

# Multilayer Ceramic Capacitors

## High Q / Low ESR Series



RoHS  
Compliant



### Description:

MLCC consists of a conducting material and electrodes. To manufacture a chip-type SMT and achieve miniaturization, high density and high efficiency, ceramic condensers are used.

WTC HH series MLCC is used at high frequencies generally have a small temperature coefficient of capacitance, typical within the  $\pm 30\text{ppm}/^\circ\text{C}$  required for NP0 (C0G) classification and have excellent conductivity internal electrode. Thus, WTC HH series MLCC will be with the feature of low ESR and high Q characteristics.

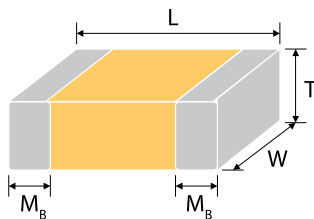
### Features:

- High Q and low ESR performance at high frequency
- Quality improvement of telephone calls for low power loss and better performance

### Applications:

- Mobile telecommunication: Mobile phone, WLAN
- RF module: Power amplifier, VCO
- Tuners

### External Dimensions:



The outline of MLCC

| Size<br>Inch (mm) | L<br>(mm)         | W<br>(mm)         | T<br>(mm)/Symbol  |   | Remark | MB<br>(mm)         |
|-------------------|-------------------|-------------------|-------------------|---|--------|--------------------|
| 0402 (1005)       | 1 $\pm$ 0.05      | 0.5 $\pm$ 0.05    | 0.5 $\pm$ 0.05    | N | #      | 0.25<br>+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<br>+0.15/-0.1 | 0.8<br>+0.15/-0.1 | 0.8<br>+0.15/-0.1 | X |        |                    |

# Reflow soldering only is recommended.

### General Electrical Data:

| Dielectric                  | NP0  |
|-----------------------------|--|
| Size                        | 0402, 0603   |
| Capacitance*                | 0402: 0.5pF to 470pF** & 0603: 0.5pF to 3300pF   |
| Capacitance tolerance       | Cap $\leq$ 5pF: B ( $\pm$ 0.1pF), C ( $\pm$ 0.25pF)<br>5pF<Cap<10pF: C ( $\pm$ 0.25pF), D ( $\pm$ 0.5pF)<br>Cap $\geq$ 10pF: F ( $\pm$ 1%), G ( $\pm$ 2%), J ( $\pm$ 5%) |
| Rated voltage (WVDC)        | 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V  |
| Q*                          | Cap<30pF: Q $\geq$ 400+20C; Cap $\geq$ 30pF: Q $\geq$ 1,000  |
| Insulation resistance at Ur | $\geq$ 10G $\Omega$ or R $\times$ C $\geq$ 100 $\Omega$ -F whichever is smaller  |
| Operating temperature       | -55 $^\circ\text{C}$ to +125 $^\circ\text{C}$  |
| Capacitance change          | $\pm$ 30ppm/ $^\circ\text{C}$  |
| Termination                 | Ni/Sn (lead-free termination)  |

\* Measured at the conditions of 25 $^\circ\text{C}$  ambient temperature and 30~70% related humidity.

Apply 1 $\pm$ 0.2Vrms, 1MHz $\pm$ 10% for Cap $\leq$ 1000pF and 1 $\pm$ 0.2Vrms, 1kHz $\pm$ 10% for Cap>1,000pF.

\*\* 0402, Capacitance <0.5pF: On request.

