APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

Middle & High Voltage Series (200V to 3kV)

0805 to 1812 Sizes

NP0, X7R & Y5V Dielectrics

ROHS compliance

CUSTOMER: _____

APPROVAL NO.: _____

ISSUE DATE: _____

APPROVED BY: Hank Chiang

CUSTOMER APPROVAL:

1. INTRODUCTION

WTC middle and high voltage 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 increased capacitance values in a given case size and voltage rating.

Chips size 1206 and larger to use on reflow soldering process only. Capacitors with X7R dielectrics are not intended for AC line filtering applications. Capacitors may require protective surface coating to prevent external arcing.

2. FEATURES

a. High voltage in a given case size.
b. High stability and reliability.

3. APPLICATIONS

a. Snubbers in high frequency power converters.
b. High voltage coupling/DC blocking.
c. DC-DC converters.
d. Back-lighting inverters

4. HOW TO ORDER

1808	N	100	G	202	L	T
Size	**Dielectric**	**Capacitance**	**Tolerance**	**Rated voltage**	**Termination**	**Packaging**
Inch (mm) **0603** (1608) **0805** (2012) **1206** (3216) **1210** (3225) **1808** (4520) **1812** (4532)	**N**=NP0 (C0G) **B**=X7R **F**=Y5V	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: R47=0.47pF 0R5=0.5pF 1R0=1.0pF 100=10x10^0 =10pF	**B**=±0.1pF **C**=±0.25pF **D**=±0.5pF **G**=±2% **J**=±5% **K**=±10% **M**=±20% **Z**=-20/+80%	Two significant digits followed by no. of zeros. And R is in place of decimal point. **201**=200 VDC **251**=250 VDC **501**=500 VDC **631**=630 VDC **102**=1000 VDC **152**=1500 VDC **202**=2000 VDC **302**=3000 VDC	**L**=Ag/Ni/Sn (for NP0 dielectric) **C**=Cu/Ni/Sn (for X7R*, Y5V dielectric)	**T**=7" reeled **G**=13" reeled

* Partial X7R items are with Ag/Ni/Sn terminations, please ref to below product range of X7R dielectric for detail.

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	0.60±0.10	A		0.50±0.20
			0.80±0.10	B		
			1.25±0.10	D	#	
1206 (3216)	3.20±0.15	1.60±0.15	0.80±0.10	B		0.60±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		0.75±0.25
			1.25±0.10	D	#	
	3.20±0.40	2.50±0.30	1.60±0.20	G	#	
			2.50±0.30	M	#	
1808 (4520)	4.50±0.40	2.03±0.25	1.25±0.10	D	#	0.50±0.25
			2.00±0.20	K	#	
1812 (4532)	4.50±0.40	3.20±0.30	1.25±0.10	D	#	0.50±0.25
			2.00±0.20	K	#	

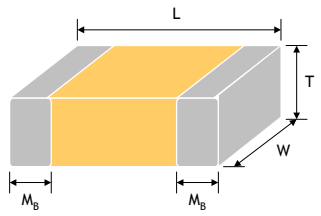


Fig. 1 The outline of MLCC

Reflow soldering only is recommended.

6. GENERAL ELECTRICAL DATA

Dielectric	NP0	X7R	Y5V
Size	0603, 0805, 1206, 1210, 1808, 1812		0805, 1206, 1210, 1812
Capacitance*	0.5pF to 6800pF	100pF to 0.47μF	0.01μnF to 0.68μF
Capacitance tolerance	Cap≤5pF: C (±0.25pF) 5pF<Cap<10pF: D (±0.5pF) Cap≥10pF: J (±5%), K (±10%)	K (±10%), M (±20%)	Z (-20/+80%)
Rated voltage (WVDC)	200V to 3kV		200V, 250V
Q*	Cap<30pF: Q≥400+20C Cap≥30pF: Q≥1000	≤2.5%	≤5%
Insulation resistance at Ur**	Ur=200~630V: ≥10GΩ or RxC≥100Ω-F whichever is smaller Ur=1000~3000V: ≥10GΩ		
Dielectric strength	200~300V: ≥2 x WVDC 500~999V: ≥1.5 x WVDC 1000~3000V: ≥1.2 x WVDC		
Operating temperature	-55 to +125°C		-25 to +85°C
Capacitance characteristic	±30ppm	±15%	+30/-80%
Termination	Ni/Sn (lead-free termination)		

* Measured at the condition of 30~70% related humidity.

