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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(C0G, 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

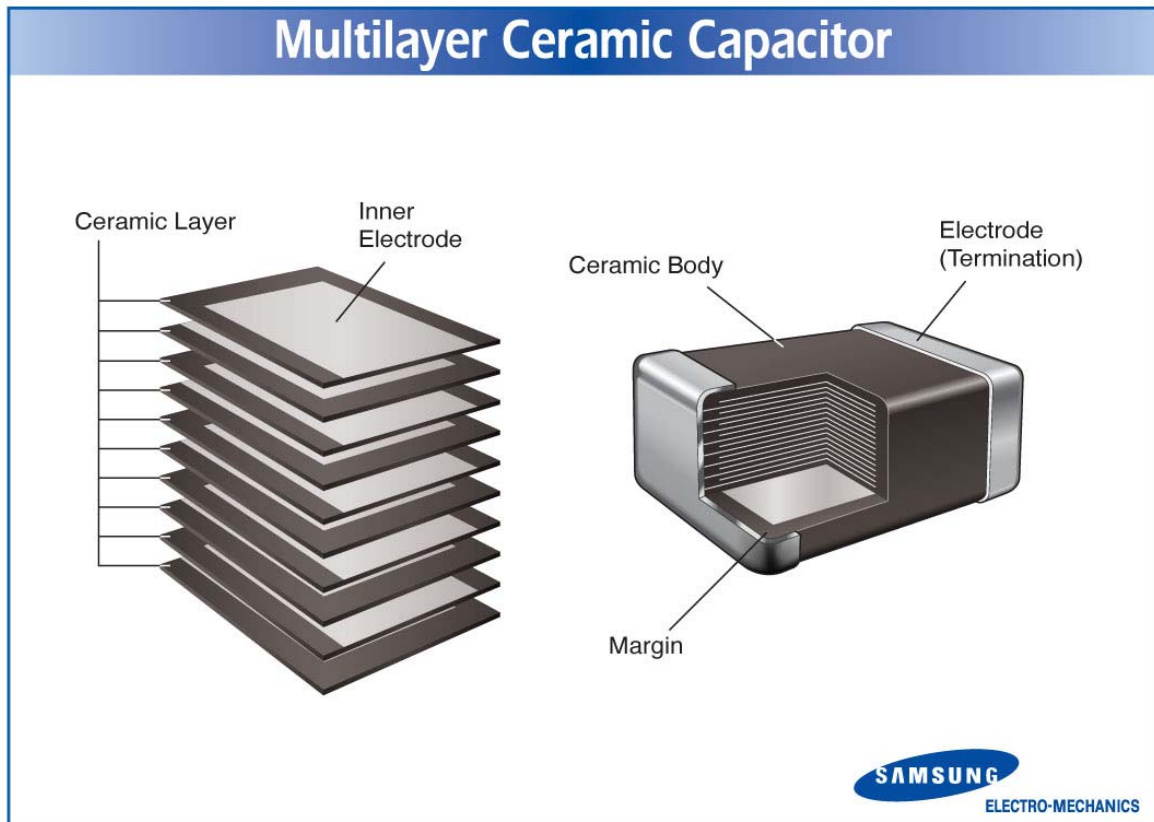
- High Frequency Circuit(Tuner, VCO, PAM etc)
- General Power Supply Circuit(SMPS etc)
- DC-DC Converter
- General Electronic Circuit

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# Multilayer Ceramic Capacitor

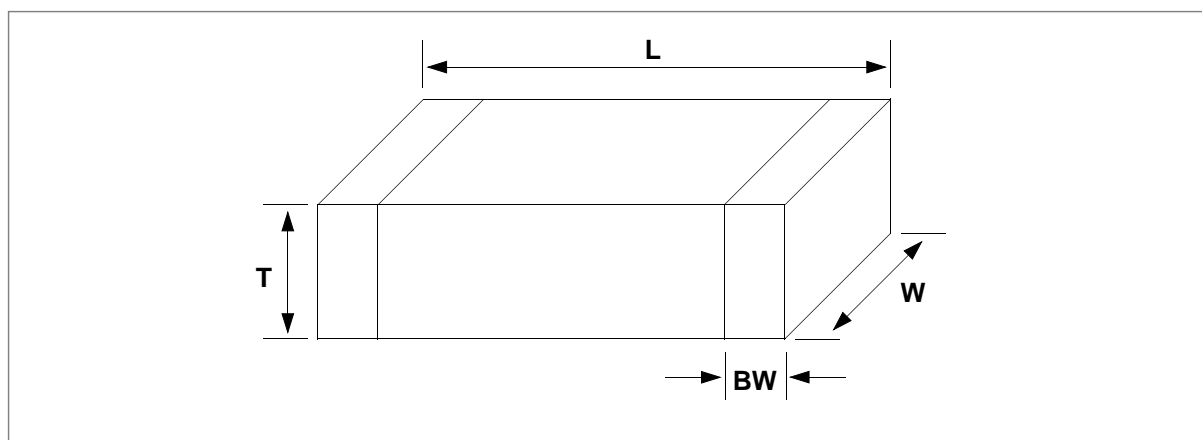
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## ■ STRUCTURE



# 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

|           |           |          |            |          |          |          |          |
|-----------|-----------|----------|------------|----------|----------|----------|----------|
| <b>CL</b> | <b>10</b> | <b>C</b> | <b>101</b> | <b>J</b> | <b>B</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> |

- 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 | : | $10 \times 10^0 =$ | 10pF   |
| 102 | : | $10 \times 10^2 =$ | 1000pF |
| 020 | : | $2 \times 10^0 =$  | 2pF    |
| 1R5 | : |                    | 1.5pF  |

## ⑤ CAPACITANCE TOLERANCE

| Temperature Characteristics  | Symbol | Tolerance           | Applicable Capacitance & Range |
|------------------------------|--------|---------------------|--------------------------------|
| C0G(NPO)<br>or<br>T.C Series | B      | $\pm 0.1\text{pF}$  | 0.5 ~ 3pF                      |
|                              | C      | $\pm 0.25\text{pF}$ | 0.5 ~ 10pF                     |
|                              | D      | $\pm 0.5\text{pF}$  |                                |
|                              | F      | $\pm 1\text{pF}$    | 6 ~ 10pF                       |
|                              | G      | $\pm 2\%$           | E-24 Series for over 10pF      |
|                              | J      | $\pm 5\%$           |                                |
|                              | K      | $\pm 10\%$          |                                |
| A(X5R)<br>B(X7R)             | J      | $\pm 5\%$           | E-12 Series                    |
|                              | K      | $\pm 10\%$          |                                |
|                              | M      | $\pm 20\%$          |                                |
| 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±30(ppm/°C) | -55 ~ +125°C      |
| P      |                             | P2H | P△  | -150±60      |                   |
| R      |                             | R2H | R△  | -220±60      |                   |
| S      |                             | S2H | S△  | -330±60      |                   |
| T      |                             | T2H | T△  | -470±60      |                   |
| U      |                             | U2J | U△  | -750±60      |                   |
| L      |                             | S2L | S△  | +350 ~ -1000 |                   |
| A      | Class II                    | X5R | X5R | ±15%         | -55 ~ +85°C       |
| B      |                             | X7R | X7R | ±15%         | -55 ~ +125°C      |
| F      |                             | Y5V | Y5V | +22 ~ -82%   | -30 ~ +85°C       |

### ※ Temperature Characteristic

| Temperature Characteristics | Below 2.0pF | 2.2 ~ 3.9pF | Above 4.0pF | Above 10pF |
|-----------------------------|-------------|-------------|-------------|------------|
| C△                          | C0G         | C0G         | C0G         | C0G        |
| P△                          | -           | P2J         | P2H         | P2H        |
| R△                          | -           | R2J         | R2H         | R2H        |
| S△                          | -           | S2J         | S2H         | S2H        |
| T△                          | -           | T2J         | T2H         | T2H        |
| U△                          | -           | U2J         | U2J         | U2J        |

