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Date : 2023/07/26

APPROVAL SHEET

Product Name : High Q / Low ESR Multilayer Ceramic Chip Capacitors

Part No. : HH Series

Description : Size 0201~0805, C0G, 10V~630V

PREPARED BY	APPROVED BY

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SPECIFICATION

FOR

Product Name : High Q / Low ESR Multilayer Ceramic Chip Capacitors

Part No. : HH Series

Description : Size 0201~0805, C0G, 10V~630V

SPEC. No. : HH-000-001-02

DATE : 2023/07/26

DRAWN BY	CHECEKED BY	APPROVED BY
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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.

HH series MLCC is used at high frequencies generally have a small temperature coefficient of capacitance, typical within the $\pm 30\text{ppm}/^\circ\text{C}$ required for NP0 (C0G) classification and have excellent conductivity internal electrode. Thus, HH series MLCC will be with the feature of low ESR and high Q characteristics.

2. FEATURES

- High Q and low ESR performance at high frequency.
- Quality improvement of telephone calls for low power loss and better performance.

3. APPLICATIONS

- Mobile telecommunication: Mobile phone, WLAN.
- RF module : Power amplifier, VCO.
- Tuners.

4. HOW TO ORDER

HH	15	N	100	G	500	C	I
Series	Size	Dielectric	Capacitance	Tolerance	Rated voltage	Termination	Packaging
HH=High Q/ Low ESR	03=0201 (0603) 15=0402 (1005) 18=0603 (1608) 21=0805 (2012)	N=NP0 (C0G)	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	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. 100=10 VDC 160=16 VDC 250=25 VDC 500=50 VDC 101=100 VDC 201=200 VDC 251=250 VDC 501=500 VDC 631=630 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)	
0201(0603)	0.6±0.03	0.3±0.03	0.3±0.03	L	#	0.15±0.05
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
	1.60 +0.15/-0.10	0.80 +0.15/-0.10	0.80 +0.15/-0.10	X		
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	#	

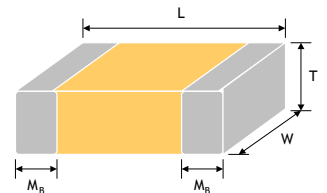


Fig. 5.1 The outline of MLCC

Reflow soldering only is recommended.

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6. GENERAL ELECTRICAL DATA

Dielectric	NP0
Size	0201, 0402, 0603, 0805
Rated voltage (WVDC)	10V, 16V, 25V, 50V, 100V, 200V, 250V, 500V, 630V
Capacitance range	0.1pF to 3300pF
Capacitance tolerance	Cap.≤5pF ^{#1} : A (±0.05pF), B (±0.1pF), C (±0.25pF) 5pF<Cap.<10pF: C (±0.25pF), D (±0.5pF) Cap.≥10pF: F (±1%), G (±2%), J (±5%)
Q	Cap.<30pF: Q≥400+20C Cap.≥30pF: Q≥1000
Capacitance & Q Test condition	Measured at the condition of 30~70% related humidity for 25°C at ambient temperature Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap.≤1000pF Apply 1.0±0.2Vrms, 1.0KHz±10% for Cap.>1000pF
Insulation resistance	≥10GΩ or RxC≥100Ω-F, whichever is smaller
Operating temperature	-55°C to +125°C
Temperature coefficient	±30ppm/°C
Termination	Ni/Sn (lead-free termination)

#1 : NP0, 0.1pF product only provide B tolerance.

** 0402, Capacitance <0.5pF : On request.

7. PACKAGING DIMENSION AND QUANTITY

Size	Thickness (mm)/Symbol		Paper tape		Plastic tape	
			7" reel	13" reel	7" reel	13" reel
0201	0.30±0.03	L	15,000	70,000	-	-
0402	0.50±0.05	N	10,000	50,000	-	-
0603	0.80±0.07	S	4,000	15,000	-	-
	0.80 +0.15/-0.10	X				
0805	0.60±0.10	A	4,000	15,000	-	-
	0.80±0.10	B				
	1.25±0.10	D	-	-	3,000	10,000