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### Capacitance Range

| DIELECTRIC    | NP0         |    |    |    |      |    |     |    |
|---------------|-------------|----|----|----|------|----|-----|----|
|               | 0402        |    |    |    | 0603 |    |     |    |
|               | 16          | 25 | 50 | 16 | 25   | 50 | 100 |    |
| SIZE          |             |    |    |    |      |    |     |    |
| Rated Voltage |             |    |    |    |      |    |     |    |
| Capacitance   | 0.5pF (0R5) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 0.6pF (0R6) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 0.7pF (0R7) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 0.8pF (0R8) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 0.9pF (0R9) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 1.0pF (1R0) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 1.2pF (1R2) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 1.5pF (1R5) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 1.8pF (1R8) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 2.2pF (2R2) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 2.7pF (2R7) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 3.3pF (3R3) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 3.9pF (3R9) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 4.7pF (4R7) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 5.6pF (5R6) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 6.8pF (6R8) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 8.2pF (8R2) | N^ | N^ | N^ | S^   | S^ | S^  | S^ |
|               | 10pF (100)  | N  | N  | N  | S    | S  | S   | S  |
|               | 12pF (120)  | N  | N  | N  | S    | S  | S   | S  |
|               | 15pF (150)  | N  | N  | N  | S    | S  | S   | S  |
| 18pF (180)    | N           | N  | N  | S  | S    | S  | S   |    |
| 22pF (220)    | N           | N  | N  | S  | S    | S  | S   |    |
| 27pF (270)    | N           | N  | N  | S  | S    | S  | S   |    |
| 33pF (330)    | N           | N  | N  | S  | S    | S  | S   |    |

| DIELECTRIC    | NP0           |    |    |    |      |    |     |   |
|---------------|---------------|----|----|----|------|----|-----|---|
|               | 0402          |    |    |    | 0603 |    |     |   |
|               | 16            | 25 | 50 | 16 | 25   | 50 | 100 |   |
| SIZE          |               |    |    |    |      |    |     |   |
| Rated Voltage |               |    |    |    |      |    |     |   |
| Capacitance   | 39pF (390)    | N  | N  | N  | S    | S  | S   | S |
|               | 47pF (470)    | N  | N  | N  | S    | S  | S   | S |
|               | 56pF (560)    | N  | N  | N  | S    | S  | S   | S |
|               | 68pF (680)    | N  | N  | N  | S    | S  | S   | S |
|               | 82pF (820)    | N  | N  | N  | S    | S  | S   | S |
|               | 100pF (101)   | N  | N  | N  | S    | S  | S   | S |
|               | 120pF (121)   | N  | N  | N  | S    | S  | S   | S |
|               | 150pF (151)   | N  | N  | N  | S    | S  | S   | S |
|               | 180pF (181)   | N  | N  | N  | S    | S  | S   | S |
|               | 220pF (221)   | N  | N  | N  | S    | S  | S   | S |
|               | 270pF (271)   | N  | N  | N  | S    | S  | S   | S |
|               | 330pF (331)   | N  | N  | N  | S    | S  | S   | S |
|               | 390pF (391)   | N  | N  | N  | S    | S  | S   | S |
|               | 470pF (471)   | N  | N  | N  | S    | S  | S   | S |
|               | 560pF (561)   |    |    |    | S    | S  | S   | S |
|               | 680pF (681)   |    |    |    | S    | S  | S   | S |
|               | 820pF (821)   |    |    |    | S    | S  | S   | S |
|               | 1,000pF (102) |    |    |    | S    | S  | S   | S |
|               | 1,200pF (122) |    |    |    | X    | X  | X   |   |
|               | 1,500pF (152) |    |    |    | X    | X  | X   |   |
| 1,800pF (182) |               |    |    | X  | X    | X  |     |   |
| 2,200pF (222) |               |    |    | X  | X    | X  |     |   |
| 2,700pF (272) |               |    |    | X  | X    | X  |     |   |
| 3,300pF (332) |               |    |    | X  | X    | X  |     |   |

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.
3. 0402, Capacitance <0.5pF: On request.
4. For more information about products with special capacitance or other data, please contact WTC local representative

### Packaging Dimension And Quantity:

| Size | Thickness (mm)/Symbol |   | Paper Tape |          |
|------|-----------------------|---|------------|----------|
|      |                       |   | 7" reel    | 13" reel |
| 0402 | 0.5±0.05              | N | 10,000     | 20,000   |
| 0603 | 0.8±0.07              | S | 4,000      | 15,000   |
|      | 0.8+0.15/-0.1         | X |            |          |