NP0: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25°C at ambient temperature

X7R, Y5V: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 20°C ambient temperature.

** Measured at 500VDC for 60 sec. for Ur>500VDC.

7. CAPACITANCE RANGE (MIDDLE VOLTAGE - 200V to 630V)

7-1 NP0 Dielectric

DIELECTRIC		NP0																	
SIZE		0603		0805				1206				1210				1812			
RATED VOLTAGE (VDC)		200	250	200	250	500	630	200	250	500	630	200	250	500	630	200	250	500	630
Capacitance	0.5pF (0R5)			A	A	A	A												
	1.0pF (1R0)			A	A	A	A												
	1.2pF (1R2)			A	A	A	A												
	1.5pF (1R5)			A	A	A	A	B	B	B	B								
	1.8pF (1R8)			A	A	A	A	B	B	B	B								
	2.2pF (2R2)			A	A	A	A	B	B	B	B								
	2.7pF (2R7)			A	A	A	A	B	B	B	B								
	3.3pF (3R3)			A	A	A	A	B	B	B	B								
	3.9pF (3R9)			A	A	A	A	B	B	B	B								
	4.7pF (4R7)			A	A	A	A	B	B	B	B								
	5.6pF (5R6)			A	A	A	A	B	B	B	B								
	6.8pF (6R8)			A	A	A	A	B	B	B	B								
	8.2pF (8R2)			A	A	A	A	B	B	B	B								
	10pF (100)			A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	12pF (120)			A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	15pF (150)			A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	18pF (180)			A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	22pF (220)	S	S	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	27pF (270)	S	S	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	33pF (330)	S	S	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	39pF (390)	S	S	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	47pF (470)	S	S	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	56pF (560)	S	S	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	68pF (680)	S	S	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
	82pF (820)	S	S	A	A	B	B	B	B	B	B	C	C	C	C	D	D	D	D
	100pF (101)	S	S	A	B	B	B	B	B	B	B	C	C	C	C	D	D	D	D
	120pF (121)			A	B	D	D	B	B	B	B	C	C	C	C	D	D	D	D
	150pF (151)			B	D	D	D	B	B	B	B	C	C	C	C	D	D	D	D
	180pF (181)			B	D	D	D	B	B	B	B	C	C	C	C	D	D	D	D
	220pF (221)			D	D	D	D	B	B	B	B	C	C	C	C	D	D	D	D
	270pF (271)			D	D	D	D	B	C	C	C	C	C	C	C	D	D	D	D
	330pF (331)			D	D	D	D	B	C	C	C	C	C	C	C	D	D	D	D
	390pF (391)			D	D	D	D	B	C	C	C	C	C	C	C	D	D	D	D
	470pF (471)			D				C	C	C	C	C	C	C	C	D	D	D	D
	560pF (561)			D				C	D	D	D	C	C	C	C	D	D	D	D
	680pF (681)			D				C	D	D	D	C	C	C	C	D	D	D	D
	820pF (821)			D				C	G	G	G	C	C	C	C	D	D	D	D
	1,000pF (102)			D				C	G	G	G	C	D	D	D	D	D	D	D
	1,200pF (122)							C				D	D	D	D	D	D	D	D
	1,500pF (152)							D				D	D	D	D	D	D	D	D
	1,800pF (182)							D				D	D	D	D	D	D	D	D
	2,200pF (222)							D				D	D			D	D	D	D
	2,700pF (272)											D	D			D	D	D	D
	3,300pF (332)											D				D	D	D	D
	3,900pF (392)											D				D			
	4,700pF (472)															D			
	5,600pF (562)															D			
	6,800pF (682)															D			

