

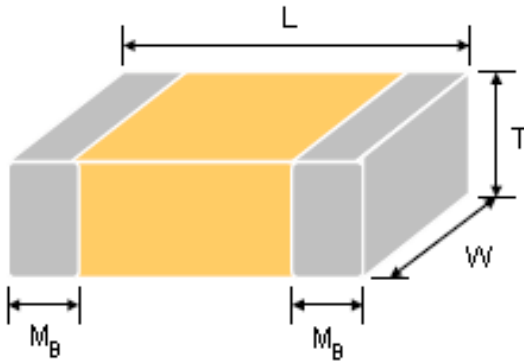
Multilayer Ceramic Capacitor

General Purpose



Features:

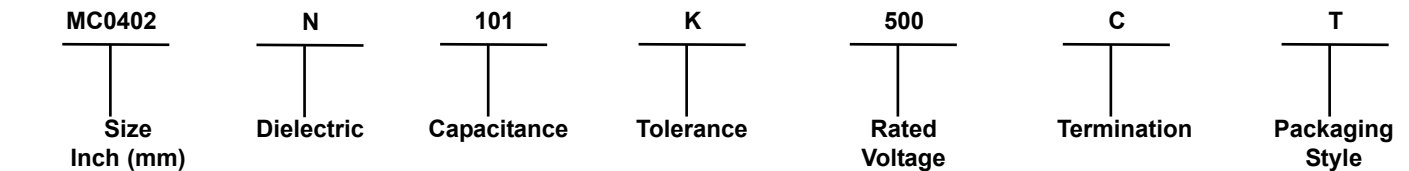
- High capacitance in given case size



Applications:

For general digital circuit
 For power supply bypass capacitors
 For consumer electronics
 For telecommunication

Part Number Explanation



Size : 0402 (1005) and 0603 (1608)
 Dielectric : N = NP0 (C0G), B = X7R AND F = Y5V
 Capacitance : Two significant digits followed by no. of zeros and R is in place of decimal point
 eg.:
 0R5 = 0.5 pF
 1R0 = 1 pF
 104 = $10 \times 10^4 = 100 \text{ nF}$
 Tolerance : 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 = -20 / +80%
 Rated voltage : Two significant digits followed by no. of zeros. And R is in place of decimal point
 100 = 10 VDC
 160 = 16 VDC
 250 = 25 VDC
 500 = 50 V DC
 101 = 100 VDC
 Termination : C=Cu/Ni/Sn (for NP0, X7R, Y5V dielectric) L = Ag/Ni/Sn (for partial NP0 items)
 Packaging Style : T = 7" reeled

* Partial NPO items are with Ag/Ni/Sn terminations, please ref to below product range of NPO dielectric for detail.

External Dimensions

| Size Inch (mm) | L (mm) | W (mm) | T (mm) / Symbol | | Remark | MB (mm) |
|-------------------|-----------------------|-----------------------|-----------------------|---|--------|------------------------|
| 0402 (1005) | 1 \pm 0.05 | 0.5 \pm 0.05 | 0.5 \pm 0.05 | N | # | 0.25 \pm 0.05 / -0.1 |
| 0603 (1608) | 1.6 \pm 0.1 | 0.8 \pm 0.1 | 0.8 \pm 0.07 | S | - | 0.4 \pm 0.15 |
| | 1.6 \pm 0.15 / -0.1 | 0.8 \pm 0.15 / -0.1 | 0.8 \pm 0.15 / -0.1 | X | - | |

Multilayer Ceramic Capacitor

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General Electrical Data

| Dielectric | NP0 | X7R | Y5V |
|-----------------------------|---|--------------------------------------|------------------|
| Size | 0402, 0603 | | |
| Capacitance range* | 0.5 pF to 0.039 uF | 100 pF to 0.82 uF | 10 nF to 0.68 uF |
| Capacitance tolerance** | Cap ≤5 pF: C (±0.25 pF) 5 pF < Cap < 10 pF: C (±0.25 pF), D (±0.5 pF) Cap ≥10 pF: F (~}1%), G (±2%), K (±10%) | K (±10%), M (±20%) | Z (-20 / +80%) |
| Rated voltage (WVDC) | 10 V, 16 V, 25 V, 50 V, 100 V | 6.3 V, 10 V, 16 V, 25 V, 50 V, 100 V | |
| Tan δ* | Cap < 30 pF: Q ≥ 400 +20C Cap ≥ 30 pF: Q ≥ 1,000 | Note 1 | |
| Insulation resistance at Ur | ≥10 GΩ or R × C ≥500 Ω × F whichever is less | | |
| Operating temperature | -55°C to +125°C | -25°C to +85°C | |
| Capacitance characteristic | ±30 ppm | ±15% | +30 / -80% |
| Termination | Ni / Sn (lead-free termination) | | |

* Measured at the condition of 30 to 70% related humidity

NP0: Apply 1 ±0.2 Vrms, 1 MHz ±10% for Cap ≤ 1,000 pF and 1 ±0.2 Vrms, 1 kHz ±10% for Cap > 1,000 pF, 25°C at ambient temperature

X7R: Apply 1 ±0.2 Vrms, 1 kHz ±10%, at 25°C ambient temperature

Y5V: Apply 1 ±0.2 Vrms, 1 kHz ±10%, at 20°C ambient temperature

** Preconditioning for Class II MLCC: Perform a heat treatment at 150 ±10°C for 1 hour, then leave in ambient condition for 24 ±2 hours before measurement

Note 1:

X7R

| Rated Voltage | D.F | Exception of D.F. | |
|---------------|-------|-------------------|--|
| | | | |
| ≥50 V | ≤2.5% | ≤3% | 0603 ≥0.047 μF; 0805 ≥0.18 μF, 1206 ≥0.47 μF |
| 25 V | ≤3.5% | ≤7% | 0603 ≥0.33 μF |
| | | ≤10% | 0402 ≥0.1 μF; 0603 ≥0.47 μF |
| 16 V | ≤3.5% | ≤5% | 0402 ≥0.033 μF; 0603 ≥0.15 μF; 0805 ≥0.68 μF |
| | ≤5% | ≤10% | 0603 ≥0.68 μF |
| 10 V | ≤5% | ≤10% | 0402 ≥0.33 μF; 0603 ≥0.33 μF |
| 6.3 V | ≤10% | --- | --- |