Unit : pieces



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### Reliability Test Conditions and Requirements:

| No | Item                             | Test Condition  | Requirements  |
|----|----------------------------------|---|---|
| 1  | Visual and Mechanical            | -   | No remarkable defect<br>Dimensions to conform to individual specification sheet   |
| 2  | Capacitance                      | Cap≤1,000pF, 1±0.2Vrms, 1MHz±10%<br>Cap>1,000pF, 1±0.2Vrms, 1kHz±10%<br>At 25°C ambient temperature   | Shall not exceed the limits given in the detailed spec  |
| 3  | Q/ D.F.<br>(Dissipation Factor)  |   | NP0: Cap≥30pF, Q≥1,000; Cap<30pF, Q≥400+20C   |
| 4  | Dielectric Strength              | To apply voltage: ( ≤100V ) 250% of rated voltage<br>Duration: 1 to 5 sec<br>Charge and discharge current less than 50mA  | No evidence of damage or flash over during test   |
|    |                                  | To apply voltage:<br>200V~300V ≥2 times V DC<br>500V~999V ≥1.5 times V DC<br>Cut-off, set at 10mA<br>TEST= 15 sec.<br>RAMP=0  |   |
| 5  | Insulation Resistance            | Rated voltage:<200V<br>To apply rated voltage for max. 120 sec.   | ≥10ΩG   |
|    |                                  | Rated voltage:200~630V<br>To apply rated voltage (500V max.) for 60 sec.  | ≥10GΩ or R×C≥100Ω-F whichever is smaller  |
| 6  | Temperature Coefficient          | With no electrical load.<br>Operating temperature: -55°C to +125°C at 25°C  | Capacitance change: within ±30ppm/°C  |
| 7  | Adhesive Strength of Termination | Pressurizing force:<br>5N (≤0603) and 10N (>0603)<br>Test time: 10±1 sec.   | No remarkable damage or removal of the terminations   |
| 8  | Vibration Resistance             | Vibration frequency: 10~55 Hz/min.<br>Total amplitude: 1.5mm<br>Test time: 6hrs. (Two hrs each in three mutually perpendicular directions.)   | No remarkable damage<br>Cap change and Q/D.F.: To meet initial spec.  |
| 9  | Solderability                    | Solder temperature: 235±5°C<br>Dipping time: 2±0.5 sec.   | 95% min. coverage of all metalized area   |
| 10 | Bending Test                     | 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±1 sec. Measurement to be made after keeping at room temp. for 24±2 hrs. | No remarkable damage<br>Cap change: within ±5.0% or ±0.5pF whichever is larger<br>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.) |