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

7-2 X7R Dielectric

DIELECTRIC		X7R															
SIZE		0805				1206				1210				1812			
RATED VOLTAGE (VDC)		200	250	500	630	200	250	500	630	200	250	500	630	200	250	500	630
Capacitance	100pF (101)	B	B	B^	B^												
	120pF (121)	B	B	B^	B^												
	150pF (151)	B	B	B^	B^	D	D	D	D								
	180pF (181)	B	B	B^	B^	D	D	D	D								
	220pF (221)	B	B	B^	B^	D	D	D	D								
	270pF (271)	B	B	B^	B^	D	D	D	D								
	330pF (331)	B	B	B^	B^	D	D	D	D								
	390pF (391)	B	B	B^	B^	D	D	D	D								
	470pF (471)	B	B	B^	B^	D	D	D	D								
	560pF (561)	B	B	B^	B^	D	D	D	D								
	680pF (681)	B	B	B^	B^	D	D	D	D								
	820pF (821)	B	B	B^	B^	D	D	D	D								
	1,000pF (102)	B	B	B^	B^	D	D	D	D	C	C	C^	C^	D	D	D^	D^
	1,200pF (122)	B	B	B^	B^	D	D	D	D	C	C	C^	C^	D	D	D^	D^
	1,500pF (152)	B	B	B^	B^	D	D	D	D	C	C	C^	C^	D	D	D^	D^
	1,800pF (182)	B	B	B^	B^	D	D	D	D	C	C	C^	C^	D	D	D^	D^
	2,200pF (222)	B	B	B^	B^	D	D	D	D	C	C	C^	C^	D	D	D^	D^
	2,700pF (272)	B	B	B^	B^	D	D	D	D	C	C	C^	C^	D	D	D^	D^
	3,300pF (332)	B	B	B^	B^	D	D	D	D	C	C	C^	C^	D	D	D^	D^
	3,900pF (392)	B	B			D	D	D	D	C	C	C^	C^	D	D	D^	D^
	4,700pF (472)	B	B			D	D	D	D	C	C	C^	C^	D	D	D^	D^
	5,600pF (562)	B	B			D	D	D	D	C	C	C^	C^	D	D	D^	D^
	6,800pF (682)	B	B			D	D	D	D	C	C	C^	C^	D	D	D^	D^
	8,200pF (822)	B	B			D	D	D	D	C	C	C^	C^	D	D	D^	D^
	0.010μF (103)	D	D			D	D	D	D	C	C	C^	C^	D	D	D^	D^
	0.012μF (123)	D	D			D	D	D^	D^	C	C	C^	C^	D	D	D^	D^
	0.015μF (153)	D	D			D	D	D^	D^	C	C	C^	C^	D	D	D^	D^
	0.018μF (183)	D	D			D	D	D^	D^	C	C	C^	C^	D	D	D^	D^
	0.022μF (223)	D	D			D	D	G^	G^	C	C	D^	D^	D	D	D^	D^
	0.027μF (273)					D	D	G^	G^	C	C	G^	G^	D	D	D^	D^
	0.033μF (333)					G	G	G^	G^	C	C	G^	G^	D	D	D^	D^
	0.039μF (393)					G	G			C	C	G^	G^	D	D	D^	D^
	0.047μF (473)					G	G			D	D	G^	G^	D	D	D^	D^
	0.056μF (563)					G	G			D	D	G^	G^	D	D	K^	K^
	0.068μF (683)					G	G			G	G			D	D	K^	K^
	0.082μF (823)					G	G			G	G			D	D	K^	K^
	0.10μF (104)					G	G			G	G			D	D	K^	K^
	0.12μF (124)									G	G			D	D		
	0.15μF (154)									M	M			K	K		
	0.18μF (184)									M	M			K	K		
	0.22μF (224)									M	M			K	K		
	0.27μF (274)									M	M			K	K		
	0.33μF (334)									M	M			K	K		
	0.39μF (394)									M	M			K	K		
	0.47μF (474)									M	M			K	K		

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with "^" mark is expressed product with Ag/Ni/Sn terminations.

