APPROVAL SHEET

MULTILAYER CERAMIC CAPACITORS

Microwave Series + High Reliability (RH)

0402 to 0805 Sizes (200V to 250V)

X8G Dielectric

Halogen Free & RoHS Compliance

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

1. INTRODUCTION

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 RH series MLCC are used at high frequencies generally and have a small temperature coefficient of capacitance, typical within the ±30ppm/℃ required for X8G classification and have internal electrodes of excellent conductivity. Thus, WTC RH series MLCC will have the feature of low ESR and high Q characteristics.

WTC RH series have high reliability characteristic, life test condition: 150℃ / 2000hrs / 2xRated Voltage.

2. FEATURES

b. High Q and low ESR performance at high frequency.
c. Ultra low capacitance to 0.1pF.
d. Ultra high reliability (150℃ / 2000hrs / 2x Rated Voltage).
e. Can offer high precision tolerance to ±0.05pF.
f. Quality improvement of telephone calls for low

3. APPLICATIONS

a. Telecommunication products & equipments: Mobile phone, WLAN, Base station, Small cell.
b. RF module: Power amplifier, VCO.
c. Tuners.
d. High quality concern wireless device.

4. HOW TO ORDER

RH	21	G	100	J	251	C	T
Series	Size	Dielectric	Capacitance	Tolerance	Rated voltage	Termination	Packaging
RH=High reliability & Ultra High Q & Low ESR	**15**=0402 (1005) **18**=0603 (1608) **11**=0505 (1414) **21**=0805 (2012)	**G**=X8G	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg. : 0R5=0.5pF 1R0=1.0pF 100=10x10^0 =10pF	**A**=±0.05pF **B**=±0.1pF **C**=±0.25pF **F**=±1% **G**=±2% **J**=±5%	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg. : **201**=200 VDC **251**=250 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)
0402 (1005)	1.00±0.05	0.50±0.05	0.50±0.05	N	#	0.25+0.05/-0.10
0603 (1608)	1.60±0.10	0.80±0.10	0.80±0.07	S		0.40±0.15
0805 (2012)	2.00±0.20	1.25±0.20	0.85±0.10	T		0.50±0.20
0505 (1414)	1.40 +0.38/-0.25	1.40±0.38	1.15±0.15	J	#	0.25+0.25/-0.13

Reflow soldering only is recommended.

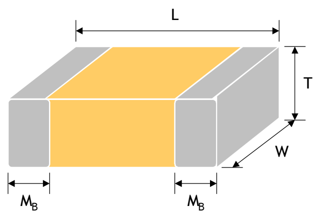


Fig. 1 The outline of MLCC

6. GENERAL ELECTRICAL DATA

Dielectric	X8G
Size	0402, 0505, 0603, 0805
Capacitance*	0.1pF to 10pF
Capacitance tolerance	Cap≤5pF: A (±0.05pF), B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: B (±0.1pF), C (±0.25pF) Cap=10pF: F (±1%), G (±2%), J (±5%)
Rated voltage (WVDC)	200V, 250V
Q*	Q≥800+20C
Insulation resistance at Ur	≥10GΩ or RxC≥100Ω-F whichever is smaller.
Operating temperature	-55 to +150℃
Capacitance change	±30ppm/℃
Termination	Ni/Sn (lead-free termination)

* Measured at the conditions of 25℃ ambient temperature 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. PACKAGING DIMENSION AND QUANTITY

Size	Thickness (mm)/Symbol		Paper tape	
			7” reel	13” reel
0402 (1005)	0.50±0.05	N	10,000	50,000
0603 (1608)	0.80±0.07	S	4,000	15,000
0805 (2012)	0.85±0.10	T	4,000	15,000
Size	**Thickness (mm)/Symbol**		**Plastic tape**	
			7” reel	**13” reel**
0505 (1414)	1.15±0.15	J	3,000	-

