APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

Low Profile Series

0402 to 1210 Sizes

X7R & X5R Dielectrics

Halogen Free & 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 and X5R 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	15	X	475	M	6R3	C	T
Series	**Size**	**Dielectric**	**Capacitance**	**Tolerance**	**Rated voltage**	**Termination**	**Packaging**
TT=Low profile	**15**=0402 (1005) **18**=0603 (1608) **21**=0805 (2012) **31**=1206 (3216) **32**=1210 (3225)	**B**=X7R **X**=X5R	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: 475=47x10^5 =4,700,000pF =4.7μF	**K**=±10% **M**=±20%	Two significant digits followed by no. of zeros. And R is in place of decimal point. **6R3**=6.3 VDC **100**=10 VDC **160**=16 VDC **250**=25 VDC **500**=50 VDC **101**=100 VDC	**C**=Cu/Ni/Sn	**T**=7" reeled **G**=13" reeled

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol		M_B (mm)
0402 (1005)	1.00±0.2	0.5±0.2	0.30±0.03	L	0.25±0.10
0603 (1608)	1.6+0.15/-0.10	0.8+0.15/-0.10	0.50±0.10	H	0.40±0.15
0805 (2012)	2.00±0.20	1.25±0.20	0.85±0.10	T	0.50±0.20
1206 (3216)	3.20±0.20	1.60±0.20	0.85±0.10	T	0.60±0.20
			1.15±0.15	J	
1210 (3225)	3.20±0.30	2.50±0.20	0.85±0.10	T	0.75±0.25
			2.00±0.20	K	

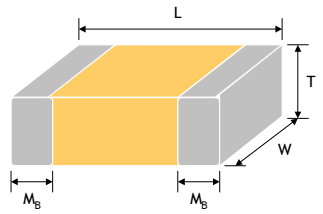


Fig. 1 The outline of MLCC

* Reflow soldering process only is recommended.

6. GENERAL ELECTRICAL DATA

Dielectric	X7R	X5R
Size	0402, 0603, 0805, 1206, 1210	
Capacitance range*	1μF to 10μF	0.22μF to 22μF
Capacitance tolerance**	K (±10%), M (±20%)	
Rated voltage (WVDC)	10V, 16V, 25V, 50V, 100V	6.3V, 10V, 16V, 25V
Operating temperature	-55 to +125℃	-55 to +85℃
Capacitance characteristic	±15%	
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.

** 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 dielectric

Dielectric		X7R										
Size		0805				1206				1210		
Rated voltage (VDC)		10	16	25	50	10	16	25	50	10	16	100
Capacitance	1.0μF (105)							T				
	1.5μF (155)											
	2.2μF (225)		T	T					T			K
	3.3μF (335)											
	4.7μF (475)	T						T				
	6.8μF (685)											
	10μF (106)					T						
	22μF (226)											

7-2 X5R dielectric

Dielectric		X5R															
Size		0402			0603		0805				1206					1210		
Rated voltage (VDC)		6.3	10	25	10	16	6.3	10	16	25	6.3	10	16	25	50	10	16	25
Capacitance	0.22uF (224)			L	H	H												
	0.47uF (474)	L		L														
	1.0μF (105)	L			H	H		T	T	T		T	T	T	T			
	1.5μF (155)							T	T			T	T	T				
	2.2μF (225)	L					T	T	T	T		T	T	T	T			
	3.3μF (335)											T	T	T		T		
	4.7μF (475)	L			H		T	T	T	T		T	T	T		T		
	6.8μF (685)																	
	10μF (106)						T	T	T		J	J/T		T		T		T
	22uF (226)						T	T			T		T				T	
	47uF (476)										T							

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
	2.00	K	-	1k

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.
* Dimensions to conform to individual specification sheet.</td></tr>
<tr><td>2.</td><td>Capacitance</td><td rowspan="2">* Test temp.: Room Temperature.
Cap≤10μF, 1.0±0.2Vrms, 1kHz±10%
Cap>10μF, 0.5±0.2Vrms, 120Hz±20%**
** Test condition: 0.5±0.2Vrms，1KHz±10%
TT18X≧475(10V) , TT15X series

Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp .</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>X7R/X5R:<table><tr><td>Rated vol.</td><td>D.F.</td></tr><tr><td>100V</td><td>≤5%</td></tr><tr><td>50V, 25V, 16V, 10V</td><td>≤10%</td></tr><tr><td>6.3V</td><td>≤15%</td></tr></table></td></tr>
<tr><td>4.</td><td>Dielectric Strength</td><td>* To apply voltage: 250% rated voltage.
* Duration: 1 to 5 sec.
* 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>* Test temp.: Room Temperature.
* 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><td>T.C.</td><td>Operating Temp</td></tr><tr><td>X7R</td><td>-55~125℃ at 25℃</td></tr><tr><td>X5R</td><td>-55~85℃ at 25℃</td></tr></table>*Before initial measurement (Class II only):
To apply de-aging at 150℃ for 1hr then set for 24± 2 hrs at room temp.
* Measurement voltage for Class II:<table><tr><td>1005</td><td>0201</td></tr><tr><td>Cap≤0.01μF: 0.5V</td><td>Cap<0.1μF:1V</td></tr><tr><td>Cap>0.01μF: 0.2V</td><td>0.1μF≤Cap<1μF: 0.2V*</td></tr><tr><td></td><td>Cap≥1μF: 0.1V*</td></tr><tr><td>*0201X104/6.3V~25V: 0.5V
0201X224&474/10V: 0.5V</td><td>*0201S104/6.3V~16V: 0.3V
0201S224/6.3V: 0.3V
0201X105/6.3V&10V: 0.3V</td></tr><tr><td>0402</td><td>0603</td></tr><tr><td>Cap<1μF: 1V</td><td>Cap<1μF: 1V</td></tr><tr><td>Cap=1μF: 0.5V**
0402B224-16V: 0.5V
0402B474-10V: 0.5V
0402X475M6R3: 0.5V</td><td>1μF≤Cap≤4.7μF: 0.5V
0603X106-10V: 0.5V</td></tr><tr><td>1μF<Cap<10μF: 0.2V
**0402B105M6R3V: 0.2V</td><td>Cap>4.7μF: 0.2V</td></tr><tr><td>Cap≥10μF: 0.1V</td><td></td></tr><tr><td>0805</td><td>1206/1210</td></tr><tr><td>Cap<10μF: 1V</td><td>Cap≤10μF: 1V</td></tr><tr><td>Cap=10μF: 0.5V
0805B475/6.3V~25V: 0.5V</td><td>10μF<Cap≤100μF: 0.5V</td></tr><tr><td>Cap>10μF: 0.2V</td><td>Cap>100μF: 0.2V
1206X107-6.3V: 0.2V</td></tr></table></td><td><table><tr><td>T.C.</td><td>Capacitance Change</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>X5R</td><td>Within ±15%</td></tr></table></td></tr>
<tr><td>7.</td><td>Adhesive Strength of Termination</td><td>* Pressurizing force：5N (≤0603) and 10N (>0603)
* 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.
* Total amplitude: 1.5mm
* Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)
* Before initial measurement (Class II only):
To apply de-aging at 150℃ for 1hr then set for 24± 2 hrs at room temp.
* Cap./DF(Q) Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.</td><td>* No remarkable damage.
* Cap change and Q/D.F.: To meet initial spec.</td></tr>
<tr><td>9.</td><td>Solderability</td><td>* Solder temperature: 235±5℃
* 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.
* Before initial measurement (Class II only):
To apply de-aging at 150℃ for 1hr then set for 24± 2 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap change：
X7R/X5R: within ±12.5%
(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</td></tr>
</table>

11.	**Resistance to Soldering Heat**	* Solder temperature: 260±5℃ * Dipping time: 10±1 sec * Preheating: 120 to 150℃ for 1 minute before imme rse the capacitor in a eutectic solder. *Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp . *Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.	* No remarkable damage. * Cap change: X7R/X5R: within ±7.5% * Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge.

