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# APPROVAL SHEET

## MULTILAYER CERAMIC CAPACITORS

Low Profile Series

0402 to 1210 Sizes

X7R, X5R & Y5V Dielectrics

Halogen Free & RoHS Compliance



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

**Multilayer Ceramic Capacitors**

**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**

<u>TT</u>	<u>15</u>	<u>X</u>	<u>475</u>	<u>M</u>	<u>6R3</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>
TT=Low profile	15=0402 (1005) 18=0603 (1608) 21=0805 (2012) 31=1206 (3216) 32=1210 (3225)	B=X7R X=X5R F=Y5V	Two significant digits followed by no. of zeros. And R is in place of decimal point.  eg.: 475=47x10 <sup>5</sup> =4,700,000pF =4.7μF	K=±10% M=±20% Z=-20/+80%	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

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**5. EXTERNAL DIMENSIONS**

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

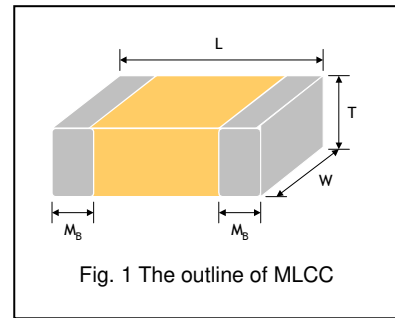


Fig. 1 The outline of MLCC

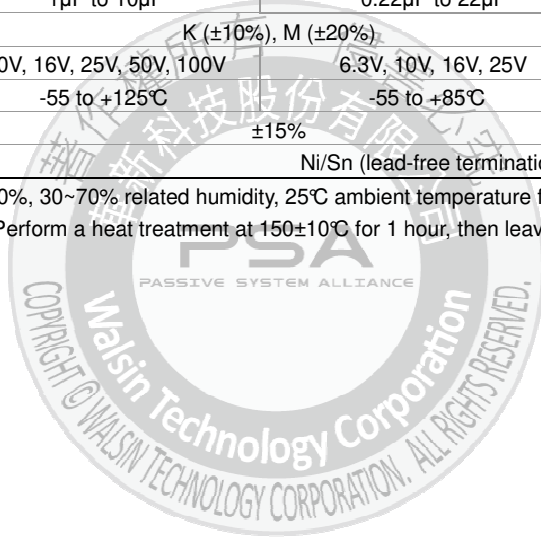
\* Reflow soldering process only is recommended.

**6. GENERAL ELECTRICAL DATA**

Dielectric	X7R	X5R	Y5V
Size	0402, 0603, 0805, 1206, 1210		
Capacitance range*	1μF to 10μF	0.22μF to 22μF	1μF to 10μF
Capacitance tolerance**	K (±10%), M (±20%)		Z (-20/+80%)
Rated voltage (WVDC)	10V, 16V, 25V, 50V, 100V	6.3V, 10V, 16V, 25V	10V, 16V, 25V, 50V
Operating temperature	-55 to +125°C	-55 to +85°C	-25 to +85°C
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°C ambient temperature for X7R, X5R and at 20°C for Y5V.

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



Multilayer Ceramic Capacitors

**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	0.22μF (224)			L	H	H													
	0.47μF (474)	L		L															
	1.0μF (105)	L			H	H		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				
	3.3μF (335)											T	T	T			T		
	4.7μF (475)	L			H			T	T	T		T	T	T			T		
	6.8μF (685)																		
	10μF (106)							T	T	T		J	J/T		T		T		T
	22μF (226)							T	T			T		T				T	
	47μF (476)											T							

**7-3 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		
	3.3μF (335)	T									
	4.7μF (475)	T	T			T	T				
	6.8μF (685)					T					
	10μF (106)	T				T					T
	22μF (226)										

