
Multilayer Ceramic Capacitor

- General -



■ 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.

■ FEATURE AND APPLICATION

● Feature

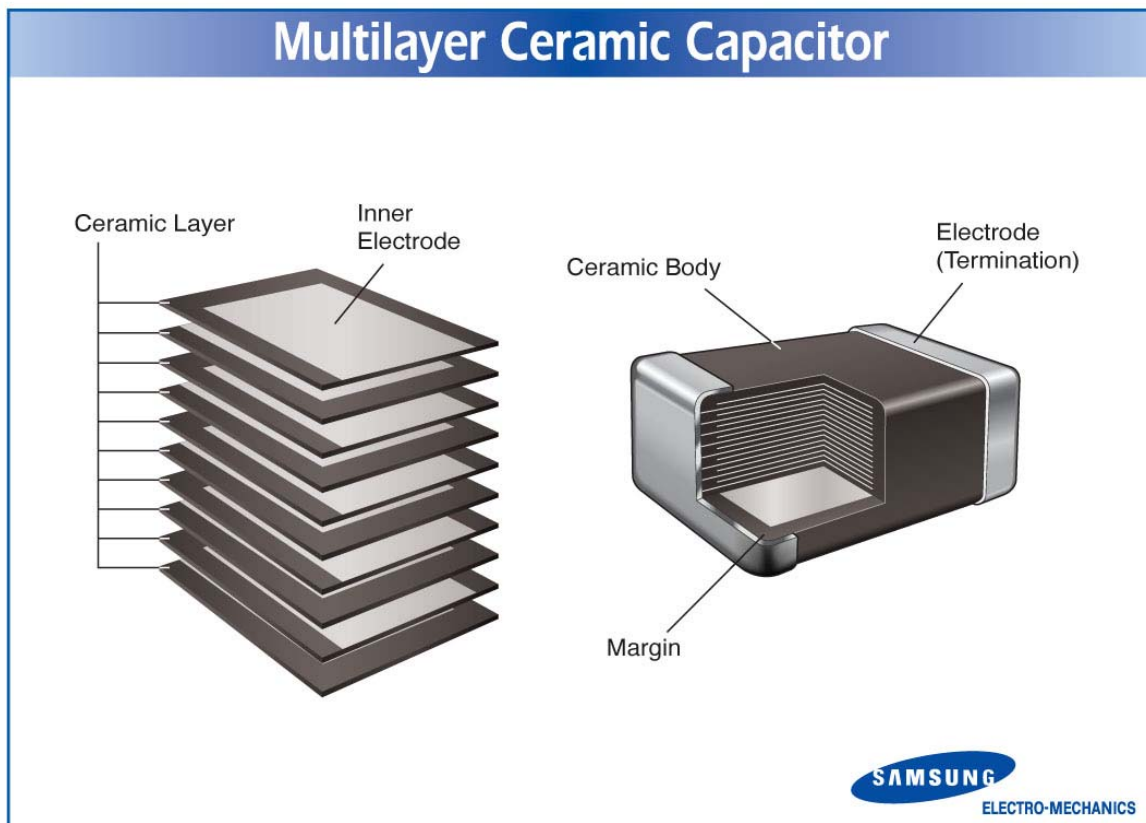
- Miniature Size
- Wide Capacitance and Voltage Range
- Tape & Reel for Surface Mount Assembly
- Low ESR

● Application

- General Electronic Circuit

Multilayer Ceramic Capacitor - General

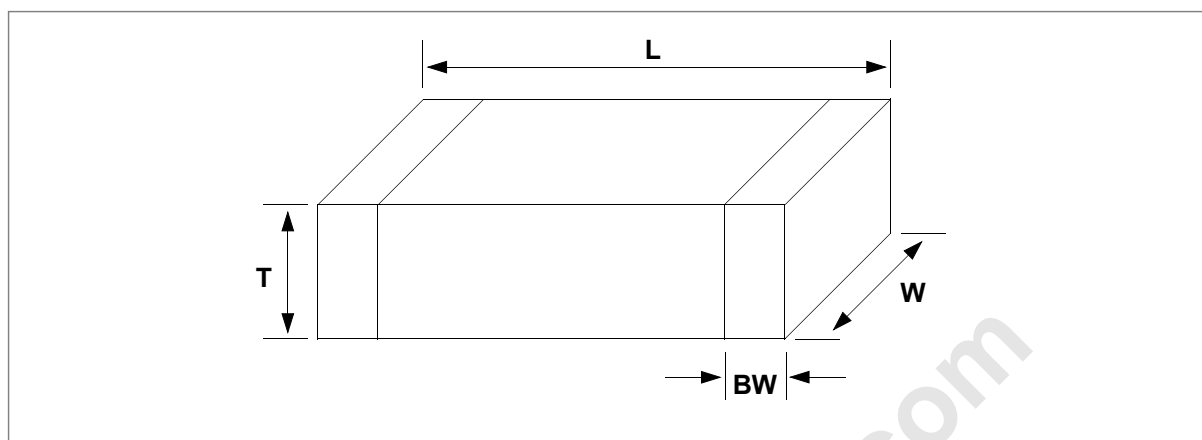
■ STRUCTURE



onlinecc

Multilayer Ceramic Capacitor - General

■ APPEARANCE AND DIMENSION



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

Multilayer Ceramic Capacitor - General

PREVIOUS PART NUMBERING

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

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

③ CAPACITANCE TEMPERATURE CHARACTERISTIC

▶ CLASS I (Temperature Compensation)

| Symble | EIA Code | Temperature Coefficient(PPM/°C) | ※ Temperature Characteristics | Operation Temperature Range |
|--------|----------|---------------------------------|-------------------------------|-----------------------------|
| C | C0G | 0 ± 30 | CΔ | -55 ~ +125°C |
| P | PH | -150 ± 60 | PΔ | |
| R | RH | -220 ± 60 | RΔ | |
| S | SH | -330 ± 60 | SΔ | |
| T | TH | -470 ± 60 | TΔ | |
| U | UJ | -750 ± 120 | UΔ | |
| L | SL | +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 | - | PJ | PH | PH | |
| RΔ | - | RJ | RH | RH | |
| SΔ | - | SJ | SH | SH | ☞ J : ±120 PPM/°C |
| TΔ | - | TJ | TH | TH | H : ±60 PPM/°C |
| UΔ | - | UJ | UJ | UJ | G : ±30 PPM/°C |