* "Room condition" Temperature: 15 to 35℃, Relativ e humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

<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): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp .
* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp .</td><td>* No remarkable damage.
* Cap change：
X7R/X5R: within ±7.5%
* 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℃
* Humidity: 90~95% RH
* Test time: 500+24/-0hrs.
* Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp .
* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp .</td><td>*No remarkable damage.
*Cap change： X7R/X5R: within ±25%
*Q/D.F. value:
X7R/X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.</th></tr>
<tr><td>100V</td><td>≤7.5%</td></tr>
<tr><td>25V, 16V</td><td>≤15%</td></tr>
<tr><td>10V</td><td>≤20%</td></tr>
<tr><td>50V, 6.3V</td><td>≤30%</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℃
* Humidity: 90~95%RH
* Test time: 500+24/-0 hrs.
* To apply voltage：Rated voltage.
* Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp .
* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp .</td><td>*No remarkable damage.
*Cap change: X7R/X5R: within ±25%
*Q/D.F. value:
X7R/X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.</th></tr>
<tr><td>100V</td><td>≤7.5%</td></tr>
<tr><td>25V, 16V</td><td>≤15%</td></tr>
<tr><td>10V</td><td>≤20%</td></tr>
<tr><td>50V, 6.3V</td><td>≤30%</td></tr>
</table>
*I.R.: 500MΩ or RxC≧5 Ω-F whichever is smaller.</td></tr>
<tr><td>15.</td><td>High Temperature Load (Endurance)</td><td>* Test temp.：
X7R: 125±3℃
X5R: 85±3℃
* Test time: 1000+24/-0 hrs.
* To apply voltage: 150% of rated voltage.
**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>TT15</td><td>X5R</td><td>6.3V</td><td>C≧1.0μF</td></tr>
<tr><td>TT21</td><td>X5R/X7R/X6S</td><td>≦10V</td><td>C≧10μF</td></tr>
</table>
*Before initial measurement (Class II only): To apply de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp .
* Cap. / DF(Q) / I.R. Measurement to ©r de-aging at 150℃ for 1hr then set for 24±2 hrs at room temp.</td><td>*No remarkable damage.
*Cap change: X7R/X5R: within ±25%
*Q/D.F. value:
X7R/X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.</th></tr>
<tr><td>100V</td><td>≤7.5%</td></tr>
<tr><td>25V, 16V</td><td>≤15%</td></tr>
<tr><td>10V</td><td>≤20%</td></tr>
<tr><td>50V, 6.3V</td><td>≤30%</td></tr>
</table>
*I.R.: 1GΩ or RxC≧10 Ω-F whichever is smaller.</td></tr>
</table>

* "Room condition" Temperature: 15 to 35℃, Relativ e humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

APPENDIXES

◙ Tape & reel dimensions

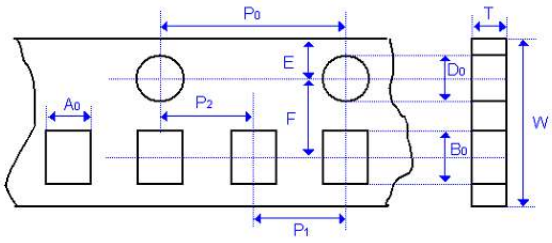


Fig. 2 The dimension of paper tape

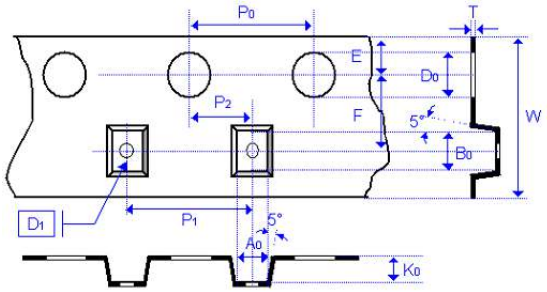


Fig. 3 The dimension of plastic tape

Size	0402	0603	0805	1206		1210	
Thickness	L	H	T	T	J	T	K
A_0	0.70 +/-0.20	1.05 +/-0.30	1.50 +/-0.20	1.90 +/-0.50	< 2.00	< 3.05	< 3.05
B_0	1.20 +/-0.20	1.80 +/-0.30	2.30 +/-0.20	3.50 +/-0.50	< 3.70	< 3.80	< 3.80
T	≦0.80	≦1.20	≦1.20	≦1.20	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1
K_0	-	-	-	-	< 2.00	< 1.50	< 2.50
W	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30	8.00 +/-0.30
P_0	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10	4.00 +/-0.10
$10xP_0$	40.00 +/-0.10	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20
P_1	2.00 +/-0.05	4.00 +/-0.10	4.00 +/-0.10	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	2.00 +/-0.05
D_0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0
D_1	-	-	-	-	1.00 +/-0.10	1.00 +/-0.10	1.00 +/-0.10
E	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	1.75 +/-0.10	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	3.50 +/-0.05