Multilayer Ceramic Capacitor

General Purpose



Note 1:

Y5V

| Rated Voltage | D.F | Exception of D.F. | |
|-----------------|--------|-------------------|---|
| ≥50 V | ≤5% | ≤7% | 0603 ≥0.1 μF; 0805 ≥0.47 μF |
| 25 V | ≤5% | ≤7% | 0402 ≥0.047 μF; 0603 ≥0.1 μF; 0805 ≥0.33 μF |
| | | ≤9% | 0402 ≥0.68 μF; 0603 ≥0.47 μF |
| 16 V (C < 1 μF) | ≤7% | ≤9% | 0402 ≥0.68 μF; 0603 ≥0.68 μF |
| 16 V (C ≥ 1 μF) | ≤9% | --- | --- |
| 10 V | ≤12.5% | --- | --- |
| 6.3 V | ≤20% | --- | --- |

Capacitance Range (NP0 Dielectric)

| Dielectric | | NP0 | | | | | | | | | |
|---------------------|--------------|------|----|----|----|-----|------|----|----|----|-----|
| Size | | 0402 | | | | | 0603 | | | | |
| Rated Voltage (Vdc) | | 10 | 16 | 25 | 50 | 100 | 10 | 16 | 25 | 50 | 100 |
| Capacitance | 0.5 pF (0R5) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 0.6 pF (0R6) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 0.7 pF (0R7) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 0.8 pF (0R8) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 0.9 pF (0R9) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 1 pF (1R0) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 1.2 pF (1R2) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 1.5 pF (1R5) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 1.8 pF (1R8) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 2.2 pF (2R2) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 2.7 pF (2R7) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 3.3 pF (3R3) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 3.9 pF (3R9) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 4.7 pF (4R7) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 5.6 pF (5R6) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 6.8 pF (6R8) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 8.2 pF (8R2) | N^ | N^ | N^ | N^ | N^ | S | S | S | S | S |
| | 10 pF (100) | N | N | N | N | N | S | S | S | S | S |
| 12 pF (120) | N | N | N | N | N | S | S | S | S | S | |
| 15 pF (150) | N | N | N | N | N | S | S | S | S | S | |
| 18 pF (180) | N | N | N | N | N | S | S | S | S | S | |

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Capacitance Range (NP0 Dielectric)

| Dielectric | | NP0 | | | | | | | | | |
|---------------------|----------------|------|----|----|----|-----|------|----|----|----|-----|
| Size | | 0402 | | | | | 0603 | | | | |
| Rated Voltage (Vdc) | | 10 | 16 | 25 | 50 | 100 | 10 | 16 | 25 | 50 | 100 |
| Capacitance | 22 pF (220) | N | N | N | N | N | S | S | S | S | S |
| | 27 pF (270) | N | N | N | N | N | S | S | S | S | S |
| | 33 pF (330) | N | N | N | N | N | S | S | S | S | S |
| | 39 pF (390) | N | N | N | N | N | S | S | S | S | S |
| | 47 pF (470) | N | N | N | N | N | S | S | S | S | S |
| | 56 pF (560) | N | N | N | N | N | S | S | S | S | S |
| | 68 pF (680) | N | N | N | N | N | S | S | S | S | S |
| | 82 pF (820) | N | N | N | N | N | S | S | S | S | S |
| | 100 pF (101) | N | N | N | N | N | S | S | S | S | S |
| | 120 pF (121) | N | N | N | N | N | S | S | S | S | S |
| | 150 pF (151) | N | N | N | N | N | S | S | S | S | S |
| | 180 pF (181) | N | N | N | N | N | S | S | S | S | S |
| | 220 pF (221) | N | N | N | N | N | S | S | S | S | S |
| | 270 pF (271) | N | N | N | N | | S | S | S | S | S |
| | 330 pF (331) | N | N | N | N | | S | S | S | S | S |
| | 390 pF (391) | N | N | N | N | | S | S | S | S | S |
| | 470 pF (471) | N | N | N | N | | S | S | S | S | S |
| | 560 pF (561) | | | | | | S | S | S | S | S |
| | 680 pF (681) | | | | | | S | S | S | S | S |
| | 820 pF (821) | | | | | | S | S | S | S | S |
| | 1,000 pF (102) | | | | | | S | S | S | S | S |
| | 1,200 pF (122) | | | | | | X | X | X | X | |
| | 1,500 pF (152) | | | | | | X | X | X | X | |
| | 1,800 pF (182) | | | | | | X | X | X | X | |
| | 2,200 pF (222) | | | | | | X | X | X | X | |
| | 2,700 pF (272) | | | | | | X | X | X | X | |
| | 3,300 pF (332) | | | | | | X | X | X | X | |
| | 3,900 pF (392) | | | | | | | | | | |
| | 4,700 pF (472) | | | | | | | | | | |
| | 5,600 pF (562) | | | | | | | | | | |
| 6,800 pF (682) | | | | | | | | | | | |
| 8,200 pF (822) | | | | | | | | | | | |
| 0.01uF (103) | | | | | | | | | | | |
| 0.012 uF (123) | | | | | | | | | | | |

1. The letter in cell is expressed the symbol of product thickness
2. The letter in cell with "A" mark is expressed product with Ag / Ni / Sn terminations