Unit: pieces

8. CAPACITANCE RANGE

DIELECTRIC		X8G	
SIZE		0402	Tolerance
RATED VOLTAGE (VDC)		200	
Capacitance	0.1pF (0R1)	N	A, B
	0.2pF (0R2)	N	A, B
	0.3pF (0R3)	N	A, B
	0.4pF (0R4)	N	A, B
	0.5pF (0R5)	N	A, B, C
	0.6pF (0R6)	N	A, B, C
	0.7pF (0R7)	N	A, B, C
	0.8pF (0R8)	N	A, B, C
	0.9pF (0R9)	N	A, B, C
	1.0pF (1R0)	N	A, B, C
	1.1pF (1R1)	N	A, B, C
	1.2pF (1R2)	N	A, B, C
	1.3pF (1R3)	N	A, B, C
	1.4pF (1R4)	N	A, B, C
	1.5pF (1R5)	N	A, B, C
	1.6pF (1R6)	N	A, B, C
	1.7pF (1R7)	N	A, B, C
	1.8pF (1R8)	N	A, B, C
	1.9pF (1R9)	N	A, B, C
	2.0pF (2R0)	N	A, B, C
	2.1pF (2R1)	N	A, B, C
	2.2pF (2R2)	N	A, B, C
	2.3pF (2R3)	N	A, B, C
	2.4pF (2R4)	N	A, B, C
	2.5pF (2R5)	N	A, B, C
	2.6pF (2R6)	N	A, B, C
	2.7pF (2R7)	N	A, B, C
	2.8pF (2R8)	N	A, B, C
	2.9pF (2R9)	N	A, B, C
	3.0pF (3R0)	N	A, B, C

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.

DIELECTRIC		X8G			
SIZE		0505	0603	0805	Tolerance
RATED VOLTAGE (VDC)		250	250	250	
Capacitance	0.3pF (0R3)		S	T	B
	0.4pF (0R4)	J	S	T	B
	0.5pF (0R5)	J	S	T	A, B, C
	0.6pF (0R6)	J	S	T	A, B, C
	0.7pF (0R7)	J	S	T	A, B, C
	0.8pF (0R8)	J	S	T	A, B, C
	0.9pF (0R9)	J	S	T	A, B, C
	1.0pF (1R0)	J	S	T	A, B, C
	1.1pF (1R1)	J	S	T	A, B, C
	1.2pF (1R2)	J	S	T	A, B, C
	1.3pF (1R3)	J	S	T	A, B, C
	1.4pF (1R4)	J	S	T	A, B, C
	1.5pF (1R5)	J	S	T	A, B, C
	1.6pF (1R6)	J	S	T	A, B, C
	1.7pF (1R7)	J	S	T	A, B, C
	1.8pF (1R8)	J	S	T	A, B, C
	1.9pF (1R9)	J	S	T	A, B, C
	2.0pF (2R0)	J	S	T	A, B, C
	2.1pF (2R1)	J	S	T	A, B, C
	2.2pF (2R2)	J	S	T	A, B, C
	2.3pF (2R3)	J	S	T	A, B, C
	2.4pF (2R4)	J	S	T	A, B, C
	2.5pF (2R5)	J	S	T	A, B, C
	2.6pF (2R6)	J	S	T	A, B, C
	2.7pF (2R7)	J	S	T	A, B, C
	2.8pF (2R8)	J	S	T	A, B, C
	2.9pF (2R9)	J	S	T	A, B, C
	3.0pF (3R0)	J	S	T	A, B, C
	3.1pF (3R1)	J	S	T	A, B, C
	3.2pF (3R2)	J	S	T	A, B, C
	3.3pF (3R3)	J	S	T	A, B, C
	3.4pF (3R4)	J	S	T	A, B, C
	3.5pF (3R5)	J	S	T	A, B, C
	3.6pF (3R6)	J	S	T	A, B, C
	3.7pF (3R7)	J	S	T	A, B, C
	3.8pF (3R8)	J	S	T	A, B, C
	3.9pF (3R9)	J	S	T	A, B, C
	4.0pF (4R0)	J	S	T	A, B, C
	4.1pF (4R1)	J	S	T	A, B, C
	4.2pF (4R2)	J	S	T	A, B, C
	4.3pF (4R3)	J	S	T	A, B, C
	4.4pF (4R4)	J	S	T	A, B, C
	4.5pF (4R5)	J	S	T	A, B, C
	4.6pF (4R6)	J	S	T	A, B, C
	4.7pF (4R7)	J	S	T	A, B, C
	4.8pF (4R8)	J	S	T	A, B, C
	4.9pF (4R9)	J	S	T	A, B, C
	5.0pF (5R0)	J	S	T	A, B, C
	5.1pF (5R1)	J	S	T	B, C
	5.2pF (5R2)	J	S	T	B, C
	5.3pF (5R3)	J	S	T	B, C
	5.4pF (5R4)	J	S	T	B, C
	5.5pF (5R5)	J	S	T	B, C
	5.6pF (5R6)	J	S	T	B, C
	5.7pF (5R7)	J	S	T	B, C
	5.8pF (5R8)	J	S	T	B, C
	5.9pF (5R9)	J	S	T	B, C
	6.0pF (6R0)	J	S	T	B, C