7-3 Y5V Dielectric

DIELECTRIC		Y5V							
SIZE		0805		1206		1210		1812	
RATED VOLTAGE (VDC)		200	250	200	250	200	250	200	250
Capacitance	0.010μF (103)	B	B	B	B	C	C	D	D
	0.015μF (153)	B	B	B	B	C	C	D	D
	0.022μF (223)	B	B	B	B	C	C	D	D
	0.033μF (333)	B	B	B	B	C	C	D	D
	0.047μF (473)	B	B	B	B	C	C	D	D
	0.068μF (683)	B	B	B	B	C	C	D	D
	0.10μF (104)			B	B	C	C	D	D
	0.15μF (154)			C	C	C	C	D	D
	0.22μF (224)							D	D
	0.33μF (334)							D	D
	0.47μF (474)							D	D
	0.68μF (684)							D	D
	1.0μF (105)								

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

8. CAPACITANCE RANGE (HIGH VOLTAGE - 1kV to 3kV)

8-1 NP0 Dielectric

DIELECTRIC		NP0									
SIZE		1206		1210		1808			1812		
RATED VOLTAGE (VDC)		1000	2000	1000	2000	1000	2000	3000	1000	2000	3000
Capacitance	1.5pF (1R5)	B	B								
	1.8pF (1R8)	B	B								
	2.0pF (2R0)	B	B			D	D	D			
	2.2pF (2R2)	B	B			D	D	D			
	2.7pF (2R7)	B	B			D	D	D			
	3.3pF (3R3)	B	B			D	D	D			
	3.9pF (3R9)	B	B			D	D	D			
	4.7pF (4R7)	B	B			D	D	D			
	5.6pF (5R6)	B	B			D	D	D			
	6.8pF (6R8)	B	B			D	D	D			
	8.2pF (8R2)	B	B			D	D	D			
	10pF (100)	B	B	C	C	D	D	D	D	D	D
	12pF (120)	B	B	C	C	D	D	D	D	D	D
	15pF (150)	B	B	C	C	D	D	D	D	D	D
	18pF (180)	B	B	C	C	D	D	D	D	D	D
	22pF (220)	B	B	C	C	D	D	D	D	D	D
	27pF (270)	B	B	C	C	D	D	D	D	D	D
	33pF (330)	B	B	C	C	D	D	D	D	D	D
	39pF (390)	B	B	C	C	D	D	D	D	D	D
	47pF (470)	B	B	C	C	D	D	D	D	D	D
	56pF (560)	B	B	C	D	D	D	D	D	D	D
	68pF (680)	B	C	C	D	D	D	D	D	D	D
	82pF (820)	B	C	C	D	D	D	D	D	D	D
	100pF (101)	B	C	C	D	D	D	D	D	D	D
	120pF (121)	B	D	C	D	D	D	D	D	D	D
	150pF (151)	C	D	C	D	D	D	D	D	D	D
	180pF (181)	C	G	C	D	D	D	K	D	D	D
	220pF (221)	D	G	C	D	D	D	K	D	D	D
	270pF (271)	D		C		D	D	K	D	D	K
	330pF (331)	G		D		D	D	K	D	D	K
	390pF (391)	G		D		D	K		D	D	K
	470pF (471)	G		D		D	K		D	D	K
	560pF (561)					K	K		D	D	
	680pF (681)					K	K		D	K	
	820pF (821)					K			D	K	
	1,000pF (102)					K			K	K	
	1,200pF (122)								K		
	1,500pF (152)								K		