▶ CLASS II (High Dielectric Constant)

| Symble | 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 - General

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) or T.C Series | A | $\pm 0.05\text{pF}$ | 0.5 ~ 3pF |
| | B | $\pm 0.1\text{pF}$ | |
| | C | $\pm 0.25\text{pF}$ | 0.5 ~ 10pF |
| | D | $\pm 0.5\text{pF}$ | |
| | F | $\pm 1\text{pF}$ | 6 ~ 10pF |
| | F | $\pm 1\%$ | E-24 Series for over 10pF |
| | G | $\pm 2\%$ | |
| | J | $\pm 5\%$ | |
| A(X5R) 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) |
|--------|--------------------|--------|--------------------|
| R | 4V | C | 100V |
| Q | 6.3V | D | 200V |
| P | 10V | G | 500V |
| O | 16V | I | 1000V |
| A | 25V | J | 2000V |
| B | 50V | K | 3000V |

Multilayer Ceramic Capacitor - General

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 ×10ⁿ "

Multilayer Ceramic Capacitor - General

NEW PART NUMBERING

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

- 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 - General

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 |

⑤ CAPACITANCE TOLERANCE

| Symbol | Tolerance | Nominal Capacitance |
|--------|-----------|------------------------------------|
| A | ±0.05pF | Less than 10pF (Including 10pF) |
| B | ±0.1pF | |
| C | ±0.25pF | |
| D | ±0.5pF | |
| F | ±1pF | |
| F | ±1% | More than 10pF |
| G | ±2% | |
| J | ±5% | |
| K | ±10% | |
| M | ±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 - General

⑦ THICKNESS OPTION

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

Multilayer Ceramic Capacitor - General

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 - General

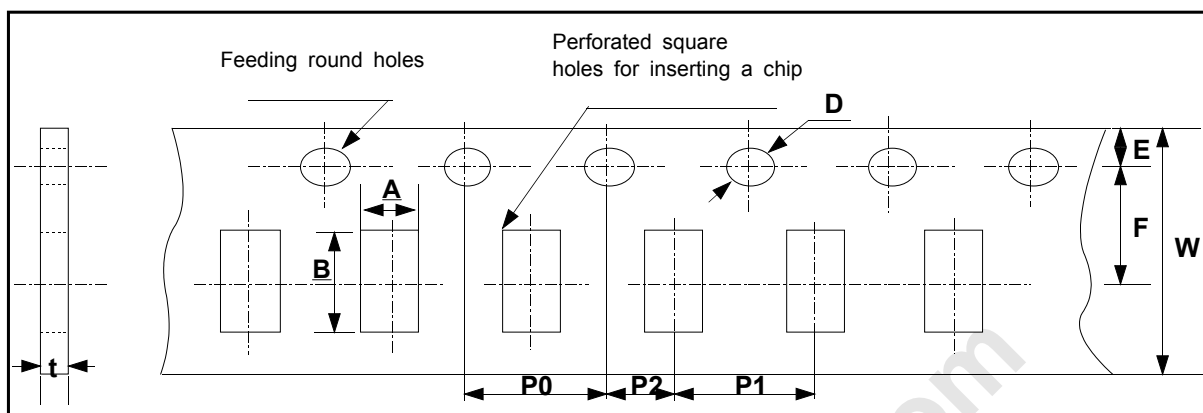
► CAPACITANCE vs CHIP THICKNESS STANDARD