J : ±120PPM/°C, H : ±60PPM/°C, G : ±30PPM/°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 μF  |
| 104    | 100,000pF, 100nF, 0.1 μF |

# 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 | <b>3</b> | 0.30         | ±0.03 |
| 1005 | <b>5</b> | 0.50         | ±0.05 |
| 1608 | <b>8</b> | 0.80         | ±0.10 |
| 2012 | <b>A</b> | 0.65         | ±0.10 |
|      | <b>C</b> | 0.85         |       |
|      | <b>F</b> | 1.25         | ±0.10 |
| 3216 | <b>C</b> | 0.85         | ±0.15 |
|      | <b>F</b> | 1.25         | ±0.15 |
|      | <b>H</b> | 1.6          | ±0.20 |
| 3225 | <b>F</b> | 1.25         | ±0.20 |
|      | <b>H</b> | 1.6          |       |
|      | <b>I</b> | 2.0          |       |
|      | <b>J</b> | 2.5          |       |
| 4532 | <b>F</b> | 1.25         | ±0.20 |
|      | <b>H</b> | 1.6          |       |
|      | <b>I</b> | 2.0          |       |
|      | <b>J</b> | 2.5          |       |
|      | <b>L</b> | 3.2          | ±0.30 |
| 5750 | <b>F</b> | 1.25         | ±0.20 |
|      | <b>H</b> | 1.6          |       |
|      | <b>I</b> | 2.0          |       |
|      | <b>J</b> | 2.5          |       |
|      | <b>L</b> | 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

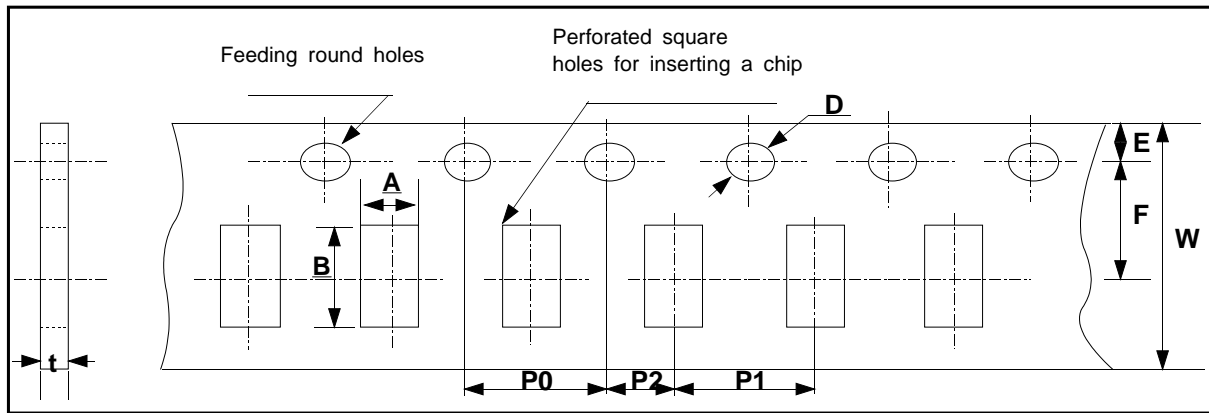
## ► CAPACITANCE vs CHIP THICKNESS STANDARD

| 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>(TP)<br>(nC)  | 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<br>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    | -               | -               | -                   | -           | -           | -      |
|                              | F<br>(Y5V)                 | 6.3V           | 10~<br>100     | -              | 2200                | -            | -             | 10000               | -             | -             | -                   | -             | -               | 47000           | -                   | -              | -               | -               | -                   | -           | -           | -      |
|                              |                            | 10V            | -              | 220~<br>330    | 100~<br>1000        | -            | -             | 4700                | -             | 4700          | 10000~<br>22000     | -             | -               | -               | 22000               | -              | -               | -               | -                   | -           | -           | 100000 |
|                              |                            | 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

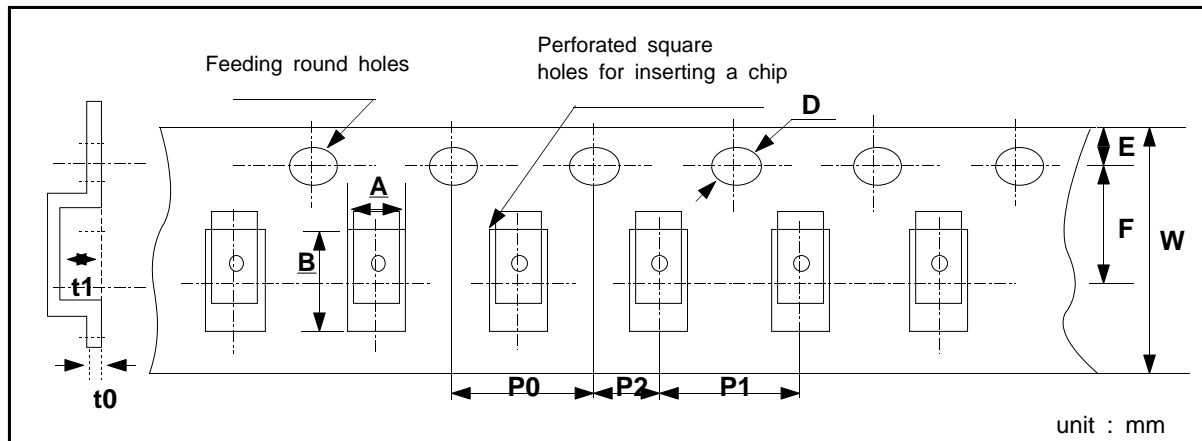
### CARDBOARD PAPER TAPE



unit : mm

| 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

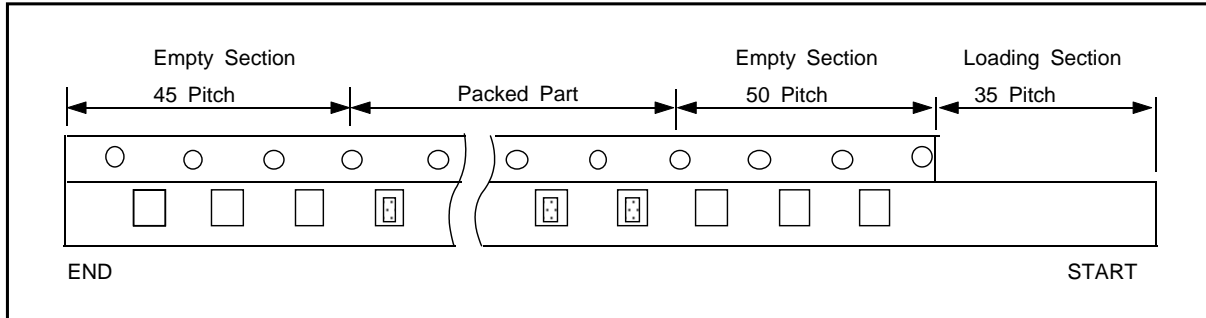


unit : mm

| 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 |             |              |              | 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 | 2.0<br>±0.2  | 3.6<br>±0.2 |
|             | 32 | 8.0<br>±0.3 | 3.5<br>±0.05 | 1.75<br>±0.1 |             |              |             |                 |            |            | 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