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8. CAPACITANCE RANGE

DIELECTRIC		NP0																		
SIZE		0201				0402				0603					0805					
Rated Voltage		10	16	25	50	16	25	50	100	16	25	50	100	200	50	100	200	250	500	630
Capacitance	0.1pF (0R1)					N	N	N	N											
	0.2pF (0R2)					N	N	N	N											
	0.3pF (0R3)	L	L	L	L	N	N	N	N											
	0.4pF (0R4)	L	L	L	L	N	N	N	N											
	0.5pF (0R5)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B				
	0.6pF (0R6)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B				
	0.7pF (0R7)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B				
	0.8pF (0R8)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B				
	0.9pF (0R9)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B				
	1.0pF (1R0)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	1.2pF (1R2)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	1.5pF (1R5)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	1.8pF (1R8)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	2.2pF (2R2)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	2.7pF (2R7)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	3.3pF (3R3)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	3.9pF (3R9)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	4.7pF (4R7)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	5.6pF (5R6)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	6.8pF (6R8)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	8.2pF (8R2)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	10pF (100)	L	L	L	L	N	N	N	N	S	S	S	S	S	B	B	B	B	B	B
	12pF (120)	L	L	L	L	N	N	N	N	S	S	S	S		B	B	B	B	B	B
	15pF (150)	L	L	L	L	N	N	N	N	S	S	S	S		B	B	B	B	B	B
	18pF (180)	L	L	L	L	N	N	N	N	S	S	S	S		B	B	B	B	B	B
	22pF (220)	L	L	L	L	N	N	N	N	S	S	S	S		B	B	B	B	B	B
	27pF (270)	L	L	L	L	N	N	N	N	S	S	S	S		B	B	B	B	B	B
	33pF (330)	L	L	L	L	N	N	N	N	S	S	S	S		B	B	B	B	B	B
	39pF (390)					N	N	N	N	S	S	S	S		B	B	B	B	B	B
	47pF (470)					N	N	N	N	S	S	S	S		B	B	B	B	B	B
	56pF (560)					N	N	N	N	S	S	S	S		B	B	B	B	B	B
	68pF (680)					N	N	N	N	S	S	S	S		B	B	B	B	B	B
	82pF (820)					N	N	N	N	S	S	S	S		B	B	B	B	B	B
	100pF (101)					N	N	N	N	S	S	S	S		B	B	B	B	B	B
	120pF (121)					N	N	N	N	S	S	S	S		D	D	D	D	D	D
	150pF (151)					N	N	N	N	S	S	S	S		D	D	D	D	D	D
180pF (181)					N	N	N	N	S	S	S	S				D	D	D	D	
220pF (221)					N	N	N	N	S	S	S	S				D	D	D	D	
270pF (271)					N	N	N		S	S	S	S				D	D	D	D	
330pF (331)					N	N	N		S	S	S	S				D	D	D	D	
390pF (391)					N	N	N		S	S	S	S				D	D	D	D	
470pF (471)					N	N	N		S	S	S	S								
560pF (561)									S	S	S	S								
680pF (681)									S	S	S	S								
820pF (821)									S	S	S	S								
1,000pF (102)									S	S	S	S								
1,200pF (122)									X	X	X									
1,500pF (152)									X	X	X									
1,800pF (182)									X	X	X									
2,200pF (222)									X	X	X									
2,700pF (272)									X	X	X									
3,300pF (332)									X	X	X									