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## High Q / Low ESR Series



### Reliability Test Conditions and Requirements:

| No   | Item                              | Test Condition   | Requirements   |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
|------|-----------------------------------|--|--|------------|-------------|---|----------------------------|-------|---|------------|-----|---|----------------------------|-------|---|------------|-----|---|
| 11   | Resistance to Soldering Heat      | Solder temperature: 260±5°C<br>Dipping time: 10±1 sec<br>Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder<br>Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II)   | No remarkable damage<br>Cap change: within ±2.5% or ±0.25pF whichever is larger<br>Q/D.F., I.R. and dielectric strength: To meet initial requirements<br>25% max. leaching on each edge  |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
| 12   | Temperature Cycle                 | Conduct the five cycles according to the temperatures and time<br><table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (Min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30 ±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30 ±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table><br>Measurement to be made after keeping at room temp. for 24±2 hrs. | Step   | Temp. (°C) | Time (Min.) | 1 | Min. operating temp. +0/-3 | 30 ±3 | 2 | Room temp. | 2~3 | 3 | Max. operating temp. +3/-0 | 30 ±3 | 4 | Room temp. | 2~3 | No remarkable damage<br>Cap change: within ±2.5% or ±0.25pF whichever is larger<br>Q/D.F., I.R. and dielectric strength: To meet initial requirements |
| Step | Temp. (°C)                        | Time (Min.)  |  |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
| 1    | Min. operating temp. +0/-3        | 30 ±3  |  |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
| 2    | Room temp.                        | 2~3  |  |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
| 3    | Max. operating temp. +3/-0        | 30 ±3  |  |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
| 4    | Room temp.                        | 2~3  |  |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
| 13   | Humidity (Damp Heat) Steady State | Test temp.: 40±2°C<br>Humidity: 90~95% RH<br>Test time: 500+24/-0hrs.<br>Measurement to be made after keeping at room temp. for 24±2 hrs.  | No remarkable damage<br>Cap change: within ±5.0% or ±0.5pF whichever is larger<br>Q/D.F. value:<br>NP0: Cap≥30pF, Q≥350; 10pF≤Cap<30pF, Q≥275+2.5C Cap<10pF; Q≥200+10C<br>I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller         |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
| 14   | Humidity (Damp Heat) Load         | Test temp.: 40±2°C<br>Humidity: 90~95%RH<br>Test time: 500+24/-0 hrs.<br>To apply voltage: rated voltage (Max. 500V)<br>Measurement to be made after keeping at room temp. for 24±2 hrs.   | No remarkable damage.<br>Cap change: within ±7.5% or ±0.75pF whichever is larger.<br>Q/D.F. value:<br>NP0: Cap≥30pF, Q≥200; Cap<30pF, Q≥100+10/3C<br>I.R.: ≥500MΩ or RxC≥25Ω-F whichever is smaller.                           |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |
| 15   | High Temperature Load (Endurance) | Test temp.: NP0: 125±3°C<br>To apply voltage:<br>(1) <500V: 200% of rated voltage.<br>(2) 500V: 150% of rated voltage.<br>(3) ≥630V: 120% of rated voltage.<br>Test time: 1000+24/-0 hrs.<br>Measurement to be made after keeping at room temp. for 24±2 hrs.  | No remarkable damage.<br>Cap change: within ±3.0% or ±0.3pF whichever is larger.<br>Q/D.F. value:<br>NP0: Cap≥30pF, Q≥350<br>10pF≤Cap<30pF, Q≥275+2.5C<br>Cap<10pF, Q≥200+10C<br>I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller. |            |             |   |                            |       |   |            |     |   |                            |       |   |            |     |   |

