flux

Although the solderability increased by the highly-activated flux, increase of activity in flux may also degrade the insulation of the chip capacitors. To avoid such degradation, it is recommended that a mildly activated rosin flux(less than 0.2% chlorine) be used.

# Multilayer Ceramic Capacitor

## ● Soldering

Since a multilayer ceramic chip capacitor comes into direct contact with melted solder during soldering, it is exposed to potentially mechanical stress caused by the sudden temperature change. The capacitor may also be subject to silver migration, and to contamination by the flux. Because of these factors, soldering technique is critical.

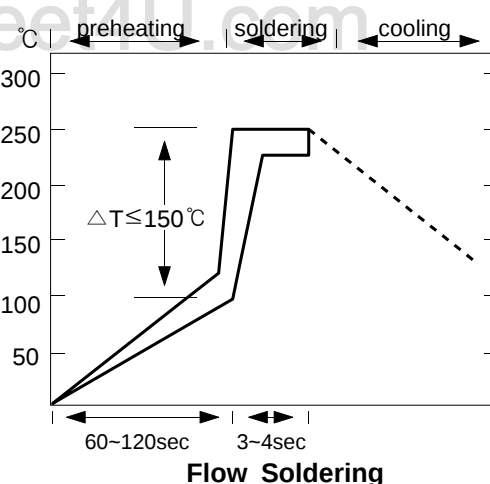
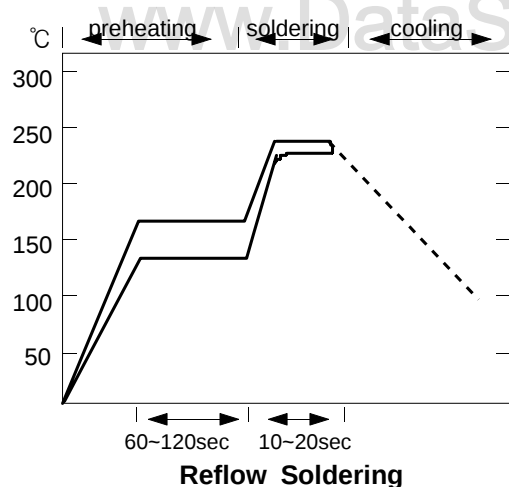
### ► Soldering Methods

| Method           | Classification                 |                                                      |
|------------------|--------------------------------|------------------------------------------------------|
| Reflow soldering | - Overall heating              | - Infrared rays<br>- Hot plate<br>- VPS(vapor phase) |
|                  | - Local heating                | - Air heater<br>- Laser<br>- Light beam              |
| Flow soldering   | - Single wave<br>- Double wave | -                                                    |

\* We recommend the reflow soldering method.

### ► Soldering Profile

To avoid crack problem by sudden temperature change, follow the temperature profile in the adjacent graph.