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

8-2 X7R Dielectric

DIELECTRIC		X7R										
SIZE		1206			1210	1808				1812		
RATED VOLTAGE (VDC)		1000	1500	2000	1000	1000	1500	2000	3000	1000	2000	3000
Capacitance	150pF (151)	B^	B^	B^		D^	D^	D^	D^			
	180pF (181)	B^	B^	B^		D^	D^	D^	D^			
	220pF (221)	B^	B^	B^		D^	D^	D^	D^			
	270pF (271)	B^	B^	B^		D^	D^	D^	D^	D^	D^	
	330pF (331)	B^	B^	B^		D^	D^	D^	K^	D^	D^	
	390pF (391)	B^	B^	C^		D^	D^	D^	K^	D^	D^	
	470pF (471)	B^	B^	C^		D^	D^	D^	K^	D^	D^	
	560pF (561)	B^	C^	C^		D^	D^	D^	K^	D^	D^	
	680pF (681)	B^	C^	C^		D^	D^	D^	K^	D^	D^	K^
	820pF (821)	B^	G^	G^		D^	D^	D^	K^	D^	D^	K^
	1,000pF (102)	B^	G^	G^	C^	D^	D^	K^	K^	D^	D^	K^
	1,200pF (122)	B^	G^		C^	D^	D^	K^		D^	D^	
	1,500pF (152)	C^	G^		C^	D^	D^	K^		D^	D^	
	1,800pF (182)	C^	G^		C^	D^	D^	K^		D^	D^	
	2,200pF (222)	D^	G^		C^	D^	D^	K^		D^	D^	
	2,700pF (272)	G^			C^	D^	D^			D^	D^	
	3,300pF (332)	G^			D^	D^	K^			D^	K^	
	3,900pF (392)	G^			G^	D^				D^	K^	
	4,700pF (472)				G^	D^				D^	K^	
	5,600pF (562)				G^	K^				D^		
	6,800pF (682)				M^	K^				D^		
	8,200pF (822)				M^	K^				D^		
	0.010μF (103)				M^	K^				D^		
	0.012μF (123)									K^		
	0.015μF (153)									K^		

1. The letter in cell is expressed the symbol of product thickness.
2. The letter in cell with "^" mark is expressed product with Ag/Ni/Sn terminations.

9. PACKAGING DIMENSION AND QUANTITY

Size	Thickness/Symbol (mm)		Paper tape		Plastic tape	
			7" reel	13" reel	7" reel	13" reel
0805	0.60±0.10	A	4k	15k	-	-
	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	-
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	-
1808	1.25±0.10	D	-	-	2k	-
	2.00±0.20	K	-	-	1k	-
1812	1.25±0.10	D	-	-	1k	-
	2.00±0.20	K	-	-	1k	-

Unit: pieces

10. 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>Class I: (NP0)</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≤1000pF, 1.0±0.2Vrms, 1MHz±10%
Cap>1000pF, 1.0±0.2Vrms, 1KHz±10%
Class II: (X7R, Y5V)
1.0±0.2Vrms, 1kHz±10%</td><td>NP0: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C
X7R: ≤2.5%
Y5V: ≤5.0%</td></tr>
<tr><td>4.</td><td>Dielectric Strength</td><td>* To apply voltage:
200V~300V ≥2 times VDC
500V~999V ≥1.5 times VDC
1000V~3000V ≥1.2 times VDC
* Cut-off, set at 10mA
* TEST= 15 sec.
* RAMP=0</td><td>* No evidence of damage or flash over during test.</td></tr>
<tr><td rowspan="2">5.</td><td rowspan="2">Insulation Resistance</td><td>Rated voltage: 200~630V</td><td>To apply rated voltage (500V max.) for 60 sec.</td><td>≥10GΩ or RxC≥100Ω-F whichever is smaller</td></tr>
<tr><td>Rated voltage: ≥630V</td><td>To apply 500V for 60 sec.</td><td>≥10GΩ</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>NP0</td><td>-55~125°C at 25°C</td></tr>
<tr><td>X7R</td><td>-55~125°C at 25°C</td></tr>
<tr><td>Y5V</td><td>-25~85°C at 20°C</td></tr>
</table></td><td><table>
<tr><th>T.C.</th><th>Capacitance Change</th></tr>
<tr><td>NP0</td><td>Within ±30ppm/°C</td></tr>
<tr><td>X7R</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)
* 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.)</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°C
* 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.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap change：
NP0: within ±5.0% or ±0.5pF whichever is larger.
X7R: 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.)</td></tr>
<tr><td>11.</td><td>Resistance to Soldering Heat</td><td>* Solder temperature: 270±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 48±4 hrs at room temp.
* 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.
* Cap change:
NP0: within ±2.5% or ±0.25pF whichever is larger.
X7R: within ±7.5%
Y5V: within ±20%
* Q/D.F., I.R. and dielectric strength: To meet initial requirements.
* 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. (°C)</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°C for 1 hr and then set for 48±4 hrs at room temp.
* 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.
* Cap change：
NP0: within ±2.5% or ±0.25pF whichever is larger.
X7R: within ±7.5%
Y5V: within ±20%
* 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°C
* Humidity: 90~95% RH
* Test time: 500+24/-0hrs.
* 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.
* Cap change: NP0: within ±5.0% or ±0.5pF whichever is larger.
X7R: within ±12.5%
Y5V: within ±30%
* Q/D.F. value:
NP0: Cap≥30pF, Q≥350; 10pF≤Cap<30pF, Q≥275+2.5C
Cap<10pF; Q≥200+10C
X7R: ≤3.0%
Y5V: ≤7.5%
* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.</td></tr>
<tr><td>14.</td><td>Humidity (Damp Heat) Load</td><td>* Test temp.: 40±2°C
* Humidity: 90~95%RH
* Test time: 500+24/-0 hrs.
* To apply voltage：rated voltage (Max. 500V)
* 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.
* Cap change: NP0: within ±7.5% or ±0.75pF whichever is larger.
X7R: within ±12.5%
Y5V: within ±30%
* Q/D.F. value:
NP0: Cap≥30pF, Q≥200; Cap<30pF, Q≥100+10/3C
X7R: ≤3.0%
Y5V: ≤7.5%
* I.R.: ≥500MΩ or RxC≥25Ω-F whichever is smaller.</td></tr>
<tr><td>15.</td><td>High Temperature Load (Endurance)</td><td>* Test temp.:
NP0, X7R: 125±3°C
Y5V: 85±3°C
* To apply voltage:
(1) V<500V: 200% of rated voltage.
(2) 500V: 150% of rated voltage.
(3) V≥630V: 120% of rated voltage.
* Test time: 1000+24/-0 hrs.
* 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.
* Cap change: NP0: within ±3.0% or ±0.3pF whichever is larger.
X7R: within ±12.5%
Y5V: within ±30%
* Q/D.F. value:
NP0: Cap≥30pF, Q≥350
10pF≤Cap<30pF, Q≥275+2.5C
Cap<10pF, Q≥200+10C
X7R: ≤3.0%
Y5V: ≤7.5%
* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.</td></tr>
</table>