Multilayer Ceramic Capacitor

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Capacitance Range (X7R Dielectric)

| Dielectric | | X7R | | | | | | | | |
|---------------------|---------------------|------|----|----|----|------|----|----|----|-----|
| Size | | 0402 | | | | 0603 | | | | |
| Rated Voltage (Vdc) | | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 100 |
| Capacitance | 100 pF (101) | N | N | N | N | S | S | S | S | S |
| | 120 pF (121) | N | N | N | N | S | S | S | S | S |
| | 150 pF (151) | N | N | N | N | S | S | S | S | S |
| | 180 pF (181) | N | N | N | N | S | S | S | S | S |
| | 220 pF (221) | N | N | N | N | S | S | S | S | S |
| | 270 pF (271) | N | N | N | N | S | S | S | S | S |
| | 330 pF (331) | N | N | N | N | S | S | S | S | S |
| | 390 pF (391) | N | N | N | N | S | S | S | S | S |
| | 470 pF (471) | N | N | N | N | S | S | S | S | S |
| | 560 pF (561) | N | N | N | N | S | S | S | S | S |
| | 680 pF (681) | N | N | N | N | S | S | S | S | S |
| | 820 pF (821) | N | N | N | N | S | S | S | S | S |
| | 1,000 pF (102) | N | N | N | N | S | S | S | S | S |
| | 1,200 pF (122) | N | N | N | N | S | S | S | S | S |
| | 1,500 pF (152) | N | N | N | N | S | S | S | S | S |
| | 1,800 pF (182) | N | N | N | N | S | S | S | S | S |
| | 2,200 pF (222) | N | N | N | N | S | S | S | S | S |
| | 2,700 pF (272) | N | N | N | N | S | S | S | S | S |
| | 3,300 pF (332) | N | N | N | N | S | S | S | S | S |
| | 3,900 pF (392) | N | N | N | N | S | S | S | S | S |
| | 4,700 pF (472) | N | N | N | N | S | S | S | S | S |
| | 5,600 pF (562) | N | N | N | N | S | S | S | S | S |
| | 6,800 pF (682) | N | N | N | N | S | S | S | S | S |
| | 8,200 pF (822) | N | N | N | N | S | S | S | S | S |
| | 0.01 μ F (103) | N | N | N | N | S | S | S | S | S |
| | 0.012 μ F (123) | N | N | N | | S | S | S | S | |
| | 0.015 μ F (153) | N | N | N | | S | S | S | S | |
| | 0.018 μ F (183) | N | N | N | | S | S | S | S | |
| | 0.022 μ F (223) | N | N | N | | S | S | S | S | |
| | 0.027 μ F (273) | N | N | | | S | S | S | S | |
| 0.033 μ F (333) | N | N | | | S | S | S | X | | |
| 0.039 μ F (393) | N | N | | | S | S | S | X | | |
| 0.047 μ F (473) | N | N | | | S | S | S | X | | |
| 0.056 μ F (563) | N | N | | | S | S | S | X | | |

Multilayer Ceramic Capacitor

General Purpose



Capacitance Range (X7R Dielectric)

| Dielectric | | X7R | | | | | | | | |
|---------------------|---------------------|------|----|----|----|------|----|----|----|-----|
| Size | | 0402 | | | | 0603 | | | | |
| Rated Voltage (Vdc) | | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 100 |
| Capacitance | 0.068 μ F (683) | N | N | | | S | S | S | X | |
| | 0.082 μ F (823) | N | N | | | S | S | S | X | |
| | 0.10 μ F (104) | N | N | | | S | S | S | X | |
| | 0.12 μ F (124) | | | | | S | S | X | | |
| | 0.15 μ F (154) | | | | | S | S | X | | |
| | 0.18 μ F (184) | | | | | S | S | X | | |
| | 0.22 μ F (224) | | | | | S | S | X | | |
| | 0.27 μ F (274) | | | | | X | X | X | | |
| | 0.33 μ F (334) | | | | | X | X | X | | |
| | 0.39 μ F (394) | | | | | X | X | X | | |
| | 0.47 μ F (474) | | | | | X | X | X | | |
| | 0.56 μ F (564) | | | | | | | | | |
| | 0.68 μ F (684) | | | | | | | | | |
| | 0.82 μ F (824) | | | | | | | | | |

1. The letter in cell is expressed the symbol of product thickness

Capacitance Range (Y5V Dielectric)

| Dielectric | | Y5V | | | | | | | | | |
|---------------------|---------------------|------|----|----|----|------|-----|----|----|----|----|
| Size | | 0402 | | | | 0603 | | | | | |
| Rated Voltage (Vdc) | | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 |
| Capacitance | 0.010 μ F (103) | | N | N | N | N | | S | S | S | S |
| | 0.015 μ F (153) | | N | N | N | N | | S | S | S | S |
| | 0.022 μ F (223) | | N | N | N | N | | S | S | S | S |
| | 0.033 μ F (333) | | N | N | N | N | | S | S | S | S |
| | 0.047 μ F (473) | | N | N | N | | | S | S | S | S |
| | 0.068 μ F (683) | | N | N | N | | | S | S | S | S |
| | 0.10 μ F (104) | | N | N | N | | | S | S | S | S |
| | 0.15 μ F (154) | | N | | | | | S | S | S | S |
| | 0.22 μ F (224) | N | N | | | | S | S | S | S | S |
| | 0.33 μ F (334) | N | N | | | | | S | S | S | |
| | 0.47 μ F (474) | N | N | | | | | S | S | | |
| | 0.68 μ F (684) | N | N | | | | | S | X | | |

Multilayer Ceramic Capacitor

General Purpose



Packaging Style and Quantity

| Size | Thickness (mm) / Symbol | | Paper tape 7" reel |
|-------------|-------------------------|---|-----------------------|
| 0402 (1005) | 0.5 ±0.05 | N | 10 k |
| 0603 (1608) | 0.8 ±0.07 | S | 4 k |
| | 0.8 +0.15 / -0.1 | X | 4 k |

