

Ultra High Q & Low ESR Multilayer Ceramic Chip Capacitors - GUQ Series



Construction and Dimensions

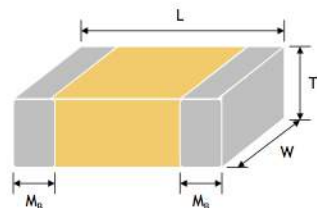
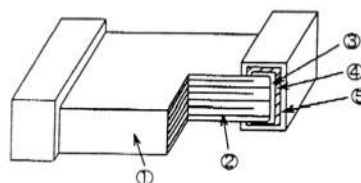


Fig. 1 The outline of MLCC



Scope

- 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.
- Calchip's GUQ series is used at high frequencies and generally have a small temperature coefficient of capacitance, typical within the $+300\text{ppm}/^{\circ}\text{C}$ required for NPO (COG) classification and have excellent conductivity internal electrode (i.e. features low ESR and high Q characteristics)

Features

- High Q and low ESR performance at high frequency.
- Ultra low capacitance to 0.1pF.
- Can offer high precision tolerance to $+0.05\text{pF}$.
- Quality improvement of telephone calls for low power loss and better performance.

Applications

- Telecommunication products and equipment; mobile phones, WLAN, Base Station
- Power amplifier, VCO
- Tuners

No.	Name		NP0
①	Ceramic material		BaTiO ₃ based
②	Inner electrode		Cu
③	Termination	Inner layer	Cu
④		Middle layer	Ni
⑤		Outer layer	Sn (Matt)

Size Inch (mm)	L (mm)	W (mm)	T (mm)	Remark	M _B (mm)
0201 (0603)	0.60±0.03	0.30±0.03	0.30±0.03	#	0.15±0.05
0402 (1005)	1.00±0.05	0.50±0.05	0.50±0.05	#	0.25±0.05/-0.10
0603 (1608)	1.60±0.10	0.80±0.10	0.80±0.07		0.40±0.15
0805 (2012)	2.00±0.15	1.25±0.10	0.60±0.10		0.50±0.20
	2.00±0.20	1.25±0.20	0.85±0.10		

Reflow soldering only is recommended.

GUQ	04	CG	101	J	16	N	T
Product Type	Dimensions	Dielectric	Capacitance	Tolerance	Rated Voltage	Termination	Packaging
	02: 0201 04: 0402 10: 0603 21: 0805	CG: NPO/COG	0R5: 0.5pF 5R0: 5pF 100: 10pF 101: 100pF	A: ±0.05pF B: ±0.1pF C: ±0.25pF D: ±0.5pF F: ±1% G: ±2% J: ±5% K: ±10% M: ±20%	6R3: 6.3 VDC 10: 10 VDC 20: 20 VDC 25: 25 VDC 50: 50 VDC 100: 100 VDC 200: 200 VDC 250: 250 VDC 500: 500 VDC	N = Cu/Ni/Sn	T: 7" reel TD: 13" reel
			* Two significant digits followed by no. of zeros. Use R in place of decimal point		* Two significant digits followed by no. of zeros. And R is in place of decimal point		

[illegible]

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Packaging Dimension and Quantity

Size	Thickness (mm)/Symbol	Paper tape	
		7" reel	13" reel
0201 (0603)	0.30±0.03	15k	70k
0402 (1005)	0.50±0.05	10k	50k
0603 (1608)	0.80±0.07	4k	15k
0805 (2012)	0.60±0.10	4k	15k
	0.85±0.10	4k	15k