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.

DIELECTRIC		X8G			
SIZE		0505	0603	0805	Tolerance
RATED VOLTAGE (VDC)		250	250	250	
Capacitance	6.1pF (6R1)	J	S	T	B, C
	6.2pF (6R2)	J	S	T	B, C
	6.3pF (6R3)	J	S	T	B, C
	6.4pF (6R4)	J	S	T	B, C
	6.5pF (6R5)	J	S	T	B, C
	6.6pF (6R6)	J	S	T	B, C
	6.7pF (6R7)	J	S	T	B, C
	6.8pF (6R8)	J	S	T	B, C
	6.9pF (6R9)	J	S	T	B, C
	7.0pF (7R0)	J	S	T	B, C
	7.1pF (7R1)	J	S	T	B, C
	7.2pF (7R2)	J	S	T	B, C
	7.3pF (7R3)	J	S	T	B, C
	7.4pF (7R4)	J	S	T	B, C
	7.5pF (7R5)	J	S	T	B, C
	7.6pF (7R6)	J	S	T	B, C
	7.7pF (7R7)	J	S	T	B, C
	7.8pF (7R8)	J	S	T	B, C
	7.9pF (7R9)	J	S	T	B, C
	8.0pF (8R0)	J	S	T	B, C
	8.1pF (8R1)	J	S	T	B, C
	8.2pF (8R2)	J	S	T	B, C
	8.3pF (8R3)	J	S	T	B, C
	8.4pF (8R4)	J	S	T	B, C
	8.5pF (8R5)	J	S	T	B, C
	8.6pF (8R6)	J	S	T	B, C
	8.7pF (8R7)	J	S	T	B, C
	8.8pF (8R8)	J	S	T	B, C
	8.9pF (8R9)	J	S	T	B, C
	9.0pF (9R0)	J	S	T	B, C
	9.1pF (9R1)	J	S	T	B, C
	9.2pF (9R2)	J	S	T	B, C
	9.3pF (9R3)	J	S	T	B, C
	9.4pF (9R4)	J	S	T	B, C
	9.5pF (9R5)	J	S	T	B, C
	9.6pF (9R6)	J	S	T	B, C
	9.7pF (9R7)	J	S	T	B, C
	9.8pF (9R8)	J	S	T	B, C
	9.9pF (9R9)	J	S	T	B, C
	10pF (100)	J	S	T	F, G, J

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.