11. APPENDIXES

◙ Tape & reel dimensions

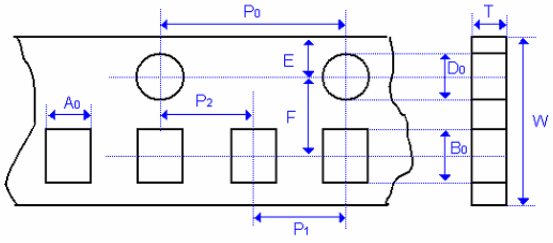


Fig. 2 The dimension of paper tape

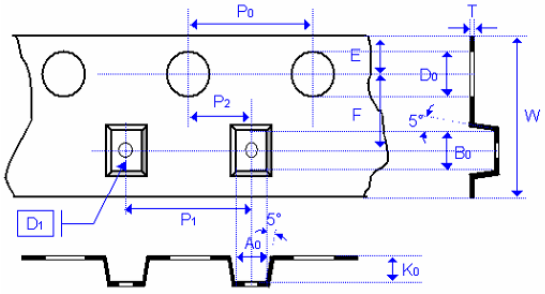


Fig. 3 The dimension of plastic tape

Size	0603	0805		1206			1210		1808		1812
Thickness	S, X	B	C, D, I	B	C, D	G	C, D, G	M	D	K	D, K
A_0	1.02±0.05	1.50±0.10	<1.57	2.00±0.10	<1.85	<1.95	<2.97	<2.97	<2.35	<2.35	<3.81
B_0	1.82±0.05	2.30±0.10	<2.40	3.50±0.10	<3.46	<3.67	<3.73	<3.73	<4.98	<5.00	<5.30
T	0.95±0.05	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	0.25±0.05	0.25±0.05
K_0	-	-	<2.50	-	<2.50	<2.50	<2.50	<3.0	<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	8.00±0.10	12.0±0.20	12.0±0.20	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±0.10	4.00±0.100	4.00±0.10	4.00±0.10	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	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	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	2.00±0.05	2.00±0.05	2.00±0.05
D_0	1.55±0.05	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	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	1.50±0.10	1.50±0.10
E	1.75±0.05	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	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	5.50±0.05	5.50±0.05	5.50±0.05