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

Multilayer Ceramic Capacitor - General

PACKAGING

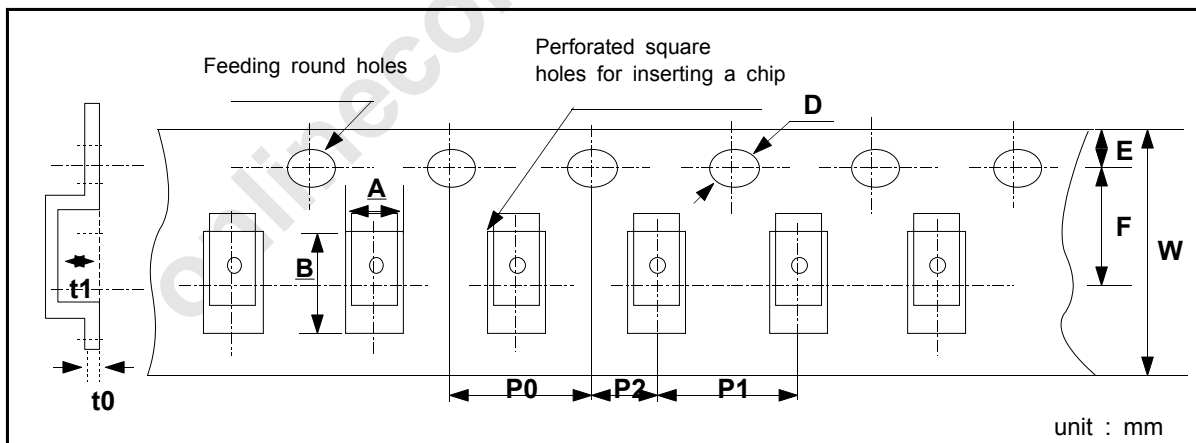
CARDBOARD PAPER TAPE



unit : mm

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

EMBOSSED PLASTIC TAPE

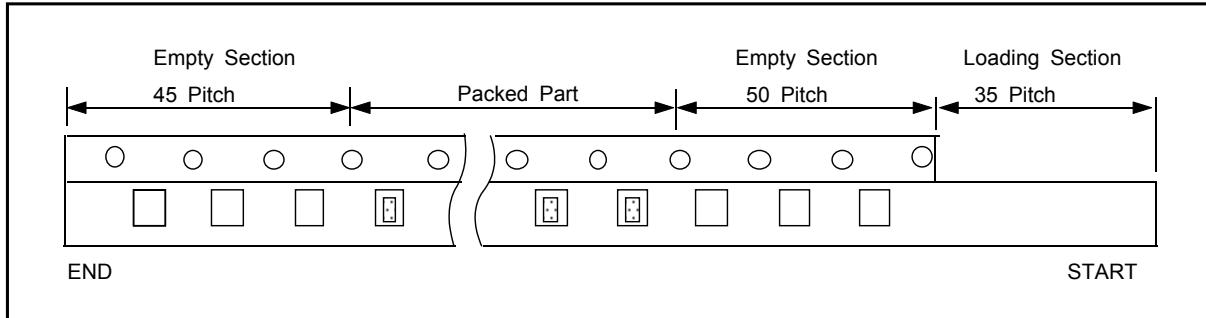


unit : mm

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

Multilayer Ceramic Capacitor - General

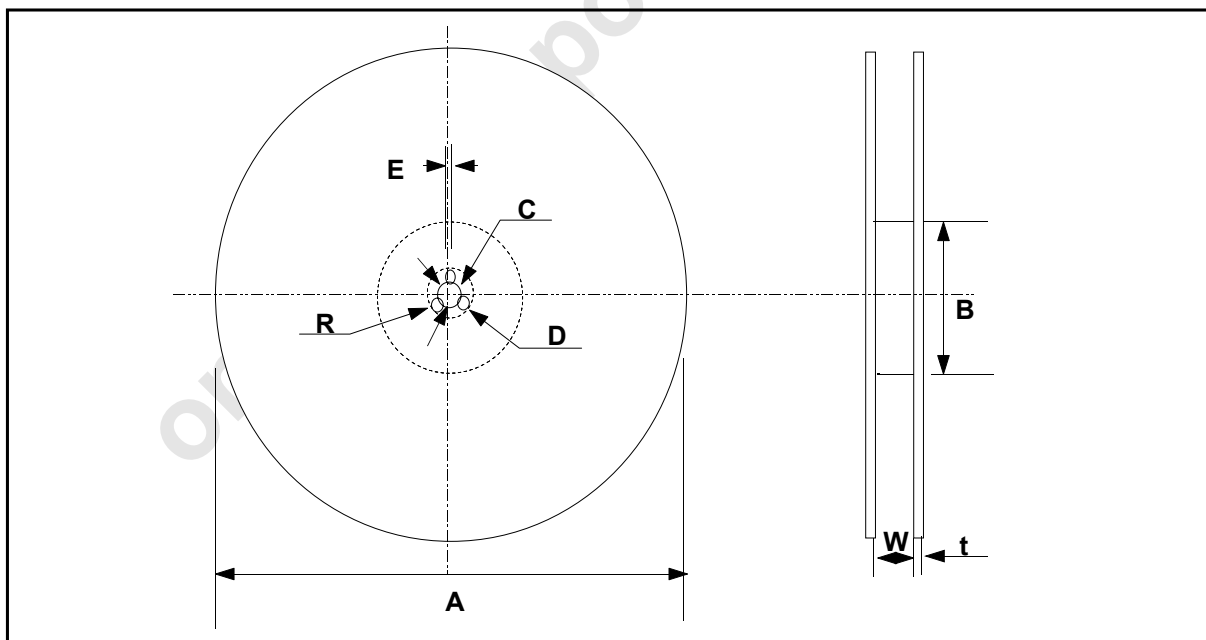
● TAPING SIZE



unit : pcs

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

● REEL DIMENSION



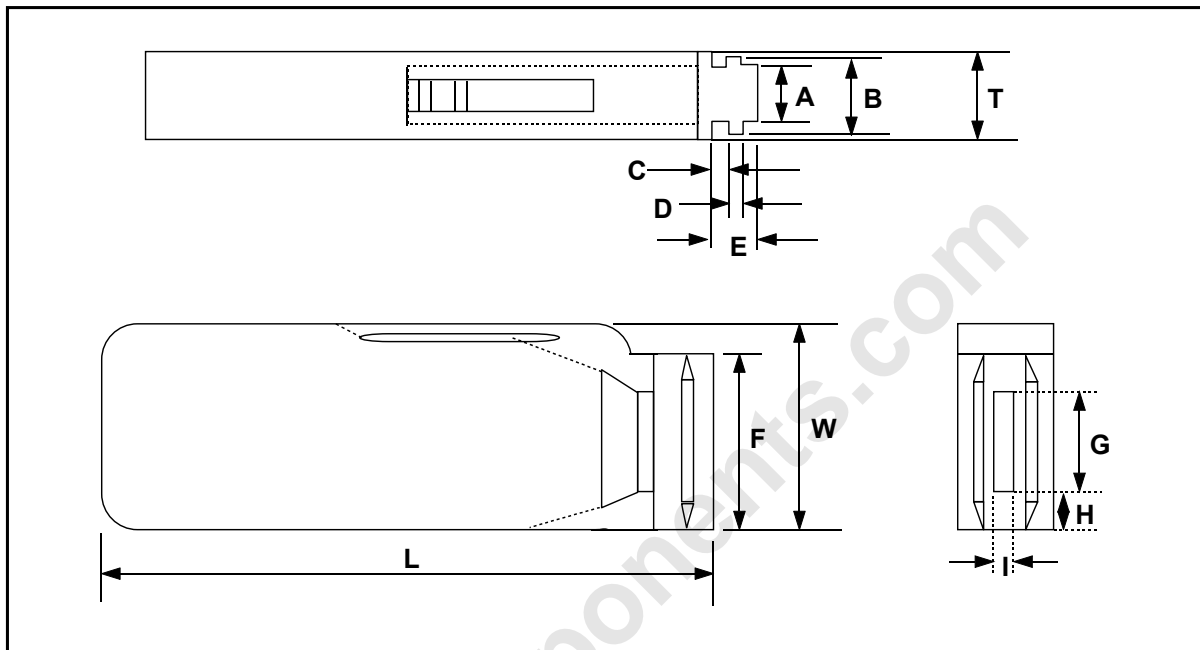
unit : mm

| 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 ± 0.8 | 2.0 ± 0.5 | 10 ± 1.5 | 0.8 ± 0.2 | 1.0 |
| 13" Reel | $\phi 330 \pm 2.0$ | min. $\phi 70$ | | | | | | |