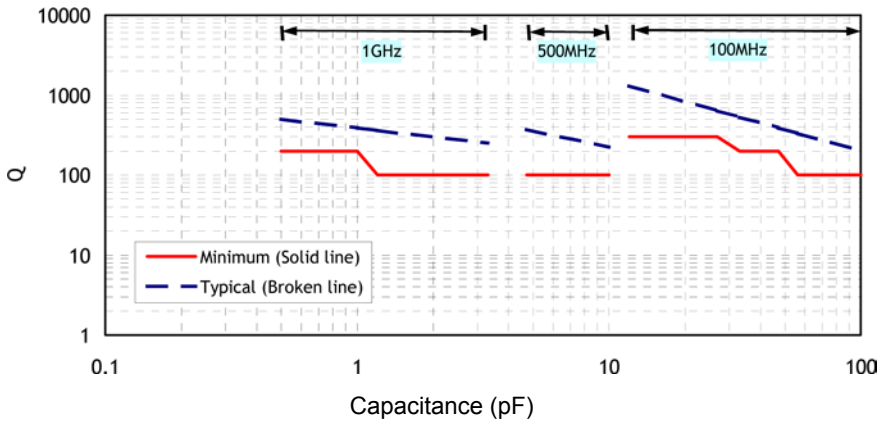
# Multilayer Ceramic Capacitors

## High Q / Low ESR Series



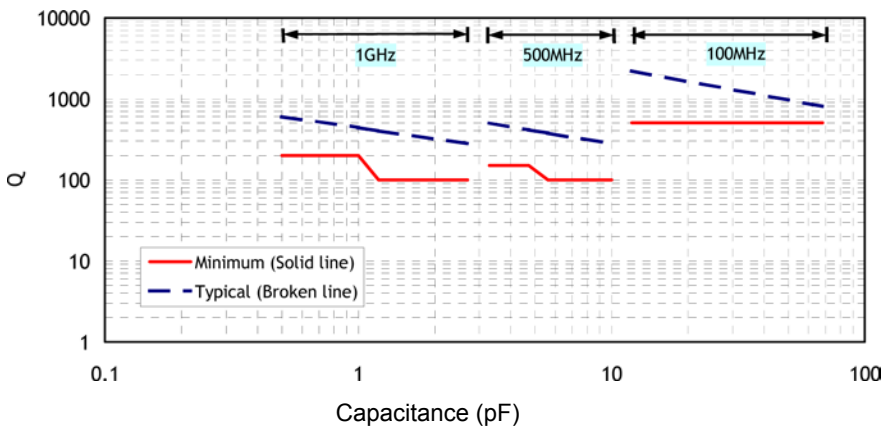
### Electrical Characteristics

Q value criteria vs. Specific frequency  
HH series, 0402



Q factor specification vs. Specific frequency for 0402

Q value criteria vs. Specific frequency  
HH series, 0603



Q factor specification vs. Specific frequency for 0603

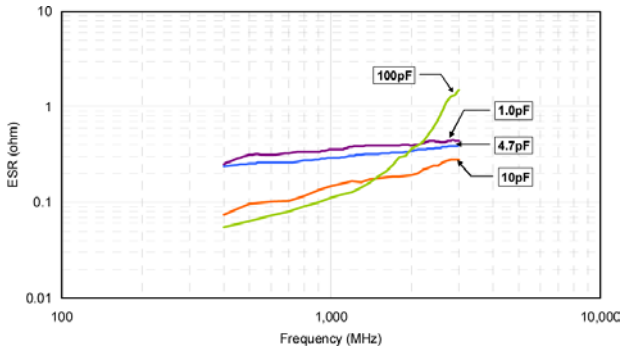
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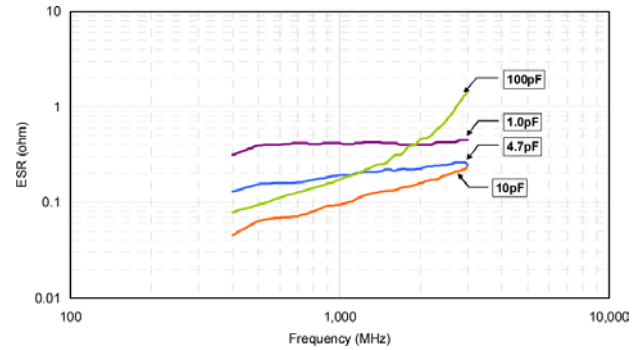
### Electrical Characteristics

