

APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

Open-Mode Series (50V to 500V)

0805 to 1812 Sizes

X7R Dielectric

RoHS Compliance

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

1. INTRODUCTION

WTC open-mode series MLCC is designed by a special internal electrode pattern, which can reduce voltage concentrations by distributing voltage gradients throughout the entire capacitor. This special design also affords open-mode pattern to prevent circuit leakage when focused to failure in a board flex situation.

2. FEATURES

- b. High voltage in a given case size.
- c. Circuit open during product cracking.
- d. High stability and reliability.

3. APPLICATIONS

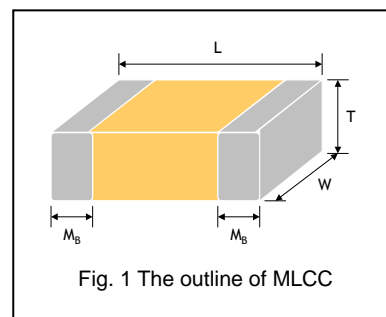
- a. High current applications.
- b. Power supply and related industries
- c. The other mechanical stress concerned products.

4. HOW TO ORDER

<u>OP</u>	<u>31</u>	<u>B</u>	<u>102</u>	<u>K</u>	<u>201</u>	<u>C</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>
OP=Open-mode	21=0805 (2012) 31=1206 (3216) 32=1210 (3225) 43=1812 (4532)	B=X7R	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: 102=10x10 ² =1000pF	K=±10% M=±20%	Two significant digits followed by no. of zeros. And R is in place of decimal point. 500=50 VDC 101=100 VDC 201=200 VDC 251=250 VDC 501=500 VDC	C=Cu/Ni/Sn	T=7" reeled G=13" reeled

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol	Remark	M _B (mm)	
0805 (2012)	2.00±0.15	1.25±0.10	0.80±0.10	B	0.40±0.20	
			1.25±0.10	D		#
1206 (3216)	3.20±0.15	1.60±0.15	0.80±0.10	B	0.50±0.20	
			0.95±0.10	C		
			1.25±0.10	D		#
	3.20±0.20	1.60±0.20	1.60±0.20	G	#	
1210 (3225)	3.20±0.30	2.50±0.20	0.95±0.10	C	0.50±0.25	
			1.25±0.10	D		#
			1.60±0.20	G		#
			2.50±0.30	M		#
1812 (4532)	4.50+0.5/-0.3	3.20±0.30	1.25±0.10	D	0.60±0.25	
			2.00±0.20	K		#



Reflow soldering only is recommended.

6. GENERAL ELECTRICAL DATA

Dielectric	X7R
Size	0805, 1206, 1210, 1812
Capacitance*	100pF to 1μF
Capacitance tolerance**	K (±10%), M (±20%)
Rated voltage (WVDC)	50V, 100V, 200V, 250V, 500V
Dielectric strength	50V, 100V: ≥2.5 x WVDC 200V and 250V: ≥2 x WVDC 500V: ≥1.5 x WVDC
Operating temperature	-55 to +125°C
Capacitance characteristic	±15%
Termination	Ni/Sn (lead-free termination)

* Measured at 25°C ambient temperature and 30~70% related humidity. Apply 1.0±0.2Vrms, 1.0kHz±10%.

