APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

Microwave Capacitors Series (RT)

Qualified to AEC-Q200

0402 Size (25V to 50V)

NP0 Dielectric

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's RT series MLCC is used at high frequencies generally have a small temperature coefficient of capacitance, typical within the ±30ppm/℃ required for NP0 (C0G) classification and have excellent conductivity internal electrode. Thus, WTC RT series MLCC will be with the feature of low ESR and high Q characteristics, stability and reliability. Besides, RT series MLCC is tighten controlling in quality in line to assure quality performance in automotive applications. The RT series is AEC-Q200 compliant.

2. FEATURES

a. High Q and low ESR performance at high frequency.
b. High reliability: AEC-Q200.
c. Ultra low capacitance to 0.1pF.
d. Can offer high precision tolerance to ±0.05pF.
e. Quality improvement of telephone calls for low power loss and better performance.

3. APPLICATIONS

a. Automotive, power supply and related industries. .
b. The other mechanical stress concerned products or the set having a high probability of fall.
c. Prevention of ceramic body cracks by board bending.
d. RF module: Power amplifier, VCO.
e. Tuners.

4. HOW TO ORDER

RT	15	N	101	J	250	C	T
Series	**Size**	**Dielectric**	**Capacitance**	**Tolerance**	**Rated voltage**	**Termination**	**Packaging style**
RT= Microwave MLCC (with AEC-Q200 qualification)	**15**=0402 (1005)	**N**=NP0	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: 0R5=0.5pF 1R0=1.0pF 100=10x10^1 =100pF	**A**=±0.05pF **B**=±0.1pF **C**=±0.25pF **D**=±0.5pF **F**=±1% **G**=±2% **J**=±5%	Two significant digits followed by no. of zeros. And R is in place of decimal point. **250**=25 VDC **500**=50 VDC	**C**= Cu+Conductive resin /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)
0402 (1005)	1.00±0.08	0.50±0.08	0.50±0.08	N	#	0.25 +0.05/-0.10

Reflow soldering only is recommended.

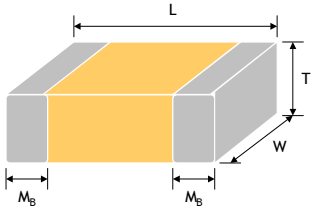


Fig. 1 The outline of MLCC

6. GENERAL ELECTRICAL DATA

Dielectric	NP0
Size	0402
Capacitance*	0.1pF to 56pF
Capacitance tolerance	Cap≤5pF[#1]: A (±0.05pF), B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: B (±0.1pF), C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%)
Rated voltage (WVDC)	25V, 50V
Q*	Cap<30pF:Q≥400+20C; Cap≥30pF:Q≥1000
Insulation resistance at Ur	≥10GΩ or RxC≥100Ω-F whichever is smaller.
Operating temperature	-55 to +125℃
Capacitance change	±30ppm/℃
Termination	Ni/Sn (lead-free termination)

#1: Cap= 0.1pF product only provide B tolerance.

* Measured at the conditions of 25℃ ambient temper ature 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.