**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

Multilayer Ceramic Capacitors

9. 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	Cap≤10μF, 1.0±0.2Vrms, 1kHz±10% Cap>10μF, 0.5±0.2Vrms, 120Hz±20%**	Shall not exceed the limits given in the detailed spec.																																										
3.	Q/ D.F. (Dissipation Factor)	** 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°C for 1hr then set for 24±2 hrs at room temp .	X7R/X5R: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table> Y5V: <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table>	Rated vol.	D.F.	100V	≤5%	50V, 25V, 16V, 10V	≤10%	6.3V	≤15%	Rated vol.	D.F.	50V	≤7%	25V	≤9%	16V/10V	≤12.5%																										
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4.	Dielectric Strength	To apply voltage: 250% rated voltage. Duration: 1 to 5 sec. Charge and discharge current less than 50mA.	* No evidence of damage or flash over during test.																																										
5.	Insulation Resistance	To apply rated voltage for max. 120 sec. Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .	*10GΩ or RxC≥100Ω·F whichever is smaller.																																										
6.	Temperature Coefficient	With no electrical load. <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X5R</td> <td>-55~85°C at 25°C</td> </tr> <tr> <td>Y5V</td> <td>-25~85°C at 20°C</td> </tr> </tbody> </table> *Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. <table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <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> </tbody> </table> <table border="1"> <thead> <tr> <th>01005</th> <th>0201</th> </tr> </thead> <tbody> <tr> <td>Cap≤0.01μF: 0.5V</td> <td>Cap&lt;0.1μF:1V</td> </tr> <tr> <td>Cap&gt;0.01μF: 0.2V</td> <td>0.1μF&lt;Cap&lt;1μF: 0.2V</td> </tr> <tr> <td></td> <td>Cap≥1μF: 0.1V</td> </tr> <tr> <th>0402</th> <th>0603</th> </tr> <tr> <td>Cap&lt;1μF: 1V</td> <td>Cap≤1μF: 1V</td> </tr> <tr> <td>Cap=1μF: 0.5V</td> <td>1μF&lt;Cap≤4.7μF: 0.5V</td> </tr> <tr> <td>1μF&lt;Cap&lt;10μF: 0.2V</td> <td>Cap&gt;4.7μF: 0.2V</td> </tr> <tr> <td>Cap≥10μF: 0.1V</td> <td></td> </tr> <tr> <th>0805</th> <th>1206/1210</th> </tr> <tr> <td>Cap&lt;10μF: 1V</td> <td>Cap≤10μF: 1V</td> </tr> <tr> <td>Cap=10μF: 0.5V</td> <td>10μF&lt;Cap≤100μF: 0.5V</td> </tr> <tr> <td>Cap&gt;10μF: 0.2V</td> <td>Cap&gt;100μF: 0.2V</td> </tr> </tbody> </table>	T.C.	Operating Temp	X7R	-55~125°C at 25°C	X5R	-55~85°C at 25°C	Y5V	-25~85°C at 20°C	T.C.	Capacitance Change	X7R	Within ±15%	X5R	Within ±15%	Y5V	Within +30%/-80%	01005	0201	Cap≤0.01μF: 0.5V	Cap<0.1μF:1V	Cap>0.01μF: 0.2V	0.1μF<Cap<1μF: 0.2V		Cap≥1μF: 0.1V	0402	0603	Cap<1μF: 1V	Cap≤1μF: 1V	Cap=1μF: 0.5V	1μF<Cap≤4.7μF: 0.5V	1μF<Cap<10μF: 0.2V	Cap>4.7μF: 0.2V	Cap≥10μF: 0.1V		0805	1206/1210	Cap<10μF: 1V	Cap≤10μF: 1V	Cap=10μF: 0.5V	10μF<Cap≤100μF: 0.5V	Cap>10μF: 0.2V	Cap>100μF: 0.2V	
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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.) * Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp. * Cap./DF(Q) Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.	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. * Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr 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/X5R: within ±12.5% Y5V: within ±30% (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): To apply de-aging at 150°C 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°C for 1hr then set for 24±2 hrs at room temp.	* No remarkable damage. * Cap change: X7R/X5R: within ±7.5% Y5V: within ±20% Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge.																																										