Reliability Test Conditions and Requirements

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|---------------------------------|---|--|---------------|-------------------|--|--|-------|-------|-----|--|------|-------|-----|---------------|------|-----------------------------|------|-------|-----|--|------|---------------|------|-----|------|------------------------------|-------|------|-----|-----|---------------|-----|-------------------|--|-------|-----|-----|-----------------------------|------|-----|-----|---|-----|------------------------------|-----------------|-----|-----|------------------------------|-----------------|-----|-----|-----|------|--------|-----|-----|-------|------|-----|-----|
| 1. | Visual and Mechanical | --- | * No remarkable defect. * Dimensions to conform to individual specification sheet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. | Capacitance | Class I:NPO | * Shall not exceed the limits given in the detailed specification | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Cap ≤ 1,000 pF 1±0.2 Vrms, 1 MHz ±10% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Q/ D.F. (Dissipation Factor) | Cap ≥ 1,000 pF 1 ±0.2 Vrms, 1 KHz ±10% Class II: X7R, Y5V Cap ≤ 10 μF, 1 ±0.2 Vrms, 1 kHz ±10% Cap > 10 μF, 0.5 ±0.2 Vrms, 120 Hz ±20% | NPO: Cap ≥ 30 pF, Q ≥ 1,000; Cap < 30 pF, Q ≥ 400 +20C X7R <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>D.F</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>≥50 V</td> <td>≤2.5%</td> <td>≤3%</td> <td>0603 ≥0.047 μF; 0805 ≥0.18 μF, 1206 ≥0.47 μF</td> </tr> <tr> <td rowspan="2">25 V</td> <td rowspan="2">≤3.5%</td> <td>≤7%</td> <td>0603 ≥0.33 μF</td> </tr> <tr> <td>≤10%</td> <td>0402 ≥0.1 μF; 0603 ≥0.47 μF</td> </tr> <tr> <td rowspan="2">16 V</td> <td rowspan="2">≤3.5%</td> <td>≤5%</td> <td>0402 ≥0.033 μF; 0603 ≥0.15 μF; 0805 ≥0.68 μF</td> </tr> <tr> <td>≤10%</td> <td>0603 ≥0.68 μF</td> </tr> <tr> <td>10 V</td> <td>≤5%</td> <td>≤10%</td> <td>0402 ≥0.33 μF; 0603 ≥0.33 μF</td> </tr> <tr> <td>6.3 V</td> <td>≤10%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> Y5V <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>D.F</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>≥50 V</td> <td>≤5%</td> <td>≤7%</td> <td>0603 ≥0.1 μF; 0805 ≥0.47 μF</td> </tr> <tr> <td rowspan="2">25 V</td> <td rowspan="2">≤5%</td> <td>≤7%</td> <td>0402 ≥0.047 μF; 0603 ≥0.1 μF; 0805 ≥0.33 μF</td> </tr> <tr> <td>≤9%</td> <td>0402 ≥0.68 μF; 0603 ≥0.47 μF</td> </tr> <tr> <td>16 V (C < 1 μF)</td> <td>≤7%</td> <td>≤9%</td> <td>0402 ≥0.68 μF; 0603 ≥0.68 μF</td> </tr> <tr> <td>16 V (C ≥ 1 μF)</td> <td>≤9%</td> <td>---</td> <td>---</td> </tr> <tr> <td>10 V</td> <td>≤12.5%</td> <td>---</td> <td>---</td> </tr> <tr> <td>6.3 V</td> <td>≤20%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> | Rated Voltage | D.F | Exception of D.F. | | ≥50 V | ≤2.5% | ≤3% | 0603 ≥0.047 μF; 0805 ≥0.18 μF, 1206 ≥0.47 μF | 25 V | ≤3.5% | ≤7% | 0603 ≥0.33 μF | ≤10% | 0402 ≥0.1 μF; 0603 ≥0.47 μF | 16 V | ≤3.5% | ≤5% | 0402 ≥0.033 μF; 0603 ≥0.15 μF; 0805 ≥0.68 μF | ≤10% | 0603 ≥0.68 μF | 10 V | ≤5% | ≤10% | 0402 ≥0.33 μF; 0603 ≥0.33 μF | 6.3 V | ≤10% | --- | --- | Rated Voltage | D.F | Exception of D.F. | | ≥50 V | ≤5% | ≤7% | 0603 ≥0.1 μF; 0805 ≥0.47 μF | 25 V | ≤5% | ≤7% | 0402 ≥0.047 μF; 0603 ≥0.1 μF; 0805 ≥0.33 μF | ≤9% | 0402 ≥0.68 μF; 0603 ≥0.47 μF | 16 V (C < 1 μF) | ≤7% | ≤9% | 0402 ≥0.68 μF; 0603 ≥0.68 μF | 16 V (C ≥ 1 μF) | ≤9% | --- | --- | 10 V | ≤12.5% | --- | --- | 6.3 V | ≤20% | --- | --- |
| | | | Rated Voltage | D.F | Exception of D.F. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | ≥50 V | ≤2.5% | ≤3% | 0603 ≥0.047 μF; 0805 ≥0.18 μF, 1206 ≥0.47 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 25 V | ≤3.5% | ≤7% | 0603 ≥0.33 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | ≤10% | 0402 ≥0.1 μF; 0603 ≥0.47 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 16 V | ≤3.5% | ≤5% | 0402 ≥0.033 μF; 0603 ≥0.15 μF; 0805 ≥0.68 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | ≤10% | 0603 ≥0.68 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 10 V | ≤5% | ≤10% | 0402 ≥0.33 μF; 0603 ≥0.33 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 6.3 V | ≤10% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Rated Voltage | D.F | Exception of D.F. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | 16 V (C < 1 μF) | ≤7% | ≤9% | 0402 ≥0.68 μF; 0603 ≥0.68 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 V (C ≥ 1 μF) | ≤9% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 V | ≤12.5% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3 V | ≤20% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Multilayer Ceramic Capacitor