7. CAPACITANCE RANGE

DIELECTRIC		NP0		
SIZE		0402		Tolerance
RATED VOLTAGE (VDC)		25	50	
Capacitance	0.1pF (0R1)	N	N	B
	0.2pF (0R2)	N	N	A, B
	0.3pF (0R3)	N	N	A, B
	0.4pF (0R4)	N	N	A, B
	0.5pF (0R5)	N	N	A, B, C
	0.6pF (0R6)	N	N	A, B, C
	0.7pF (0R7)	N	N	A, B, C
	0.75pF (R75)	N	N	A, B, C
	0.8pF (0R8)	N	N	A, B, C
	0.9pF (0R9)	N	N	A, B, C
	1.0pF (1R0)	N	N	A, B, C
	1.1pF (1R1)	N	N	A, B, C
	1.2pF (1R2)	N	N	A, B, C
	1.3pF (1R3)	N	N	A, B, C
	1.5pF (1R5)	N	N	A, B, C
	1.6pF (1R6)	N	N	A, B, C
	1.8pF (1R8)	N	N	A, B, C
	2.0pF (2R0)	N	N	A, B, C
	2.2pF (2R2)	N	N	A, B, C
	2.4pF (2R4)	N	N	A, B, C
	2.7pF (2R7)	N	N	A, B, C
	3.0pF (3R0)	N	N	A, B, C
	3.3pF (3R3)	N	N	A, B, C
	3.6pF (3R6)	N	N	A, B, C
	3.9pF (3R9)	N	N	A, B, C
	4.0pF (4R0)	N	N	A, B, C
	4.3pF (4R3)	N	N	A, B, C
	4.7pF (4R7)	N	N	A, B, C
	5.0pF (5R0)	N	N	A, B, C
	5.1pF (5R1)	N	N	B, C, D
	5.6pF (5R6)	N	N	B, C, D
	6.0pF (6R0)	N	N	B, C, D
	6.2pF (6R2)	N	N	B, C, D
	6.7pF (6R7)	N	N	B, C, D
	6.8pF (6R8)	N	N	B, C, D
	7.0pF (7R0)	N	N	B, C, D
	7.5pF (7R5)	N	N	B, C, D
	8.0pF (8R0)	N	N	B, C, D
	8.2pF (8R2)	N	N	B, C, D
	9.0pF (9R0)	N	N	B, C, D
	9.1pF (9R1)	N	N	B, C, D
	10pF (100)	N	N	F, G, J
	11pF (110)	N	N	F, G, J
	12pF (120)	N	N	F, G, J
	13pF (130)	N	N	F, G, J
	15pF (150)	N	N	F, G, J
	16pF (160)	N	N	F, G, J
	18pF (180)	N	N	F, G, J
	20pF (200)	N	N	F, G, J
	22pF (220)	N	N	F, G, J
	24pF (240)	N	N	F, G, J
	27pF (270)	N	N	F, G, J
	30pF (300)	N	N	F, G, J
	33pF (330)	N	N	F, G, J
	36pF (360)	N	N	F, G, J
	39pF (390)	N	N	F, G, J
	43pF (430)	N	N	F, G, J
	47pF (470)	N	N	F, G, J
	51pF (510)	N		F, G, J
	56pF (560)	N		F, G, J
	62pF (620)			
	68pF (680)			
	75pF (750)			
	82pF (820)			
	91pF (910)			
	100pF (101)			

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

8. PACKAGING STYLE AND QUANTITY

Size	Thickness (mm)/Symbol		Paper tape	
			7" reel	13" reel
0402 (1005)	0.50±0.08	N	10,000	50,000

Unit: pieces

9. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	AEC-Q200 Test Item	AEC-Q200 Test Condition	Requirements
1.	**Pre-and Post-Stress Electrical Test**	---	
2.	**High Temperature Exposure (Storage)** MIL-STD-202 Method 108	* Test temp.: 150±3℃ * Unpowered. * Test time: 1000+24/-0 hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change：NPO: within ±2.5% or ±0.25pF whichever is larger. * Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C. * I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.
3.	**Temperature Cycling** JESD22 Method JA-104	* Conduct 1000 cycles according to the temperatures and time. Step / Temp. (℃) / Time (min.) 1 / -55℃ +0/-3 / 5±1 2 / +125℃ +3/-0 / 5±1 *Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change：NPO: within ±2.5% or 0.25pF whichever is larger. * Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C. * I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.
4.	**Destructive Physical Analysis** EIA-469	Per EIA-469	No defects or abnormalities
5.	**Moisture Resistance** MIL-STD-202 Method 106	* Test temp.: 25~65℃ * Humidity: 80~100% RH * Test time: 10 cycles, t=24hrs/cycle. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change : NPO: within ±3.0% or 0.30pF whichever is larger * Q. value: NPO: More than 30pF Q≥350 ; 10pF≤C≤30pF, Q≥275+2.5C Less than 10pF Q≥200+10C * I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.
6.	**Biased Humidity** MIL-STD-202 Method 103	* Test temp.: 85±3℃ * Humidity: 85%RH * Test time: 1000+24/-0 hrs. * To apply voltage：rated voltage and 1.3~1.5Vdc. (add 100k ohm resistor) * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change: NPO: within ±3.0% or 0.30pF whichever is larger. * Q. value: NPO: C≥30pF , Q≥200 ; C<30pF , Q≥100+10/3C * I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.
7.	**Operational Life** MIL-STD-202 Method 108	* Test temp.: 125±3℃ * To apply voltage: 200% of rated voltage. * Test time: 1000+24/-0 hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change: NPO: within ±3.0% or ±0.3pF whichever is larger * Q. value: NPO: More than 30pF, Q≥350 ; 10pF≤C<30pF, Q≥275+2.5C Less than 10pF, Q≥200+10C * I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.
8.	**External Visual** MIL-STD-883 Method 2009	Visual inspection	No remarkable defect.
9.	**Physical Dimension** JESD22 Method JB-100	Using by calipers	Within the specified dimensions