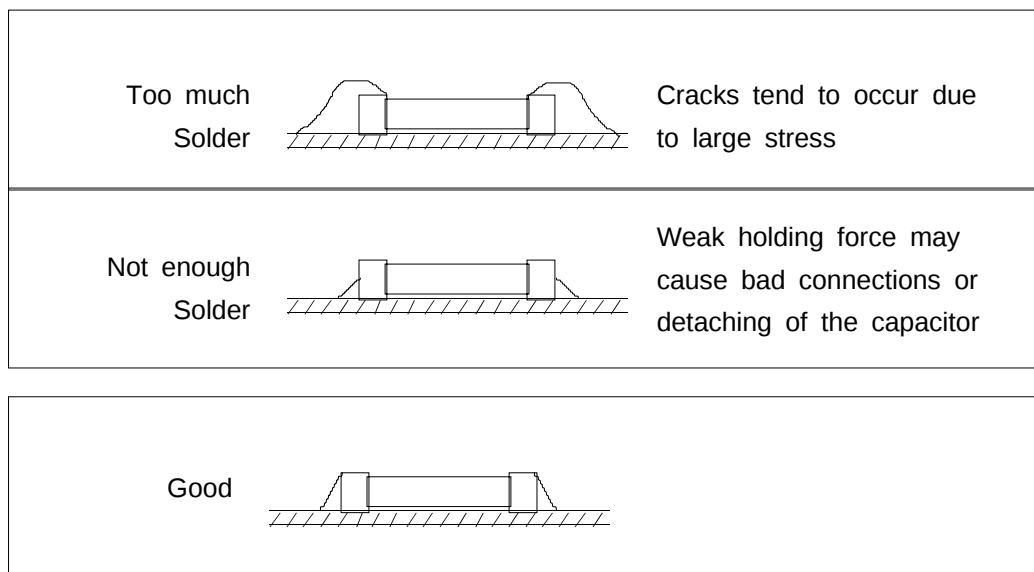


### ► Manual Soldering

Manual soldering can pose a great risk of creating thermal cracks in chip capacitors. The hot soldering iron tip comes into direct contact with the end terminations, and operator's carelessness may cause the tip of the soldering iron to come into direct contact with the ceramic body of the capacitor. Therefore the soldering iron must be handled carefully, and close attention must be paid to the selection of the soldering iron tip and to temperature control of the tip.

# Multilayer Ceramic Capacitor

## ► Amount of Solder



## ► Cooling

Natural cooling using air is recommended. If the chips are dipped into solvent for cleaning, the temperature difference( $\Delta T$ ) must be less than 100°C

### 6-6. Cleaning

If rosin flux is used, cleaning usually is unnecessary. When strongly activated flux is used, chlorine in the flux may dissolve into some types of cleaning fluids, thereby affecting the chip capacitors. This means that the cleaning fluid must be carefully selected, and should always be new.

## ► Notes for Separating Multiple, Shared PC Boards.

A multi-PC board is separated into many individual circuit boards after soldering has been completed. If the board is bent or distorted at the time of separation, cracks may occur in the chip capacitors. Carefully choose a separation method that minimizes the bending of the circuit board.