Unit: pieces

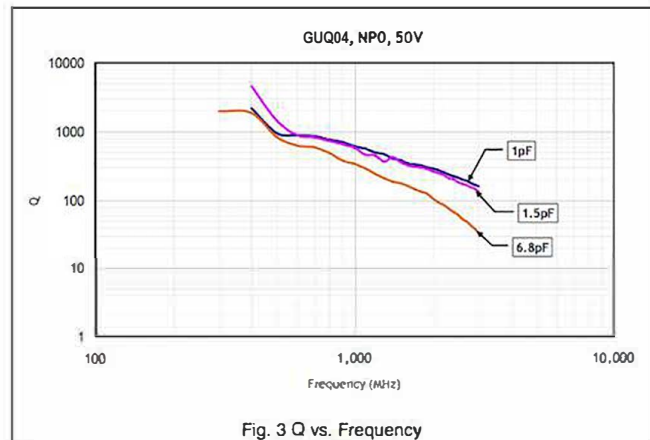
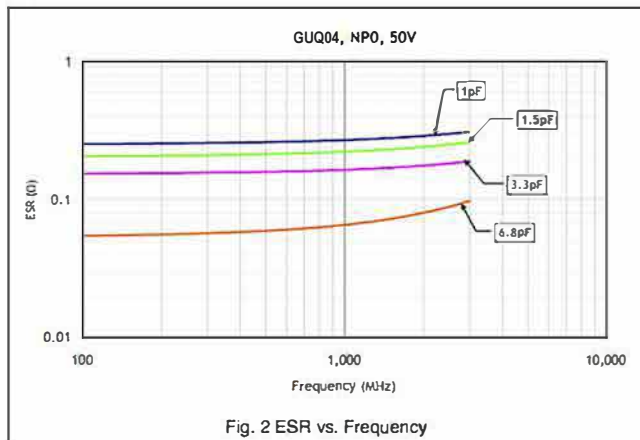
General Electrical Data

