# APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

Low Profile Series

0603 to 1210 Sizes

X7R, X5R & Y5V Dielectrics

RoHS Compliance

*Contents in this sheet are subject to change without prior notice.

## 1. 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 TT series MLCC is used in product having thickness concerned generally have high capacitance and thinner product thickness. The high dielectric constant material X7R, X5R and Y5V are used for this series product.

## 2. FEATURES

a. Standard size with thin thickness.
b. Small size with high capacitance.
c. Capacitor with lead-free termination (pure Tin).

## 3. APPLICATIONS

a. For LCD panels.
b. For PCMCA cards.
c. For IC packaging and modules.
d. Any thickness concerned products.

## 4. HOW TO ORDER

| TT | 31 | X | 225 | K | 100 | C | T |
|---|---|---|---|---|---|---|---|
| **Series** | **Size** | **Dielectric** | **Capacitance** | **Tolerance** | **Rated voltage** | **Termination** | **Packaging style** |
| **TT**=Low profile | **18**=0603 (1608)<br>**21**=0805 (2012)<br>**31**=1206 (3216)<br>**32**=1210 (3225) | **B**=X7R<br>**X**=X5R<br>**F**=Y5V | Two significant digits followed by no. of zeros. And R is in place of decimal point.<br><br>eg.:<br>225=22x10$^5$<br>=2,200,000pF<br>=2.2μF | **K**=±10%<br>**M**=±20%<br>**Z**=-20/+80% | Two significant digits followed by no. of zeros. And R is in place of decimal point.<br><br>**6R3**=6.3 VDC<br>**100**=10 VDC<br>**160**=16 VDC<br>**250**=25 VDC<br>**500**=50 VDC | **C**=Cu/Ni/Sn | **T**=7" reel (paper tape)<br>**P**=7" reel (plastic tape) |

## 5. EXTERNAL DIMENSIONS

| Size Inch (mm) | L (mm) | W (mm) | T max (mm)/Symbol | | $M_B$ (mm) |
|---|---|---|---|---|---|
| 0402 (1005) | 1.00±0.05 | 0.5±0.05 | 0.33 | L | 0.25±0.10 |
| 0603 (1608) | 1.6+0.15/-0.10 | 0.8+0.15/-0.10 | 0.60 | H | 0.40±0.15 |
| 0805 (2012) | 2.00±0.20 | 1.25±0.20 | 0.95 | T | 0.50±0.20 |
| 1206 (3216) | 3.20±0.20 | 1.60±0.20 | 0.95 | T | 0.60±0.20 |
| | | | 1.30 | J | |
| 1210 (3225) | 3.20±0.30 | 2.50±0.20 | 0.95 | T | 0.75±0.25 |

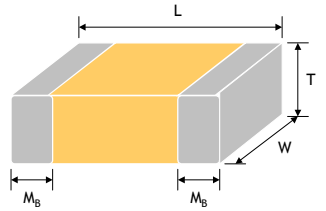

Fig. 1 The outline of MLCC

* Reflow soldering process only is recommended.

## 6. GENERAL ELECTRICAL DATA

| | | | |
|---|---|---|---|
| **Dielectric** | X7R | X5R | Y5V |
| **Size** | 1206 | 0603, 0805, 1206, 1210 | |
| **Capacitance range*** | 1.0μF | 0.22μF to 10μF | 1.0μF to 10μF |
| **Capacitance tolerance**** | K (±10%), M (±20%) | | Z (-20/+80%) |
| **Rated voltage (WVDC)** | 25V | 6.3V, 10V, 16V, 25V | 10V, 16V, 25V, 50V |
| **Tan δ*** | 25V: ≤10% | 25V, 16V, 10V: ≤10%;<br>6.3V: ≤15.0% | 50V: ≤7.0%<br>25V: ≤9.0%<br>16V, 10V: ≤12.5% |
| **Insulation resistance at Ur** | RxC≥100ΩxF | | |
| **Operating temperature** | -55 to +125℃ | -55 to +85℃ | -25 to +85℃ |
| **Capacitance characteristic** | ±15% | | +30/-80% |
| **Termination** | Ni/Sn (lead-free termination) | | |

* Measured at 1.0±0.2Vrms, 1.0kHz±10%, 30~70% related humidity, 25℃ ambient temperature for X7R, X5R and at 20℃ for Y5V.