General Purpose



Reliability Test Conditions and Requirements

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | |
|------|----------------------------------|---|---|-----------------------|-----|-----------------------|-----|------------------------|-----|-----------------------|---|------|--------------------|-----|------------------------|-----|-------------------|-----|--------------------|
| 4. | Dielectric Strength | <ul style="list-style-type: none"> * To apply voltage (≤ 100 V) 250%. * Duration: 1 to 5 s * Charge and discharge current less than 50 mA | * No evidence of damage or flash over during test | | | | | | | | | | | | | | | | |
| 5. | Insulation Resistance | To apply rated voltage for maximum 120 s | ≥ 10 G Ω or $R \times C \geq 500$ Ω F whichever is smaller | | | | | | | | | | | | | | | | |
| 6. | Temperature Coefficient | With no electrical load | | | | | | | | | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temperature</th> </tr> </thead> <tbody> <tr> <td>NPO</td> <td>-55°C to 125°C at 5°C</td> </tr> <tr> <td>X7R</td> <td>-55°C to 125°C at 25°C</td> </tr> <tr> <td>Y5V</td> <td>-25°C to 85°C at 20°C</td> </tr> </tbody> </table> | T.C. | Operating Temperature | NPO | -55°C to 125°C at 5°C | X7R | -55°C to 125°C at 25°C | Y5V | -25°C to 85°C at 20°C | <table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>NPO</td> <td>Within ± 30 ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within $\pm 15\%$</td> </tr> <tr> <td>Y5V</td> <td>Within +30% / -80%</td> </tr> </tbody> </table> | T.C. | Capacitance Change | NPO | Within ± 30 ppm/°C | X7R | Within $\pm 15\%$ | Y5V | Within +30% / -80% |
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| X7R | Within $\pm 15\%$ | | | | | | | | | | | | | | | | | | |
| Y5V | Within +30% / -80% | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 7. | Adhesive Strength of Termination | <ul style="list-style-type: none"> * Pressurizing force : 5 N (≤ 0603) and 10 N (>0603) * Test time: 10 \pm1 s | * No remarkable damage or removal of the terminations | | | | | | | | | | | | | | | | |
| 8. | Vibration Resistance | <ul style="list-style-type: none"> * Vibration frequency: 10 to 55 Hz / minimum * Total amplitude: 1.5 mm * Test time: 6 hours (Two hours each in three mutually perpendicular directions) | <ul style="list-style-type: none"> * No remarkable damage * Cap change and Q/D.F.: To meet initial specification | | | | | | | | | | | | | | | | |
| 9. | Solderability | <ul style="list-style-type: none"> * Solder temperature: 235 \pm5°C * Dipping time: 2 \pm0.5 s | 95% minimum coverage of all metalized area | | | | | | | | | | | | | | | | |
| 10. | Bending Test | <ul style="list-style-type: none"> * The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5 \pm1 s * Measurement to be made after keeping at room temperature for 24 \pm2 hours | <ul style="list-style-type: none"> * No remarkable damage. Cap change: NPO: within $\pm 5\%$ or ± 05 pF whichever is larger X7R, X5R: within $\pm 12.5\%$ Y5V: within $\pm 30\%$ (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test) | | | | | | | | | | | | | | | | |
| 11. | Resistance to Soldering Heat | <ul style="list-style-type: none"> * Solder temperature: 270 \pm5°C * Dipping time: 10 \pm1 s * Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder * Before initial measurement (Class II only): Perform 150 \pm0 / -10°C for 1 hour and then set for 48 \pm4 hours at room temperature * Measurement to be made after keeping at room temperature for 48 \pm4 hours | <ul style="list-style-type: none"> * No remarkable damage. Cap change: NPO: within $\pm 2.5\%$ or ± 0.25 pF whichever is larger X7R: within $\pm 7.5\%$ Y5V: within $\pm 20\%$ * Q/D.F., I.R. and dielectric strength: To meet initial requirements * 25% maximum leaching on each edge | | | | | | | | | | | | | | | | |

Multilayer Ceramic Capacitor

General Purpose



Reliability Test Conditions and Requirements

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------|---------------------------------------|---|--|------------------|----------------|-------------------|---------------------------------------|-------|-----|------------------|-------------------------------|------|---------------------------------------|-------|---------------|------------------|-----------------------------|--|-----|------|-------------------------------|------|---------------|------|-------|------|------------------------------|-------|------|-----|-----|
| 12. | Temperature Cycle | <p>* Conduct the five cycles according to the temperatures and time.</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> <th>Time (minimum)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Minimum operating temperature +0 / -3</td> <td>30 ±3</td> </tr> <tr> <td>2</td> <td>Room temperature</td> <td>2 to 3</td> </tr> <tr> <td>3</td> <td>Maximum operating temperature +3 / -0</td> <td>30 ±3</td> </tr> <tr> <td>4</td> <td>Room temperature</td> <td>2 to 3</td> </tr> </tbody> </table> <p>* Before initial measurement (Class II only): Perform 150 +0 / -10°C for 1 hour and then set for 48 ±4 hrs at room temperature * Measurement to be made after keeping at room temperature for 48 ±4 hours</p> | Step | Temperature (°C) | Time (minimum) | 1 | Minimum operating temperature +0 / -3 | 30 ±3 | 2 | Room temperature | 2 to 3 | 3 | Maximum operating temperature +3 / -0 | 30 ±3 | 4 | Room temperature | 2 to 3 | <p>* No remarkable damage.</p> <p>Cap change: NPO: within ±2.5% or ±0.25 pF whichever is larger X7R, X5R: within ±7.5% Y5V: within ±20%</p> <p>* Q/D.F., I.R. and dielectric strength: To meet initial requirements</p> | | | | | | | | | | | | | |
| Step | Temperature (°C) | Time (minimum) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 2 | Room temperature | 2 to 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 4 | Room temperature | 2 to 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13. | Humidity (Damp Heat) Steady State | <p>* Test temperature: 40 ±2°C * Humidity: 90 to 95% RH * Test time: 500 +24 / -0 hours * Measurement to be made after keeping at room temperature for 48 ±4 hours</p> | <p>* No remarkable damage.</p> <p>Cap change: NPO: within ±2.5% or ±0.25 pF whichever is larger X7R: ≥10 V, within ±12.5%; 6.3 V, within ±25% Y5V: ≥10 V, within ±30%; 6.3 V, within +30 / -40% Q/D.F. value: NPO: More than 30 pF Q ≥ 350, 10 pF ≤ C ≤ 30pF, Q ≥ 275+2.5C Less than 10 pF Q ≥ 200+10C X7R</p> <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>D.F</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>≥50 V</td> <td>≤3%</td> <td>≤6%</td> <td>0603 ≥0.047 μF; 0805 ≥0.18 μF</td> </tr> <tr> <td rowspan="2">25 V</td> <td rowspan="2">≤5%</td> <td>≤14%</td> <td>0603 ≥0.33 μF</td> </tr> <tr> <td>≤15%</td> <td>0402 ≥0.1 μF; 0603 ≥0.47 μF</td> </tr> <tr> <td rowspan="2">16 V</td> <td rowspan="2">≤5%</td> <td>≤10%</td> <td>0402 ≥0.033 μF; 0603 ≥0.15 μF</td> </tr> <tr> <td>≤15%</td> <td>0603 ≥0.68 μF</td> </tr> <tr> <td>10 V</td> <td>≤7.5%</td> <td>≤15%</td> <td>0402 ≥0.33 μF; 0603 ≥0.33 μF</td> </tr> <tr> <td>6.3 V</td> <td>≤10%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> | Rated Voltage | D.F | Exception of D.F. | | ≥50 V | ≤3% | ≤6% | 0603 ≥0.047 μF; 0805 ≥0.18 μF | 25 V | ≤5% | ≤14% | 0603 ≥0.33 μF | ≤15% | 0402 ≥0.1 μF; 0603 ≥0.47 μF | 16 V | ≤5% | ≤10% | 0402 ≥0.033 μF; 0603 ≥0.15 μF | ≤15% | 0603 ≥0.68 μF | 10 V | ≤7.5% | ≤15% | 0402 ≥0.33 μF; 0603 ≥0.33 μF | 6.3 V | ≤10% | --- | --- |
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Multilayer Ceramic Capacitor