# Multilayer Ceramic Capacitor

## CROSS REFERENCE

| P/N                             | COMPANY        | SAMSUNG                                                                                        | AVX  | JOHANSON | KEMET | KYOCERA | MURATA | NOVACAP | PANASONIC | ROHM  | TAIYO<br>- YUDEN | TDK    | VITRAMON |
|---------------------------------|----------------|------------------------------------------------------------------------------------------------|------|----------|-------|---------|--------|---------|-----------|-------|------------------|--------|----------|
| ① COMPANY                       | MODEL(MLCC)    | CL                                                                                             | -    | -        | C     | CM      | GRM    | -       | ECJ       | MCH   | MK               | C      | VJ       |
| ② SIZE<br>(EIA/JIS)             | 0201(0603)     | 03                                                                                             | -    | -        | -     | 03      | 33     | -       | Z         | -     | 063              | 0603   | -        |
|                                 | 0402(1005)     | 05                                                                                             | 0402 | R07      | 0402  | 05      | 36     | 0402    | 0         | 15    | 105              | 1005   | 0402     |
|                                 | 0603(1608)     | 10                                                                                             | 0603 | R14      | 0603  | 105     | 39     | 0603    | 1         | 18    | 107              | 1608   | 0603     |
|                                 | 0805(2012)     | 21                                                                                             | 0805 | R15      | 0805  | 21      | 40     | 0805    | 2         | 21    | 212              | 2012   | 0805     |
|                                 | 1206(3216)     | 31                                                                                             | 1206 | R18      | 1206  | 316     | 42-6   | 1206    | 3         | 31    | 316              | 3216   | 1206     |
|                                 | 1210(3225)     | 32                                                                                             | 1210 | S41      | 1210  | 32      | 42-2   | 1210    | 4         | 32    | 325              | 3225   | 1210     |
|                                 | 1808(4520)     | 42                                                                                             | 1808 | R29      | 1808  | 42      | -      | 1808    | -         | -     | -                | 4520   | 1808     |
|                                 | 1812(4532)     | 43                                                                                             | 1812 | S43      | 1812  | 43      | 43-2   | 1812    | -         | 43    | 432              | 4532   | 1812     |
|                                 | 2220(5750)     | 55                                                                                             | -    | -        | 2220  | 55      | 44-1   | 2221    | -         | -     | 550              | 5650   | -        |
| ③ TEMPERATURE<br>CHARACTERISTIC | COG(NPO)       | C                                                                                              | A    | N        | G     | CG      | COG/CH | N       | C         | A     | C                | COG/CH | A        |
|                                 | P2H(N150)      | P                                                                                              | S    | -        | -     | P       | P2H    | -       | P         | -     | P                | PH     | -        |
|                                 | R2H(N220)      | R                                                                                              | 1    | -        | -     | R       | R2H    | -       | R         | -     | R                | RH     | -        |
|                                 | S2H(N330)      | S                                                                                              | 3    | -        | -     | S       | S2H    | -       | S         | -     | S                | SH     | -        |
|                                 | T2H(N470)      | T                                                                                              | O    | -        | -     | T       | T2H    | -       | T         | -     | T                | TH     | -        |
|                                 | U2J(N750)      | U                                                                                              | Z    | -        | -     | U       | U2J    | -       | U         | UJ    | U                | UJ     | -        |
|                                 | S2L            | L                                                                                              | Y    | -        | -     | SL      | SL     | -       | G         | SL    | SL               | SL     | -        |
|                                 | X7R            | B                                                                                              | C    | W        | R(X)  | X7R     | X7R    | B       | B         | C     | BJ               | X7R(B) | Y(X)     |
|                                 | Z5U            | E                                                                                              | E    | Z        | U     | -       | Z5U    | Z       | -         | E     | -                | Z5U    | U        |
|                                 | Y5V            | F                                                                                              | G    | Y        | V     | Y5V     | Y5V    | Y       | F         | F     | F                | Y5V    | -        |
| ④ NOMINAL CAPACITANCE           |                | EX) 103=10,000pF    221=220pF    225=2,200,000pF=2.2μF    1R5=1.5pF    010=1pF                 |      |          |       |         |        |         |           |       |                  |        |          |
| ⑤ CAPACITANCE TOLERANCE         |                | B:±0.1pF    C:±0.25pF    D:±0.5pF    F:±1%    G:±2%    J:±5%    K:±10%    M:±20%    Z:-20~+80% |      |          |       |         |        |         |           |       |                  |        |          |
| ⑥ RATED<br>VOLTAGE              | 6.3V           | Q                                                                                              | 6    | -        | 9     | 06      | 6.3    | -       | 0J        | -     | J                | 0J     | -        |
|                                 | 10 V           | P                                                                                              | Z    | 100      | 8     | 10      | 10     | -       | 1A        | 4     | L                | 1A     | -        |
|                                 | 16 V           | O                                                                                              | Y    | 160      | 4     | 16      | 16     | 160     | 1C        | 3     | E                | 1C     | J        |
|                                 | 25 V           | A                                                                                              | 3    | 250      | 3     | 25      | 25     | 250     | 1E        | 2     | T                | 1E     | X        |
|                                 | 50 V           | B                                                                                              | 5    | 500      | 5     | 50      | 50     | 500     | 1H        | 5     | U                | 1H     | A        |
|                                 | 100 V          | C                                                                                              | 1    | 101      | 1     | 100     | 100    | 101     | 2A        | 1     | -                | 2A     | B        |
|                                 | 200V           | D                                                                                              | 2    | 201      | 2     | 200     | 200    | 201     | 2D        | -     | -                | -      | C        |
|                                 | 250V           | E                                                                                              | V    | -        | -     | 250     | 250    | 251     | -         | -     | -                | 2E     | -        |
|                                 | 500V           | G                                                                                              | 7    | 501      | -     | 500     | 500    | 501     | -         | -     | -                | -      | E        |
|                                 | 630V           | H                                                                                              | -    | -        | -     | 630     | 630    | -       | -         | -     | -                | 2J     | -        |
|                                 | 1000V          | I                                                                                              | A    | 102      | -     | 1000    | 1K     | 102     | -         | -     | -                | 3A     | G        |
|                                 | 2000V          | J                                                                                              | G    | 202      | -     | 2000    | 2K     | 202     | -         | -     | -                | 3D     | -        |
|                                 | 3000V          | K                                                                                              | H    | 302      | -     | 3000    | 3K     | 302     | -         | -     | -                | 3F     | H        |
|                                 | 4000V          | -                                                                                              | J    | -        | -     | 4000    | -      | 402     | -         | -     | -                | -      | -        |
| ⑦ TERMINATION                   | NICKEL BARRIER | N                                                                                              | T    | V        | C     | A       | (GRM)  | N       | -         | (MCH) | -                | -      | X        |
|                                 | Ag/Pd          | P                                                                                              | 1    | -        | -     | B       | (GR)   | P       | -         | (MC)  | -                | -      | F        |
| ⑧ PACKAGE                       | BULK(VINYL)    | B                                                                                              | 9    | (NONE)   | -     | B       | PB     | *       | X         | -     | B                | B      | B        |
|                                 | PAPER TAPING   | C                                                                                              | 2, 4 | T, R     | -     | T, L    | PT     | T       | E, V, W   | K, L  | T                | T      | C, P     |
|                                 | PLASTIC TAPING | E                                                                                              | 1, 3 | E, U     | -     | H, N    | PT     | -       | F, Y      | P, Q  | T                | -      | T, R     |
|                                 | BULK CASE      | P                                                                                              | 7    | -        | -     | C       | PC     | -       | C         | C     | -                | -      | G        |