** 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.

7. CAPACITANCE RANGE

DIELECTRIC	X7R																	
	SIZE	0805				1206					1210				1812			
	RATED VOLTAGE	100	200	250	500	50	100	200	250	500	100	200	250	500	100	200	250	500
100pF (101)	B	B	B	B														
120pF (121)	B	B	B	B														
150pF (151)	B	B	B	B	B	B	D	D	D									
180pF (181)	B	B	B	B	B	B	D	D	D									
220pF (221)	B	B	B	B	B	B	D	D	D									
270pF (271)	B	B	B	B	B	B	D	D	D									
330pF (331)	B	B	B	B	B	B	D	D	D									
390pF (391)	B	B	B	B	B	B	D	D	D									
470pF (471)	B	B	B	B	B	B	D	D	D									
560pF (561)	B	B	B	B	B	B	D	D	D									
680pF (681)	B	B	B	B	B	B	D	D	D									
820pF (821)	B	B	B	B	B	B	D	D	D									
1,000pF (102)	B	B	B	B	B	B	D	D	D	C	C	C	D	D	D	D	D	D
1,200pF (122)	B	B	B	B	B	B	D	D	D	C	C	C	D	D	D	D	D	D
1,500pF (152)	B	B	B	B	B	B	D	D	D	C	C	C	D	D	D	D	D	D
1,800pF (182)	B	B	B	B	B	B	D	D	D	C	C	C	D	D	D	D	D	D
2,200pF (222)	B	B	B	B	B	B	D	D	D	C	C	C	D	D	D	D	D	D
2,700pF (272)	B	B	B	B	B	B	D	D	D	C	C	C	D	D	D	D	D	D
3,300pF (332)	B	B	B	B	B	B	D	D	D	C	C	C	D	D	D	D	D	D
3,900pF (392)	B	B	B		B	B	D	D	D	C	C	C	D	D	D	D	D	D
4,700pF (472)	B	B	B		B	B	D	D	D	C	C	C	D	D	D	D	D	D
5,600pF (562)	B	D	D		B	B	D	D	D	C	C	C	D	D	D	D	D	D
6,800pF (682)	B	D	D		B	B	D	D	D	C	C	C	D	D	D	D	D	D
8,200pF (822)	B	D	D		B	B	D	D	D	C	C	C	D	D	D	D	D	D
0.010μF (103)	B	D	D		B	B	D	D	D	C	C	C	D	D	D	D	D	D
0.012μF (123)	B	D	D		B	B	D	D	D	C	C	C	D	D	D	D	D	D
0.015μF (153)	B	D	D		B	B	D	D	D	C	C	C	D	D	D	D	D	D
0.018μF (183)	B	D	D		B	B	D	D	D	C	C	C	D	D	D	D	D	D
0.022μF (223)	B	D	D		B	B	D	D	G	C	C	C	D	D	D	D	D	D
0.027μF (273)	D				B	B	D	D	G	C	C	C	D	D	D	D	D	D
0.033μF (333)	D				B	B	G	G	G	C	C	C	G	D	D	D	D	D
0.039μF (393)	D				B	B	G	G		C	C	C	G	D	D	D	D	D
0.047μF (473)	D				B	B	G	G		C	D	D	G	D	D	D	D	D
0.056μF (563)					B	B	G	G		C	D	D	G	D	D	D	K	
0.068μF (683)					B	B	G	G		C	G	G	G	D	D	D	K	
0.082μF (823)					D	D	G	G		C	G	G		D	D	D	K	
0.10μF (104)					D	D	G	G		C	G	G		D	D	D	K	
0.12μF (124)					D	D				C	G	G		D	D	D		
0.15μF (154)					D	G				D	M	M		D	K	K		
0.18μF (184)					D	G				D	M	M		D	K	K		
0.22μF (224)					D	G				D	M	M		D	K	K		
0.27μF (274)					D					G				D	K	K		
0.33μF (334)					D					G				D	K	K		
0.39μF (394)					D					M				D	K	K		
0.47μF (474)					D					M				K	K	K		
0.56μF (564)										M				K				
0.68μF (684)														K				
0.82μF (824)														K				
1.0μF (105)														K				