General Purpose



Reliability Test Conditions and Requirements

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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Multilayer Ceramic Capacitor

General Purpose



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| 14. | Humidity (Damp Heat) Load | <ul style="list-style-type: none"> * Test temperature: 40 ±2°C * Humidity: 90 to 95% RH * Test time: 500 +24 / -0 hours * To apply voltage: rated voltage * Measurement to be made after keeping at room temperature for 48 ±4 hours | <p>Y5V</p> <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>D.F</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>≥50 V</td> <td>≤7.5%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25 V</td> <td rowspan="2">≤7.5%</td> <td>≤10%</td> <td>0402 ≥0.047 μF; 0603 ≥0.1 μF;</td> </tr> <tr> <td>≤15%</td> <td>0402 ~≥0.68 μF; 0603 ~≥0.47 μF</td> </tr> <tr> <td>16 V (C < 1 μF)</td> <td>≤10%</td> <td>≤12.5%</td> <td>0402 ~≥0.68 μF; 0603 ~≥0.68 μF</td> </tr> <tr> <td>10 V</td> <td>≤20%</td> <td>---</td> <td>---</td> </tr> <tr> <td>6.3 V</td> <td>≤30%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>I.R.: ≥10 V, ≥500 MΩ or R × C ≥ 25 Ω-F whichever is smaller 6.3 V, R × C ≥5 Ω-F</p> | Rated Voltage | D.F | Exception of D.F. | | ≥50 V | ≤7.5% | --- | --- | 25 V | ≤7.5% | ≤10% | 0402 ≥0.047 μF; 0603 ≥0.1 μF; | ≤15% | 0402 ~≥0.68 μF; 0603 ~≥0.47 μF | 16 V (C < 1 μF) | ≤10% | ≤12.5% | 0402 ~≥0.68 μF; 0603 ~≥0.68 μF | 10 V | ≤20% | --- | --- | 6.3 V | ≤30% | --- | --- | | |
| Rated Voltage | D.F | Exception of D.F. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≥50 V | ≤7.5% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 V | ≤7.5% | ≤10% | 0402 ≥0.047 μF; 0603 ≥0.1 μF; | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤15% | 0402 ~≥0.68 μF; 0603 ~≥0.47 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 V (C < 1 μF) | ≤10% | ≤12.5% | 0402 ~≥0.68 μF; 0603 ~≥0.68 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 V | ≤20% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3 V | ≤30% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15. | High Temperature Load (Endurance) | <ul style="list-style-type: none"> * Test temperature: NPO, X7R: 125 ±3°C Y5V: 85 ±3°C * To apply voltage: 200% of rated voltage * Test time: 1,000 +24 / -0 hours * Measurement to be made after keeping at temperature for 48 ±4 hours | <ul style="list-style-type: none"> * No remarkable damage. Cap change: NPO: ±3% or ±0.3 pF whichever is larger X7R: ≥ 10 V, within ±12.5%; 6.3 V, within ±25% Y5V: ≥ 10 V, within ±30%; 6.3 V, within +30 / -40% Q/D.F. value: NPO: More than 30 pF, Q ≥ 350 10 pF ≤ C < 30 pF, Q ≥ 275 +2.5C Less than 10 pF, Q ≥ 200 +10C X7R: <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>D.F</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>≥50 V</td> <td>≤3%</td> <td>≤6%</td> <td>0603 ≥0.047 μF</td> </tr> <tr> <td rowspan="2">25 V</td> <td rowspan="2">≤5%</td> <td>≤14%</td> <td>0603 ≥0.33 μF</td> </tr> <tr> <td>≤15%</td> <td>0402 ~≥0.1 μF; 0603 ~≥0.47 μF</td> </tr> <tr> <td rowspan="2">16 V</td> <td rowspan="2">≤5%</td> <td>≤10%</td> <td>0402 ≥0.033 μF; 0603 ≥0.15 μF</td> </tr> <tr> <td>≤15%</td> <td>0603 ≥0.68 μF</td> </tr> <tr> <td>10 V</td> <td>≤7.5%</td> <td>≤15%</td> <td>0603 ≥0.33 μF</td> </tr> <tr> <td>6.3 V</td> <td>≤10%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> | Rated Voltage | D.F | Exception of D.F. | | ≥50 V | ≤3% | ≤6% | 0603 ≥0.047 μF | 25 V | ≤5% | ≤14% | 0603 ≥0.33 μF | ≤15% | 0402 ~≥0.1 μF; 0603 ~≥0.47 μF | 16 V | ≤5% | ≤10% | 0402 ≥0.033 μF; 0603 ≥0.15 μF | ≤15% | 0603 ≥0.68 μF | 10 V | ≤7.5% | ≤15% | 0603 ≥0.33 μF | 6.3 V | ≤10% | --- | --- |
| Rated Voltage | D.F | Exception of D.F. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≥50 V | ≤3% | ≤6% | 0603 ≥0.047 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 V | ≤5% | ≤14% | 0603 ≥0.33 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤15% | 0402 ~≥0.1 μF; 0603 ~≥0.47 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 V | ≤5% | ≤10% | 0402 ≥0.033 μF; 0603 ≥0.15 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | ≤15% | 0603 ≥0.68 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 V | ≤7.5% | ≤15% | 0603 ≥0.33 μF | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3 V | ≤10% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