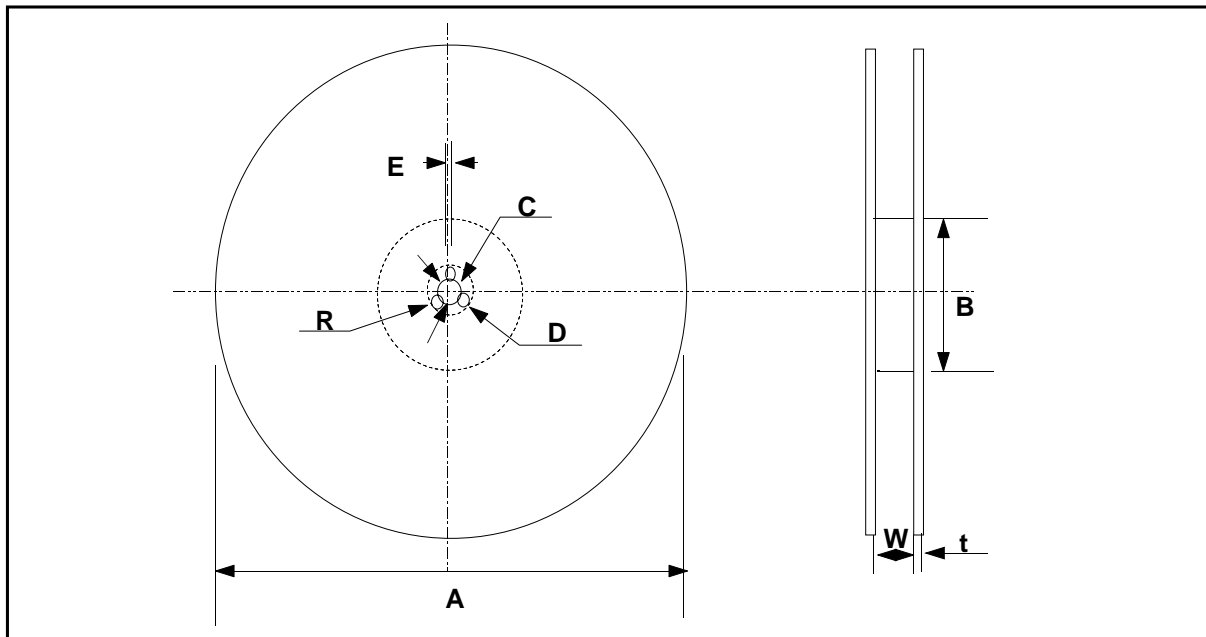
## ● TAPING SIZE



unit : pcs

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

## ● REEL DIMENSION



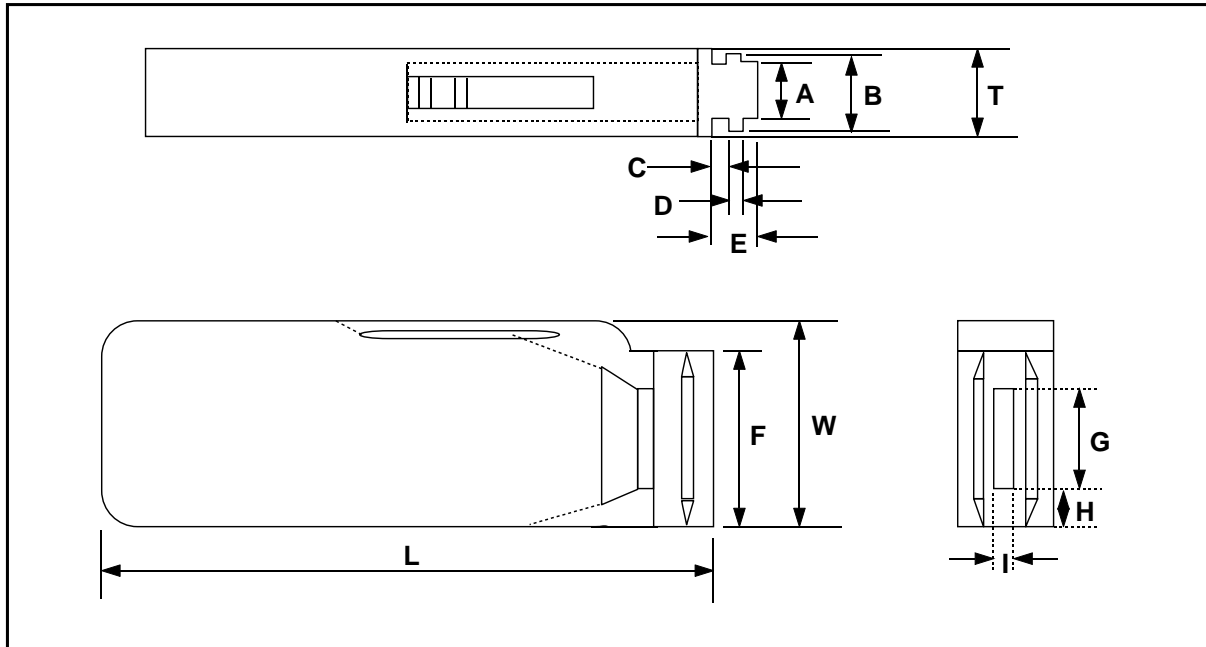
unit : mm

| 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±0.1 | 8.8±0.1 | 12±0.1 | 1.5+0.1/-0 | 2+0/-0.1 | 4.7±0.1 |

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

## ● QUANTITY

| Size     | 05(0402) | 10(0603)       | 21(0805) |         |
|----------|----------|----------------|----------|---------|
|          |          |                | T≤0.85mm | T≥1.0mm |
| 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 | 100000000 |  |  |  |  |
| SL,UJ                       | 05<br>(0402) | 50V     | ████████████████████   |    |     | 240                                      |  |                      |         |          |           |  |  |  |  |
|                             | 10<br>(0603) | 50V     | ██   |    |     |  | 1000                                     |                      |         |          |           |  |  |  |  |
|                             | 21<br>(0805) | 50V     | ██                     |    |     |  |  | 2700                 |         |          |           |  |  |  |  |
|                             | 31<br>(1206) | 50V     | ██ |    |     |  |  |                      | 8200    |          |           |  |  |  |  |
| C(COG) &<br>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)

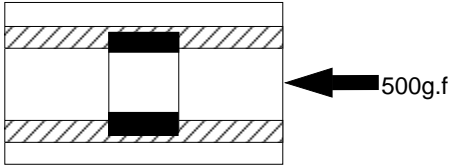
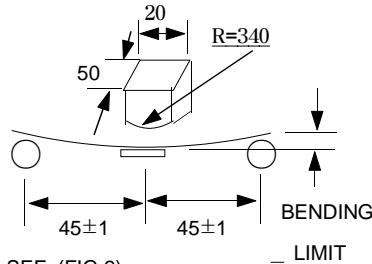
| Temperature Characteristics | Size         | Voltage | Capacitance Range (pF) |     |      |            |            |            |            |            |            |           |
|-----------------------------|--------------|---------|------------------------|-----|------|------------|------------|------------|------------|------------|------------|-----------|
|                             |              |         | 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    |                        |     |      |            |            |            | 4700000    | ██████████ | 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