# Multilayer Ceramic Capacitor

## ► SAMSUNG : CL10B104KA8NNNC

| CL                                                                                                   | 10                                                                                                         | B                                                                                      | 104                                                                                                                             | K                                                                                                                             | A                                                                                                        | 8                                                                       | N                                                                                                                                          | N        | N                                                                                                                                                                                     | C         |
|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Series                                                                                               | Size                                                                                                       | Dielectric                                                                             | Capacitance                                                                                                                     | Tolerance                                                                                                                     | Voltage                                                                                                  | Thickness                                                               | Electrode/<br>Termination/<br>Plating                                                                                                      | Products | Special                                                                                                                                                                               | Packaging |
| 03 = 0201<br>05 = 0402<br>10 = 0603<br>21 = 0805<br>31 = 1206<br>32 = 1210<br>43 = 1812<br>55 = 2220 | C = C0G<br>P = P2H<br>R = R2H<br>S = S2H<br>T = T2H<br>U = U2H<br>L = S2L<br>B = X7R<br>A = X5R<br>F = Y5V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | A = ±0.05pF<br>B = ±0.1pF<br>C = ±0.25pF<br>D = ±0.5pF<br>F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10%<br>M = ±20%<br>Z = +80,-20% | Q = 6.3V<br>P = 10V<br>O = 16V<br>A = 25V<br>B = 50V<br>C = 100V<br>D = 200V<br>E = 250V<br>G = 500V<br>H = 630V<br>I = 1000V | 3 = 0.30<br>5 = 0.50<br>8 = 0.80<br>A = 0.65<br>C = 0.85<br>H = 1.60<br>I = 2.00<br>J = 2.50<br>L = 3.20 | A = Pd/Ag/<br>Sn 100%<br>N = Ni/Cu/<br>Sn 100%<br>G = Cu/Cu/<br>Sn 100% | A = Array<br>(2-element)<br>B = Array<br>(4-element)<br>C = High - Q<br>L = LICC<br>N = Normal<br>P = Automotive<br>W = 3 terminal<br>chip | Various  | B = Bulk<br>P = Cassette<br>C = Paper 7"<br>D = Paper 13"<br>(10,000EA)<br>E = Embossing 7"<br>F = Embossing 13"<br>L = Paper 13"<br>(15,000EA)<br>O = Paper 10"<br>S = Embossing 10" |           |