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

## 7. CAPACITANCE RANGE

### 7-1 X7R & X5R dielectric

| Dielectric | | X7R | X5R | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | | 1206 | 0402 | 0603 | | 0805 | | | | 1206 | | | | | 1210 | |
| Rated voltage (VDC) | | 25 | 6.3 | 25 | 10 | 16 | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 50 | 10 | 25 |
| Capacitance | 0.22uF (224) | | | L | H | H | | | | | | | | | | | |
| | 0.47uF (474) | | | L | | | | | | | | | | | | | |
| | 1.0μF (105) | T | L | | H | H | | T | T | T | | T | T | T | | | |
| | 1.5μF (155) | | | | | | | T | T | | | T | T | T | | | |
| | 2.2μF (225) | | | | | | T | T | T | T | | T | T | T | T | | |
| | 3.3μF (335) | | | | | | | | | | | T | T | T | | T | |
| | 4.7μF (475) | | | | | | T | T | T | | | T | T | T | | T | |
| | 6.8μF (685) | | | | | | | | | | | | | | | | |
| | 10μF (106) | | | | | | T | T | | | J | J/T | | | | | T |
| | 22uF (226) | | | | | | T | | | | T | | | | | | |

### 7-2 Y5V dielectric

| Dielectric | | Y5V | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Size | | 0805 | | | | 1206 | | | | 1210 | |
| Rated voltage (VDC) | | 10 | 16 | 25 | 50 | 10 | 16 | 25 | 50 | 10 | 16 |
| Capacitance | 1.0μF (105) | | | | T | | | | | | |
| | 1.5μF (155) | | | | | | | | | | |
| | 2.2μF (225) | | T | T | | T | T | T | T | | |
| | 3.3μF (335) | T | | | | | | | | | |
| | 4.7μF (475) | T | T | | | T | T | | | | |
| | 6.8μF (685) | | | | | T | | | | | |
| | 10μF (106) | T | | | | T | | | | T | |
| | 22μF (226) | | | | | J | | | | | |

## 8. PACKAGING STYLE AND QUANTITY

| Size | Thickness Max (mm)/Symbol | | 7" reel | |
|---|---|---|---|---|
| | | | Paper tape | Plastic tape |
| 0402 (1005) | 0.33 | L | 15k | - |
| 0603 (1608) | 0.60 | H | 4k | - |
| 0805 (2012) | 0.95 | T | 4k | - |
| 1206 (3216) | 0.95 | T | 4k | - |
| | 1.30 | J | - | 3k |
| 1210 (3225) | 0.95 | T | - | 3k |