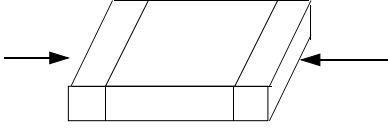
## RELIABILITY TEST DATA

| 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<br>WITHIN THE SPECIFIED TOLERANCE  | CAPACITANCE   | FREQUENCY                                | VOLTAGE      |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       |  | 1,000pF AND BELOW   | 1Mhz±10%                                 | 0.5 ~ 5 Vrms |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       | MORE THAN 1,000pF  | 1kHz±10%  |  |              |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       | CLASS II<br>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<br>OVER 30pF : Q ≥1,000<br>LESS THAN 30pF: Q ≥400 +20C<br>( C : CAPACITANCE )                    | CAPACITANCE   | FREQUENCY                                | VOLTAGE      |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       |  | 1,000pF AND BELOW   | 1Mhz±10%                                 | 0.5 ~ 5 Vrms |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       |  | MORE THAN 1,000pF   | 1kHz±10%                                 |              |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 6              | Tanδ                  | CLASS II   | 1. CHAR : B   |  |              |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       |  | <table border="1"> <thead> <tr> <th>RATED VOLTAGE</th> <th>DF SPEC</th> </tr> </thead> <tbody> <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> </tbody> </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 |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       |  | 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                                |              |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       |  | 2. CHAR : F   |  |              |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
|                |                       |  | <table border="1"> <thead> <tr> <th></th> <th>6.3V</th> <th>10V</th> <th>16V</th> <th>25V</th> <th>50V</th> </tr> </thead> <tbody> <tr> <td>1005</td> <td>-</td> <td>0.125max</td> <td>0.09max (C &lt; 220nF)<br/>0.125max (C ≥ 220nF)</td> <td>0.05max</td> <td>0.05max</td> </tr> <tr> <td>1608</td> <td>0.16max</td> <td>0.125max</td> <td>0.09max</td> <td>0.05max(C ≤ 100nF)<br/>0.07max(C &gt; 100nF)</td> <td>0.05max</td> </tr> <tr> <td>2012</td> <td>0.16max</td> <td>0.125max</td> <td>0.09max</td> <td>0.07max</td> <td>0.05max</td> </tr> <tr> <td>3216</td> <td>0.16max</td> <td>0.125max</td> <td>0.09max</td> <td>0.07max</td> <td>0.05max</td> </tr> <tr> <td>3225</td> <td>0.16max</td> <td>0.125max</td> <td>0.09max</td> <td>0.07max(C ≤ 6.8μF)<br/>0.09max(C &gt; 6.8μF)</td> <td>0.05max</td> </tr> <tr> <td>4532</td> <td>0.16max</td> <td>0.16max</td> <td>0.09max</td> <td>-</td> <td>-</td> </tr> <tr> <td>5750</td> <td></td> <td>0.125max</td> <td>-</td> <td>-</td> <td>-</td> </tr> </tbody> </table> |  |              |               | 6.3V    | 10V  | 16V      | 25V | 50V      | 1005 | -         | 0.125max | 0.09max (C < 220nF)<br>0.125max (C ≥ 220nF) | 0.05max | 0.05max   | 1608 | 0.16max | 0.125max | 0.09max | 0.05max(C ≤ 100nF)<br>0.07max(C > 100nF) | 0.05max | 2012 | 0.16max | 0.125max | 0.09max | 0.07max | 0.05max | 3216 | 0.16max | 0.125max | 0.09max | 0.07max | 0.05max | 3225 | 0.16max | 0.125max | 0.09max | 0.07max(C ≤ 6.8μF)<br>0.09max(C > 6.8μF) | 0.05max | 4532 | 0.16max | 0.16max | 0.09max | - | - | 5750 |  | 0.125max |
|                | 6.3V                  | 10V  | 16V   | 25V                                      | 50V          |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 1005           | -                     | 0.125max   | 0.09max (C < 220nF)<br>0.125max (C ≥ 220nF)   | 0.05max                                  | 0.05max      |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 1608           | 0.16max               | 0.125max   | 0.09max   | 0.05max(C ≤ 100nF)<br>0.07max(C > 100nF) | 0.05max      |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 2012           | 0.16max               | 0.125max   | 0.09max   | 0.07max                                  | 0.05max      |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 3216           | 0.16max               | 0.125max   | 0.09max   | 0.07max                                  | 0.05max      |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 3225           | 0.16max               | 0.125max   | 0.09max   | 0.07max(C ≤ 6.8μF)<br>0.09max(C > 6.8μF) | 0.05max      |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 4532           | 0.16max               | 0.16max  | 0.09max   | -  | -            |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 5750           |                       | 0.125max   | -   | -  | -            |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| CAPACITANCE    | FREQUENCY             | VOLTAGE  |   |  |              |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| 10μF AND BELOW | 1kHz±10%              | 1.0±0.2Vrms  |   |  |              |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |
| MORE THAN 10μF | 120Hz±20%             | 0.5±0.1Vrms  |   |  |              |               |         |      |          |     |          |      |           |          |   |         |           |      |         |          |         |  |         |      |         |          |         |         |         |      |         |          |         |         |         |      |         |          |         |  |         |      |         |         |         |   |   |      |  |          |