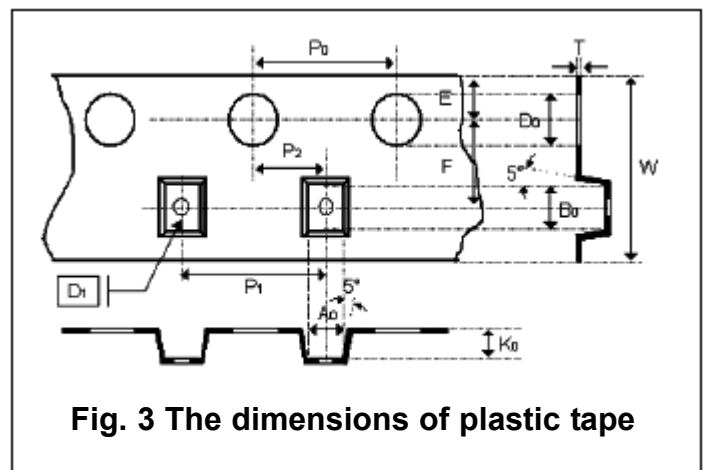
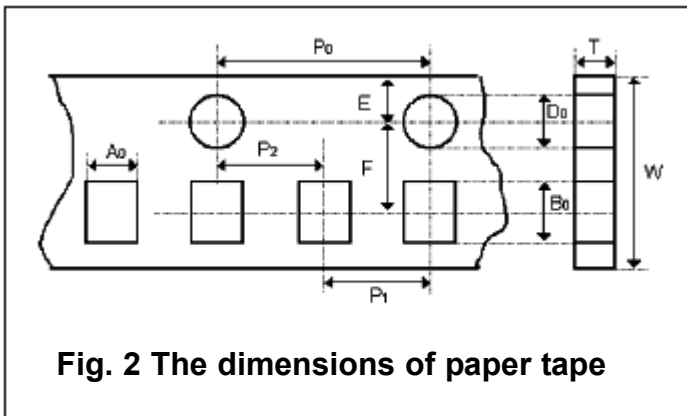
Multilayer Ceramic Capacitor General Purpose



Reliability Test Conditions and Requirements

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|-----------------------------------|---|--|---------------|-----|-------------------|--|-------|--------|------|--------------|------|--------|------|-------------------------------|---------|------------------------------|-----------------|------|---------|------------------------------|------|------|-----|-----|-------|------|-----|-----|
| 15. | High Temperature Load (Endurance) | <p>* Test temperature: NPO, X7R: 125 ±3°C Y5V: 85 ±3°C</p> <p>* To apply voltage: 200% of rated voltage</p> <p>* Test time: 1,000 +24 / -0 hours</p> <p>* Measurement to be made after keeping at temperature for 48 ±4 hours</p> | <p>Y5V:</p> <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>D.F</th> <th colspan="2">Exception of D.F.</th> </tr> </thead> <tbody> <tr> <td>≥50 V</td> <td>≤7.5 %</td> <td>≤10%</td> <td>0603 ≥0.1 μF</td> </tr> <tr> <td rowspan="2">25 V</td> <td rowspan="2">≤7.5 %</td> <td>≤10%</td> <td>0402 ≥0.047 μF; 0603 ≥0.1 μF;</td> </tr> <tr> <td>≤12.5 %</td> <td>0402 ≥0.68 μF; 0603 ≥0.47 μF</td> </tr> <tr> <td>16 V (C < 1 μF)</td> <td>≤10%</td> <td>≤12.5 %</td> <td>0402 ≥0.68 μF; 0603 ≥0.68 μF</td> </tr> <tr> <td>10 V</td> <td>≤20%</td> <td>---</td> <td>---</td> </tr> <tr> <td>6.3 V</td> <td>≤30%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>I.R.: ≥10 V, ≥1 GΩ or R × C ≥ 50 Ω-F whichever is smaller 6.3 V, R × C ≥ 10 Ω-F</p> | Rated Voltage | D.F | Exception of D.F. | | ≥50 V | ≤7.5 % | ≤10% | 0603 ≥0.1 μF | 25 V | ≤7.5 % | ≤10% | 0402 ≥0.047 μF; 0603 ≥0.1 μF; | ≤12.5 % | 0402 ≥0.68 μF; 0603 ≥0.47 μF | 16 V (C < 1 μF) | ≤10% | ≤12.5 % | 0402 ≥0.68 μF; 0603 ≥0.68 μF | 10 V | ≤20% | --- | --- | 6.3 V | ≤30% | --- | --- |
| Rated Voltage | D.F | Exception of D.F. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≥50 V | ≤7.5 % | ≤10% | 0603 ≥0.1 μF | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 V | ≤7.5 % | ≤10% | 0402 ≥0.047 μF; 0603 ≥0.1 μF; | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 16 V (C < 1 μF) | ≤10% | ≤12.5 % | 0402 ≥0.68 μF; 0603 ≥0.68 μF | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 V | ≤20% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3 V | ≤30% | --- | --- | | | | | | | | | | | | | | | | | | | | | | | | | | |