9. ELECTRICAL CHARACTERISTICS

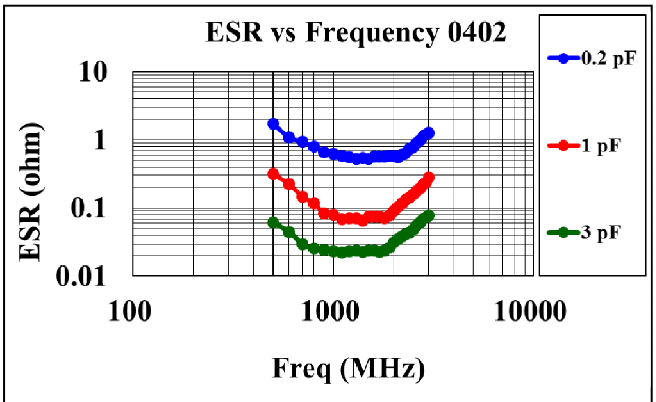


Fig. 2 ESR vs. Frequency (0402 size)

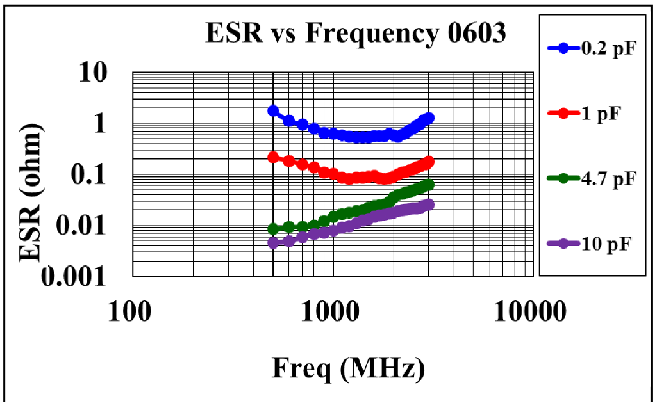


Fig. 3 ESR vs. Frequency (0603 size)

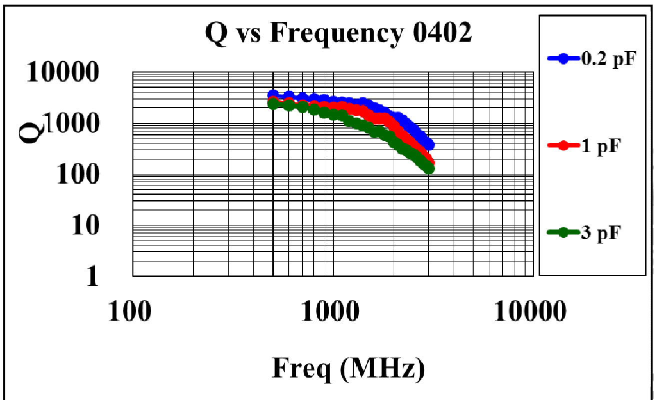


Fig. 4 Q vs. Frequency (0402 size)

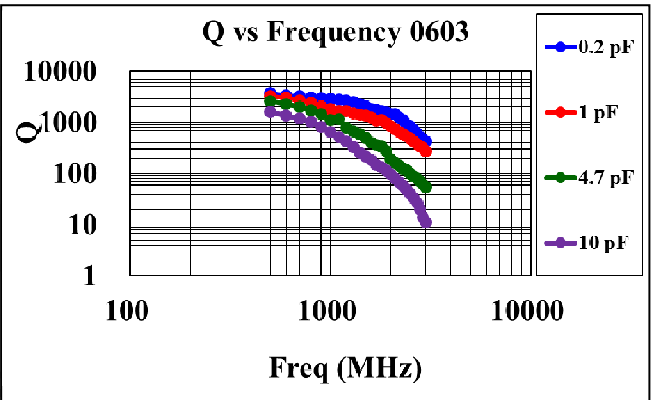


Fig. 5 Q vs. Frequency (0603 size)

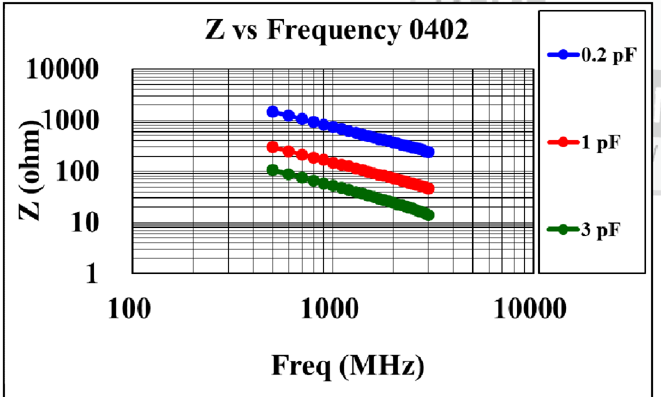


Fig. 6 Impedance vs. Frequency. (0402 size)