# Multilayer Ceramic Capacitor

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

# Multilayer Ceramic Capacitor

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

\* THE INITIAL VALUE OF HIGH DIELECTRIC CONSTANT SERIES SHALL BE MEASURED AFTER THE HEAT TREATMENT OF 150 +0/-10℃, 1hr AND SITTING OF 48±4hr 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   |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   | CAPACITANCE  | CHARACTERISTIC   | CAPACITANCE CHANGE  |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   |  | CLASS I  | WITHIN $\pm 5\%$ OR<br>$\pm 0.5\text{pF}$ WHICHEVER<br>IS LARGER      |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   |  | CLASS II   | WITHIN $\pm 30\%$   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   | Q  | 30pF AND OVER : $Q \geq 350$<br>10 ~30pF : $Q \geq 275 + 2.5 \times C$<br>LESS THAN 10pF : $Q \geq 200 + 10 \times C$  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| Tan $\delta$                   | <table border="1"> <thead> <tr> <th>CHAR.</th> <th>25V AND OVER</th> <th>16V</th> <th>10V</th> <th>6.3V</th> <th>4V</th> </tr> </thead> <tbody> <tr> <td>A,B</td> <td>0.05</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<br/>(C &lt; 1.0<math>\mu\text{F}</math>)<br/>0.125<br/>MAX<br/>(C <math>\geq 1.0\mu\text{F}</math>)</td> <td>0.15<br/>MAX</td> <td>0.195<br/>MAX</td> <td>0.25<br/>MAX</td> </tr> </tbody> </table> | CHAR.  | 25V AND OVER   | 16V   | 10V                  | 6.3V              | 4V                            | A,B                          | 0.05                         | 0.05 MAX                      | 0.05 MAX                      | 0.075 MAX                     | 0.1 MAX                        | F | 0.075 MAX | 0.1MAX<br>(C < 1.0 $\mu\text{F}$ )<br>0.125<br>MAX<br>(C $\geq 1.0\mu\text{F}$ ) | 0.15<br>MAX | 0.195<br>MAX | 0.25<br>MAX |
| CHAR.                          | 25V AND OVER  | 16V  | 10V  | 6.3V  | 4V                   |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| A,B                            | 0.05  | 0.05 MAX   | 0.05 MAX   | 0.075 MAX   | 0.1 MAX              |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| F                              | 0.075 MAX   | 0.1MAX<br>(C < 1.0 $\mu\text{F}$ )<br>0.125<br>MAX<br>(C $\geq 1.0\mu\text{F}$ ) | 0.15<br>MAX  | 0.195<br>MAX  | 0.25<br>MAX          |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| INSULATION RESISTANCE          | MINIMUM INSULATION RESISTANCE:<br>1,000 M $\Omega$ OR 50M $\Omega \cdot \mu\text{F}$ PRODUCT WHICHEVER IS SMALLER   |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| 15                             | MOISTURE<br>RESISTANCE  | APPEARANCE   | NO MECHANICAL DAMAGE SHALL OCCUR   |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   | CAPACITANCE  | CHARACTERISTIC   | CAPACITANCE CHANGE  |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   |  | CLASS I  | WITHIN $\pm 7.5\%$ OR<br>$\pm 0.75\text{pF}$ WHICHEVER<br>IS LARGER   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   |  | CLASS II   | WITHIN $\pm 12.5\%$<br><br>WITHIN $\pm 30\%$<br><br>WITHIN +30~ - 40% |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   | Q  | 30pF AND OVER : $Q \geq 200$<br>30pF AND BELOW : $Q \geq 100 + 10/3 \times C$  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| Tan $\delta$                   | <table border="1"> <thead> <tr> <th>CHAR.</th> <th>25V AND OVER</th> <th>16V</th> <th>10V</th> <th>6.3V</th> <th>4V</th> </tr> </thead> <tbody> <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<br/>(C &lt; 1.0<math>\mu\text{F}</math>)<br/>0.125MAX<br/>(C <math>\geq 1.0\mu\text{F}</math>)</td> <td>0.15<br/>MAX</td> <td>0.195<br/>MAX</td> <td>0.25<br/>MAX</td> </tr> </tbody> </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<br>(C < 1.0 $\mu\text{F}$ )<br>0.125MAX<br>(C $\geq 1.0\mu\text{F}$ )     | 0.15<br>MAX | 0.195<br>MAX | 0.25<br>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<br>(C < 1.0 $\mu\text{F}$ )<br>0.125MAX<br>(C $\geq 1.0\mu\text{F}$ )     | 0.15<br>MAX  | 0.195<br>MAX  | 0.25<br>MAX          |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| INSULATION RESISTANCE          | MINIMUM INSULATION RESISTANCE:<br>500 M $\Omega$ OR 25M $\Omega \cdot \mu\text{F}$ PRODUCT,<br>WHICHEVER IS SMALLER.  |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   |  | <p>APPLIED VOLTAGE :<br/>RATED VOLTAGE</p> <p>TEMPERATURE : <math>40 \pm 2</math> °C<br/>RELATIVE HUMIDITY:90~95%RH<br/>TEST TIME : 500 +12/-0 Hr.<br/>CURRENT APPLIED : 50mA MAX.</p> <p><b>&lt;INITIAL MEASUREMENT&gt;</b><br/>CLASS II SHOULD BE MEASURED<br/>INITIAL VALUE AFTER BE HEAT-TREATED<br/>FOR 1 HR IN 150°C+0/-10°C AND BE LEFT<br/>FOR 48±4HR AT ROOM TEMPERATURE.</p> <p><b>&lt;LATTER MEASUREMENT&gt;</b><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°C+0/-10<br/>°C AND BE LEFT FOR 48±4HR AT ROOM<br/>TEMPERATURE.</p> |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                |   |  | <table border="1"> <thead> <tr> <th>6.3V Tan<math>\delta</math></th> <th>0.125 MAX *Condition</th> </tr> </thead> <tbody> <tr> <td rowspan="6">CLASS II<br/>(A,B)</td> <td>1005 C <math>\geq 0.22\mu\text{F}</math></td> </tr> <tr> <td>1608 C <math>\geq 2.2\mu\text{F}</math></td> </tr> <tr> <td>2012 C <math>\geq 4.7\mu\text{F}</math></td> </tr> <tr> <td>3216 C <math>\geq 10.0\mu\text{F}</math></td> </tr> <tr> <td>3225 C <math>\geq 22.0\mu\text{F}</math></td> </tr> <tr> <td>4532 C <math>\geq 47.0\mu\text{F}</math></td> </tr> <tr> <td>5750 C <math>\geq 100.0\mu\text{F}</math></td> </tr> </tbody> </table>  | 6.3V Tan $\delta$   | 0.125 MAX *Condition | CLASS II<br>(A,B) | 1005 C $\geq 0.22\mu\text{F}$ | 1608 C $\geq 2.2\mu\text{F}$ | 2012 C $\geq 4.7\mu\text{F}$ | 3216 C $\geq 10.0\mu\text{F}$ | 3225 C $\geq 22.0\mu\text{F}$ | 4532 C $\geq 47.0\mu\text{F}$ | 5750 C $\geq 100.0\mu\text{F}$ |   |           |  |             |              |             |
| 6.3V Tan $\delta$              | 0.125 MAX *Condition  |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| CLASS II<br>(A,B)              | 1005 C $\geq 0.22\mu\text{F}$   |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                | 1608 C $\geq 2.2\mu\text{F}$  |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                | 2012 C $\geq 4.7\mu\text{F}$  |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                | 3216 C $\geq 10.0\mu\text{F}$   |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                | 3225 C $\geq 22.0\mu\text{F}$   |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
|                                | 4532 C $\geq 47.0\mu\text{F}$   |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |
| 5750 C $\geq 100.0\mu\text{F}$ |   |  |  |   |                      |                   |                               |                              |                              |                               |                               |                               |                                |   |           |  |             |              |             |