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

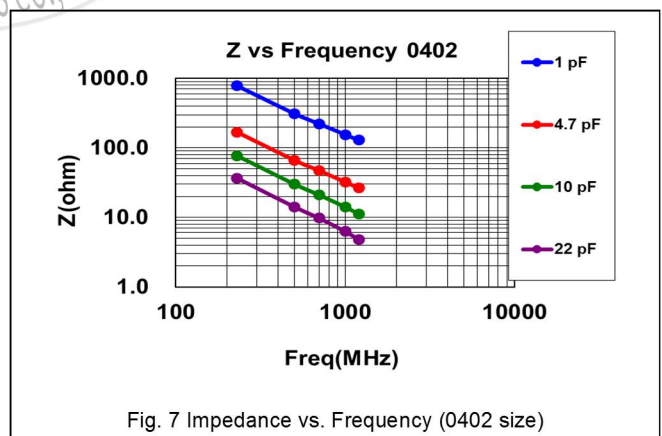
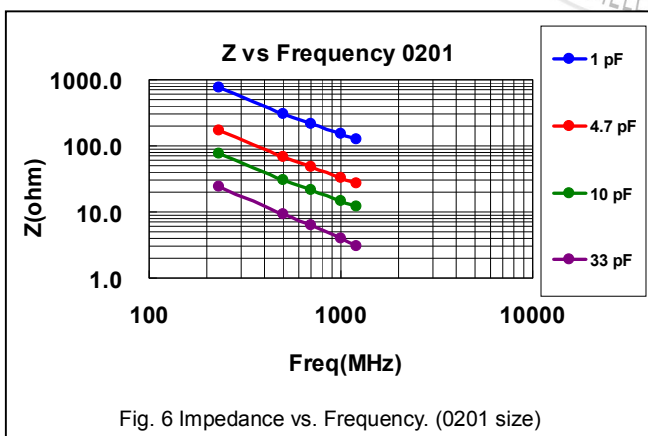
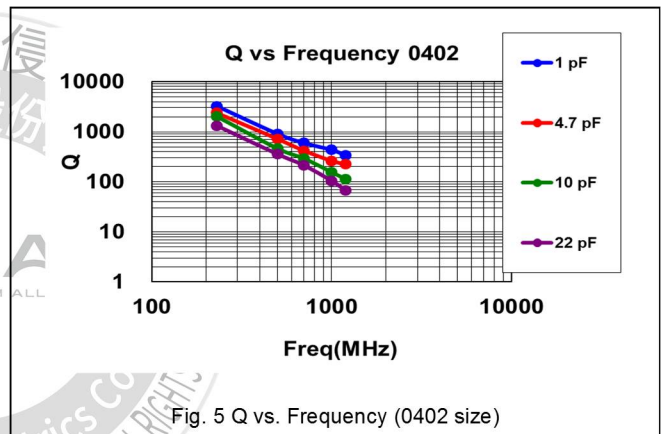
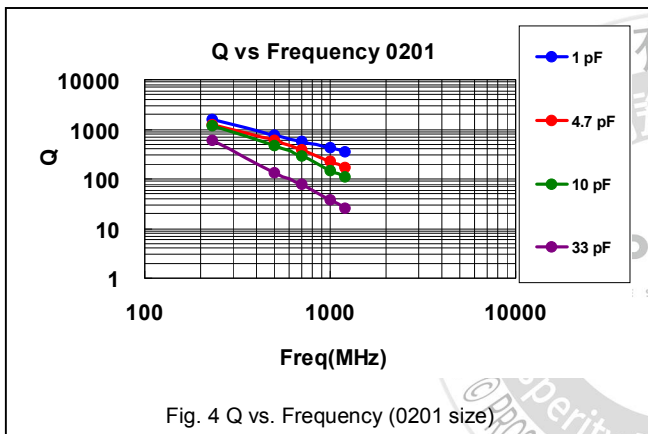
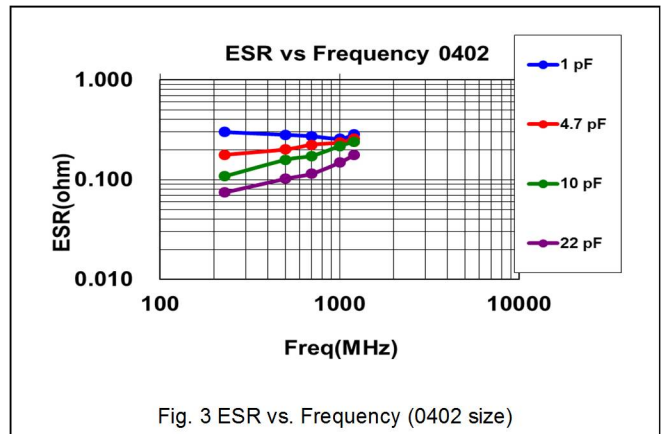
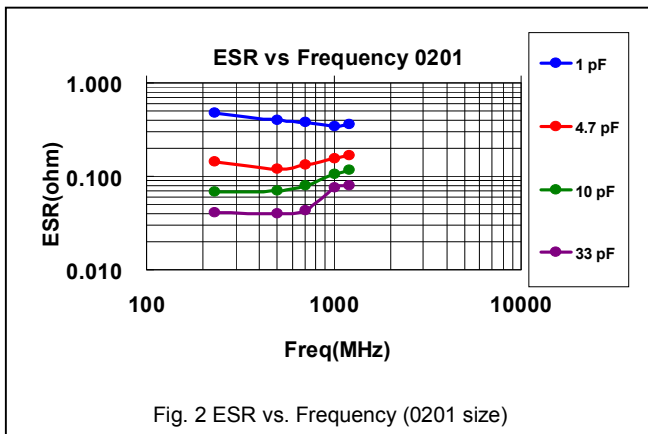
2. 0201 & 0402, Capacitance <0.5pF : On request.