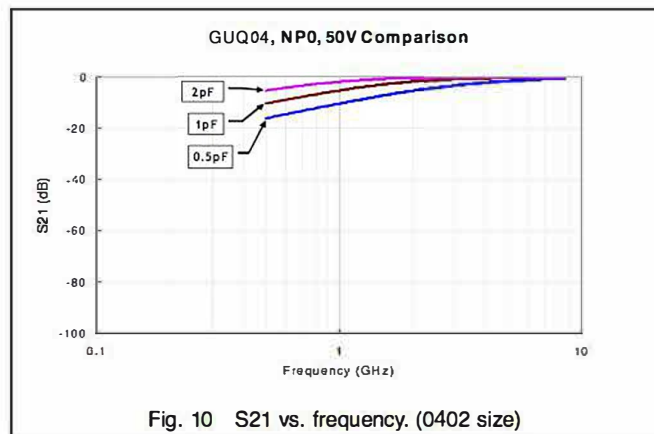
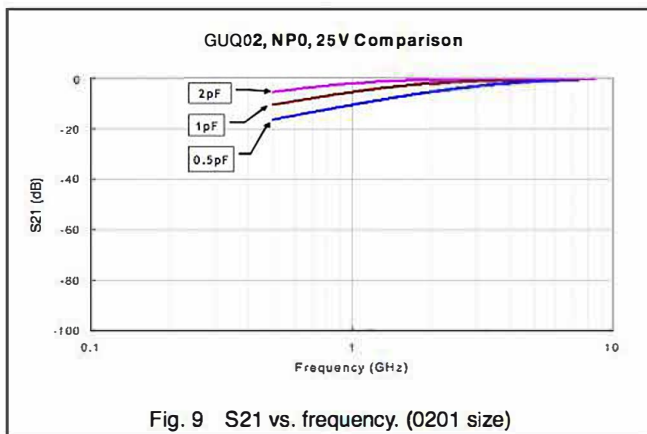
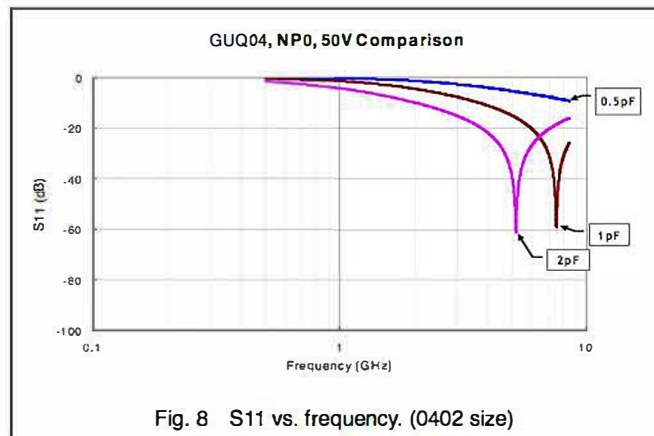
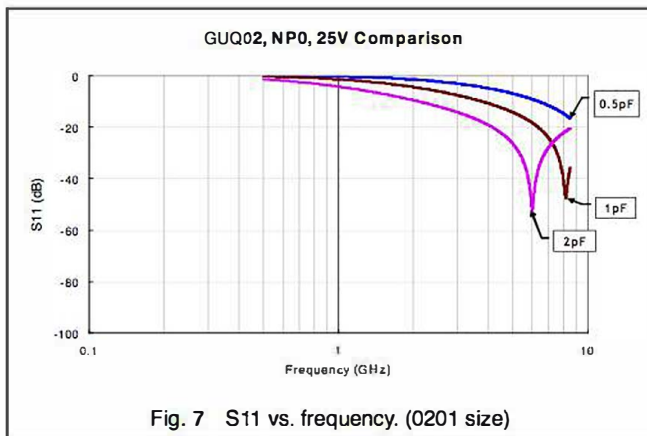
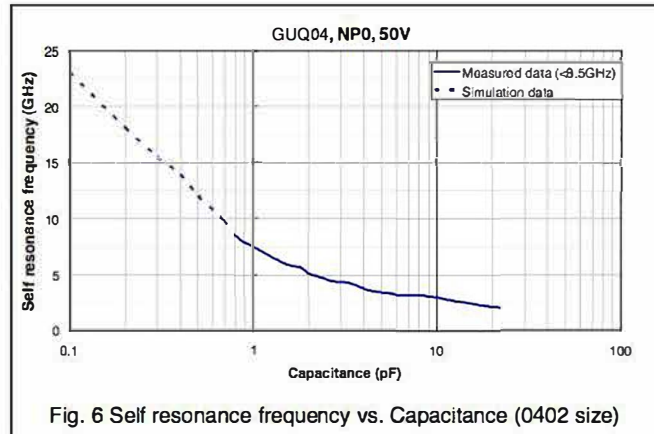
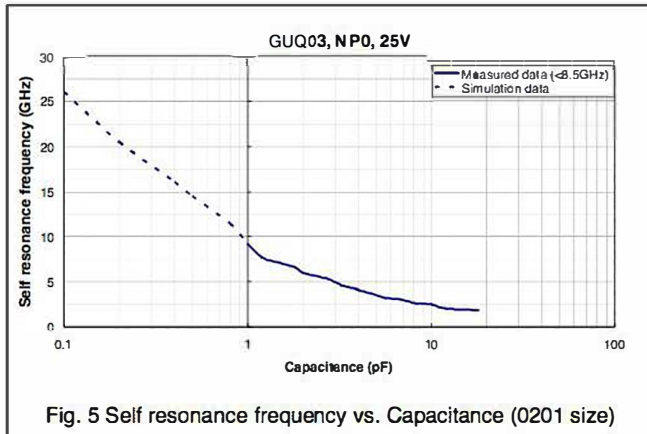
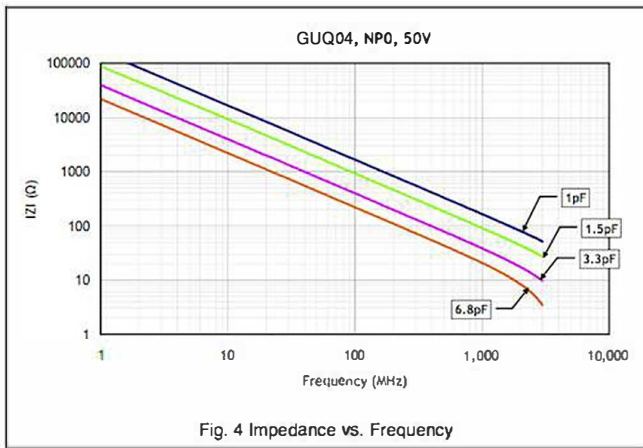
Dielectric	NPO
Size	0201, 0402, 0603, 0805
Capacitance*	0201: 0.1pF to 33pF; 0402: 0.1pF to 100pF; 0603: 0.3pF to 100pF; 0805: 0.2pF to 100pF
Capacitance tolerance	Cap≤5pF: A (±0.05pF), B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: B (±0.1pF), C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%)
Rated voltage (WVDC)	6.3V, 10V, 25V, 50V, 100V, 250V, 500V
Q*	Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C
Insulation resistance at Ur	≥10GΩ or RxC≥100Ω-F whichever is smaller.
Operating temperature	-55 to +125°C
Capacitance change	±30ppm/°C; 0201Cap≥22pF, ±60ppm/°C
Termination	Ni/Sn (lead-free termination)

* Measured at the conditions of 25°C ambient temperature and 30~70% related humidity.