# Multilayer Ceramic Capacitor

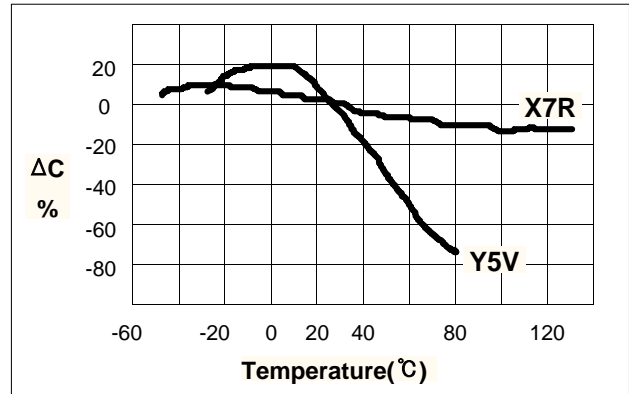
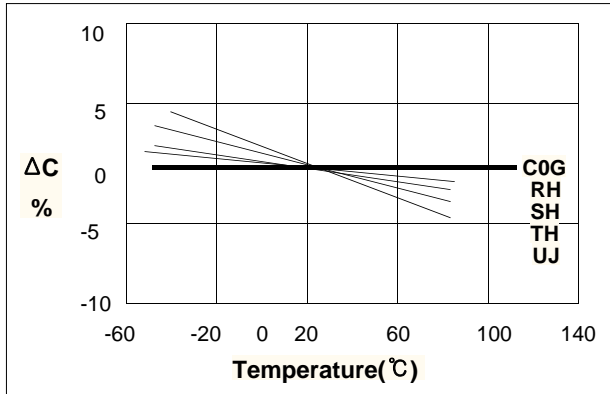
| NO                    | ITEM  | PERFORMANCE  | TEST CONDITION  |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|-----------------------|---|--|---|---|--|-----------|--------------------------------|----------------------|----------|-------------------------------|----------|--------------------------------|---------|-------------------------------|-----------|--|------------------|---|----------|
| 16                    | HIGH TEMPERATURE RESISTANCE   | APPEARANCE   | NO MECHANICAL DAMAGE SHALL OCCUR  |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   | CAPACITANCE  | CHARACTERISTIC  | CAP. CHANGE   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   |  | CLASS I   | WITHIN $\pm 3\%$ OR $\pm 0.3\text{pF}$ , WHICHEVER IS LARGER  |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   |  | CLASS II  | A,B   | WITHIN $\pm 12.5\%$  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   |  |   | F   | WITHIN $\pm 30\%$<br>WITHIN $+30\sim 40\%$<br>1005 C $> 0.47\mu\text{F}$<br>1608 C $> 1.0\mu\text{F}$<br>2012 C $> 4.7\mu\text{F}$<br>3216 C $> 10.0\mu\text{F}$<br>3225 C $> 22.0\mu\text{F}$<br>4532 C $> 47.0\mu\text{F}$ |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   | Q CLASS I  | 30pF AND OVER : $Q \geq 350$<br>10 ~ 30 pF : $Q \geq 275 + 2.5 \times C$<br>LESS THAN 10pF : $Q \geq 200 + 10 \times C$   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| Tan $\delta$ CLASS II | <table border="1"> <thead> <tr> <th>CHAR.</th> <th>25V AND OVER</th> <th>16V</th> <th>10V</th> <th>6.3V</th> <th>4V</th> </tr> </thead> <tbody> <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;1.0<math>\mu\text{F}</math>)<br/>0.125MAX (C<math>\geq 1.0\mu\text{F}</math>)</td> <td>0.15 MAX</td> <td>0.195 MAX</td> <td>0.25 MAX</td> </tr> </tbody> </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<1.0 $\mu\text{F}$ )<br>0.125MAX (C $\geq 1.0\mu\text{F}$ ) | 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<1.0 $\mu\text{F}$ )<br>0.125MAX (C $\geq 1.0\mu\text{F}$ ) | 0.15 MAX  | 0.195 MAX   | 0.25 MAX   |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| INSULATION RESISTANCE | MINIMUM INSULATION RESISTANCE:<br>1,000 M $\Omega$ OR 50M $\Omega \cdot \mu\text{F}$ PRODUCT<br>WHICHEVER IS SMALLER  |  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   |  | <p>APPLIED VOLTAGE :<br/>150%, 200% OF RATED VOLTAGE<br/>TEST TIME : 1000 +48/-0 Hr.<br/>CURRENT APPLIED : 50mA MAX.</p> <table border="1"> <thead> <tr> <th>CHAR.</th> <th>TEMP.</th> </tr> </thead> <tbody> <tr> <td>CLASS I</td> <td>125 <math>\pm 3</math> <math>^{\circ}\text{C}</math></td> </tr> <tr> <td rowspan="3">CLASS II</td> <td>A</td> <td>85 <math>\pm 3</math> <math>^{\circ}\text{C}</math></td> </tr> <tr> <td>B</td> <td>125 <math>\pm 3</math> <math>^{\circ}\text{C}</math></td> </tr> <tr> <td>F</td> <td>85 <math>\pm 3</math> <math>^{\circ}\text{C}</math></td> </tr> </tbody> </table> <p>&lt;INITIAL MEASUREMENT&gt;<br/>CLASS II SHOULD BE MEASURED INITIAL VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150<math>^{\circ}\text{C} \pm 0/-10^{\circ}\text{C}</math> AND BE LEFT FOR 48<math>\pm</math> 4HR AT ROOM TEMPERATURE.<br/>&lt;LATTER MEASUREMENT&gt;<br/>CLASS I SHOULD BE MEASURED AFTER LEFT FOR 24<math>\pm 2</math> HRS IN ROOM TEMPERATURE AND HUMIDITY.<br/>CLASS II SHOULD BE MEASURED LATTER VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150<math>^{\circ}\text{C} \pm 0/-10^{\circ}\text{C}</math> AND BE LEFT FOR 48<math>\pm</math> 4HR AT ROOM TEMPERATURE.</p> <table border="1"> <thead> <tr> <th></th> <th>*150% Authorization Conditions</th> </tr> </thead> <tbody> <tr> <td>CLASS II (A,B,F)</td> <td>1005 C <math>&gt; 0.47\mu\text{F}</math><br/>1608 C <math>\geq 2.2\mu\text{F}</math><br/>2012 C <math>\geq 4.7\mu\text{F}</math><br/>3216 C <math>\geq 10.0\mu\text{F}</math><br/>3225 C <math>\geq 22.0\mu\text{F}</math><br/>4532 C <math>\geq 47.0\mu\text{F}</math><br/>5750 C <math>\geq 100.0\mu\text{F}</math></td> </tr> </tbody> </table> <p>(TWICE OF RATED VOLTAGE WILL BE APPLIED TO ALL SERIES BUT ABOVE)<br/>** HOWEVER, A/B <math>\neq</math> 1005 C <math>\geq 0.22\mu\text{F}</math> SEE (FIG.3)</p> | CHAR.   | TEMP.  | CLASS I   | 125 $\pm 3$ $^{\circ}\text{C}$ | CLASS II             | A        | 85 $\pm 3$ $^{\circ}\text{C}$ | B        | 125 $\pm 3$ $^{\circ}\text{C}$ | F       | 85 $\pm 3$ $^{\circ}\text{C}$ |           | *150% Authorization Conditions                                       | CLASS II (A,B,F) | 1005 C $> 0.47\mu\text{F}$<br>1608 C $\geq 2.2\mu\text{F}$<br>2012 C $\geq 4.7\mu\text{F}$<br>3216 C $\geq 10.0\mu\text{F}$<br>3225 C $\geq 22.0\mu\text{F}$<br>4532 C $\geq 47.0\mu\text{F}$<br>5750 C $\geq 100.0\mu\text{F}$ |          |
| CHAR.                 | TEMP.   |  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| CLASS I               | 125 $\pm 3$ $^{\circ}\text{C}$  |  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| CLASS II              | A   | 85 $\pm 3$ $^{\circ}\text{C}$  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       | B   | 125 $\pm 3$ $^{\circ}\text{C}$                                       |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       | F   | 85 $\pm 3$ $^{\circ}\text{C}$  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       | *150% Authorization Conditions  |  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| CLASS II (A,B,F)      | 1005 C $> 0.47\mu\text{F}$<br>1608 C $\geq 2.2\mu\text{F}$<br>2012 C $\geq 4.7\mu\text{F}$<br>3216 C $\geq 10.0\mu\text{F}$<br>3225 C $\geq 22.0\mu\text{F}$<br>4532 C $\geq 47.0\mu\text{F}$<br>5750 C $\geq 100.0\mu\text{F}$   |  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| 17                    | TEMPERATURE CYCLE   | APPEARANCE   | NO MECHANICAL DAMAGE SHALL OCCUR  |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   | CAPACITANCE  | CHARACTERISTIC  | CAP. CHANGE   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   |  | CLASS I   | WITHIN $\pm 2.5\%$ OR $\pm 0.25\text{pF}$ WHICHEVER IS LARGER |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   |  | CLASS II  | A,B   | WITHIN $\pm 7.5\%$   |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   |  |   | F   | WITHIN $\pm 20\%$  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   | Q CLASS I  | 30 pF AND OVER : $Q \geq 1000$<br>LESS THAN 30pF: $Q \geq 400 + 20 \times C$  |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| Tan $\delta$ CLASS II | TO SATISFY THE SPECIFIED INITIAL VALUE  |  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| INSULATION RESISTANCE | TO SATISFY THE SPECIFIED INITIAL VALUE  |  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
|                       |   |  | <p>CAPACITORS SHALL BE SUBJECTED TO FIVE CYCLES OF THE TEMPERATURE CYCLE AS FOLLOWING</p> <table border="1"> <thead> <tr> <th>STEP</th> <th>TEMP.(<math>^{\circ}\text{C}</math>)</th> <th>TIME(MIN)</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>MEASURE AT ROOM TEMPERATURE AFTER COOLING FOR<br/>CLASS I : 24<math>\pm 2</math> Hr.<br/>CLASS II : 48<math>\pm 4</math> Hr.</p>   | STEP  | TEMP.( $^{\circ}\text{C}$ )  | 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.( $^{\circ}\text{C}$ )   | TIME(MIN)  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| 1                     | MIN.RATED TEMP.+0/-3  | 30   |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| 2                     | 25  | 2~3  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| 3                     | MAX.RATED TEMP.+3/-0  | 30   |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |
| 4                     | 25  | 2~3  |   |   |  |           |                                |                      |          |                               |          |                                |         |                               |           |  |                  |   |          |

# Multilayer Ceramic Capacitor

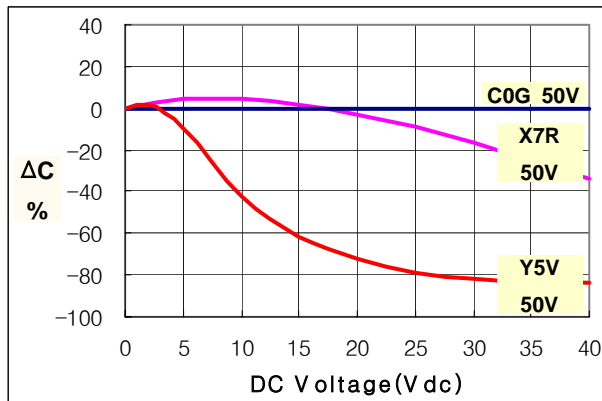
## CHARACTERISTIC GRAPH

### ELECTRICAL CHARACTERISTICS

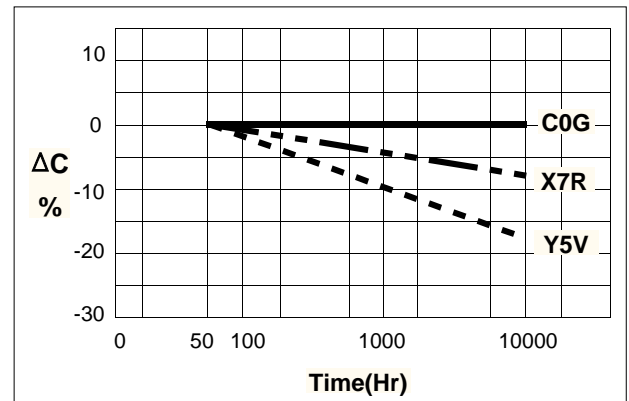
#### CAPACITANCE - TEMPERATURE CHARACTERISTICS