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

<table>
<tr><th>No.</th><th>AEC-Q200 Test Item</th><th>AEC-Q200 Test Condition</th><th>Requirements</th></tr>
<tr><td>10.</td><td>Resistance to Solvents
MIL-STD-202
Method 215</td><td>* Temperature: 25±5℃
* Time: 3+0.5/-0 min.
* Solvent: Iso-propyl alcohol.</td><td>* No remarkable damage.
* Cap.: within the specified tolerance.
* Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C.
* I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>11.</td><td>Mechanical Shock
MIL-STD-202
Method 213</td><td>* Peak value: 1500g's.
* Wave: 1/2 sine.
* Velocity: 15.4 ft/sec
* Three shocks in each direction should be applied along
3 mutually perpendicular axes of the test specimen (18 shocks)</td><td>* No remarkable damage.
* Cap.: within the specified tolerance.
* Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C.
* I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>12.</td><td>Vibration
MIL-STD-202
Method 204</td><td>* Vibration frequency: 10~2000 Hz/min.
(5g's for 20 min)
* Total amplitude: 1.5mm
* 12 cycles each of 3 orientations (36 times)</td><td>* No remarkable damage.
* Cap.: within the specified tolerance.
* Q. value: NPO:Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C.
* I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>13.</td><td>Resistance to Soldering Heat
MIL-STD-202
Method 210</td><td>* Solder temperature: 270±5℃
* Dipping time: 10±1 sec
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap change: NPO: within ±2.5% or 0.25pF whichever is larger
* Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C.
* I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>14</td><td>Thermal Shock
MIL-STD-202
Method 107</td><td>* Conduct 300 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>-55℃ +0/-3</td><td>15±3</td></tr><tr><td>2</td><td>+125℃ +3/-0</td><td>15±3</td></tr></table>* Max. transfer time: 20 sec.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap change：NPO: within ±2.5% or 0.25pF whichever is larger.
* Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C.
* I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>15.</td><td>ESD
AEC-Q200-002</td><td>Per AEC-Q200-002</td><td>* No remarkable damage.
* Cap.: within the specified tolerance.
* Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C.
* I.R.: ≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>16.</td><td>Solderability
J-STD-002
JESD22-B102E</td><td>* Condition A
Un-mounted chips 4hrs / 155°C*dry then completely immersed for 5±0.5 sec in solder bath at 235±5°C.
* Condition B
Un-mounted chips steam 8 hrs then completely immersed for 10±1sec in solder bath at 215+5/-0°C.
* Condition C
Un-mounted chips steam 8 hrs then completely immersed for 10±1 sec. in solder bath at 260+0/-5°C.</td><td>All terminations shall exhibit a continuous solder coating free from defects from a minimum of 95% of the critical surface area of any individual termination.</td></tr>
</table>