Apply 1.0±0.2Vrms, 1.0MHz±10% for Caps<1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF.

Electrical Characteristics





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	1.0±0.2Vrms, 1MHz±10%	* Shall not exceed the limits given in the detailed spec.
3.	Q/ D.F. (Dissipation Factor)	At 25°C ambient temperature.	* Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C
4.	Dielectric Strength	* To apply voltage: ≤100V, ≥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 1000V~3000V ≥1.2 times VDC * Cut-off, set at 10mA * TEST= 15 sec. * RAMP=0	* No evidence of damage or flash over during test.
5.	Insulation Resistance	≤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: -55~125°C at 25°C	* Capacitance change: within ±30ppm/°C; 0201Cap≥22pF, within ±60ppm/°C
7.	Adhesive Strength of Termination	* Pressurizing force : 0201: 2N 0402 & 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.) * Measurement to be made after keeping at room temp. for 24±2 hrs.	* 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. * 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°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 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* 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.

No.	Item	Test Condition	Requirements																
12.	Temperature Cycle	* 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 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	Step	Temp. (°C)	Time (min.)	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30±3	4	Room temp.	2~3	* 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.	
Step	Temp. (°C)	Time (min.)																	
1	Min. operating temp. +0/-3	30±3																	
2	Room temp.	2~3																	
3	Max. operating temp. +3/-0	30±3																	
4	Room temp.	2~3																	
13.	Humidity (Damp Heat) Steady State	* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and 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: within ±5.0% or ±0.5pF whichever is larger. * Q/D.F. value: Cap≥30pF, Q≥350; 10pF≤Cap<30pF, Q≥275+2.5C Cap<10pF; Q≥200+10C * I.R.: ≥1GΩ.																
14.	Humidity (Damp Heat) Load	* Test temp.: 40±2°C * Humidity: 90~95%RH * Test time: 500+24/-0 hrs. * To apply voltage : rated voltage * Before initial measurement (Class II only): To apply test voltage for 1hr at 40°C and 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: within ±7.5% or ±0.75pF whichever is larger. * Q/D.F. value: Cap≥30pF, Q≥200; Cap<30pF, Q≥100+10/3C * I.R.: ≥500MΩ.																
15.	High Temperature Load (Endurance)	* Test temp.: 125±3°C * To apply voltage: (1) 10V≤Ur<500V: 200% of rated voltage. (2) ≤6.3V or 500V: 150% of rated voltage. (3) Ur≥630V: 120% of rated voltage. * Test time: 1000+24/-0 hrs. * Before initial measurement (Class II only): To apply test voltage for 1hr at test temp. and 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: within ±3.0% or ±0.3pF whichever is larger. * Q/D.F. value: Cap≥30pF, Q≥350 10pF≤Cap<30pF, Q≥275+2.5C Cap<10pF, Q≥200+10C * I.R.: ≥1GΩ.																
16.	ESR	The ESR should be measured at room temperature and tested at frequency 1±0.1 GHz.	<table><tr><th>0201</th><th>0402</th></tr><tr><td>0.1pF≤Cap≤1pF:< 350mΩ</td><td>0.1pF≤Cap≤1pF:< 350mΩ</td></tr><tr><td>1pF<Cap≤5pF:< 300mΩ</td><td>1pF<Cap≤5pF:< 300mΩ</td></tr><tr><td>5pF<Cap≤22pF:< 250mΩ</td><td>5pF<Cap≤100pF:< 250mΩ</td></tr></table> <table><tr><th>0603</th><th>0805</th></tr><tr><td>0.3pF≤Cap≤1pF:< 1500mΩ</td><td>0.3pF≤Cap≤1pF:< 1500mΩ</td></tr><tr><td>1pF<Cap≤10pF:< 250mΩ</td><td>1pF<Cap≤10pF:< 250mΩ</td></tr><tr><td>10pF<Cap≤100pF:< 200mΩ</td><td>Cap>10pF:< 200mΩ</td></tr></table> The ESR should be measured at room temperature and tested at frequency 500±50 MHz.	0201	0402	0.1pF≤Cap≤1pF:< 350mΩ	0.1pF≤Cap≤1pF:< 350mΩ	1pF<Cap≤5pF:< 300mΩ	1pF<Cap≤5pF:< 300mΩ	5pF<Cap≤22pF:< 250mΩ	5pF<Cap≤100pF:< 250mΩ	0603	0805	0.3pF≤Cap≤1pF:< 1500mΩ	0.3pF≤Cap≤1pF:< 1500mΩ	1pF<Cap≤10pF:< 250mΩ	1pF<Cap≤10pF:< 250mΩ	10pF<Cap≤100pF:< 200mΩ	Cap>10pF:< 200mΩ
0201	0402																		
0.1pF≤Cap≤1pF:< 350mΩ	0.1pF≤Cap≤1pF:< 350mΩ																		
1pF<Cap≤5pF:< 300mΩ	1pF<Cap≤5pF:< 300mΩ																		
5pF<Cap≤22pF:< 250mΩ	5pF<Cap≤100pF:< 250mΩ																		
0603	0805																		
0.3pF≤Cap≤1pF:< 1500mΩ	0.3pF≤Cap≤1pF:< 1500mΩ																		
1pF<Cap≤10pF:< 250mΩ	1pF<Cap≤10pF:< 250mΩ																		
10pF<Cap≤100pF:< 200mΩ	Cap>10pF:< 200mΩ																		