## ► AVX : 06033C104KAT2A

| 0603                                                                 | 3                                                                                                                           | C                                                   | 104                                                                                       | K                                                                                                                                                                                                                     | A            | T                                           | 2                                                       | A                                                      |
|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------------------------|---------------------------------------------------------|--------------------------------------------------------|
| Size                                                                 | Voltage                                                                                                                     | Dielectric                                          | Capacitance                                                                               | Tolerance                                                                                                                                                                                                             | Failure Rate | Termination                                 | Packaging                                               | Special                                                |
| 0201<br>0402<br>0603<br>0805<br>1206<br>1210<br>1812<br>2220<br>2225 | 4 = 4V<br>6 = 6.3V<br>Z = 10V<br>Y = 16V<br>3 = 25V<br>B = 50V<br>C = 100V<br>D = 200V<br>E = 250V<br>G = 500V<br>I = 1000V | A = C0G<br>C = X7R<br>D = X5R<br>E = Z5U<br>G = Y5V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal<br>point | B = $\pm 0.1\mu\text{F}$<br>C = $\pm 0.25\mu\text{F}$<br>D = $\pm 0.5\mu\text{F}$<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = $+80, -20\%$<br>P = GMV, $+100, -0\%$ | A = N/A      | T = Sn 100%<br>7 = Gold Plated<br>1 = Pd/Ag | 2 = 7" Reel<br>4 = 13" Reel<br>7 = Cassette<br>9 = Bulk | A = Standard<br>T = 0.66mm<br>S = 0.56mm<br>R = 0.46mm |

## ► JOHANSON : 250R14W104KV6T

| 250                                                    | R14                                                                                                                                      | W                                                   | 104                                                                                    | K                                                                                                                                                                                                                     | V              | 6                          | T                                                                                                     |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------|-------------------------------------------------------------------------------------------------------|
| Voltage                                                | Size                                                                                                                                     | Dielectric                                          | Capacitance                                                                            | Tolerance                                                                                                                                                                                                             | Termination    | Marking                    | Packaging                                                                                             |
| 2<br>significant<br>figures<br>+<br>number<br>of zeros | R07 = 0402<br>R14 = 0603<br>R15 = 0805<br>R18 = 1206<br>S41 = 1210<br>S43 = 1812<br>S47 = 2220<br>S48 = 2225<br>S49 = 1825<br>S54 = 3640 | N = C0G<br>W = X7R<br>X = X5R<br>Z = Z5U<br>Y = Y5V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | B = $\pm 0.1\mu\text{F}$<br>C = $\pm 0.25\mu\text{F}$<br>D = $\pm 0.5\mu\text{F}$<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = $+80, -20\%$<br>P = GMV, $+100, -0\%$ | V = Ni Barrier | 4 = No Mark<br>6 = Marking | E = 7" Reel Plastic<br>T = 7" Reel Paper<br>R = 13" Reel Paper<br>U = 13" Reel Plastic<br>None = Bulk |