Unit: pieces

## 9. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>1.</td><td>Visual and Mechanical</td><td>---</td><td>* No remarkable defect.<br>* Dimensions to conform to individual specification sheet.</td></tr>
<tr><td>2.</td><td>Capacitance</td><td>Cap≤10μF, 1.0±0.2Vrms, 1kHz±10%</td><td>* Shall not exceed the limits given in the detailed spec.</td></tr>
<tr><td>3.</td><td>Q/ D.F. (Dissipation Factor)</td><td>Cap>10μF, 0.5±0.2Vrms, 120Hz±20%</td><td>X7R/X5R:<table><tr><th>Rated vol.</th><th>D.F.</th></tr><tr><td>25V, 16V, 10V</td><td>≤10%</td></tr><tr><td>6.3V</td><td>≤15%</td></tr></table>Y5V:<table><tr><th>Rated vol.</th><th>D.F.</th></tr><tr><td>50V</td><td>≤7%</td></tr><tr><td>25V</td><td>≤9%</td></tr><tr><td>16V/10V</td><td>≤12.5%</td></tr></table></td></tr>
<tr><td>4.</td><td>Dielectric Strength</td><td>* To apply voltage: 250% rated voltage.<br>* Duration: 1 to 5 sec.<br>* Charge and discharge current less than 50mA.</td><td>* No evidence of damage or flash over during test.</td></tr>
<tr><td>5.</td><td>Insulation Resistance</td><td>To apply rated voltage for max. 120 sec.</td><td>≥10GΩ or RxC≥100Ω-F whichever is smaller.</td></tr>
<tr><td>6.</td><td>Temperature Coefficient</td><td>With no electrical load.<table><tr><th>T.C.</th><th>Operating Temp</th></tr><tr><td>X7R</td><td>-55~125℃ at 25℃</td></tr><tr><td>X5R</td><td>-55~85℃ at 25℃</td></tr><tr><td>Y5V</td><td>-25~85℃ at 20℃</td></tr></table></td><td><table><tr><th>T.C.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>X5R</td><td>Within ±15%</td></tr><tr><td>Y5V</td><td>Within +30%/-80%</td></tr></table></td></tr>
<tr><td>7.</td><td>Adhesive Strength of Termination</td><td>* Pressurizing force：5N (≤0603) and 10N (>0603)<br>* Test time: 10±1 sec.</td><td>* No remarkable damage or removal of the terminations.</td></tr>
<tr><td>8.</td><td>Vibration Resistance</td><td>* Vibration frequency: 10~55 Hz/min.<br>* Total amplitude: 1.5mm<br>* Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)</td><td>* No remarkable damage.<br>* Cap change and Q/D.F.: To meet initial spec.</td></tr>
<tr><td>9.</td><td>Solderability</td><td>* Solder temperature: 235±5℃<br>* Dipping time: 2±0.5 sec.</td><td>95% min. coverage of all metalized area.</td></tr>
<tr><td>10.</td><td>Bending Test</td><td>* 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.<br>* Measurement to be made after keeping at room temp. for 48±4 hrs.</td><td>* No remarkable damage.<br>* Cap change：<br>X7R/X5R: within ±12.5%<br>Y5V: within ±30%<br>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</td></tr>
<tr><td>11.</td><td>Resistance to Soldering Heat</td><td>* Solder temperature: 260±5℃<br>* Dipping time: 10±1 sec<br>* Preheating: 120 to 150℃ for 1 minute before imme rse the capacitor in a eutectic solder.<br>* Before initial measurement (Class II only): Perform 150+0/-10℃ for 1 hr and then set for 48±4 hrs at r oom temp.<br>* Measurement to be made after keeping at room temp. for 48±4 hrs. (Class II).</td><td>* No remarkable damage.<br>* Cap change:<br>X7R/X5R: within ±7.5%<br>Y5V: within ±20%<br>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.<br>* 25% max. leaching on each edge.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>12.</td><td>Temperature Cycle</td><td>* Conduct the five cycles according to the temperatures and time.
<table>
<tr><th>Step</th><th>Temp. (℃)</th><th>Time (min.)</th></tr>
<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>
</table>
* Before initial measurement (Class II only): Perform 150+0/-10℃ for 1 hr and then set for 48±4 hrs at r oom temp.<br>* Measurement to be made after keeping at room temp. for 48±4 hrs.</td><td>* No remarkable damage.<br>* Cap change：<br>X7R/X5R: within ±7.5%<br>Y5V: within ±20%<br>* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</td></tr>
<tr><td>13.</td><td>Humidity (Damp Heat) Steady State</td><td>* Test temp.: 40±2℃<br>* Humidity: 90~95% RH<br>* Test time: 500+24/-0hrs.<br>* Measurement to be made after keeping at room temp. for 48±4 hrs.</td><td>*No remarkable damage.<br>*Cap change： X7R/X5R: within ±25%<br>Y5V: within ±30%; 6.3V, within +30/-40%<br>*Q/D.F. value:<br>X7R/X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.</th></tr>
<tr><td>25V, 16V</td><td>≤15%</td></tr>
<tr><td>10V</td><td>≤20%</td></tr>
<tr><td>6.3V</td><td>≤30%</td></tr>
</table>
Y5V:
<table>
<tr><th>Rated vol.</th><th>D.F.</th></tr>
<tr><td>50V</td><td>≤10%</td></tr>
<tr><td>25V</td><td>≤15%</td></tr>
<tr><td>16V, 10V</td><td>≤20%</td></tr>
</table>
*I.R.: 1GΩ or RxC≧10 Ω-F whichever is smaller.</td></tr>
<tr><td>14.</td><td>Humidity (Damp Heat) Load</td><td>* Test temp.: 40±2℃<br>* Humidity: 90~95%RH<br>* Test time: 500+24/-0 hrs.<br>* To apply voltage：Rated voltage.<br>* Measurement to be made after keeping at room temp. for 48±4 hrs.</td><td>*No remarkable damage.<br>*Cap change: X7R/X5R: within ±25%<br>Y5V: within ±30%; 6.3V, within +30/-40%<br>*Q/D.F. value:<br>X7R/X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.</th></tr>
<tr><td>25V, 16V</td><td>≤15%</td></tr>
<tr><td>10V</td><td>≤20%</td></tr>
<tr><td>6.3V</td><td>≤30%</td></tr>
</table>
Y5V:
<table>
<tr><th>Rated vol.</th><th>D.F.</th></tr>
<tr><td>50V</td><td>≤10%</td></tr>
<tr><td>25V</td><td>≤15%</td></tr>
<tr><td>16V, 10V</td><td>≤20%</td></tr>
</table>
*I.R.: 500MΩ or RxC≧5 Ω-F whichever is smaller.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>15.</td><td>High Temperature Load (Endurance)</td><td>
* Test temp. :<br>
NP0, X7R/X7E: 125±3℃<br>
X5R, Y5V: 85±3℃<br>
* Test time: 1000+24/-0 hrs.<br>
* To apply voltage: 150% of rated voltage.<br>
**100% of rated voltage for below range.
<table>
<tr><th>Size</th><th>Dielectric</th><th>Rated voltage</th><th>Capacitance range</th></tr>
<tr><td>0603</td><td>Y5V</td><td>6.3V,10V</td><td>TT≧2.2μF</td></tr>
<tr><td>0805</td><td>Y5V</td><td>6.3V</td><td>TT≧10μF</td></tr>
<tr><td>1206</td><td>Y5V</td><td>6.3V</td><td>TT≧22μF</td></tr>
</table>
* Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II).
</td><td>
*No remarkable damage.<br>
*Cap change: X7R/X5R: within ±25%<br>
Y5V: within ±30%; 6.3V, within +30/-40%<br>
*Q/D.F. value:<br>
X7R/X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.</th></tr>
<tr><td>25V, 16V</td><td>≤15%</td></tr>
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Y5V:
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<tr><td>25V</td><td>≤15%</td></tr>
<tr><td>16V, 10V</td><td>≤20%</td></tr>
</table>
*I.R.: 1GΩ or RxC≧10 Ω-F whichever is smaller.
</td></tr>
</table>