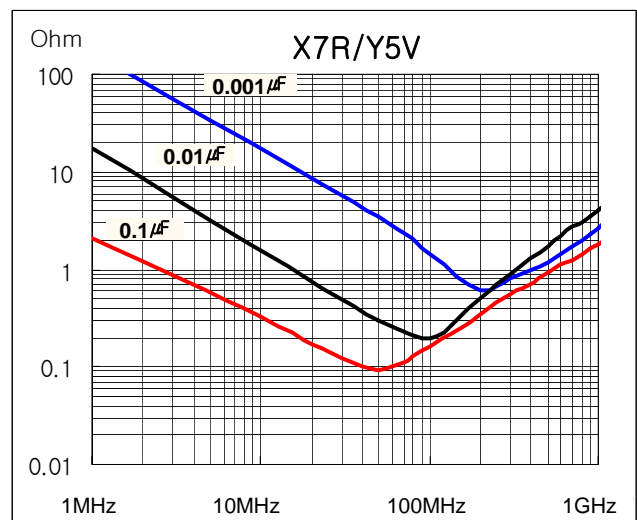
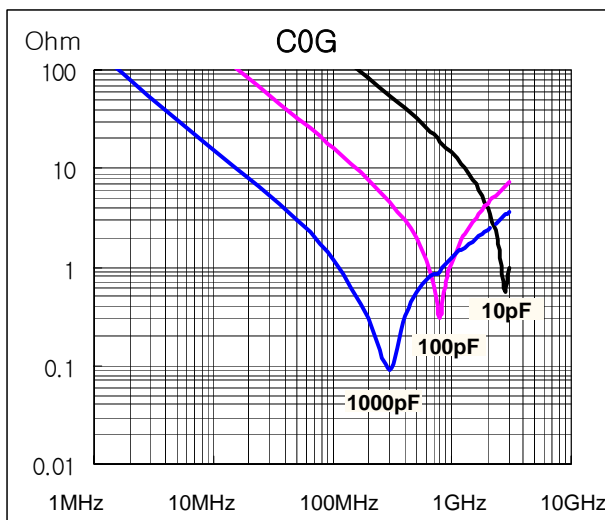
#### CAPACITANCE - DC VOLTAGE CHARACTERISTICS



#### 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°C 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.

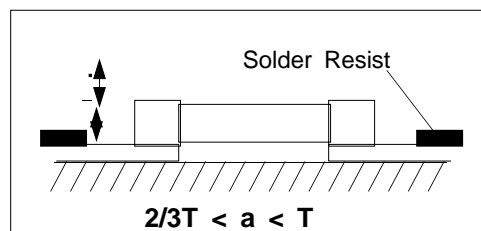
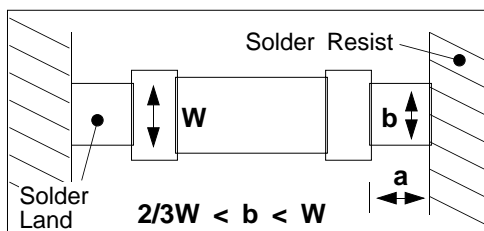
#### ▶ Temperature Fluctuations

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.

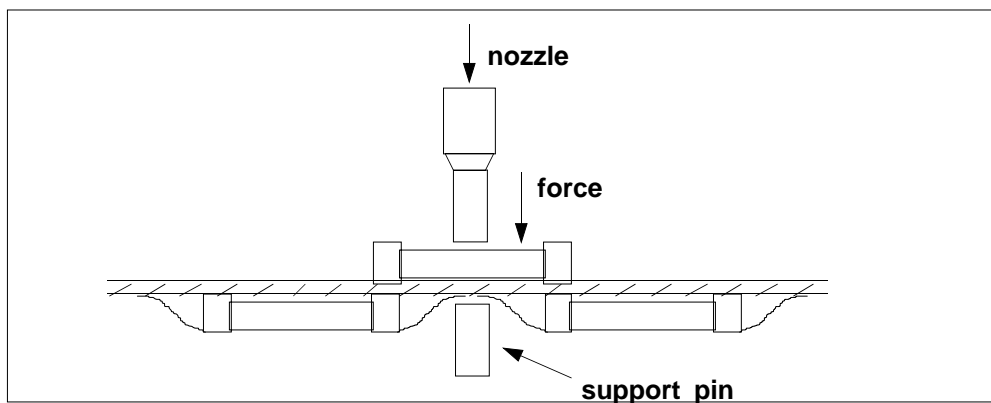
## ● Mounting

### ▶ 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.

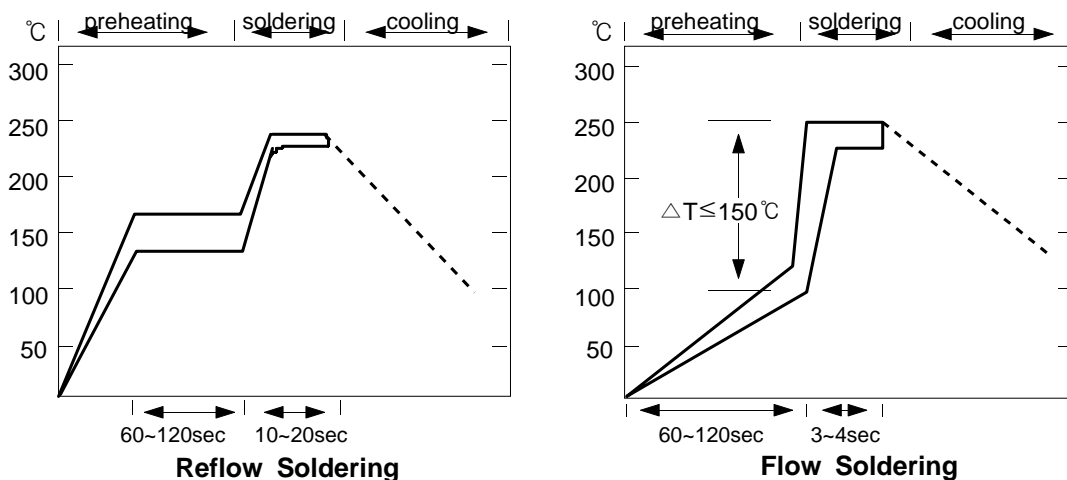
### ▶ Soldering Methods

| 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.

