

# MULTILAYER CERAMIC CAPACITORS

## High Q / Low ESR Series (HH)



### 1. INTRODUCTION

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.

### 2. FEATURES

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

### 3. APPLICATIONS

- a. Mobile telecommunication: Mobile phone, WLAN.
- b. RF module: Power amplifier, VCO.
- c. Tuners.

### 4. HOW TO ORDER

| <u>HH</u>             | <u>15</u>                                          | <u>N</u>          | <u>100</u>                                                                                                                                                                              | <u>G</u>                                                     | <u>500</u>                                                                                                                                                    | <u>L</u>           | <u>I</u>                     |
|-----------------------|----------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------------------|
| <u>Series</u>         | <u>Size</u>                                        | <u>Dielectric</u> | <u>Capacitance</u>                                                                                                                                                                      | <u>Tolerance</u>                                             | <u>Rated voltage</u>                                                                                                                                          | <u>Termination</u> | <u>Packaging</u>             |
| HH=High Q/<br>Low ESR | 15=0402 (1005)<br>18=0603 (1608)<br>21=0805 (2012) | N=NP0<br>(C0G)    | Two significant<br>digits followed by<br>no. of zeros. And<br>R is in place of<br>decimal point.<br><br>eg.:<br>R47=0.47pF<br>0R5=0.5pF<br>1R0=1.0pF<br>100=10x10 <sup>0</sup><br>=10pF | B=±0.1pF<br>C=±0.25pF<br>D=±0.5pF<br>F=±1%<br>G=±2%<br>J=±5% | Two significant<br>digits followed by<br>no. of zeros. And<br>R is in place of<br>decimal point.<br><br>160=16 VDC<br>250=25 VDC<br>500=50 VDC<br>101=100 VDC | L=Ag/Ni/Sn         | T=7" reeled<br>G= 13" reeled |

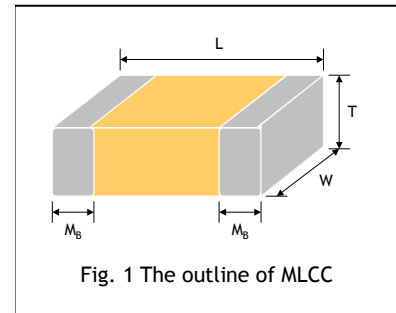
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### 5. EXTERNAL DIMENSIONS

| Size<br>Inch (mm) | L (mm)    | W (mm)    | T (mm)/Symbol  | M <sub>B</sub> (mm) |
|-------------------|-----------|-----------|----------------|---------------------|
| 0402 (1005)       | 1.00±0.05 | 0.50±0.05 | 0.50±0.05<br>N | 0.25<br>+0.05/-0.10 |
| 0603 (1608)       | 1.60±0.10 | 0.80±0.10 | 0.80±0.07<br>S | 0.40±0.15           |
| 0805 (2012)       | 2.00±0.15 | 1.25±0.10 | 0.60±0.10<br>A | 0.50±0.20           |



### 6. GENERAL ELECTRICAL DATA

|                             |                                                                                                                  |
|-----------------------------|------------------------------------------------------------------------------------------------------------------|
| Dielectric                  | NPO                                                                                                              |
| Size                        | 0402, 0603                                                                                                       |
| Capacitance*                | 0402: 0.5pF to 470pF<br>0603: 0.5pF to 3300pF<br>0805: 0.5pF to 150pF                                            |
| Capacitance tolerance       | Cap≤5pF: B (±0.1pF), C (±0.25pF)<br>5pF<Cap<10pF: C (±0.25pF), D (±0.5pF)<br>Cap≥10pF: F (±1%), G (±2%), J (±5%) |
| Rated voltage (WVDC)        | 16V, 25V, 50V, 100V                                                                                              |
| Q*                          | Cap<30pF: Q≥400+20C<br>Cap≥30pF: Q≥1000                                                                          |
| Insulation resistance at Ur | ≥10GΩ                                                                                                            |
| Operating temperature       | -55 to +125°C                                                                                                    |
| Capacitance change          | ±30ppm                                                                                                           |
| ESR                         | Cap<2.2pF: ≤1000mΩ@900±100MHz<br>2.2pF≤Cap≤470pF: ≤500mΩ@900±100MHz<br>Cap>470pF: ≤500mΩ@60±10MHz                |
| Termination                 | Ni/Sn (lead-free termination)                                                                                    |

\* Measured at the conditions of 25°C ambient temperature and 30-70% related humidity.

Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF.

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## 7. CAPACITANCE RANGE

| DIELECTRIC          |               | NPO  |    |    |      |    |    |     |      |     |
|---------------------|---------------|------|----|----|------|----|----|-----|------|-----|
| SIZE                |               | 0402 |    |    | 0603 |    |    |     | 0805 |     |
| RATED VOLTAGE (VDC) |               | 16   | 25 | 50 | 16   | 25 | 50 | 100 | 50   | 100 |
| Capacitance         | 0.5pF (0R5)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 0.6pF (0R6)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 0.7pF (0R7)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 0.8pF (0R8)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 0.9pF (0R9)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 1.0pF (1R0)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 1.2pF (1R2)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 1.5pF (1R5)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 1.8pF (1R8)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 2.2pF (2R2)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 2.7pF (2R7)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 3.3pF (3R3)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 3.9pF (3R9)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 4.7pF (4R7)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 5.6pF (5R6)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 6.8pF (6R8)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 8.2pF (8R2)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 10pF (100)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 12pF (120)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 15pF (150)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 18pF (180)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 22pF (220)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 27pF (270)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 33pF (330)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 39pF (390)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 47pF (470)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 56pF (560)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 68pF (680)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 82pF (820)    |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 100pF (101)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 120pF (121)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 150pF (151)   |      | N  | N  |      | S  | S  | S   | A    | A   |
|                     | 180pF (181)   |      | N  | N  |      | S  | S  | S   |      |     |
|                     | 220pF (221)   |      | N  | N  |      | S  | S  | S   |      |     |
|                     | 270pF (271)   | N    |    |    |      | S  | S  | S   |      |     |
|                     | 330pF (331)   | N    |    |    |      | S  | S  | S   |      |     |
|                     | 390pF (391)   | N    |    |    |      | S  | S  | S   |      |     |
|                     | 470pF (471)   | N    |    |    |      | S  | S  | S   |      |     |
|                     | 560pF (561)   |      |    |    |      | S  | S  |     |      |     |
|                     | 680pF (681)   |      |    |    |      | S  | S  |     |      |     |
|                     | 820pF (821)   |      |    |    |      | S  | S  |     |      |     |
|                     | 1,000pF (102) |      |    |    |      | S  | S  |     |      |     |
|                     | 1,200pF (122) |      |    |    | S    |    |    |     |      |     |
|                     | 1,500pF (152) |      |    |    | S    |    |    |     |      |     |
|                     | 1,800pF (182) |      |    |    | S    |    |    |     |      |     |
|                     | 2,200pF (222) |      |    |    | S    |    |    |     |      |     |
|                     | 2,700pF (272) |      |    |    | S    |    |    |     |      |     |
|                     | 3,300pF (332) |      |    |    | S    |    |    |     |      |     |

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

2. For more information about products with special capacitance or other data, please contact WTC local representative.

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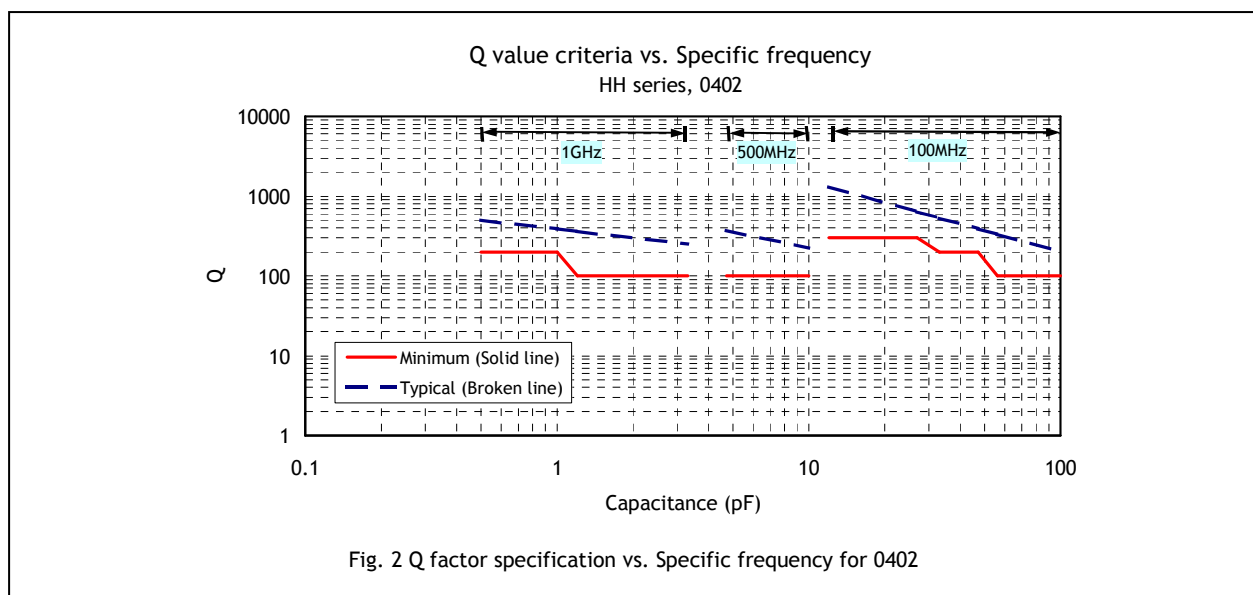
## 8. PACKAGING DIMENSION AND QUANTITY