Multilayer Ceramic Capacitor - General

● 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 - General

CHARACTERISTIC MAP

CLASS I

| Temperature Characteristics | Size | Voltage | Capacitance Range (pF) | | | | | | | | | | | |
|-----------------------------|-----------|--|--|----|-----|------|-------|--|--|------------------|-----------|--|--|--|
| | | | 0.5 | 10 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000 | 100000000 | | | |
| SL,UJ | 05 (0402) | 50V | ████████████████████ | | | 240 | | | | | | | | |
| | 10 (0603) | 50V | ██ | | | | 1000 | | | | | | | |
| | 21 (0805) | 50V | ██ | | | | | 2700 | | | | | | |
| | 31 (1206) | 50V | ██ | | | | | | 8200 | | | | | |
| C(COG) & TC Series | 03 (0201) | 25V | ████████████████ | | 47 | | | | | | | | | |
| | 05 (0402) | 25V | ████████████████████ | | | 220 | | | | | | | | |
| | | 50V | ████████████████████ | | | 180 | | | | | | | | |
| | 10 (0603) | 25V | ██ | | | | 1000 | | | | | | | |
| | | 50V | ██ | | | | 1000 | | | | | | | |
| | 21 (0805) | 25V | ██ | | | | | 3300 | ████████████████ | 8200 | | | | |
| | | 50V | ██ | | | | | 3300 | | | | | | |
| | 31 (1206) | 25V | ██ | | | | | | 1500 | ████████████████ | 10000 | | | |
| | | 50V | ██ | | | | | | 4700 | | | | | |
| | 32 (1210) | 50V | ██ | | | | 560 | ██ | 47000 | | | | | |
| | | 100V | ██ | | | | | 4700 | ████████████████ | 18000 | | | | |
| | 43 (1812) | 25V | ██ | | | | | | | 100000 | | | | |
| | | 50V | ██ | | | | | 1000 | ██ | 68000 | | | | |
| 55 (2220) | 50V | ██ | | | | | | 43000 | ████████████████ | 130000 | | | | |

Multilayer Ceramic Capacitor - General

● CLASS II , A(X5R)

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

Multilayer Ceramic Capacitor - General

● CLASS II , B(X7R)

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

Multilayer Ceramic Capacitor - General

● CLASS II , B(X7R)

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

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Multilayer Ceramic Capacitor - General

● CLASS II , F(Y5V)

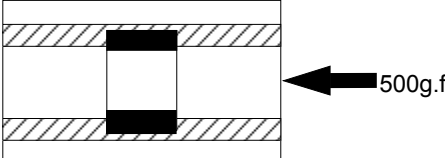
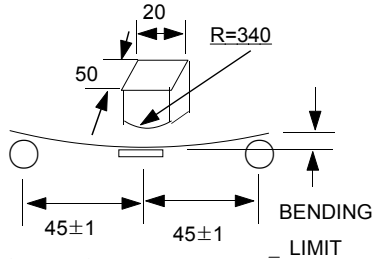
| Temperature Characteristics | Size | Voltage | Capacitance Range (pF) | | | | | | | | | | | |
|-----------------------------|-----------|---------|------------------------|-----|------|----------|----------|----------|----------|-----------|----------|----------|----------|-----------|
| | | | 10 |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

Multilayer Ceramic Capacitor - General

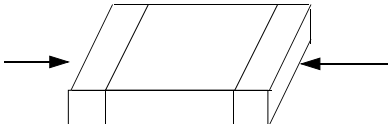
RELIABILITY TEST DATA

| 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 (RATED VOLTAGE IS BELOW 16V : 10,000MΩ OR 100MΩ·μF) | RATED VOLTAGE SHALL BE APPLIED. 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, CLASS II : 250% OF THE RATED VOLTAGE FOR 1~5 SEC IS APPLIED WITH LESS THAN 50mA CURRENT | | | | | |
| 4 | CAPACITANCE | CLASS I WITHIN THE SPECIFIED TOLERANCE | CAPACITANCE | FREQUENCY | VOLTAGE | | | |
| | | | 1,000pF AND BELOW | 1MHz±10% | 0.5 ~ 5 Vrms | | | |
| | | MORE THAN 1,000pF | 1kHz±10% | | | | | |
| | | CLASS II WITHIN THE SPECIFIED TOLERANCE | CAPACITANCE | FREQUENCY | VOLTAGE | | | |
| 10μF AND BELOW | 1kHz±10% | | 1.0±0.2Vrms | | | | | |
| | | MORE THAN 10μF | 120Hz±20% | 0.5±0.1Vrms | | | | |
| 5 | Q | CLASS I OVER 30pF : Q ≥1,000 LESS THAN 30pF: Q ≥400 +20C (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 | | | | | |
| | | | CAPACITANCE | FREQUENCY | VOLTAGE | | | |
| | | | 10μF AND BELOW | 1kHz±10% | 1.0±0.2Vrms | | | |
| | | | MORE THAN 10μF | 120Hz±20% | 0.5±0.1Vrms | | | |
| | | | 2. CHAR : F | | | | | |
| | | | | 6.3V | 10V | 16V | 25V | 50V |
| | | | 1005 | - | 0.125max | 0.09max (C < 220nF) 0.125max (C ≥ 220nF) | 0.05max | 0.05max |
| | | | 1608 | 0.16max | 0.125max | 0.09max | 0.05max(C ≤ 100nF) 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) 0.09max(C > 6.8μF) | 0.05max | | | |
| 4532 | 0.16max | 0.16max | 0.09max | - | - | | | |
| 5750 | | 0.125max | - | - | - | | | |