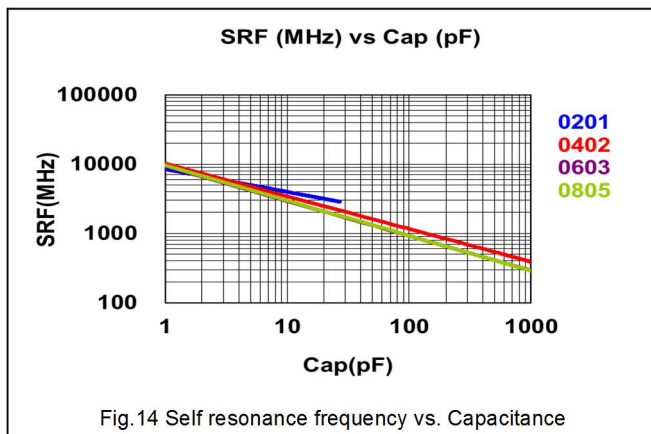
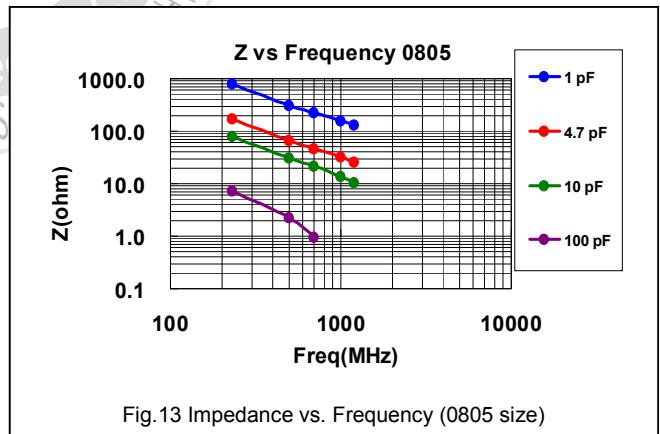
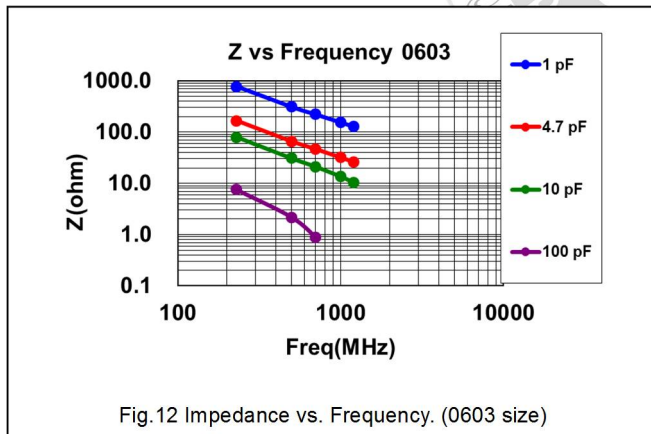
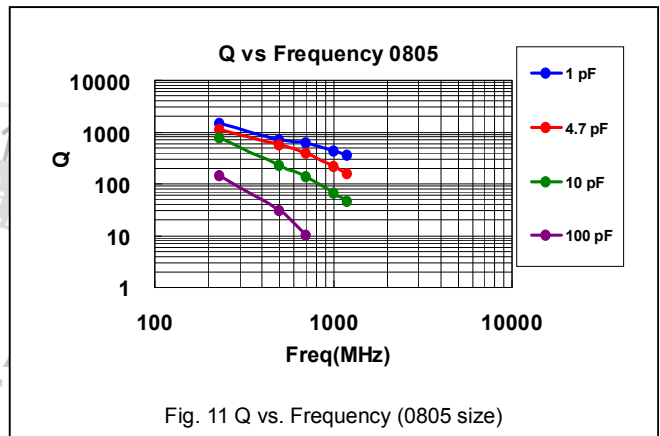
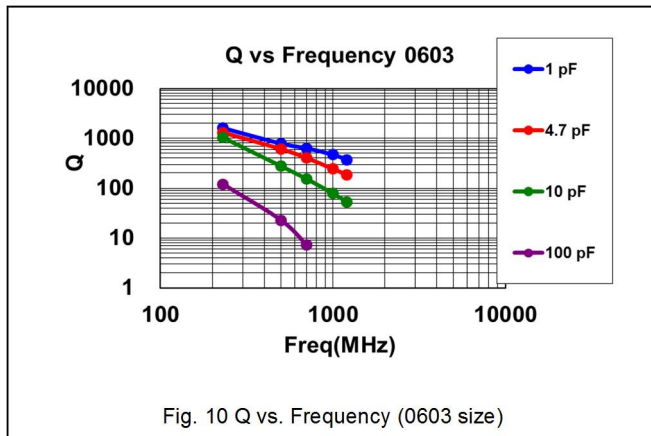