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13.	Humidity (Damp Heat) Steady State	<p>* Test temp.: 40±2°C</p> <p>* Humidity: 90~95% RH</p> <p>* Test time: 500+24/-0hrs.</p> <p>* Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p>	<p>No remarkable damage.</p> <p>Cap change : X7R/X5R: within ±25% Y5V: within ±30%; 6.3V, within +30/-40%</p> <p>Q/D.F. value: X7R/X5R:</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Y5V:</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>*I.R.: 1GΩ or RxC ≥ 10 Ω-F whichever is smaller.</p>	Rated vol.	D.F.	100V	≤7.5%	25V, 16V	≤15%	10V	≤20%	50V, 6.3V	≤30%	Rated vol.	D.F.	50V	≤10%	25V	≤15%	16V, 10V	≤20%																							
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15.	High Temperature Load (Endurance)	<p>Test temp. : NP0, X7R/X7E: 125±3°C X5R, Y5V: 85±3°C</p> <p>* Test time: 1000+24/-0 hrs.</p> <p>* To apply voltage: 150% of rated voltage.</p> <p>**100% of rated voltage for below range.</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Dielectric</th> <th>Rated voltage</th> <th>Capacitance range</th> </tr> </thead> <tbody> <tr> <td>TT15</td> <td>X5R</td> <td>6.3V</td> <td>C ≥ 1.0μF</td> </tr> <tr> <td>TT18</td> <td>Y5V</td> <td>6.3V,10V</td> <td>C ≥ 2.2μF</td> </tr> <tr> <td rowspan="2">TT21</td> <td>Y5V</td> <td>6.3V</td> <td>C ≥ 10μF</td> </tr> <tr> <td>X5R/X7R/X6S</td> <td>≤ 10V</td> <td>C ≥ 10μF</td> </tr> <tr> <td>TT31</td> <td>Y5V</td> <td>6.3V</td> <td>C ≥ 22μF</td> </tr> </tbody> </table> <p>*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p> <p>* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</p>	Size	Dielectric	Rated voltage	Capacitance range	TT15	X5R	6.3V	C ≥ 1.0μF	TT18	Y5V	6.3V,10V	C ≥ 2.2μF	TT21	Y5V	6.3V	C ≥ 10μF	X5R/X7R/X6S	≤ 10V	C ≥ 10μF	TT31	Y5V	6.3V	C ≥ 22μF	<p>No remarkable damage.</p> <p>Cap change: X7R/X5R: within ±25% Y5V: within ±30%; 6.3V, within +30/-40%</p> <p>Q/D.F. value: X7R/X5R:</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Y5V:</p> <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>*I.R.: 1GΩ or RxC ≥ 10 Ω-F whichever is smaller.</p>	Rated vol.	D.F.	100V	≤7.5%	25V, 16V	≤15%	10V	≤20%	50V, 6.3V	≤30%	Rated vol.	D.F.	50V	≤10%	25V	≤15%	16V, 10V	≤20%
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Multilayer Ceramic Capacitors

**APPENDIXES**

▣ Tape & reel dimensions

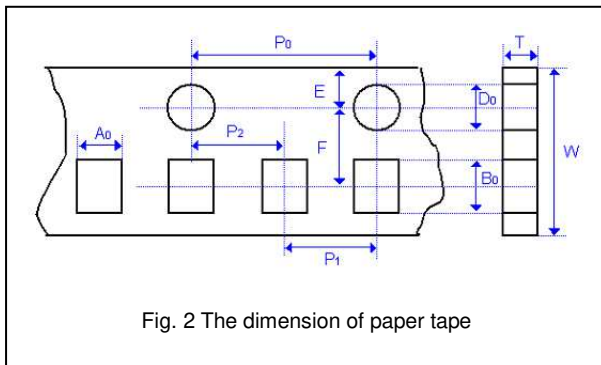


Fig. 2 The dimension of paper tape

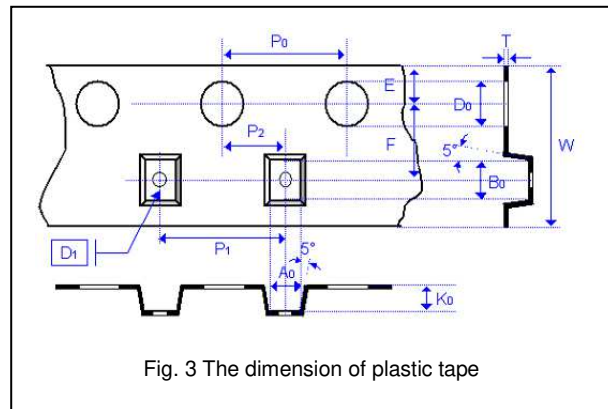


Fig. 3 The dimension of plastic tape

Size	0402	0603	0805	1206		1210	
Thickness	L	H	T	T	J	T	K
A <sub>0</sub>	0.70 +/-0.2	1.05 +/-0.30	1.50 +/-0.20	1.90 +/-0.50	< 2.00	< 3.05	< 3.05
B <sub>0</sub>	1.20 +/-0.2	1.80 +/-0.30	2.30 +/-0.20	3.50 +/-0.50	< 3.70	< 3.80	< 3.80
T	≤ 0.80	≤ 1.20	≤ 1.30	≤ 1.30	0.23 +/-0.1	0.23 +/-0.1	0.23 +/-0.1
K <sub>0</sub>	-	-	-	-	< 2.50	< 1.50	< 2.50
W	8.00 +/-0.10	8.00 +/-0.10	8.00 +/-0.10	8.00 +/-0.10	8.00 +/-0.20	8.00 +/-0.20	8.00 +/-0.20
P <sub>0</sub>	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 <sub>0</sub>	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 <sub>1</sub>	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 <sub>2</sub>	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 <sub>0</sub>	1.55 +/-0.05	1.55 +/-0.05	1.55 +/-0.05	1.55 +/-0.05	1.50 +0.1/-0	1.50 +0.1/-0	1.50 +0.1/-0
D <sub>1</sub>	-	-	-	-	1.00 +/-0.10	1.00 +/-0.10	1.00 +/-0.10
E	1.75 +/-0.05	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	3.50 +/-0.05