| Size | Thickness (mm)/Symbol |   | Paper tape |          |
|------|-----------------------|---|------------|----------|
|      |                       |   | 7" reel    | 13" reel |
| 0402 | 0.50±0.05             | N | 10K        | 20K      |
| 0603 | 0.80±0.07             | S | 4K         | 15K      |
| 0805 | 0.60±0.10             | A | 4k         | 15k      |

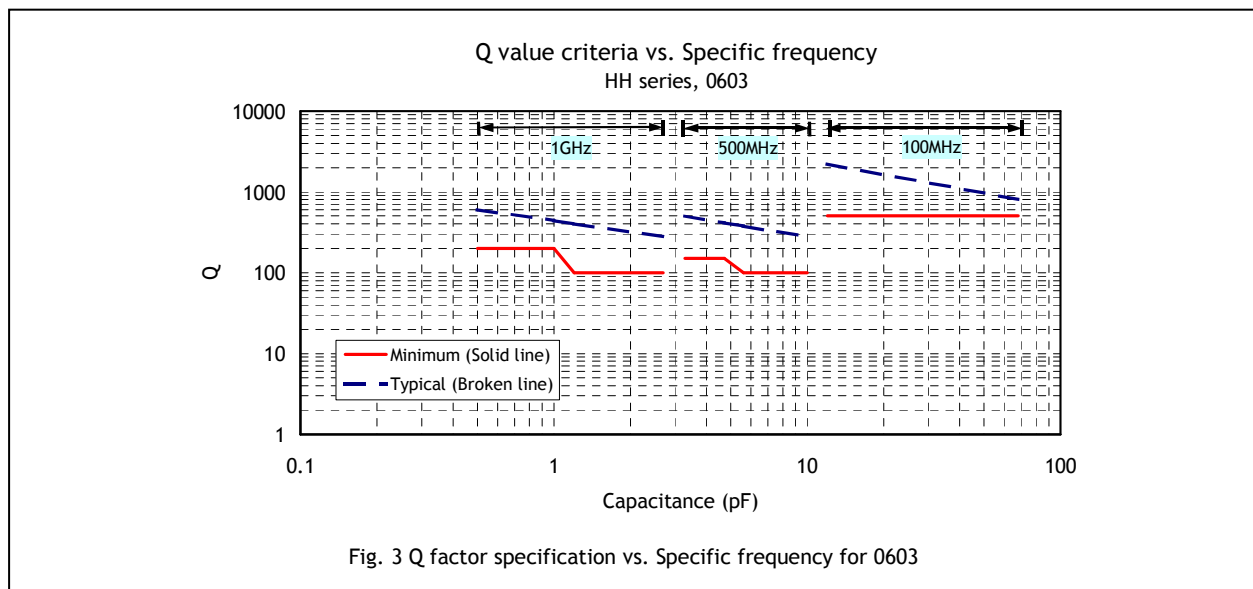
Unit: pieces

## 9. ELECTRICAL CHARACTERISTICS

### Q factor specification vs. Specific frequency



### Q factor specification vs. Specific frequency



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## Typical ESR vs. Frequency