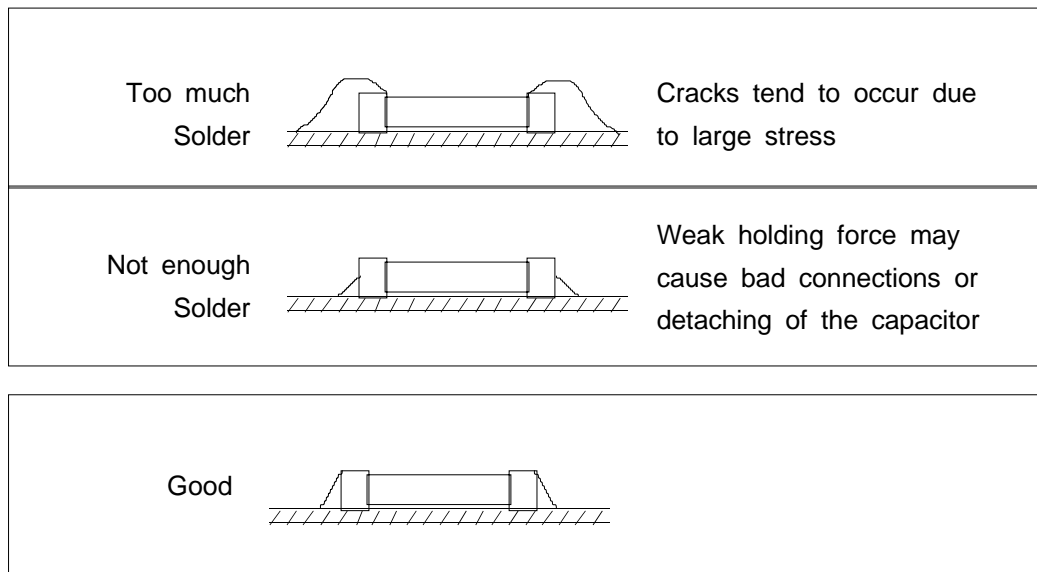


### ▶ Manual Soldering

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 : CL10B104KA8NNC

| CL   | 10   | B  | 104   | K   | A  | 8   | N  | N               | N   | C                |
|--|--|--|---|---|--|---|--|-----------------|---|------------------|
| <b>Series</b>  | <b>Size</b>  | <b>Dielectric</b>  | <b>Capacitance</b>  | <b>Tolerance</b>  | <b>Voltage</b>   | <b>Thickness</b>  | <b>Electrode/<br/>Termination/<br/>Plating</b>   | <b>Products</b> | <b>Special</b>  | <b>Packaging</b> |
| 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  |
|--|---|---|---|---|---------------------|---|---|--|
| <b>Size</b>  | <b>Voltage</b>  | <b>Dielectric</b>                                   | <b>Capacitance</b>  | <b>Tolerance</b>  | <b>Failure Rate</b> | <b>Termination</b>                          | <b>Packaging</b>  | <b>Special</b>   |
| 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 = ±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 = 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   |
|--|--|---|--|---|--------------------|----------------------------|---|
| <b>Voltage</b>   | <b>Size</b>  | <b>Dielectric</b>                                   | <b>Capacitance</b>   | <b>Tolerance</b>  | <b>Termination</b> | <b>Marking</b>             | <b>Packaging</b>  |
| 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 = ±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 = 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

| C  | 0603   | C  | 104   | K  | 3  | R   | A  | C                  |
|--|--|--|---|--|--|---|--|--------------------|
| <b>Series</b>  | <b>Size</b>  | <b>Specification</b>   | <b>Capacitance</b>  | <b>Tolerance</b>   | <b>Voltage</b>   | <b>Dielectric</b>   | <b>Failure Rate</b>  | <b>Termination</b> |
| 0402<br>0603<br>0805<br>1206<br>1210<br>1812<br>2220<br>2225 | C = Standard<br>A = GR900<br>P = Mil-C-55681<br>CDR01-CDR06<br>N = Mil-C-55681<br>CDR31-CDR35<br>Z = Mil-C-123<br>E = Mil Equivalent<br>(Group A Only) | 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% | 9 = 6.3V<br>8 = 10V<br>4 = 16V<br>3 = 25V<br>5 = 50V<br>1 = 100V<br>2 = 200V | G = C0G<br>R = X7R<br>P = X5R<br>U = Z5U<br>X = BX(Mil)<br>V = Y5V | A = Standard<br>M = 1.0 (Mil)<br>P = 0.1 (Mil)<br>R = 0.01 (Mil)<br>S = 0.001 (Mil) | C = Ni w/Tin Plate<br>H = Ni w/Solder<br>T = Silver<br>G = Gold Plated |                    |

# Multilayer Ceramic Capacitor

## ► KYOCERA : CM105X7R104K25AT

| CM            | 105   | X7R  | 104  | K   | 25   | A                  | T  |
|---------------|---|--|--|---|--|--------------------|--|
| <b>Series</b> | <b>Size</b>   | <b>Dielectric</b>                            | <b>Capacitance</b>   | <b>Tolerance</b>  | <b>Voltage</b>   | <b>Termination</b> | <b>Packaging</b>   |
|               | 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 = $\pm 0.1\text{pF}$<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% | 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  |
|---------------|---|--|--|--|---|--|--------------------------------------|--|
| <b>Series</b> | <b>Size</b>   | <b>Thickness</b>   | <b>Dielectric</b>  | <b>Voltage</b>   | <b>Capacitance</b>  | <b>Tolerance</b>   | <b>Individual Specification Code</b> | <b>Packaging</b>   |
| 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              |
|--|--|--|---|--|---|------------------|--|----------------|
| <b>Size</b>  | <b>Dielectric</b>                                  | <b>Capacitance</b>   | <b>Tolerance</b>  | <b>Voltage</b>   | <b>Termination</b>  | <b>Thickness</b> | <b>Packaging</b>                           | <b>Marking</b> |
| 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,<br>0% | 2<br>significant<br>figures<br>+<br>number<br>of zeros | P = Pd/Ag<br>N = Ni Barrier<br>(Sn 100%)<br>Y = Ni Barrier<br>(Sn/Pb) | Per Specified    | T = Reel<br>None = Bulk<br>W = Waffle Pack |                |

## ► PANASONIC : ECJ1EB1E104K

| ECJ           | 1  | E   | B                                  | 1E  | 104  | K  |
|---------------|--|---|------------------------------------|---|--|--|
| <b>Series</b> | <b>Size</b>  | <b>Packaging</b>  | <b>Dielectric</b>                  | <b>Voltage</b>  | <b>Capacitance</b>   | <b>Tolerance</b>   |
|               | 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

| MCH           | 18   | 2  | C                             | 104  | K  | K   | N                               |
|---------------|--|--|-------------------------------|--|--|---|---------------------------------|
| <b>Series</b> | <b>Size</b>  | <b>Voltage</b><br>e                      | <b>Dielectric</b>             | <b>Capacitance</b>   | <b>Tolerance</b>   | <b>Packaging</b>  | <b>Marking/Thickness</b>        |
|               | 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 = ±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% | 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

| T  | M                          | K                  | 107  | BJ  | 104  | K  | -              | T                    |
|--|----------------------------|--------------------|--|---|--|--|----------------|----------------------|
| <b>Voltage</b>   | <b>Type</b>                | <b>Termination</b> | <b>Size</b>  | <b>Dielectric</b>   | <b>Capacitance</b>   | <b>Tolerance</b>   | <b>Special</b> | <b>Packaging</b>     |
| 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 = ±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% | Various        | T = Reel<br>B = Bulk |

## ▶ TDK : C1608X7R1E104KT

| C             | 1608   | X7R                     | 1E  | 104  | K   | T                    |
|---------------|--|-------------------------|---|--|---|----------------------|
| <b>Series</b> | <b>Size</b>  | <b>Dielectric</b>       | <b>Voltage</b>  | <b>Capacitance</b>   | <b>Tolerance</b>  | <b>Packaging</b>     |
|               | 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 = ±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% | T = Reel<br>B = Bulk |

## ▶ VITRAMON : VJ0603Y104KXXMC

| VJ            | 0603   | Y  | 104  | K   | X                                       | X   | M                             | C  |
|---------------|--|--|--|---|---|---|-------------------------------|--|
| <b>Series</b> | <b>Size</b>  | <b>Dielectric</b>                                    | <b>Capacitance</b>   | <b>Tolerance</b>  | <b>Termination</b>                      | <b>Voltage</b>  | <b>Marking</b>                | <b>Packaging</b>   |
|               | 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 = ±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% | 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 |