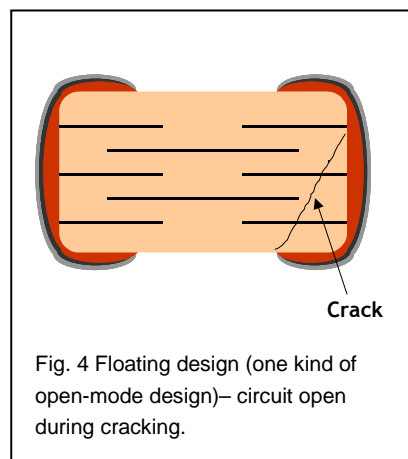
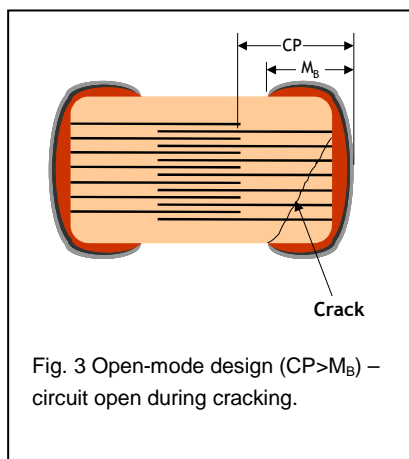
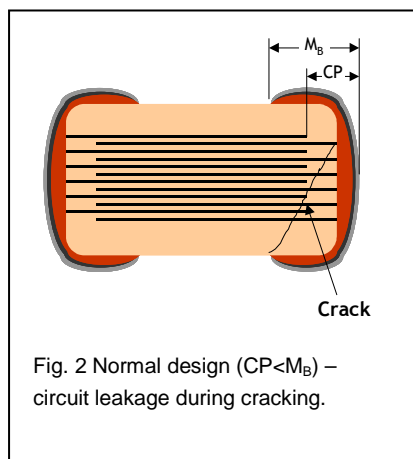
The letter in cell is expressed the symbol of product thickness.

8. PACKAGING DIMENSION AND QUANTITY

Size	Thickness (mm)/Symbol		Paper tape		Plastic tape	
			7" reel	13" reel	7" reel	13" reel
0805	0.80±0.10	B	4k	15k	-	-
	1.25±0.10	D	-	-	3k	10k
1206	0.80±0.10	B	4k	15k	-	-
	0.95±0.10	C	-	-	3k	10k
	1.25±0.10	D	-	-	3k	10k
	1.60±0.20	G	-	-	2k	10k
1210	0.95±0.10	C	-	-	3k	10k
	1.25±0.10	D	-	-	3k	10k
	1.60±0.20	G	-	-	2k	-
	2.50±0.30	M	-	-	1k	6k
1812	1.25±0.10	D	-	-	1k	5k
	2.00±0.20	K	-	-	1k	-

Unit: pieces

9. INNER CONSTRUCTION OF OPEN-MODE DESIGN



10. 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	1.0±0.2Vrms, 1kHz±10%	Shall not exceed the limits given in the detailed spec.
3.	Q/ D.F. (Dissipation Factor)		* D.F. ≤2.5% * D.F. ≤3% : 50V / 1206 ≥0.47μF
4.	Dielectric Strength	To apply voltage: 50V, 100V ≥2.5 times VDC 200V~300V ≥2 times VDC 500V ≥1.5 times VDC * Cut-off, set at 10mA * TEST= 15 sec. * RAMP=0	No evidence of damage or flash over during test.
5.	Insulation Resistance	50V, 100V, To apply rated voltage for max. 120 sec. ≥200V, To apply rated voltage for 60 sec.	≥10GΩ or RxC≥100Ω-F whichever is smaller. X7R=100V: RxC≥100Ω-F
6.	Temperature Coefficient	With no electrical load. Operating temperature: -55~125°C at 25°C	Within ±15%.
7.	Adhesive Strength of Termination	* Pressurizing force : 5N (≤0603) and 10N (>0603) * Test time: 10±1 sec.	* No remarkable damage or removal of the terminations.
8.	Vibration Resistance	* Vibration frequency: 10~55 Hz/min. * Total amplitude: 1.5mm * Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.) * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change and Q/D.F.: To meet initial spec.
9.	Solderability	* Solder temperature: 235±5°C * 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. Cap change: X7R: within ±12.5% (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	* Solder temperature: 260±5°C * Dipping time: 10±1 sec * Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder. * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	No remarkable damage. Cap change: X7R: within ±7.5% Q/D.F., I.R. and dielectric strength: To meet initial requirements. 25% max. leaching on each edge.