Multilayer Ceramic Capacitor - General

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

Multilayer Ceramic Capacitor - General

| 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℃ DIP TIME : 3±1 Sec SOLDER : H63A FLUX : RMA TYPE *PB-FREE SOLDER TEMPERATURE : 260±5℃ SOLDER : Sn96.5-3Ag-0.5Cu Flux : RMA TYPE DIP TIME : 3±0.1Sec * PRE-HEATING : AT 80~120℃ FOR 10~30SEC.</p> | | | | | | | | | |
| 12 | RESISTANCE TO SOLDERING HEAT | APPEARANCE | NO MECHANICAL DAMAGE SHALL OCCUR | | <p>DIP : SOLDER TEMPERATURE OF 270±5℃ DIP TIME :10±1 SEC. EACH TERMINATION SHALL BE FULLY IMMERSED AND PREHEATED AS FOLLOWING:</p> <table border="1" data-bbox="1029 929 1412 1086"> <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 CLASS I : 24 ± 2 HOURS CLASS II : 48 ± 4 HOURS</p> | STEP | TEMP.(℃) | TIME (SEC.) | 1 | 80~100 | 60 | 2 | 150~180 | 60 |
| | | STEP | TEMP.(℃) | TIME (SEC.) | | | | | | | | | | |
| | | 1 | 80~100 | 60 | | | | | | | | | | |
| | | 2 | 150~180 | 60 | | | | | | | | | | |
| | | CAPACITANCE | CHARACTERISTIC | CAP. CHANGE | | | | | | | | | | |
| | | | CLASS I | WITHIN ±2.5% OR ±0.25pF WHICHEVER IS LARGER | | | | | | | | | | |
| | | | | CLASS II | | A,B | WITHIN ±7.5% | | | | | | | |
| F | WITHIN ±20% | | | | | | | | | | | | | |
| Q | CLASS I | 30pF AND OVER : Q≥ 1000 LESS THAN 30pF : Q≥ 400+20×C | | | | | | | | | | | | |
| Tanδ | CLASS II | TO SATISFY THE SPECIFIED INITIAL VALUE | | | | | | | | | | | | |
| INSULATION RESISTANCE | TO SATISFY THE SPECIFIED INITIAL VALUE | | | | | | | | | | | | | |
| WITHSTANDING VOLTAGE | TO SATISFY THE SPECIFIED INITIAL VALUE | | | | | | | | | | | | | |
| 13 | VIBRATION TEST | 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" data-bbox="1037 1512 1412 1601"> <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" data-bbox="1037 1624 1412 1691"> <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. 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 | |
| | | CHAR. | FREQUENCY RANGE | | | | | | | | | | | |
| | | A,B,C,F | 10Hz → 55Hz → 10Hz | | | | | | | | | | | |
| | | CHAR. | TRAVERSED TIME | | | | | | | | | | | |
| | | A,B,C,F | 1 min | | | | | | | | | | | |
| | | CAPACITANCE | CHARACTERISTIC | CAP. CHANGE | | | | | | | | | | |
| CLASS I | WITHIN ±2.5% OR ±0.25pF WHICHEVER IS LARGER | | | | | | | | | | | | | |
| | CLASS II | | A,B | WITHIN ±5% | | | | | | | | | | |
| F | WITHIN ±20% | | | | | | | | | | | | | |
| Q | CLASS I | 30pF AND OVER : Q≥ 1000 LESS THAN 30pF : Q≥ 400+20×C | | | | | | | | | | | | |
| Tanδ | CLASS II | TO SATISFY THE SPECIFIED INITIAL VALUE | | | | | | | | | | | | |
| INSULATION RESISTANCE | TO SATISFY THE SPECIFIED INITIAL VALUE | | | | | | | | | | | | | |

* 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 - General

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

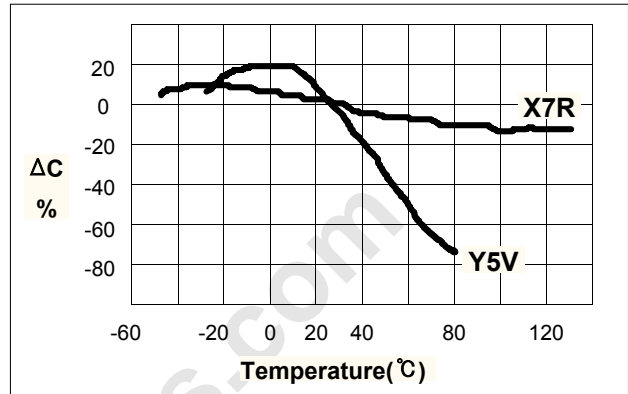
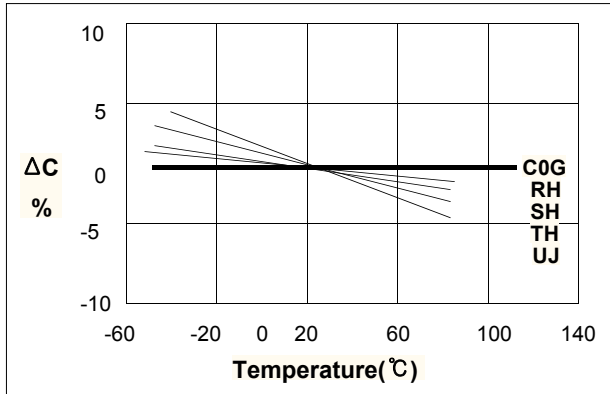
Multilayer Ceramic Capacitor - General