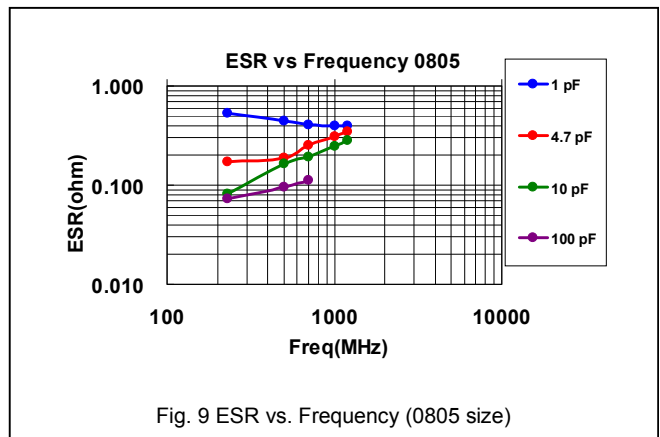
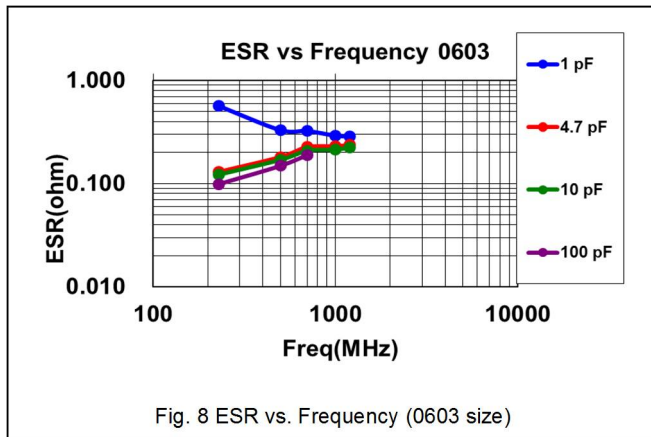
3. For more information about products with special capacitance or other data, please contact WTC local representative.