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>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> <p>* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.</p>	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	<p>No remarkable damage. Cap change : within ±7.5% Q/D.F., I.R. and dielectric strength: To meet initial requirements.</p>
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	<p>* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.</p>	<p>* No remarkable damage. * Cap change: within ±12.5% * Q/D.F. value: D.F. ≤3.0% D.F. ≤6% : 50V / 1206 ≥ 0.47μF * I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller. X7R=100V: RxC≥10Ω-F</p>															
14.	Humidity (Damp Heat) Load	<p>* Test temp.: 40±2°C * Humidity: 90~95%RH * Test time: 500+24/-0 hrs. * To apply voltage : rated voltage. * Before initial measurement (Class II only): To apply test voltage for 1hr at 40°C and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.</p>	<p>* No remarkable damage. * Cap change: within ±12.5% * Q/D.F. value: D.F. ≤3.0% D.F. ≤6% : 50V / 1206 ≥ 0.47μF * I.R.: ≥500MΩ or RxC≥25Ω-F whichever is smaller. X7R=100V: RxC≥5Ω-F</p>															
15.	High Temperature Load (Endurance)	<p>* Test temp.: X7R: 125±3°C * To apply voltage: (1) V<500V: 200% of rated voltage. (2) 500V: 150% of rated voltage. * Test time: 1000+24/-0 hrs. * Before initial measurement (Class II only): To apply test voltage for 1hr at test temp. and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs</p>	<p>* No remarkable damage. * Cap change: within ±12.5% * Q/D.F. value: D.F. ≤3.0% D.F. ≤6% : 50V / 1206 ≥ 0.47μF * I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller. X7R=100V: RxC≥10Ω-F</p>															

APPENDIXES

▣ Tape & reel dimensions

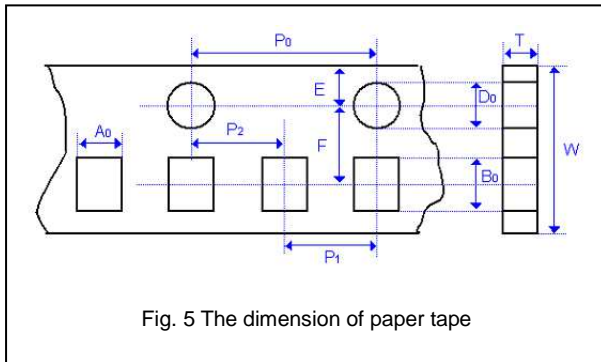


Fig. 5 The dimension of paper tape

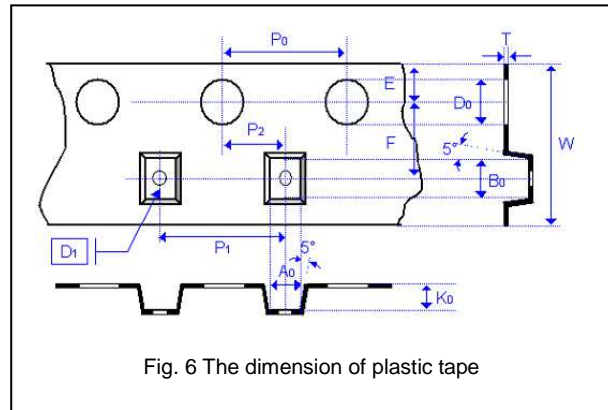


Fig. 6 The dimension of plastic tape

Size	0805		1206			1210		1812
Thickness	B	C, D, I	B	C, D	G	C, D	G	D, K, M
A ₀	1.50±0.10	<1.57	2.00±0.10	<1.85	<1.95	<2.97	<2.97	<3.81
B ₀	2.30±0.10	<2.40	3.50±0.10	<3.46	<3.67	<3.73	<3.73	<5.30
T	0.95±0.05	0.23±0.05	0.95±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.25±0.05
K ₀	-	<2.50	-	<2.50	<2.50	<2.50	<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	8.00±0.10	12.0±0.20
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	4.00±0.10	4.00±0.10
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	40.0±0.10	40.0±0.10
P ₁	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	8.00±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	2.00±0.05
D ₀	1.55±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05	1.50±0.05
D ₁	-	1.00±0.10	-	1.00±0.10	1.00±0.10	1.00±0.10	1.00±0.10	1.50±0.10
E	1.75±0.05	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	5.50±0.05