| NO | ITEM | PERFORMANCE | TEST CONDITION | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|---|--|---|---|--|-----------|----------|----------------------|----------|----------|----------|-----------|---------|----------------------|-----------|--|------------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|
| 16 | HIGH TEMPERATURE RESISTANCE | APPEARANCE | NO MECHANICAL DAMAGE SHALL OCCUR | | | | | | | | | | | | | | | | | | | | | |
| | | CAPACITANCE | CHARACTERISTIC | CAP. CHANGE | | | | | | | | | | | | | | | | | | | | |
| | | | CLASS I | WITHIN ±3% OR ±0.3pF, WHICHEVER IS LARGER | | | | | | | | | | | | | | | | | | | | |
| | | | CLASS II | A,B | WITHIN ±12.5% | | | | | | | | | | | | | | | | | | | |
| | | | | F | WITHIN ±30% WITHIN+30~40% 1005 C>0.47μF 1608 C>1.0μF 2012 C>4.7μF 3216 C>10.0μF 3225 C>22.0μF 4532 C>47.0μF | | | | | | | | | | | | | | | | | | | |
| | | Q CLASS I | 30pF AND OVER : Q ≥ 350 10 ~ 30 pF : Q ≥ 275 + 2.5×C LESS THAN 10pF :Q ≥200 + 10×C | | | | | | | | | | | | | | | | | | | | | |
| Tanδ 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<1.0μF) 0.125MAX (C≥1.0μF)</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<1.0μF) 0.125MAX (C≥1.0μF) | 0.15 MAX | 0.195 MAX | 0.25 MAX | | | | | |
| CHAR. | 25V AND OVER | 16V | 10V | 6.3V | 4V | | | | | | | | | | | | | | | | | | | |
| A,B | 0.05 MAX | 0.05 MAX | 0.05 MAX | 0.075 MAX | 0.1 MAX | | | | | | | | | | | | | | | | | | | |
| F | 0.075 MAX | 0.1MAX (C<1.0μF) 0.125MAX (C≥1.0μF) | 0.15 MAX | 0.195 MAX | 0.25 MAX | | | | | | | | | | | | | | | | | | | |
| INSULATION RESISTANCE | MINIMUM INSULATION RESISTANCE: 1,000 MΩ OR 50MΩ·μF PRODUCT WHICHEVER IS SMALLER | | | | | | | | | | | | | | | | | | | | | | | |
| 17 | TEMPERATURE CYCLE | 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% F : WITHIN ±20% | | | | | | | | | | | | | | | | | | | | |
| | | Q CLASS I | 30 pF AND OVER : Q ≥ 1000 LESS THAN 30pF:Q ≥400 +20×C | | | | | | | | | | | | | | | | | | | | | |
| | | Tanδ CLASS II | TO SATISFY THE SPECIFIED INITIAL VALUE | | | | | | | | | | | | | | | | | | | | | |
| INSULATION RESISTANCE | TO SATISFY THE SPECIFIED INITIAL VALUE | | | | | | | | | | | | | | | | | | | | | | | |
| | | | <p>APPLIED VOLTAGE : 150%, 200% OF RATED VOLTAGE TEST TIME : 1000 +48/-0 Hr. 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 ±3 ℃</td> </tr> <tr> <td rowspan="3">CLASS II</td> <td>A</td> <td>85 ±3 ℃</td> </tr> <tr> <td>B</td> <td>125 ±3 ℃</td> </tr> <tr> <td>F</td> <td>85 ±3 ℃</td> </tr> </tbody> </table> <p><INITIAL MEASUREMENT> CLASS II SHOULD BE MEASURED INITIAL VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150℃+0/-10℃ AND BE LEFT FOR 48±4HR AT ROOM TEMPERATURE. <LATTER MEASUREMENT> CLASS I SHOULD BE MEASURED AFTER LEFT FOR 24±2 HRS IN ROOM TEMPERATURE AND HUMIDITY. CLASS II SHOULD BE MEASURED LATTER VALUE AFTER BE HEAT-TREATED FOR 1 HR IN 150℃+0/-10℃ AND BE LEFT FOR 48±4HR AT ROOM TEMPERATURE.</p> <table border="1"> <thead> <tr> <th></th> <th>*150% Authorization Conditions</th> </tr> </thead> <tbody> <tr> <td rowspan="6">CLASS II (A,B,F)</td> <td>1005 C>0.47μF</td> </tr> <tr> <td>1608 C ≥2.2μF</td> </tr> <tr> <td>2012 C ≥4.7μF</td> </tr> <tr> <td>3216 C ≥10.0μF</td> </tr> <tr> <td>3225 C ≥22.0μF</td> </tr> <tr> <td>4532 C ≥47.0μF</td> </tr> <tr> <td>5750 C ≥100.0μF</td> </tr> </tbody> </table> <p>(TWICE OF RATED VOLTAGE WILL BE APPLIED TO ALL SERIES BUT ABOVE) ** HOWEVER, A/B≧1005 C ≥0.22μF SEE (FIG.3)</p> | CHAR. | TEMP. | CLASS I | 125 ±3 ℃ | CLASS II | A | 85 ±3 ℃ | B | 125 ±3 ℃ | F | 85 ±3 ℃ | | *150% Authorization Conditions | CLASS II (A,B,F) | 1005 C>0.47μF | 1608 C ≥2.2μF | 2012 C ≥4.7μF | 3216 C ≥10.0μF | 3225 C ≥22.0μF | 4532 C ≥47.0μF | 5750 C ≥100.0μF |
| CHAR. | TEMP. | | | | | | | | | | | | | | | | | | | | | | | |
| CLASS I | 125 ±3 ℃ | | | | | | | | | | | | | | | | | | | | | | | |
| CLASS II | A | 85 ±3 ℃ | | | | | | | | | | | | | | | | | | | | | | |
| | B | 125 ±3 ℃ | | | | | | | | | | | | | | | | | | | | | | |
| | F | 85 ±3 ℃ | | | | | | | | | | | | | | | | | | | | | | |
| | *150% Authorization Conditions | | | | | | | | | | | | | | | | | | | | | | | |
| CLASS II (A,B,F) | 1005 C>0.47μF | | | | | | | | | | | | | | | | | | | | | | | |
| | 1608 C ≥2.2μF | | | | | | | | | | | | | | | | | | | | | | | |
| | 2012 C ≥4.7μF | | | | | | | | | | | | | | | | | | | | | | | |
| | 3216 C ≥10.0μF | | | | | | | | | | | | | | | | | | | | | | | |
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| | 4532 C ≥47.0μF | | | | | | | | | | | | | | | | | | | | | | | |
| 5750 C ≥100.0μF | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | <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.(℃)</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 CLASS I : 24±2 Hr. CLASS II : 48±4 Hr.</p> | STEP | TEMP.(℃) | TIME(MIN) | 1 | MIN.RATED TEMP.+0/-3 | 30 | 2 | 25 | 2~3 | 3 | MAX.RATED TEMP.+3/-0 | 30 | 4 | 25 | 2~3 | | | | | | |
| STEP | TEMP.(℃) | TIME(MIN) | | | | | | | | | | | | | | | | | | | | | | |
| 1 | MIN.RATED TEMP.+0/-3 | 30 | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 25 | 2~3 | | | | | | | | | | | | | | | | | | | | | | |
| 3 | MAX.RATED TEMP.+3/-0 | 30 | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 25 | 2~3 | | | | | | | | | | | | | | | | | | | | | | |