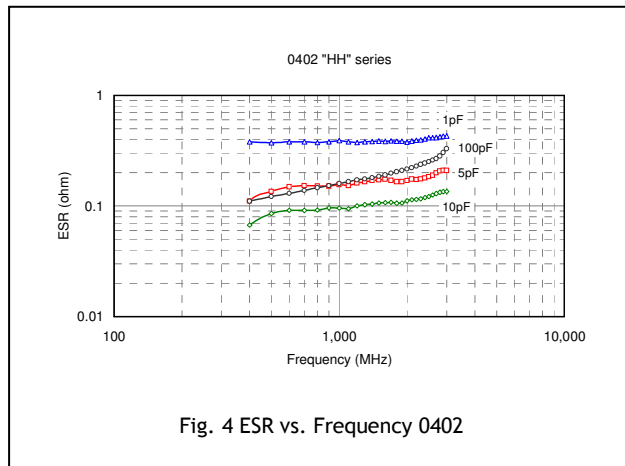


Fig. 4 ESR vs. Frequency 0402

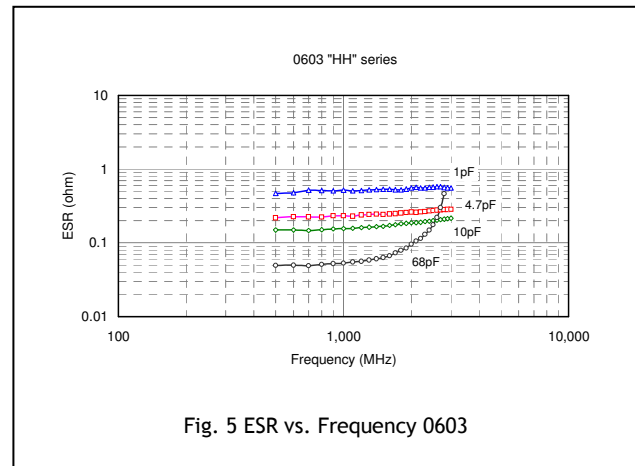


Fig. 5 ESR vs. Frequency 0603

## Typical Impedance vs. Frequency

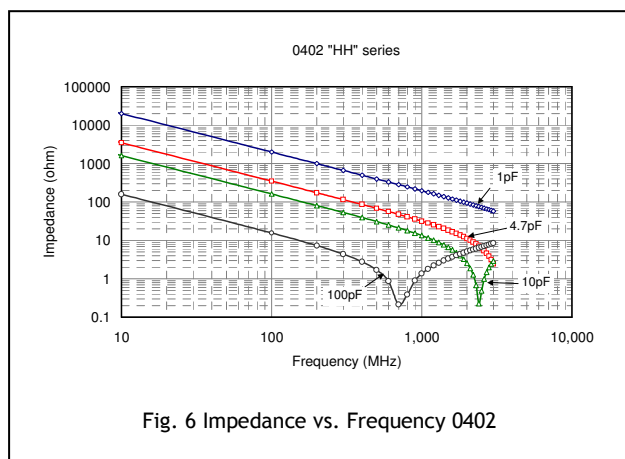


Fig. 6 Impedance vs. Frequency 0402

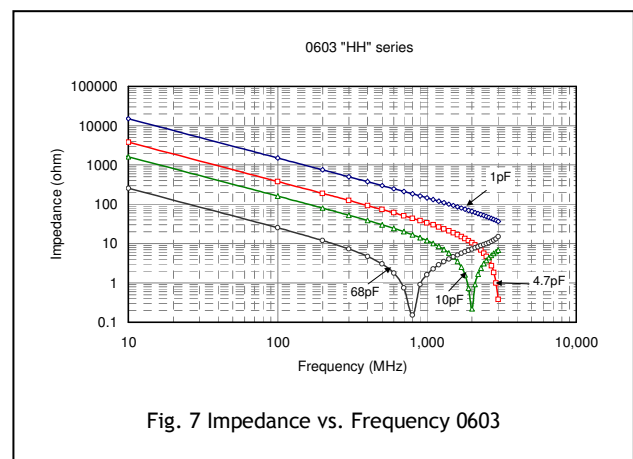


Fig. 7 Impedance vs. Frequency 0603

## SRF vs. Capacitance

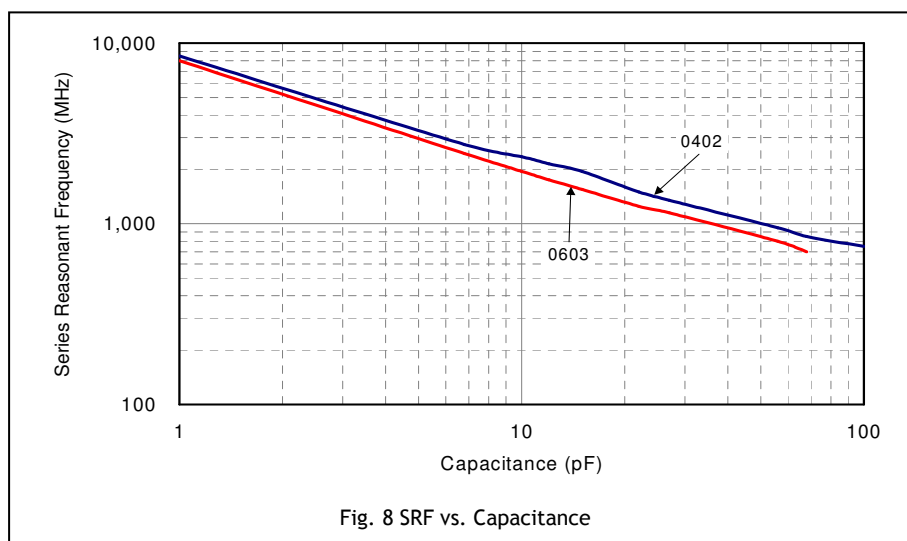


Fig. 8 SRF vs. Capacitance

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## 10. APPENDIXES

### ■ Tape & reel dimensions

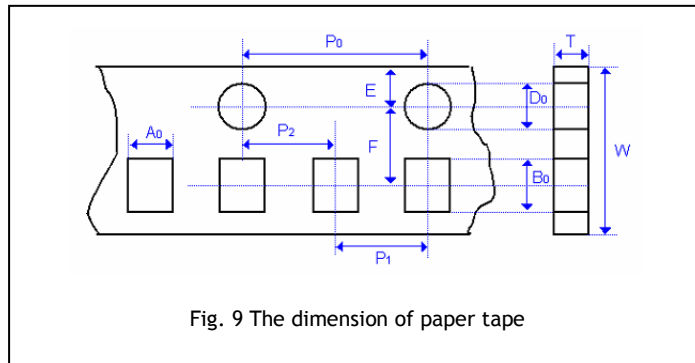


Fig. 9 The dimension of paper tape

| Size              | 0402      | 0603      |