## ► KEMET : C0603C104K3RAC

| <u>C</u> | <u>0603</u>        | <u>C</u>      | <u>104</u>    | <u>K</u>  | <u>3</u>    | <u>R</u>        | <u>A</u>           | <u>C</u>    |
|----------|--------------------|---------------|---------------|-----------|-------------|-----------------|--------------------|-------------|
| Series   | Size               | Specification | Capacitance   | Tolerance | Voltage     | Dielectric      | Failure Rate       | Termination |
| 0402     | C = Standard       | 2             | B = ±0.1pF    | 9 = 6.3V  | G = C0G     | A = Standard    | C = Ni w/Tin Plate |             |
| 0603     | A = GR900          | significant   | C = ±0.25pF   | 8 = 10V   | R = X7R     | M = 1.0 (Mil)   | H = Ni w/Solder    |             |
| 0805     | P = Mil-C-55681    | figures       | D = ±0.5pF    | 4 = 16V   | P = X5R     | P = 0.1 (Mil)   | T = Silver         |             |
| 1206     | CDR01-CDR06        | +             | F = ±1%       | 3 = 25V   | U = Z5U     | R = 0.01 (Mil)  | G = Gold Plated    |             |
| 1210     | N = Mil-C-55681    | number        | G = ±2%       | 5 = 50V   | X = BX(Mil) | S = 0.001 (Mil) |                    |             |
| 1812     | CDR31-CDR35        | of zeros      | J = ±5%       | 1 = 100V  | V = Y5V     |                 |                    |             |
| 2220     | Z = Mil-C-123      | Use "R" for   | K = ±10%      | 2 = 200V  |             |                 |                    |             |
| 2225     | E = Mil Equivalent | decimal point | M = ±20%      |           |             |                 |                    |             |
|          | (Group A Only)     |               | Z = +80, -20% |           |             |                 |                    |             |
|          |                    |               | P = +100, 0%  |           |             |                 |                    |             |

# Multilayer Ceramic Capacitor

## ► KYOCERA : CM105X7R104K25AT

| CM                                                                                                                  | 105                                          | X7R                                                                                    | 104                                                                                                                               | K                                                                                                                              | 25             | A                                                                                                                                                        | T         |
|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Series                                                                                                              | Size                                         | Dielectric                                                                             | Capacitance                                                                                                                       | Tolerance                                                                                                                      | Voltage        | Termination                                                                                                                                              | Packaging |
| 03 = 0201<br>05 = 0402<br>105 = 0603<br>21 = 0805<br>316 = 1206<br>32 = 1210<br>42 = 1808<br>43 = 1812<br>55 = 2220 | CG<br>X8R<br>X7R<br>X5R<br>Z5U<br>Y5V<br>Y5U | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | B = ±0.1pF<br>C = ±0.25pF<br>D = ±0.5pF<br>F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10%<br>M = ±20%<br>Z = +80, -20%<br>P = +100, 0% | 04 = 4V<br>06 = 6.3V<br>10 = 10V<br>16 = 16V<br>25 = 25V<br>50 = 50V<br>100 = 100V<br>250 = 250V<br>500 = 500V<br>1000 = 1000V | A = Ni Barrier | T = 7" Reel (4mm Pitch)<br>L = 13" Reel (4mm Pitch)<br>H = 7" Reel (2mm Pitch)<br>N = 13" Reel (2mm Pitch)<br>B = Bulk (Vinyl Bags)<br>C = Bulk Cassette |           |

## ► MURATA : GRM188R71E104KA01D

| GRM        | 18                                                                                                                | 8                                                                                                                  | R7                                                       | 1E                                                                                                             | 104                                                                                       | K                                                                                                                                                                                                   | A01                           | D                                                                                                                                        |
|------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Series     | Size                                                                                                              | Thickness                                                                                                          | Dielectric                                               | Voltage                                                                                                        | Capacitance                                                                               | Tolerance                                                                                                                                                                                           | Individual Specification Code | Packaging                                                                                                                                |
| Ni Barrier | 03 = 0201<br>15 = 0402<br>18 = 0603<br>21 = 0805<br>31 = 1206<br>32 = 1210<br>42 = 1808<br>43 = 1812<br>55 = 2220 | 3 = 0.3mm<br>5 = 0.5mm<br>8 = 0.8mm<br>A = 1.0mm<br>B = 1.25mm<br>C = 1.6mm<br>D = 2.0mm<br>E = 2.5mm<br>F = 3.2mm | 5C = C0G<br>R7 = X7R<br>R6 = X5R<br>E4 = Z5U<br>F5 = Y5V | 0J = 6.3V<br>1A = 10V<br>1C = 16V<br>1E = 25V<br>1H = 50V<br>2A = 100V<br>2E = 250V<br>2H = 500V<br>3A = 1000V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal<br>point | B = $\pm 0.1\text{pF}$<br>C = $\pm 0.25\text{pF}$<br>D = $\pm 0.5\text{pF}$<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = +80, -20%<br>P = +100, 0% |                               | D = 7" Reel Paper<br>L = 7" Reel Plastic<br>J = 13" Reel Paper<br>K = 13" Reel Plastic<br>B = Bulk<br>C = Bulk Cassette<br>T = Bulk Tray |