Specification No. : HH-001-001-02

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9. ELECTRICAL CHARACTERISTICS





10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

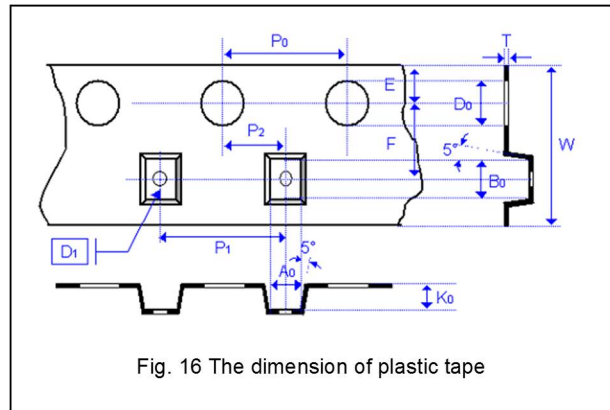
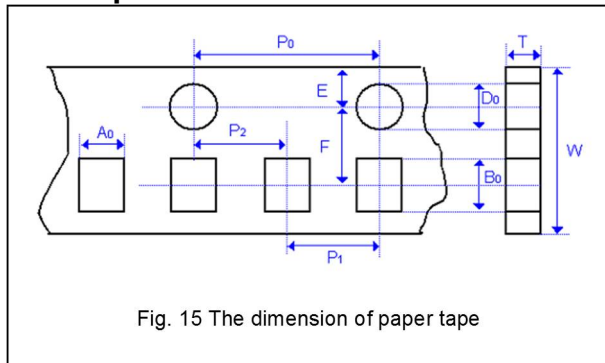
No.	Item	Test Conditions	Requirements
1.	Visual and Mechanical	---	* No remarkable defect. * Dimensions to conform to individual specification sheet.
2.	Capacitance	* Cap. $\leq 1000\text{pF}$, $1.0 \pm 0.2\text{Vrms}$, $1\text{MHz} \pm 10\%$	* Shall not exceed the limits given in the detailed spec.
3.	Q/ D.F. (Dissipation Factor)	* Cap. $> 1000\text{pF}$, $1.0 \pm 0.2\text{Vrms}$, $1\text{KHz} \pm 10\%$ * At 25°C ambient temperature.	* NP0 : Cap. $\geq 30\text{pF}$, $Q \geq 1000$; Cap. $< 30\text{pF}$, $Q \geq 400 + 20\text{C}$.
4.	Dielectric Strength	* To apply voltage : ($\leq 100\text{V}$) 250% of rated voltage. * Duration : 1 to 5 sec. * Charge and discharge current less than 50mA . * To apply voltage : 200V~300V ≥ 2 times VDC. 500V~999V ≥ 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	* Rated voltage : $< 200\text{V}$. * To apply rated voltage for max. 120 sec. * Rated voltage : $200 \sim 630\text{V}$. * To apply rated voltage (500V max.) for 60 sec.	* $\geq 10\text{G}\Omega$. * $\geq 10\text{G}\Omega$ or $R \times C \geq 100\Omega \cdot \text{F}$, whichever is smaller.
6.	Temperature Coefficient	* With no electrical load. * Operating temperature : $-55 \sim 125^\circ\text{C}$ at 25°C .	* Capacitance change : within $\pm 30\text{ppm}/^\circ\text{C}$.
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 : $10 \sim 55\text{ Hz/min}$. * 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°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 : $235 \pm 5^\circ\text{C}$. * 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 : within $\pm 5.0\%$ or $\pm 0.5\text{pF}$ 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: $260 \pm 5^\circ\text{C}$. * Dipping time: 10 ± 1 sec. * Preheating: 120 to 150°C 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°C for 1hr then set for 24 ± 2 hrs at room temp.	* No remarkable damage. * Cap. change : within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ whichever is larger. * Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge.

10. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

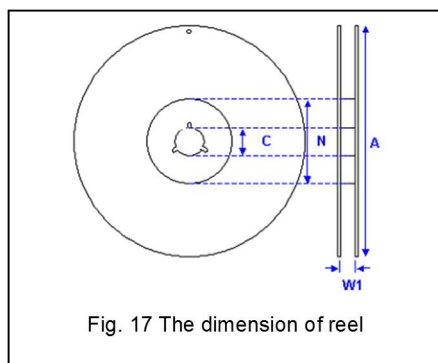
No.	Item	Test Condition	Requirements														
12.	Temperature Cycle	* Conduct the five cycles according to the temperatures and time.	* No remarkable damage.														
			* Cap change : within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ whichever is larger.														
			* Q/D.F., I.R. and dielectric strength : To meet initial requirements.														
		<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$\pm$3</td></tr><tr><td>2</td><td>Room temp.</td><td>2~3</td></tr><tr><td>3</td><td>Max. operating temp. +3/-0</td><td>30$\pm$3</td></tr><tr><td>4</td><td>Room temp.</td><td>2~3</td></tr></table>	Step	Temp.(°C)	Time(min.)	1	Min. operating temp. +0/-3	30 $\pm$ 3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30 $\pm$ 3	4	Room temp.	2~3
Step	Temp.(°C)	Time(min.)															
1	Min. operating temp. +0/-3	30 $\pm$ 3															
2	Room temp.	2~3															
3	Max. operating temp. +3/-0	30 $\pm$ 3															
4	Room temp.	2~3															
		* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24 $\pm$ 2 hrs at room temp.															
13.	Humidity (Damp Heat) Steady State	* Test temp. : 40 $\pm$ 2°C.	* No remarkable damage.														
		* Humidity : 90~95% RH.	* Cap. change : within $\pm 5.0\%$ or $\pm 0.5\text{pF}$ whichever is larger.														
		* Test time : 500+24/-0hrs.	* Q/D.F. value :														
		* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24 $\pm$ 2 hrs at room temp.	NP0 : Cap. $\geq$ 30pF, Q $\geq$ 350.														
			10pF $\leq$ Cap. $<$ 30pF, Q $\geq$ 275+2.5C.														
			Cap. $<$ 10pF; Q $\geq$ 200+10C.														
			* I.R. : $\geq$ 1G Ω or RxC $\geq$ 50 Ω -F, whichever is smaller.														
14.	Humidity (Damp Heat) Load	* Test temp. : 40 $\pm$ 2°C	* No remarkable damage.														
		* Humidity : 90~95%RH	* Cap. change : within $\pm 7.5\%$ or $\pm 0.75\text{pF}$ whichever is larger.														
		* Test time : 500+24/-0 hrs.	* Q/D.F. value :														
		* To apply voltage : Rated voltage (Max. 500V)	NP0 : Cap. $\geq$ 30pF, Q $\geq$ 200; Cap. $<$ 30pF, Q $\geq$ 100+10/3C.														
		* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24 $\pm$ 2 hrs at room temp.	* I.R. : $\geq$ 500M Ω or RxC $\geq$ 25 Ω -F, whichever is smaller.														
15.	High Temperature Load (Endurance)	* Test temp. : NP0 : 125 $\pm$ 3°C.	* No remarkable damage.														
		* To apply voltage :	* Cap. change : within $\pm 3.0\%$ or $\pm 0.3\text{pF}$ whichever is larger.														
		(1) $<$ 500V : 200% of rated voltage.	* Q/D.F. value :														
		(2) 500V : 150% of rated voltage.	NP0 : Cap. $\geq$ 30pF, Q $\geq$ 350.														
		(3) $\geq$ 630V : 120% of rated voltage.	10pF $\leq$ Cap. $<$ 30pF, Q $\geq$ 275+2.5C.														
		* Test time : 1000+24/-0 hrs.	Cap. $<$ 10pF, Q $\geq$ 200+10C.														
		* Cap. / DF(Q) / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24 $\pm$ 2 hrs at room temp.	* I.R. : $\geq$ 1G Ω or RxC $\geq$ 50 Ω -F, whichever is smaller.														