|-------------------|-----------|-----------|
| Thickness         | N         | S         |
| A <sub>0</sub>    | 0.62±0.05 | 1.02±0.05 |
| B <sub>0</sub>    | 1.12±0.05 | 1.82±0.05 |
| T                 | 0.60±0.05 | 0.95±0.05 |
| K <sub>0</sub>    | -         | -         |
| W                 | 8.00±0.10 | 8.00±0.10 |
| P <sub>0</sub>    | 4.00±0.10 | 4.00±0.10 |
| 10xP <sub>0</sub> | 40.0±0.10 | 40.0±0.10 |
| P <sub>1</sub>    | 2.00±0.05 | 4.00±0.10 |
| P <sub>2</sub>    | 2.00±0.05 | 2.00±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                 | 3.50±0.05 | 3.50±0.05 |

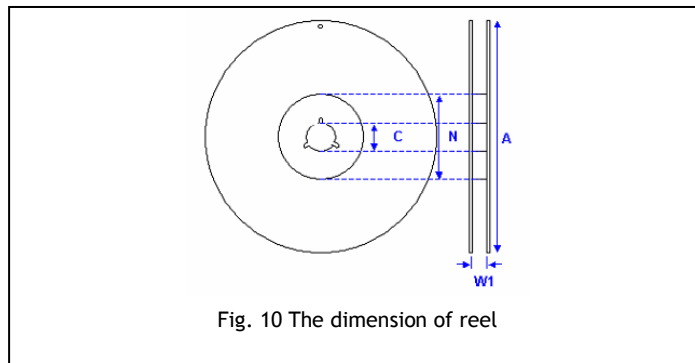
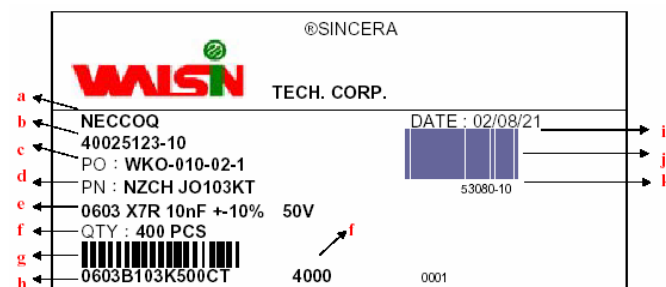