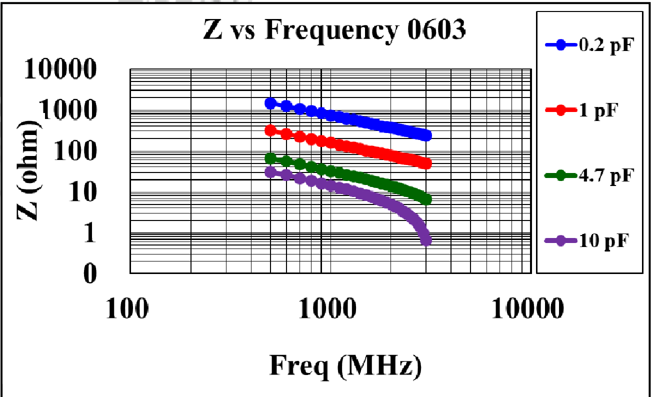


Fig. 7 Impedance vs. Frequency (0603 size)

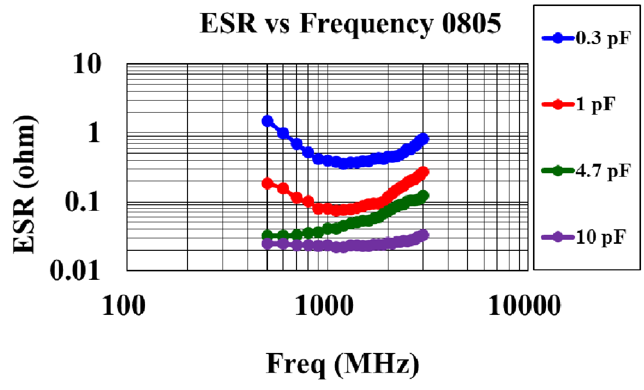


Fig. 8 ESR vs. Frequency (0805 size)

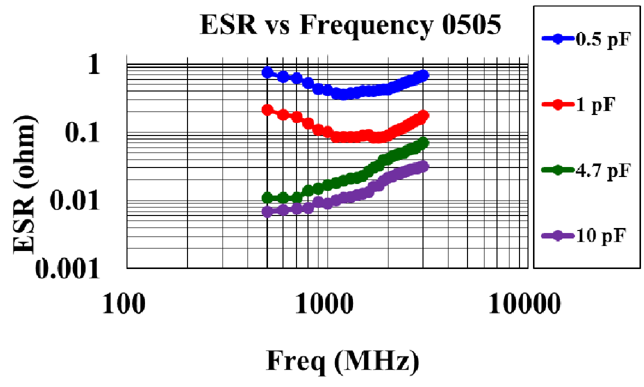


Fig. 9 ESR vs. Frequency (0505 size)

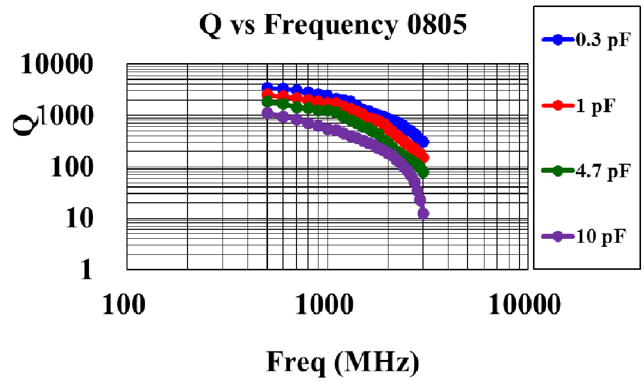


Fig. 10 Q vs. Frequency (0805 size)