0402 "HH" Series



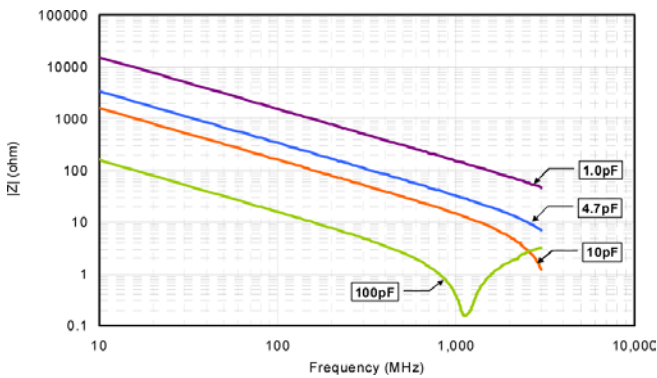
ESR vs. Frequency 0402

0603 "HH" Series



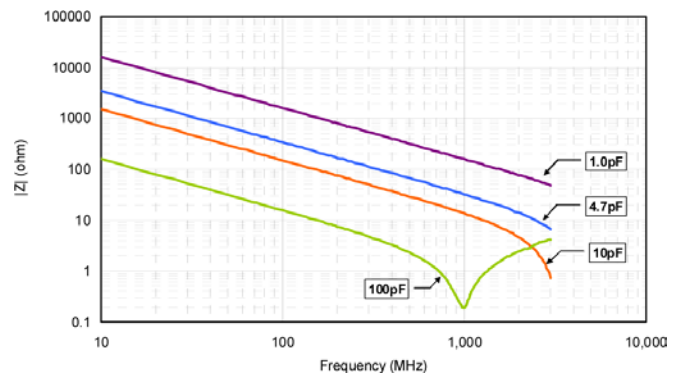
ESR vs. Frequency 0603

0402 "HH" Series

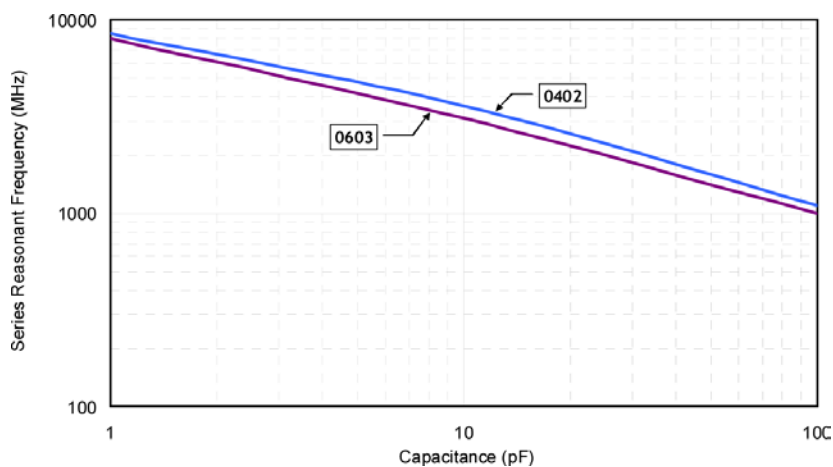


Impedance vs. Frequency 0402

0603 "HH" Series



Impedance vs. Frequency 0603



SRF vs. Capacitance



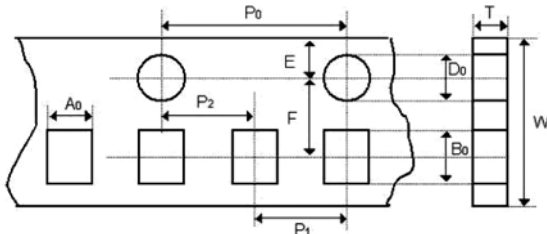
# Multilayer Ceramic Capacitors

## High Q / Low ESR Series

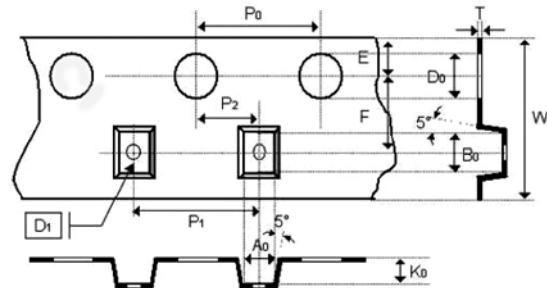


### Appendixes

#### Tape & Reel Dimensions

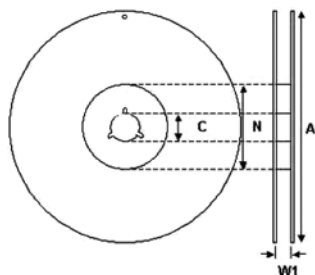


The dimension of paper tape



The dimension of plastic tape

| Size              | 0402       | 0603       |
|-------------------|------------|------------|
| Thickness         | N          | S, X       |
| A <sub>0</sub>    | 0.62 ±0.05 | 1.02 ±0.05 |
| B <sub>0</sub>    | 1.12 ±0.05 | 1.8 ±0.05  |
| T                 | 0.6 ±0.05  | 0.95 ±0.05 |
| K <sub>0</sub>    | -          | -          |
| W                 | 8 ±0.1     | 8 ±0.1     |
| P <sub>0</sub>    | 4 ±0.1     | 4 ±0.1     |
| 10×P <sub>0</sub> | 40 ±0.1    | 40 ±0.1    |
| P <sub>1</sub>    | 2 ±0.05    | 4 ±0.1     |
| P <sub>2</sub>    | 2 ±0.05    | 2 ±0.05    |
| D <sub>0</sub>    | 1.55 ±0.05 | 1.55 ±0.05 |
| D <sub>1</sub>    | -          | -          |
| E                 | 1.75 ±0.05 | 1.75 ±0.05 |
| F                 | 3.5 ±0.05  | 3.5 ±0.05  |



The dimension of reel

| Size           | 0402 & 0603  |              |
|----------------|--------------|--------------|
| Reel size      | 7"           | 13"          |
| C              | 13 +0.5/-0.2 | 13 +0.5/-0.2 |
| W <sub>1</sub> | 8.4 +1.5/-0  | 8.4 +1.5/-0  |
| A              | 178 ±0.1     | 250 ±1       |
| N              | 60 +1/-0     | 100 ±1       |