Fig. 10 The dimension of reel

| Size           | 0402, 0603    |               |
|----------------|---------------|---------------|
| Reel size      | 7"            | 13"           |
| C              | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 |
| W <sub>1</sub> | 8.4+1.5/-0    | 8.4+1.5/-0    |
| A              | 178.0±0.10    | 330.0±1.0     |
| N              | 60.5±1.0      | 100±1.0       |

### ■ Description of customer label



- a. Customer name
- b. WTC order series and item number
- c. Customer P/O
- d. Customer P/N
- e. Description of product
- f. Quantity
- g. Bar code including quantity & WTC P/N or customer
- h. WTC P/N
- i. Shipping date
- j. Order bar code including series and item numbers
- k. Serial number of label

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### ▣ Constructions

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

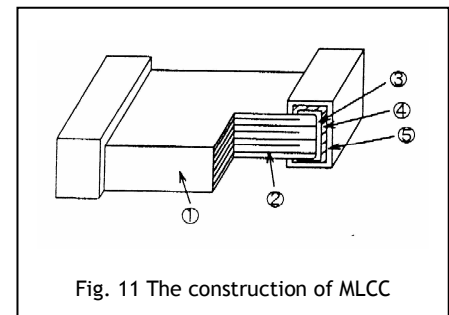


Fig. 11 The construction of MLCC

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

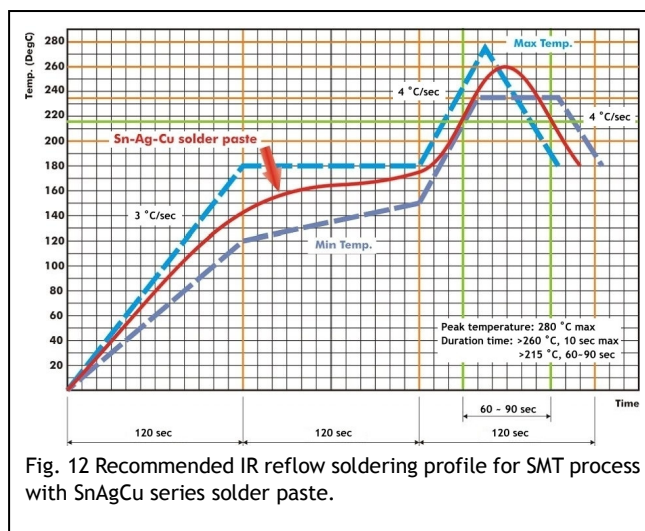


Fig. 12 Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste.

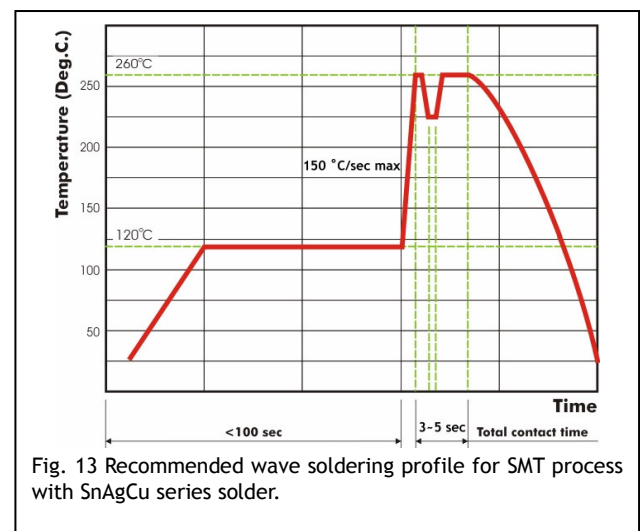


Fig. 13 Recommended wave soldering profile for SMT process with SnAgCu series solder.