11. APPENDIXES

11.1 Tape & reel dimensions :



Size	0201	0402	0603	0805		
Thickness	L	N	S, X	A	B	C, D, I
A ₀	0.39 +/-0.07	0.70 +/-0.2	1.05 +/-0.30	1.50 +/-0.20	1.50 +/-0.20	< 1.80
B ₀	0.69 +/-0.07	1.20 +/-0.2	1.80 +/-0.30	2.30 +/-0.20	2.30 +/-0.20	< 2.70
T	≤ 0.50	≤ 0.80	≤ 1.20	≤ 1.15	≤ 1.30	0.23 +/-0.1
K ₀	-	-	-	-	-	< 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 +/-0.20
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
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
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
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
D ₀	1.55 +/-0.05	1.55 +/-0.05	1.55 +/-0.05	1.55 +/-0.05	1.55 +/-0.05	1.50 +0.1/-0
D ₁	-	-	-	-	-	1.00 +/-0.10
E	1.75 +/-0.05	1.75 +/-0.05	1.75 +/-0.05	1.75 +/-0.05	1.75 +/-0.05	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



Size	0201, 0402, 0603, 0805		
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 ₁	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

11. APPENDIXES

11.2 Constructions :

No.	Name	NPO
①	Ceramic material	BaTiO ₃ based
②	Inner electrode	Ni
③	Termination	Inner layer
④		Middle layer
⑤		Outer layer
		Sn

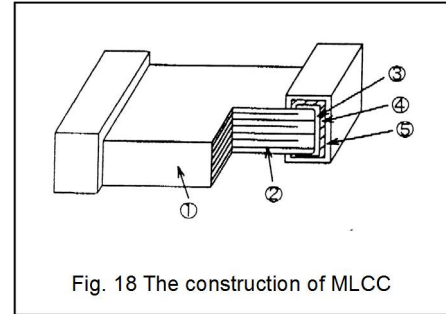


Fig. 18 The construction of MLCC

11.3 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.

11.4 Storage and handling 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.

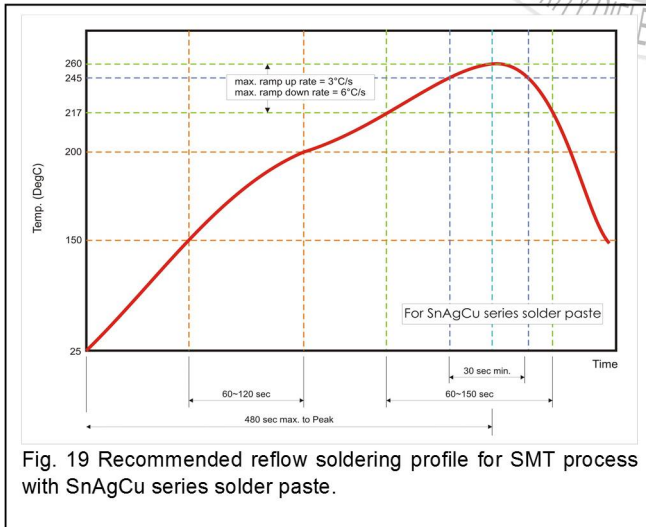


Fig. 19 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

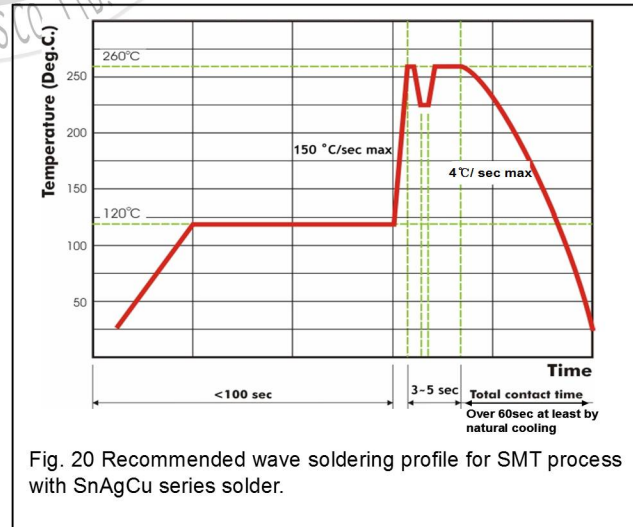


Fig. 20 Recommended wave soldering profile for SMT process with SnAgCu series solder.