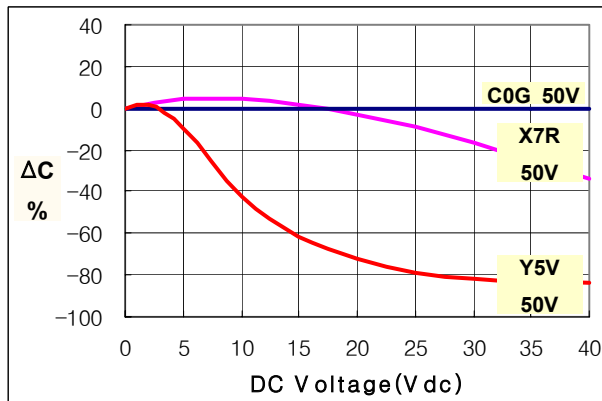
CHARACTERISTIC GRAPH

ELECTRICAL CHARACTERISTICS

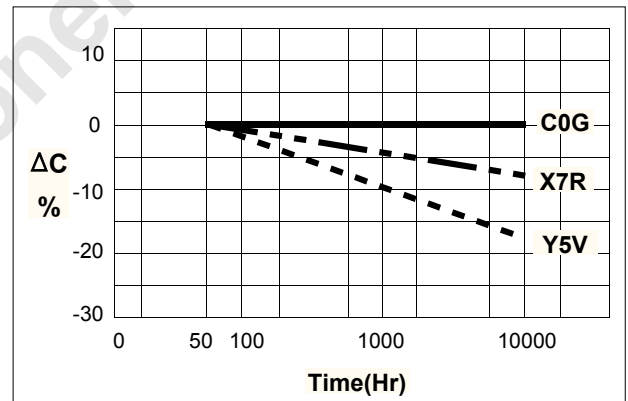
CAPACITANCE - TEMPERATURE CHARACTERISTICS



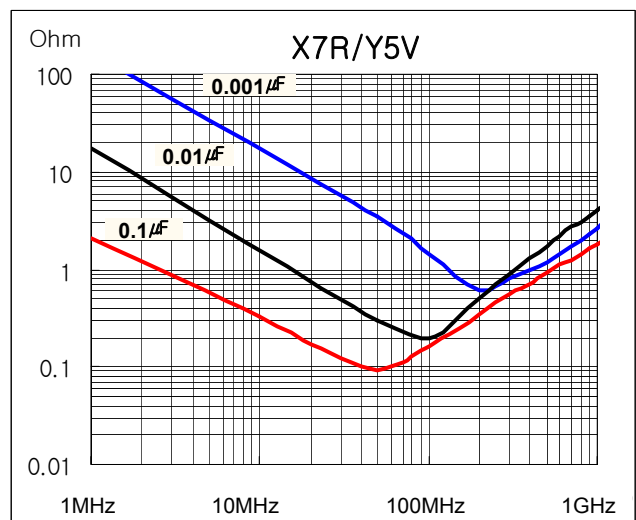
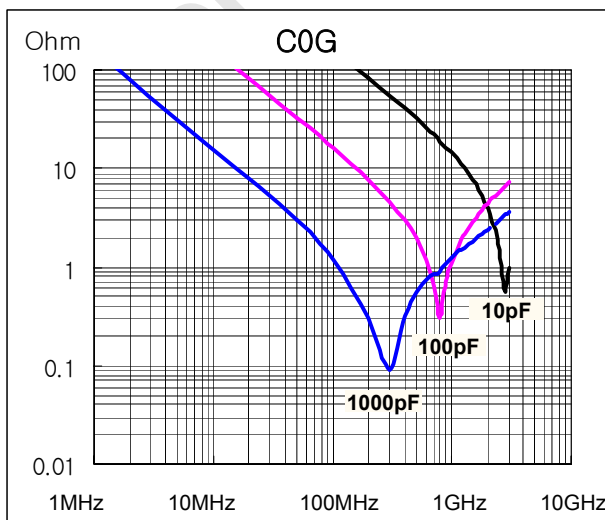
CAPACITANCE - DC VOLTAGE CHARACTERISTICS



CAPACITANCE CHANGE - AGING



IMPEDANCE - FREQUENCY CHARACTERISTICS



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.

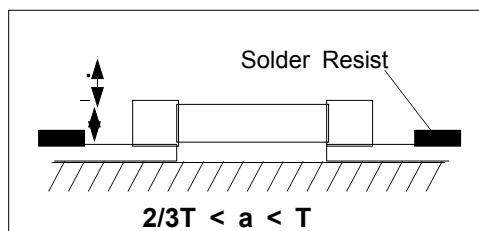
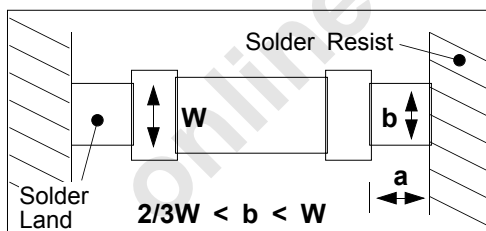
▶ Temperature Fluctuations

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.

Multilayer Ceramic Capacitor - General

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.