# APPENDIXES

## ◙ Tape & reel dimensions

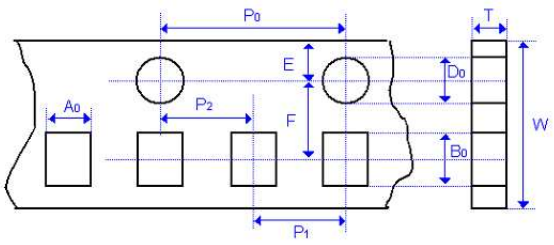



Fig. 2 The dimension of paper tape

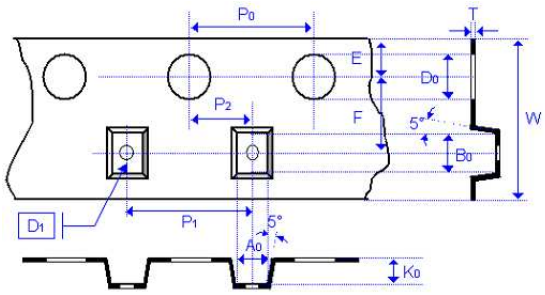



Fig. 3 The dimension of plastic tape

| Size | 0603 | | 0805 | 1206 | | 1210 |
|---|---|---|---|---|---|---|
| Thickness | N | H | T | T | J | T |
| $A_0$ | 0.62±0.05 | 1.10±0.10 | 1.50±0.10 | 2.00±0.10 | <1.85 | <2.97 |
| $B_0$ | 1.12±0.05 | 1.90±0.10 | 2.30±0.10 | 3.50±0.10 | <3.46 | <3.73 |
| T | 0.60±0.05 | 0.60±0.05 | 0.95±0.05 | 0.95±0.05 | 0.23±0.05 | 0.23±0.05 |
| $K_0$ | - | | - | - | <2.50 | <2.50 |
| W | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 |
| $P_0$ | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.100 |
| $10xP_0$ | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 | 40.0±0.10 |
| $P_1$ | 2.00±0.05 | 2.00±0.05 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 |
| $P_2$ | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 |
| $D_0$ | 1.55±0.05 | 1.55±0.05 | 1.55±0.05 | 1.50±0.05 | 1.50±0.05 | 1.50±0.05 |
| $D_1$ | - | | - | - | 1.00±0.10 | 1.00±0.10 |
| E | 1.75±0.05 | 1.75±0.05 | 1.75±0.05 | 1.75±0.10 | 1.75±0.10 | 1.75±0.10 |
| F | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 | 3.50±0.05 |