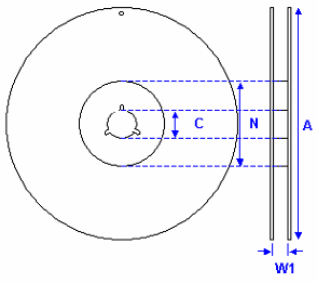
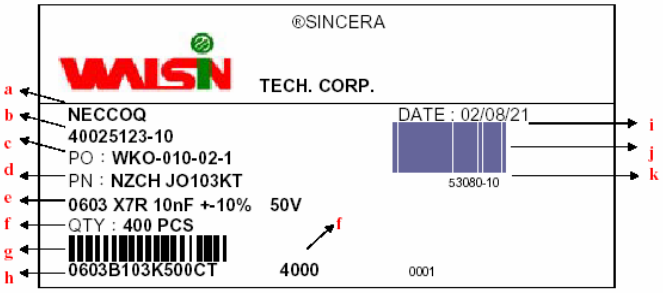


Fig. 4 The dimension of reel

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	60.5±1.0	100.0±1.0	100±1.0	60.5±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		NP0, X7R	X7R, Y5V
①	Ceramic material		$BaTiO_3$ based	
②	Inner electrode		AgPd alloy	Ni
③	Termination	Inner layer	Ag	Cu
④		Middle layer	Ni	
⑤		Outer layer	Sn (Matt)	

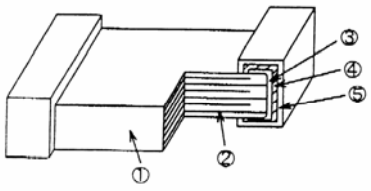


Fig. 5 The construction of MLCC

◙ 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. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid. It may cause oxidization of electrode, which easily be resulted in poor soldering.
b. To store products on the shelf and avoid exposure to moisture.
c. Don't expose products to excessive shock, vibration, direct sunlight and so on.

◙ 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.

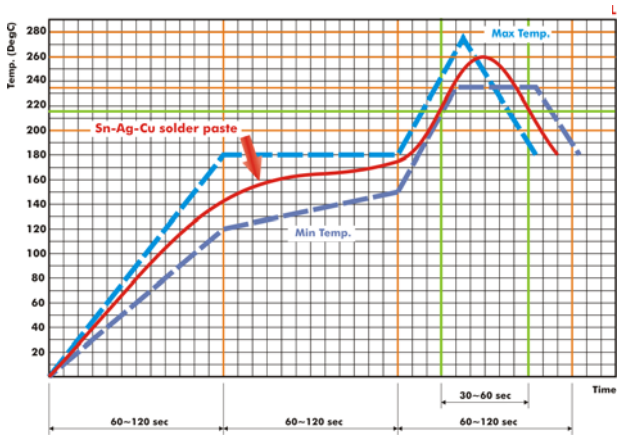


Fig. 6 IR reflow soldering profile for SMT process with SnAgCu series solder paste.

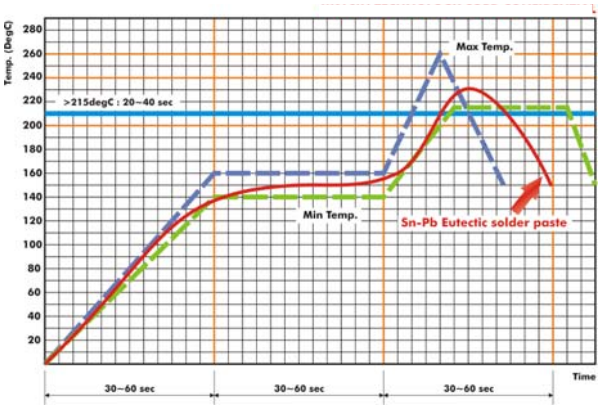


Fig. 7 IR reflow soldering profile for SMT process with eutectic SnPb solder paste.