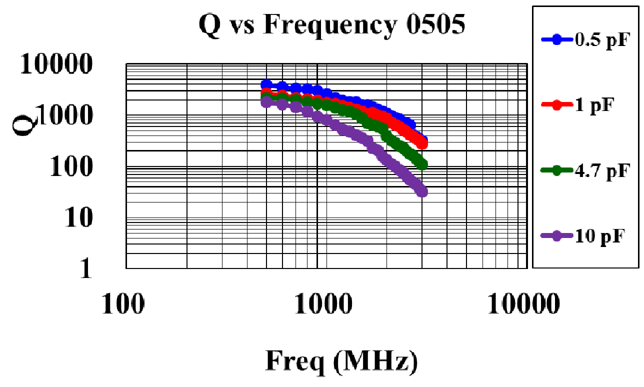


Fig. 11 Q vs. Frequency (0505 size)

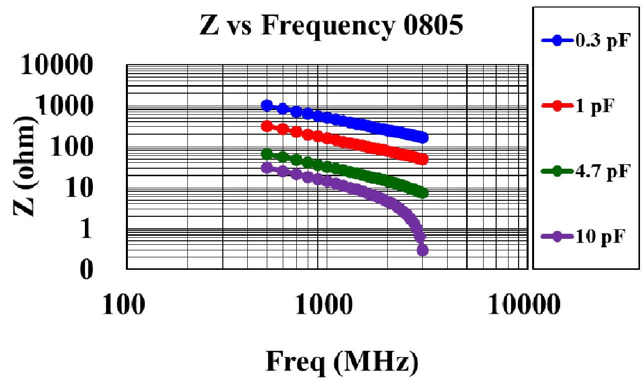


Fig. 12 Impedance vs. Frequency. (0805 size)

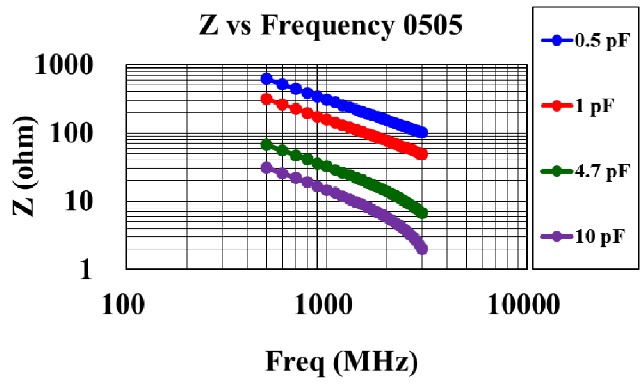


Fig. 13 Impedance vs. Frequency (0505 size)

10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Conditions	Requirements
1.	**Visual and Mechanical**	---	* No remarkable defect. * Dimensions to conform to individual specification sheet.
2.	**Capacitance**	* Test temp.: Room Temperature. 1.0±0.2Vrms, 1MHz±10%	* Shall not exceed the limits given in the detailed spec.
3.	**Q/ D.F. (Dissipation Factor)**		* Q≥800+20C
4.	**Dielectric Strength**	* To apply voltage: 200V ~ 250V : 200% of rated voltage. * Duration: 1 to 5 sec. * Charge & discharge current less than 50mA.	* No evidence of damage or flash over during test.
5.	**Insulation Resistance**	* Test temp.: Room Temperature. ≤100V : To apply rated voltage for max. 120 sec. ≥200V :To apply rated voltage (500V max.) for 60 sec.	≥10GΩ or RxC≥100Ω-F whichever is smaller
6.	**Temperature Coefficient**	With no electrical load. Operating temperature: -55~150℃ at 25℃	* Capacitance change: within ±30ppm/℃;
7.	**Adhesive Strength of Termination**	* Pressurizing force： 0402 to 0603: 5N >0603: 10N * 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.) * Cap./DF(Q) 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 and Q/D.F.: To meet initial spec.
9.	**Solderability**	* Solder temperature: 235±5℃ * 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: within ±5.0% 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.)
11.	**Resistance to Soldering Heat**	* Solder temperature: 260±5℃ * Dipping time: 10±1 sec * Preheating: 120 to 150℃ for 1 minute before immerse the capacitor in a eutectic solder. * 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: within ±2.5% or ±0.25pF whichever is larger. * Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge.