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

No.	AEC-Q200 Test Item	AEC-Q200 Test Condition	Requirements
17.	**Electrical Characterization**	* Capacitance * Q. value Cap≤1000pF 1.0±0.2Vrms, 1MHz±10% Cap>1000pF 1.0±0.2Vrms, 1KHz±10% * Test temp.: Room Temperature. * Insulation Resistance To apply rated voltage(500V max.) for max. 120 sec * Test temp.: Room Temperature.. * Dielectric Strength To apply voltage: ≦100 ≥2.5 times VDC , duration 1~5 sec, charge and discharge current less than 50mA. * Temperature Coefficient (with no electrical load) Operation temperature: -55~125℃ at 25℃	* Capacitance within the specified tolerance. * Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C. * IR. ≥10GΩ or RxC≥500Ω-F whichever is smaller. * Dielectric strength No evidence of damage or flash over during test. * Temperature Coefficient Capacitance Change: NPO: Within ±30ppm/℃
18.	**Board Flex** AEC-Q200-005	* 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 5 mm and then the pressure shall be maintained for 60±1 sec. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap change： NPO: within ±5% or 0.5pF whichever is larger (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)
19.	**Terminal Strength** AEC-Q200-006	* Pressurizing force： 2N (0201 & 0402), 10N(0603), 18N(≥0805). * Test time: 60±1 sec.	* No remarkable damage or removal of the terminations. * Capacitance within the specified tolerance. * Q. value: NPO: Cap≥30pF, Q≥1000 ; Cap<30pF, Q≥400+20C.
20	**Beam Load Test** AEC-Q200-003	* Break strength test * Beam speed: 2.5±0.25 mm/sec	The chip endure following force * Chip length ≤2.5mm: Thickness >0.5mm (20N), ≤0.5mm (8N) * Chip length ≥3.2mm: Thickness ≥1.25mm (54.5N), <1.25mm (15N)
21	**ESR**	The ESR should be measured at room temperature and tested at frequency 1±0.1 GHz.	0402 0.1pF≤Cap≤1pF:< 350mΩ/pF 1pF<Cap≤5pF:< 300mΩ 5pF<Cap≤100pF:< 250mΩ

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

APPENDIXES

◙ Tape & reel dimensions

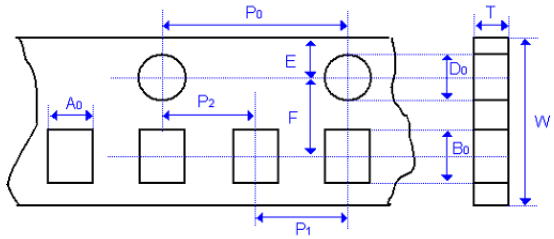


Fig. 2 The dimension of paper tape

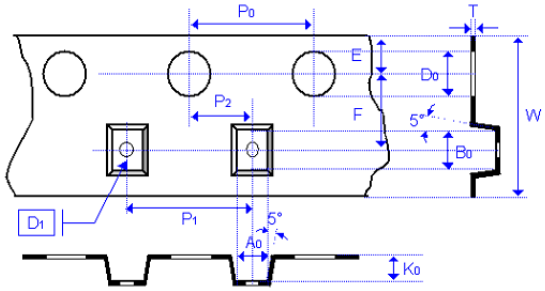


Fig. 3 The dimension of plastic tape

Size	0201	0402	0603	0805			1206			1210		
Thickness	L	N,E	S,H,X	A,H	B,T	D,I	B,T	C,J,D	G,P	T	C,D,G,K	M
A_0	0.40 +/-0.10	0.70 +/-0.20	1.05 +/-0.30	1.50 +/-0.20	1.50 +/-0.20	< 1.80	1.90 +/-0.50	< 2.00	<2.30	< 3.05	< 3.05	< 3.20
B_0	0.70 +/-0.10	1.20 +/-0.20	1.80 +/-0.30	2.30 +/-0.20	2.30 +/-0.20	< 2.70	3.50 +/-0.50	< 3.70	< 4.00	< 3.80	< 3.80	<4.00
T	≦0.55	≦0.80	≦1.20	≦1.15	≦1.20	0.23 +/-0.1	≦1.20	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1
K_0	-	-	-	-	-	< 2.50	-	< 2.50	< 2.50	< 1.50	< 2.50	< 3.20
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	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	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 +/-0.10	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20	40.00 +/-0.20
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	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	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	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	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	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	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05	3.50 +/-0.05