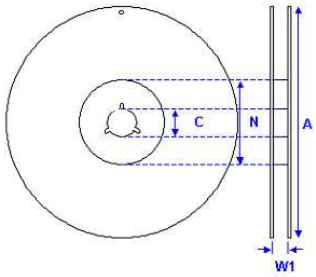
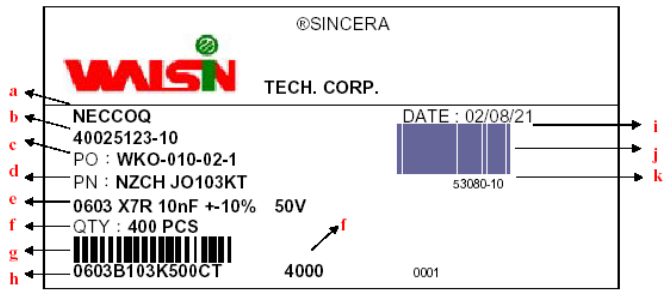



Fig. 4 The dimension of reel

| Size | 0603, 0805, 1206, 1210 | | |
|---|---|---|---|
| Reel size | 7” | 10” | 13” |
| C | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 |
| $W_1$ | 8.4+1.5/-0 | 8.4+1.5/-0 | 8.4+1.5/-0 |
| A | 178.0±0.10 | 250.0±1.0 | 330.0±1.0 |
| N | 60.0+1.0/-0 | 100.0±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

## ◙ Constructions

| No. | Name | | X7R, X5R, Y5V |
|---|---|---|---|
| ① | Ceramic material | | $BaTiO_3$ based |
| ② | Inner electrode | | Ni |
| ③ | Termination | Inner layer | Cu |
| ④ | | Middle layer | Ni |
| ⑤ | | Outer layer | Sn (Matt) |

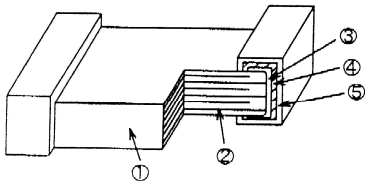



Fig. 5 The construction of MLCC

## ◙ 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. 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 $N_2$ within oven are recommended.

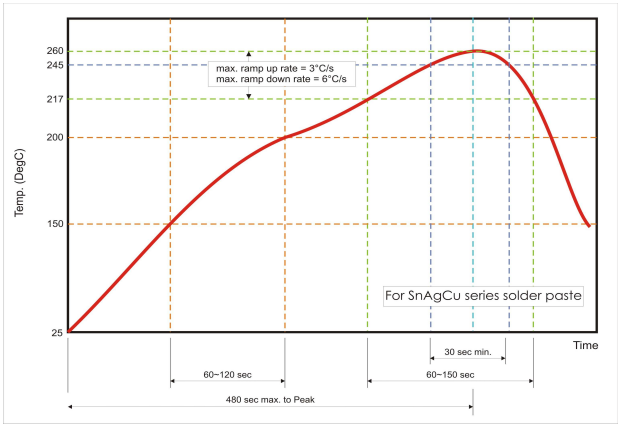



Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

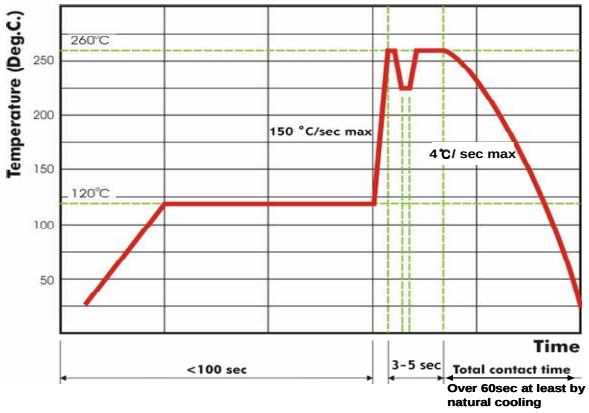



Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.