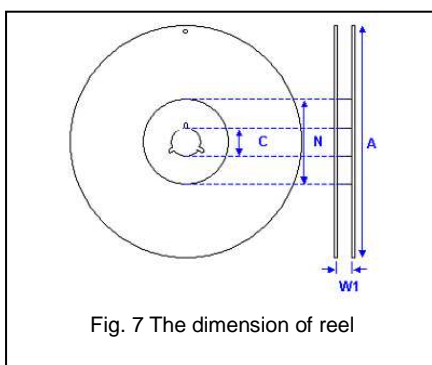
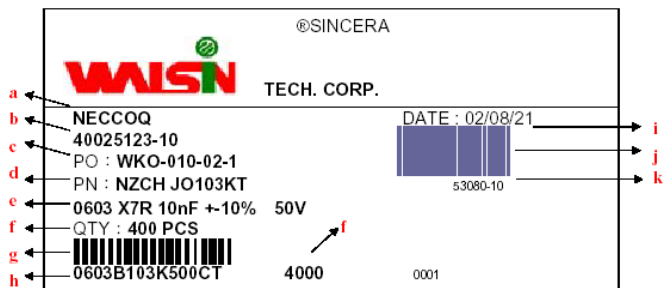


Fig. 7 The dimension of reel

Size	0603, 0805, 1206, 1210			1808, 1812
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	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	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	330.0±1.0	178.0±0.10
N	60.0+1/-0	100.0±1.0	100±1.0	60.0+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
①	Ceramic material	BaTiO ₃ based
②	Inner electrode	Ni
③	Termination	Inner layer Cu
④		Middle layer Ni
⑤		Outer layer Sn (Matt)

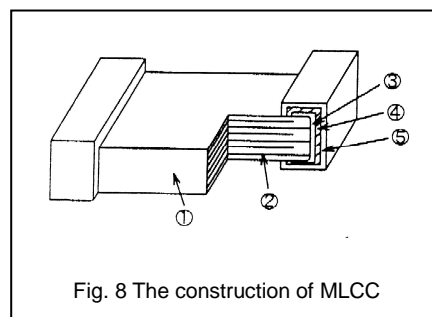


Fig. 8 The construction of MLCC

▣ 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 N₂ within oven are recommended.

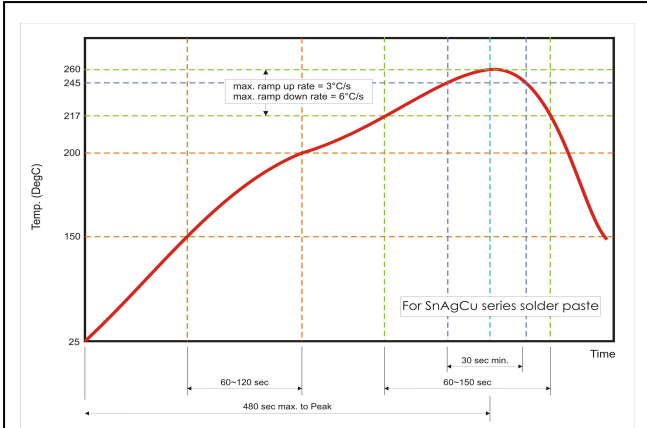


Fig. 9 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

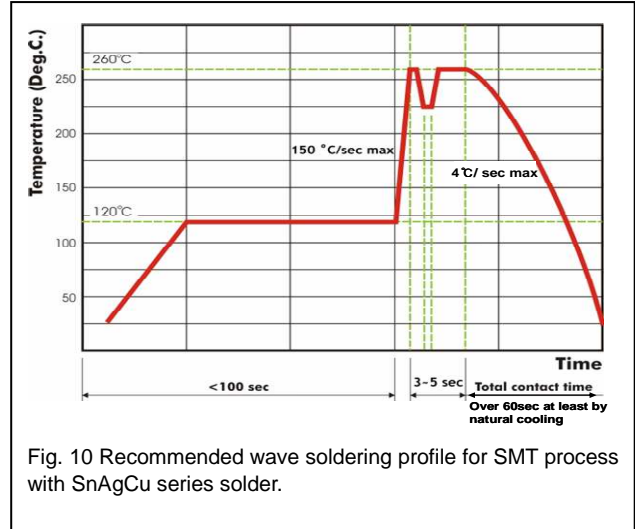


Fig. 10 Recommended wave soldering profile for SMT process with SnAgCu series solder.