## ► NOVACAP : 0603B104K250N\_TM

| 1206                                                                 | B                                                  | 104                                                                                    | K                                                                                                                                                                                                   | 250                                                    | N                                                               | -             | T                                          | M       |
|----------------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------------|---------------|--------------------------------------------|---------|
| Size                                                                 | Dielectric                                         | Capacitance                                                                            | Tolerance                                                                                                                                                                                           | Voltage                                                | Termination                                                     | Thickness     | Packaging                                  | Marking |
| 0402<br>0603<br>0805<br>1005<br>1206<br>1210<br>1808<br>1812<br>2220 | N = C0G<br>B = X7R<br>X = BX<br>Z = Z5U<br>Y = Y5V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | B = $\pm 0.1\text{pF}$<br>C = $\pm 0.25\text{pF}$<br>D = $\pm 0.5\text{pF}$<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = +80, -20%<br>P = +100, 0% | 2<br>significant<br>figures<br>+<br>number<br>of zeros | P = Pd/Ag<br>N = Ni Barrier (Sn 100%)<br>Y = Ni Barrier (Sn/Pb) | Per Specified | T = Reel<br>None = Bulk<br>W = Waffle Pack |         |

## ► PANASONIC : ECJ1EB1E104K

| ECJ    | 1                                                                    | E                                                                                                                                   | B                                  | 1E                                                                                  | 104                                                                                    | K                                                                                                                                        |
|--------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Series | Size                                                                 | Packaging                                                                                                                           | Dielectric                         | Voltage                                                                             | Capacitance                                                                            | Tolerance                                                                                                                                |
|        | Z = 0201<br>0 = 0402<br>1 = 0603<br>2 = 0805<br>3 = 1206<br>4 = 1210 | X = Bulk<br>E = Paper 2mm<br>V = Paper 4mm<br>F, Y = Plastic 4mm<br>W = Large Reels 2mm<br>Z = Large Reels 4mm<br>C = Bulk Cassette | C = C0G<br>B = X7R, X5R<br>F = Y5V | 0J = 6.3V<br>1A = 10V<br>1C = 16V<br>1E = 25V<br>1H = 50V<br>2A = 100V<br>2D = 200V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | C = $\pm 0.25\text{pF}$<br>D = $\pm 0.5\text{pF}$<br>F = $\pm 1\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = +80, -20% |

# Multilayer Ceramic Capacitor

## ► ROHM : MCH182C104KKN

| <u>MCH</u> | <u>18</u>                                                                  | <u>2</u>                                 | <u>C</u>                      | <u>104</u>                                                                             | <u>K</u>                                                                                                                                                                                                  | <u>K</u>                                                                                                                | <u>N</u>                        |
|------------|----------------------------------------------------------------------------|------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Series     | Size                                                                       | Voltage                                  | Dielectric                    | Capacitance                                                                            | Tolerance                                                                                                                                                                                                 | Packaging                                                                                                               | Marking/Thickness               |
|            | 15 = 0402<br>18 = 0603<br>21 = 0805<br>31 = 1206<br>32 = 1210<br>43 = 1812 | 4 = 10V<br>3 = 16V<br>2 = 25V<br>5 = 50V | A = C0G<br>C = X7R<br>F = Y5V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | B = $\pm 0.1\text{pF}$<br>C = $\pm 0.25\text{pF}$<br>D = $\pm 0.5\text{pF}$<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = $+80, -20\%$<br>P = $+100, 0\%$ | K = 7" Reel Paper<br>P = 7" Reel Plastic<br>L = 13" Reel Paper<br>Q = 13" Reel Plastic<br>B = Bulk<br>C = Bulk Cassette | N = Marked<br>Special Thickness |