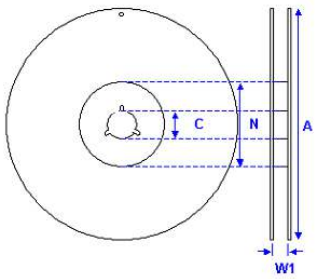
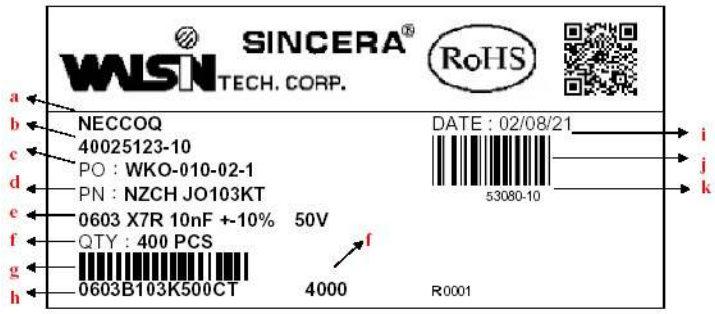


Fig. 4 The dimension of reel

Size	0402, 0603, 0805, 1206, 1210		
Reel size	7”	10”	13”
C	13.0±0.5	13.0±0.5	13.0±0.5
W_1	10.0±1.5	10.0±1.5	10.0±1.5
A	178.0±2.0	250.0±2.0	330.0±2.0
N	60.0+1.0/-0	50 min	50 min

◙ Example of customer label



*Customized label is available upon request

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
①	Ceramic material		$BaTiO_3$ based
②	Inner electrode		Ni
③	Termination	Inner layer	Cu
④		Middle layer	Ni
⑤		Outer layer	Sn (Matt)

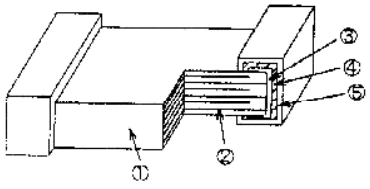


Fig. 5 The construction of MLCC

◙ Storage and handling conditions

(1) To store products at 5 to 40°C ambient temperature and 20 to 70% related humidity conditions; MSL Level 1.
(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.

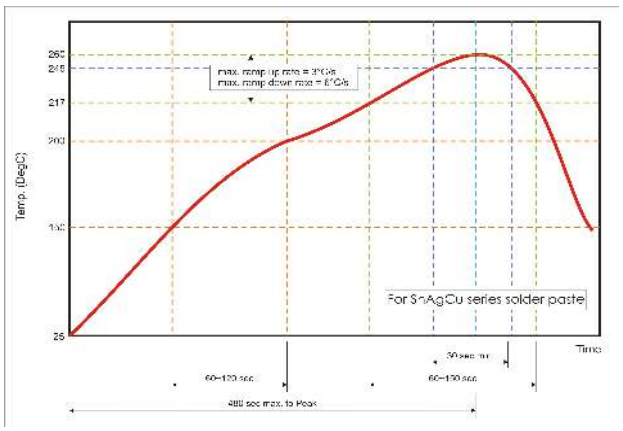


Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

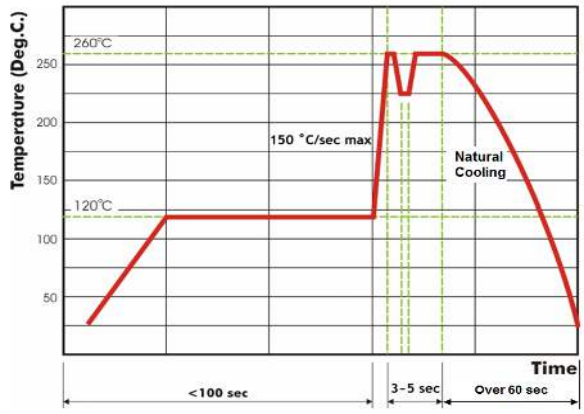


Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.