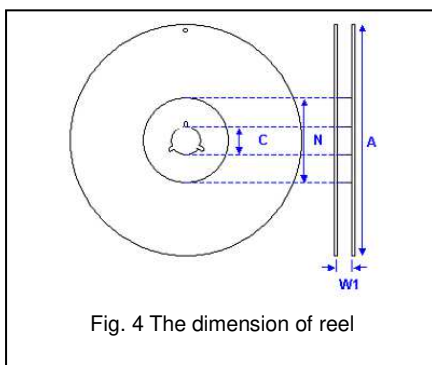


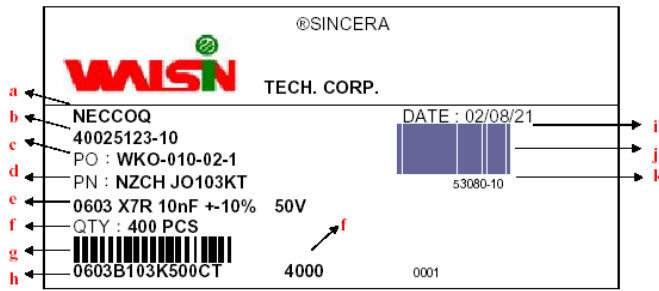
Fig. 4 The dimension of reel

Size	0402, 0603, 0805, 1206, 1210		
Reel size	7"	10"	13"
C	13.0+0.5/-0.2	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	8.4+1.5/-0
A	178.0±1.0	250.0±1.0	330.0±1.0
N	60.0+1.0/-0	100.0±1.0	100±1.0



Multilayer Ceramic Capacitors

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 <sub>3</sub> based
②	Inner electrode	Ni
③	Termination	Inner layer Cu
④		Middle layer Ni
⑤		Outer layer Sn (Matt)

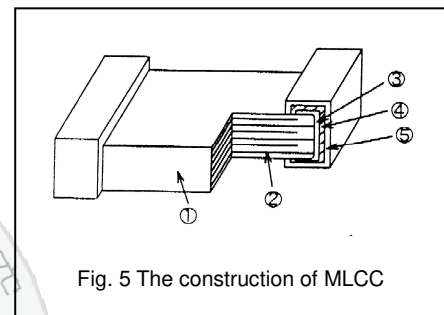


Fig. 5 The construction of MLCC

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.

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☐ 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.

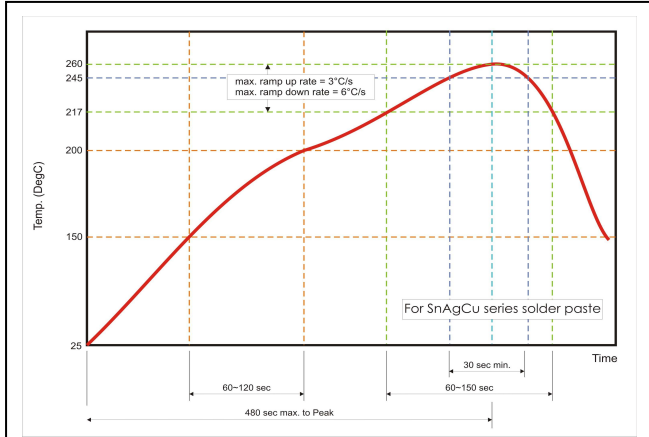


Fig. 6 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

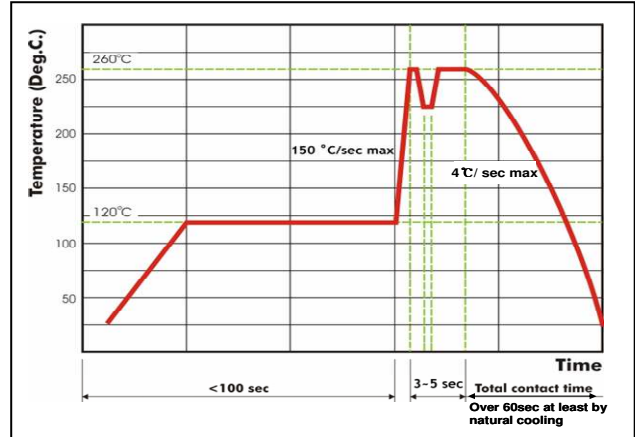


Fig. 7 Recommended wave soldering profile for SMT process with SnAgCu series solder.