* "Room condition" Temperature: 15 to 35℃, Relative 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：within ±2.5％ or ±0.25pF whichever is larger.
* 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.
* 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: within ±5.0% or ±0.5pF whichever is larger.
* Q/D.F. value: 10pF≤Cap<30pF, Q≥275+2.5C
Cap<10pF; Q≥200+10C
* I.R.: ≥1GΩ.</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 (MAX. 500V)
* 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: within ±7.5% or ±0.75pF whichever is larger.
* Q/D.F. value: Cap<30pF, Q≥100+10/3C
* I.R.: ≥500MΩ.</td></tr>
<tr><td>15.</td><td>High Temperature Load (Endurance)</td><td>* Test temp.: 150±3℃
* To apply voltage:
10V≦Ur<500V : 200% of rated voltage.
* Test time: 2000+24/-0 hrs.
* 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: within ±3.0% or ±0.3pF whichever is larger.
* Q/D.F. value: Cap≤10pF, Q≥200+10C
* I.R.: ≥1GΩ.</td></tr>
<tr><td>16.</td><td>ESR</td><td>The ESR should be measured at room temperature and tested at frequency 1±0.1 GHz.</td><td>
<table>
<tr><th>RH15(0402)</th><th>RH18(0603)</th></tr>
<tr><td>0.1pF≤Cap≤1pF:< 330mΩ/pF</td><td>0.2pF≤Cap≤1pF:< 1400mΩ</td></tr>
<tr><td>1pF<Cap≤3pF:< 280mΩ</td><td>1pF<Cap≤10pF:< 230mΩ</td></tr>
<tr><td></td><td></td></tr>
</table>
<table>
<tr><th>RH21(0805)</th><th>RH11(0505)</th></tr>
<tr><td>0.3pF≤Cap≤1pF: < 1400mΩ</td><td>0.4pF≤Cap<1pF: < 1400mΩ</td></tr>
<tr><td>1pF<Cap≤10pF: < 230mΩ</td><td>1.0pF≤Cap<10pF: < 230mΩ</td></tr>
<tr><td></td><td>Cap=10pF: < 200mΩ</td></tr>
</table>
</td></tr>
</table>

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

APPENDIXES

◙ Tape & reel dimensions

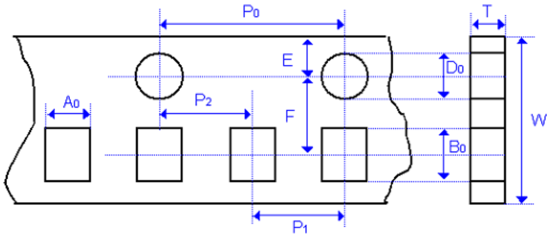


Fig. 14 The dimension of paper tape

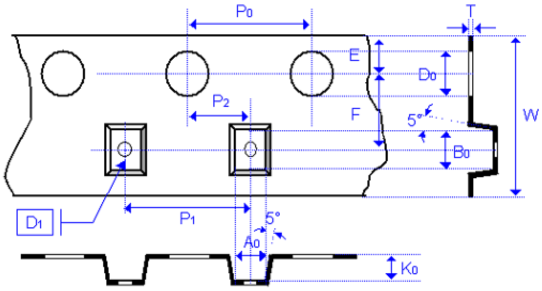


Fig. 15 The dimension of plastic tape

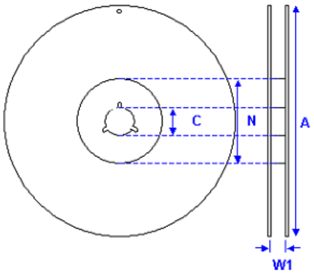
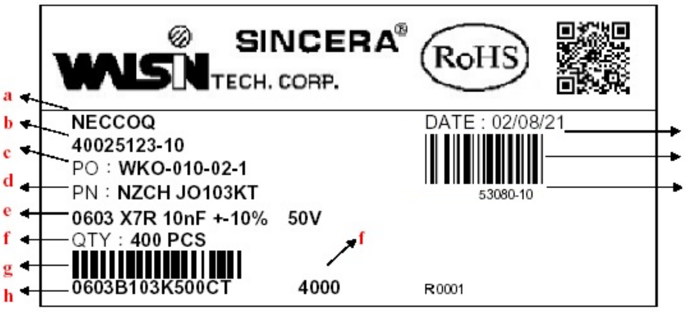