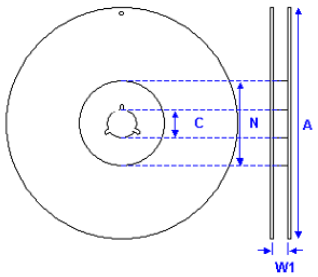
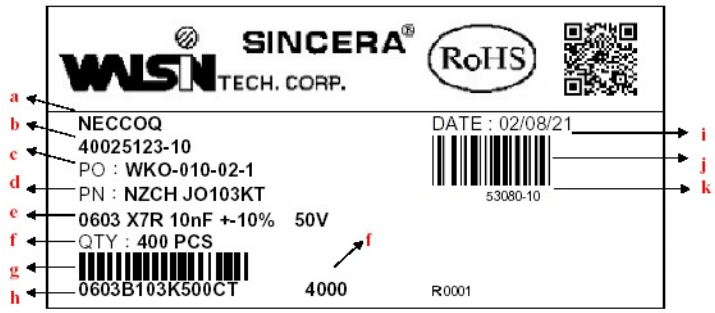


Fig. 4 The dimension of reel

Size	0201, 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		NP0
①	Ceramic material		Hi-Q dielectric ceramic
②	Inner electrode		Cu
③	Termination	Inner layer	Cu + Conductive Resin
④		Middle layer	Ni
⑤		Outer layer	Sn (Matt)

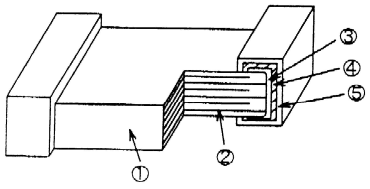


Fig. 5 The construction of MLCC

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.

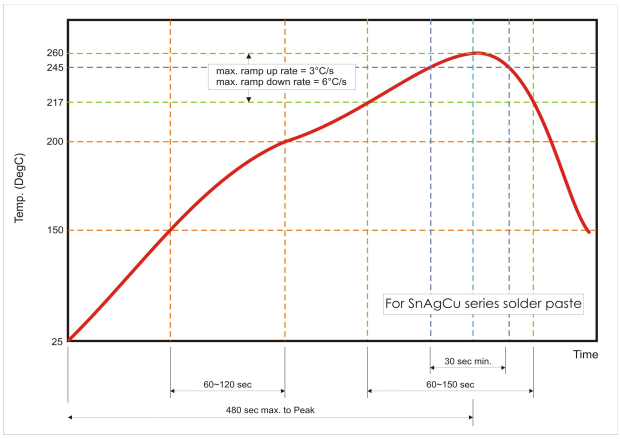


Fig. 5 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

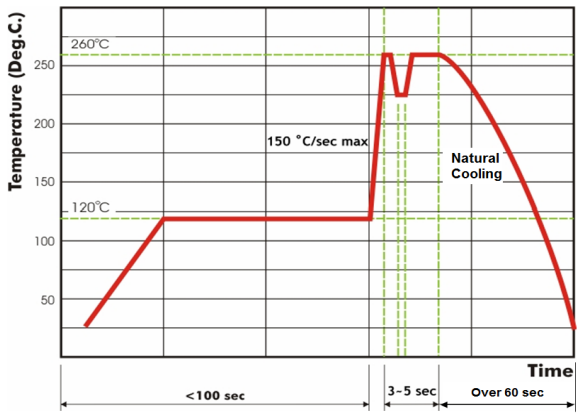


Fig. 6 Recommended wave soldering profile for SMT process with SnAgCu series solder.

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