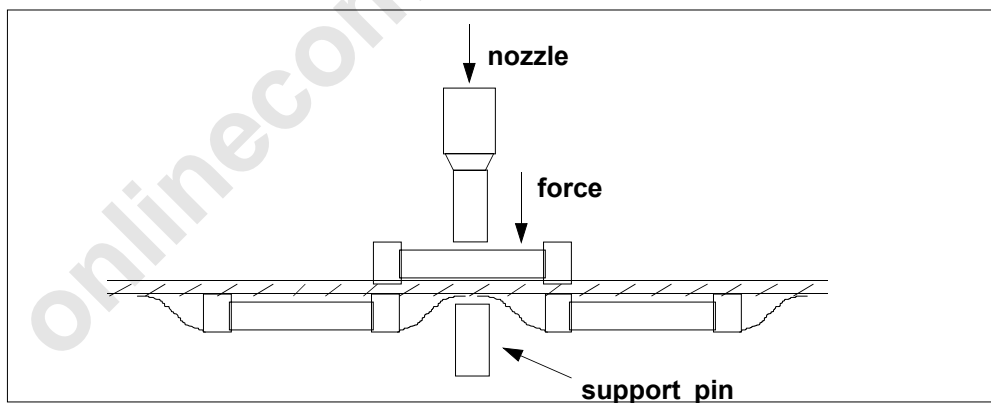
● Mounting

► 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 - General

● 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.

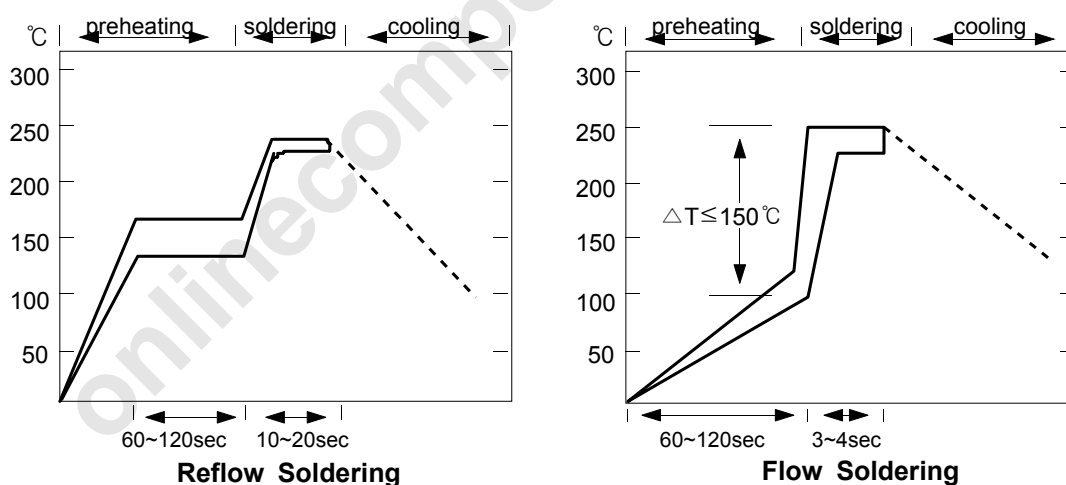
▶ Soldering Methods

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

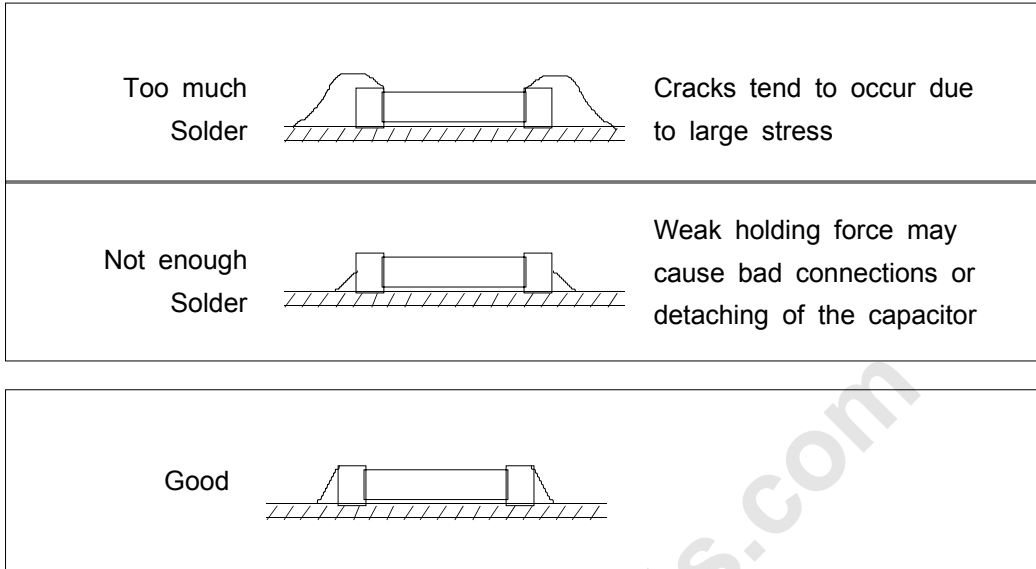


▶ Manual Soldering

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 - General

► Amount of Solder



► Cooling

Natural cooling using air is recommended. If the chips are dipped into solvent for cleaning, the temperature difference (ΔT) 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 - General

CROSS REFERENCE

| P/N | COMPANY | SAMSUNG | AVX | JOHANSON | KEMET | KYOCERA | MURATA | NOVACAP | PANASONIC | ROHM | TAIYO - YUDEN | TDK | VITRAMON |
|---------------------------------|----------------|--|------|----------|-------|---------|--------|---------|-----------|-------|------------------|--------|----------|
| ① COMPANY | MODEL(MLCC) | CL | - | - | C | CM | GRM | - | ECJ | MCH | MK | C | VJ |
| ② SIZE (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 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 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 - General

► SAMSUNG : CL10B104KA8NNNC

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

► AVX : 06033C104KAT2A

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

► JOHANSON : 250R14W104KV6T

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

► KEMET : C0603C104K3RAC

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

Multilayer Ceramic Capacitor - General

► KYOCERA : CM105X7R104K25AT

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

► MURATA : GRM188R71E104KA01D

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

► NOVACAP : 0603B104K250N_TM

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

► PANASONIC : ECJ1EB1E104K

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

Multilayer Ceramic Capacitor - General

► ROHM : MCH182C104KKN

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

► TAIYO-YUDEN : TMK107BJ104K_T

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

► TDK : C1608X7R1E104KT

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

► VITRAMON : VJ0603Y104KXXMC

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