Fig. 16 The dimension of reel

Size	0402	0505	0603	0805
Thickness	N	J	S	T
A_0	0.70 +/-0.20	< 1.90	1.05 +/-0.30	1.50 +/-0.20
B_0	1.20 +/-0.20	< 1.90	1.80 +/-0.30	2.30 +/-0.20
T	≦0.80	0.23 +/-0.1	≦1.20	≦1.20
K_0	-	< 1.50	-	-
W	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
$10xP_0$	40.00 +/-0.10	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
P_2	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
D_1	-	1.00 +/-0.10	-	-
E	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

Size	0402, 0505, 0603, 0805	
Reel size	7”	13”
C	13.0±0.5	13.0±0.5
W_1	10.0±1.5	10.0±1.5
A	178.0±2.0	330.0±2.0
N	60.0+1.0/-0	50 min

◙ Example of customer label



NECCOQ
40025123-10
PO : WKO-010-02-1
PN : NZCH JO103KT
0603 X7R 10nF +-10% 50V
QTY : 400 PCS
0603B103K500CT
4000
DATE : 02/08/21
53080-10
R0001

*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		X8G
①	Ceramic material		Hi-Q dielectric ceramic
②	Inner electrode		Cu
③	Termination	Inner layer	Cu
④		Middle layer	Ni
⑤		Outer layer	Sn (Matt)

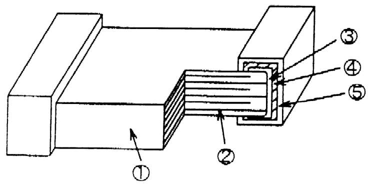


Fig. 17 The construction of MLCC

◙ 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.

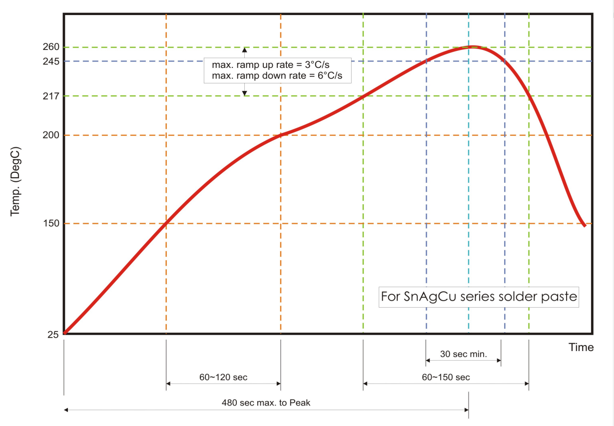


Fig. 18 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

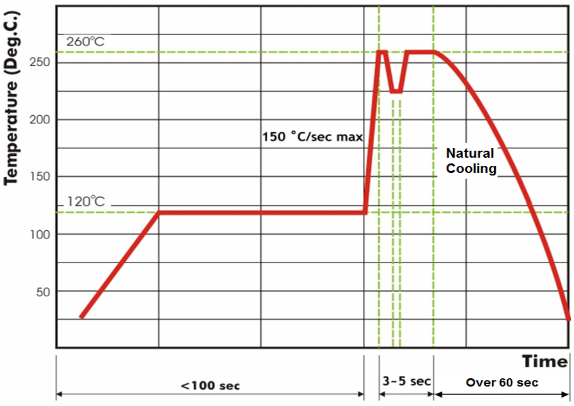


Fig. 19 Recommended wave soldering profile for SMT process with SnAgCu series solder.