Tape & Reel Dimensions

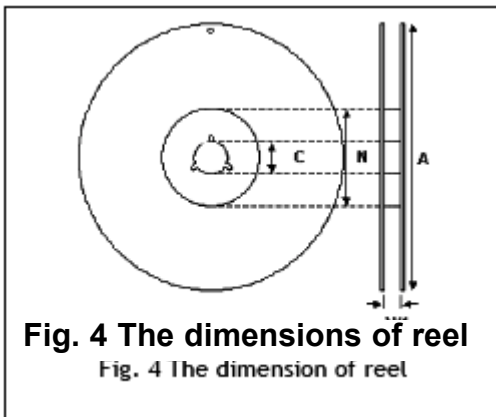


Multilayer Ceramic Capacitor

General Purpose



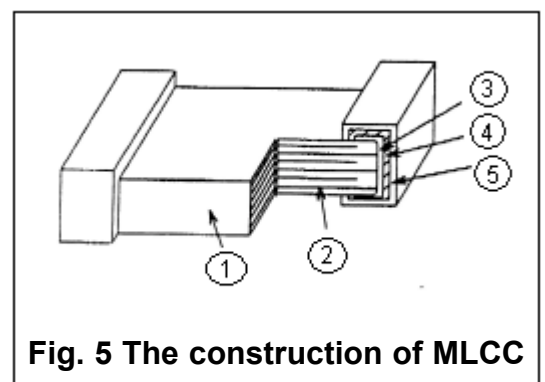
| Size | 0402 | 0603 |
|-----------|------------|------------|
| Thickness | N | S, X |
| A0 | 0.62 ±0.05 | 1.02 ±0.05 |
| B0 | 1.12 ±0.05 | 1.8 ±0.05 |
| T | 0.60 ±0.05 | 0.95 ±0.05 |
| K0 | - | - |
| W | 8 ±0.1 | 8 ±0.1 |
| P0 | 4 ±0.1 | 4 ±0.1 |
| 10 × P0 | 40 ±0.1 | 40 ±0.1 |
| P1 | 2 ±0.05 | 4 ±0.1 |
| P2 | 2 ±0.05 | 2 ±0.05 |
| D0 | 1.55 ±0.05 | 1.55 ±0.05 |
| D1 | - | - |
| E | 1.75 ±0.05 | 1.75 ±0.05 |
| F | 3.5 ±0.05 | 3.5 ±0.05 |



| Size | 0402 and 0603 |
|-----------|----------------|
| Reel size | 7" |
| C | 13 +0.5 / -0.2 |
| W1 | 8.4 +1.5 / -0 |
| A | 178 ±0.1 |
| N | 60 +1 / -0 |

Constructions

| No. | Name | NPO* | NPO, X7R, Y5V |
|-----|------------------|--------------------------|---------------|
| 1 | Ceramic Material | BaTiO ₃ based | |
| 2 | Inner Electrode | AgPd alloy | Ni |
| 3 | Termination | Inner Layer | Ag |
| 4 | | Middle Layer | Ni |
| 5 | | Outer Layer | Sn |



Partial NPO items are with Ag / Ni / Sn terminations, please ref to product range of NPO dielectric for detail

Multilayer Ceramic Capacitor

General Purpose



Storage and Handling Conditions

- (1) To store products at 5 to 40°C ambient temperature and 20 to 70% related humidity conditions
- (2) The product is recommended to be used within one year after shipment. Check solderability in case of shelf life extension is needed.

Cautions:

- a. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid. It may cause oxidization of electrode, which easily be resulted in poor soldering
- b. To store products on the shelf and avoid exposure to moisture
- c. Don't expose products to excessive shock, vibration, direct sunlight and so on

Recommended Soldering Conditions

The lead-free termination MLCCs are not only to be used on SMT against lead-free solder paste, but also suitable against lead containing solder paste. If the optimized solder joint is requested, increasing soldering time, temperature and concentration of N₂ within oven are recommended

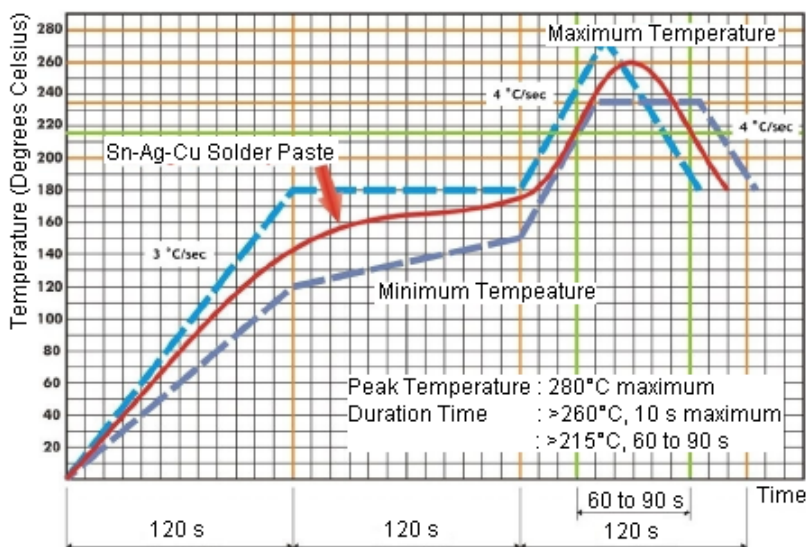
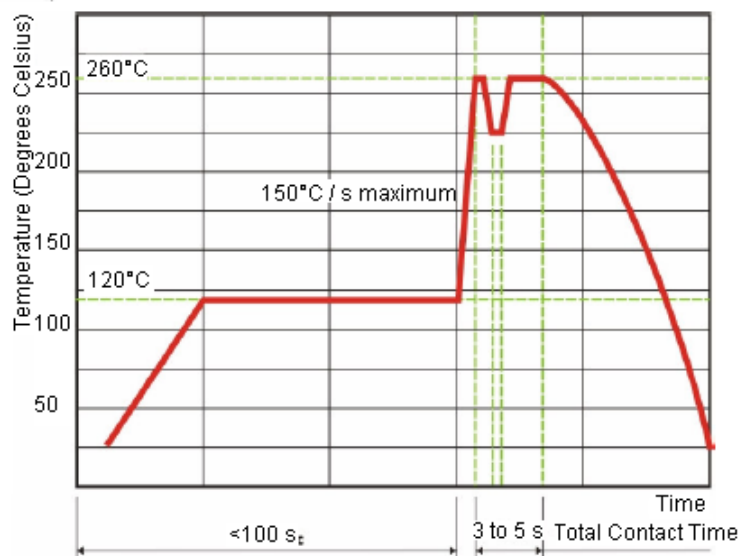


Fig. 6 Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste

Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder



Part Number Table

| Description | Part Number |
|------------------------------|------------------|
| Multilayer Ceramic Capacitor | MC0402N101K500CT |

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