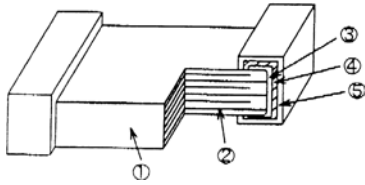


# Multilayer Ceramic Capacitors

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### Constructions:



The construction of MLCC

| No. | Name             | NP0*  | NP0 |
|-----|------------------|---|-----|
| 1   | Ceramic material | CaZrO <sub>3</sub> / BaTiO <sub>3</sub> based |     |
| 2   | Inner electrode  | AgPd alloy                                    | Ni  |
| 3   | Termination      | Inner layer                                   | Ag  |
| 4   |                  | Middle layer                                  | Ni  |
| 5   |                  | Outer layer                                   | Sn  |

\* Partial NP0 items are with Ag/Ni/Sn(NME) terminations, please ref to product range for detail.

### Storage and handling conditions

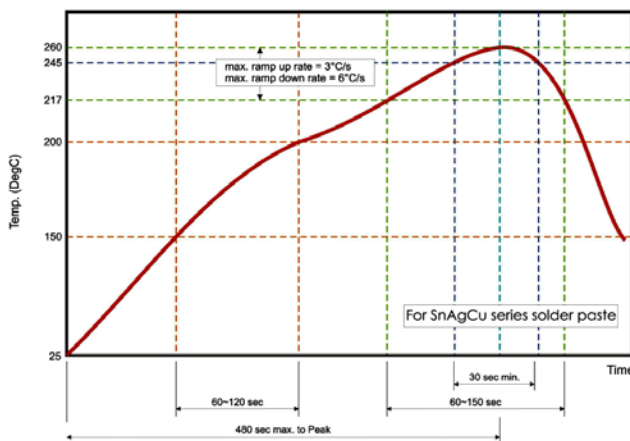
- (1) To store products at 5 to 40°C ambient temperature and 20 to 70% related humidity conditions.
- (2) The product is recommended to be used within one year after shipment. Check solderability in case of shelf life extension is needed.

### Cautions:

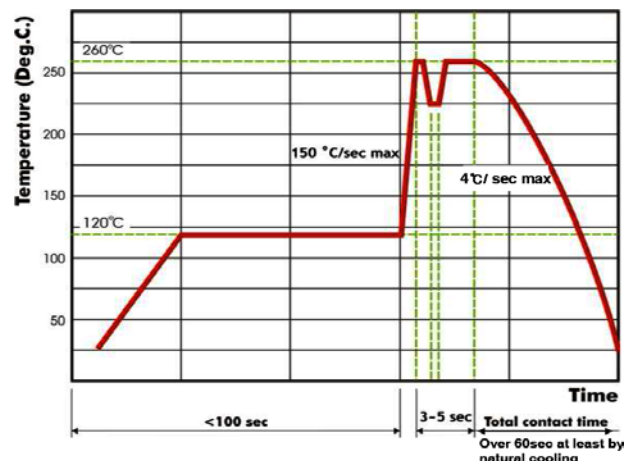
- a. The corrosive gas reacts on the terminal electrodes of capacitors, and results in the poor solderability. Do not store the capacitors in the ambience of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)
- b. In corrosive atmosphere, solderability might be degraded, and silver migration might occur to cause low reliability.
- c. Due to the dewing by rapid humidity change, or the photochemical change of the terminal electrode by direct sunlight, the solderability and electrical performance may deteriorate. Do not store capacitors under direct sunlight or dewing condition. To store products on the shelf and avoid exposure to moisture.