## ► TAIYO-YUDEN : TMK107BJ104K\_T

| <u>T</u>                                                       | <u>M</u>                   | <u>K</u>       | <u>107</u>                                                                                     | <u>BJ</u>                                                                   | <u>104</u>                                                                             | <u>K</u>                                                                                                                                                     | <u>-</u> | <u>T</u>             |
|----------------------------------------------------------------|----------------------------|----------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------|
| Voltage                                                        | Type                       | Termination    | Size                                                                                           | Dielectric                                                                  | Capacitance                                                                            | Tolerance                                                                                                                                                    | Special  | Packaging            |
| A = 4V<br>J = 6.3V<br>L = 10V<br>E = 16V<br>T = 25V<br>U = 50V | M = Multilayer<br>V = Hi Q | K = Ni Barrier | 105 = 0402<br>107 = 0603<br>212 = 0805<br>316 = 1206<br>325 = 1210<br>432 = 1812<br>550 = 2220 | CG = C0G<br>CH = C0H<br>CJ = C0J<br>CK = C0K<br>BJ = X5R,<br>X7R<br>F = Y5V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | C = $\pm 0.25\text{pF}$<br>D = $\pm 0.5\text{pF}$<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = $+80, -20\%$ | Various  | T = Reel<br>B = Bulk |

## ► TDK : C1608X7R1E104KT

| <u>C</u> | <u>1608</u>                                                                                                          | <u>X7R</u>              | <u>1E</u>                                                 | <u>104</u>                                                                             | <u>K</u>                                                                                                                                                     | <u>T</u>             |
|----------|----------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Series   | Size                                                                                                                 | Dielectric              | Voltage                                                   | Capacitance                                                                            | Tolerance                                                                                                                                                    | Packaging            |
|          | 0603 = 0201<br>1005 = 0402<br>1608 = 0603<br>2012 = 0805<br>3216 = 1206<br>3225 = 1210<br>4532 = 1812<br>5650 = 2220 | CG<br>X7R<br>Z5U<br>Y5V | 0J = 6.3V<br>1A = 10V<br>1C = 16V<br>1E = 25V<br>1H = 50V | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | C = $\pm 0.25\text{pF}$<br>D = $\pm 0.5\text{pF}$<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = $+80, -20\%$ | T = Reel<br>B = Bulk |

## ► VITRAMON : VJ0603Y104KXXMC

| <u>VJ</u> | <u>0603</u>                                          | <u>Y</u>                                             | <u>104</u>                                                                             | <u>K</u>                                                                                                                                                                                                  | <u>X</u>                                | <u>X</u>                                              | <u>M</u>                      | <u>C</u>                                                                                           |
|-----------|------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------|
| Series    | Size                                                 | Dielectric                                           | Capacitance                                                                            | Tolerance                                                                                                                                                                                                 | Termination                             | Voltage                                               | Marking                       | Packaging                                                                                          |
|           | 0402<br>0603<br>0805<br>1206<br>1210<br>1812<br>2225 | X = BX<br>A,N = C0G<br>Y = X7R<br>U = Z5U<br>H = X8R | 2<br>significant<br>figures<br>+<br>number<br>of zeros<br>Use "R" for<br>decimal point | B = $\pm 0.1\text{pF}$<br>C = $\pm 0.25\text{pF}$<br>D = $\pm 0.5\text{pF}$<br>F = $\pm 1\%$<br>G = $\pm 2\%$<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = $+80, -20\%$<br>P = $+100, 0\%$ | X = Silver,<br>Ni Barrier<br>Tin Plated | J = 16V<br>X = 25V<br>A = 50V<br>B = 100V<br>C = 200V | M = Marking<br>A = No Marking | C = 7" Reel Paper<br>T = 7" Reel Plastic<br>P = 13" Reel Paper<br>R = 13" Reel Plastic<br>B = Bulk |