### 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 N<sub>2</sub> within oven are recommended.



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



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





# Multilayer Ceramic Capacitors

## High Q / Low ESR Series



### Part Number Table

| Description                           | Part Number |
|---------------------------------------|-------------|
| Capacitor, RF, 0.5PF, 50V, NP0, 0402  | MC000269    |
| Capacitor, RF, 0.5PF, 50V, NP0, 0402  | MC000270    |
| Capacitor, RF, 0.6PF, 50V, NP0, 0402  | MC000271    |
| Capacitor, RF, 0.8PF, 50V, NP0, 0402  | MC000272    |
| Capacitor, RF, 10PF, 50V, NP0, 0402   | MC000273    |
| Capacitor, RF, 100PF, 50V, NP0, 0402  | MC000274    |
| Capacitor, RF, 1PF, 50V, NP0, 0402    | MC000275    |
| Capacitor, RF, 1PF, 50V, NP0, 0402    | MC000276    |
| Capacitor, RF, 1.2PF, 50V, NP0, 0402  | MC000277    |
| Capacitor, RF, 1.5PF, 50V, NP0, 0402  | MC000278    |
| Capacitor, RF, 1.5PF, 50V, NP0, 0402  | MC000279    |
| Capacitor, RF, 1.8PF, 50V, NP0, 0402  | MC000280    |
| Capacitor, RF, 1.8PF, 50V, NP0, 0402  | MC000281    |
| Capacitor, RF, 2.2PF, 50V, NP0, 0402  | MC000282    |
| Capacitor, RF, 2.2PF, 50V, NP0, 0402  | MC000283    |
| Capacitor, RF, 2.7PF, 50V, NP0, 0402  | MC000284    |
| Capacitor, RF, 3PF, 50V, NP0, 0402    | MC000285    |
| Capacitor, RF, 3.9PF, 50V, NP0, 0402  | MC000286    |
| Capacitor, RF, 3.9PF, 50V, NP0, 0402  | MC000287    |
| Capacitor, RF, 4.7PF, 50V, NP0, 0402  | MC000288    |
| Capacitor, RF, 4.7PF, 50V, NP0, 0402  | MC000289    |
| Capacitor, RF, 5.1PF, 50V, NP0, 0402  | MC000290    |
| Capacitor, RF, 5.6PF, 50V, NP0, 0402  | MC000291    |
| Capacitor, RF, 6.8PF, 50V, NP0, 0402  | MC000292    |
| Capacitor, RF, 6.8PF, 50V, NP0, 0402  | MC000293    |
| Capacitor, RF, 6.8PF, 50V, NP0, 0402  | MC000294    |
| Capacitor, RF, 8.2PF, 50V, NP0, 0402  | MC000295    |
| Capacitor, RF, 0.75PF, 50V, NP0, 0402 | MC000296    |
| Capacitor, RF, 100PF, 50V, NP0, 0603  | MC000297    |
| Capacitor, RF, 1PF, 50V, NP0, 0603    | MC000298    |
| Capacitor, RF, 2.2PF, 50V, NP0, 0603  | MC000299    |
| Capacitor, RF, 2.7PF, 50V, NP0, 0603  | MC000300    |
| Capacitor, RF, 3.3PF, 50V, NP0, 0603  | MC000301    |