Packaging

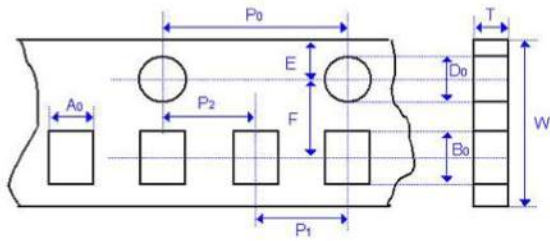


Fig. 11 The dimension of paper tape

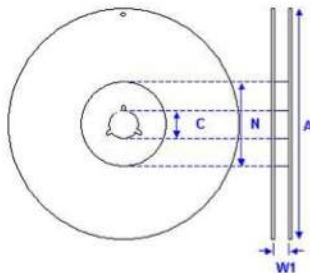


Fig. 12 The dimension of reel

Size	0201	0402	0603	0805
Thickness	0.30±0.30	0.50±0.05	0.80±0.07	0.85±0.10
A ₀	0.37±0.03	0.62±0.05	1.00 +0.05/-0.1	1.50±0.10
B ₀	0.67±0.03	1.12±0.05	1.80±0.10	2.30±0.10
T	0.42±0.03	0.60±0.05	0.95±0.05	0.95±0.05
K ₀	-	-	-	-
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P ₀	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±0.20	40.0±0.20
P ₁	2.00±0.05	2.00±0.05	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	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05
D ₁	-	-	-	-
E	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.05
F	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05

Size	0201, 0402, 0603, 0805	
Reel size	7"	13"
C	13.0+0.5/-0.2	13.0+0.5/-0.2
W ₁	8.4+1.5/-0	8.4+1.5/-0
A	178.0±1.0	330.0±1.0
N	60.0+1.0/-0	100±1.0

Storage and Handling

- (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.

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 N₂ within oven are recommended.

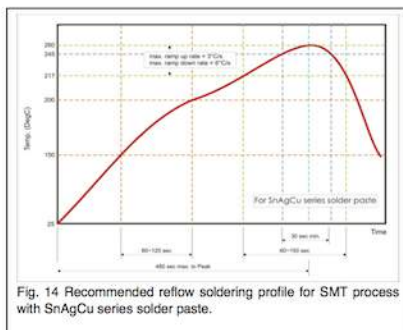


Fig. 14 Recommended reflow soldering profile for SMT process with SnAgCu series solder paste.

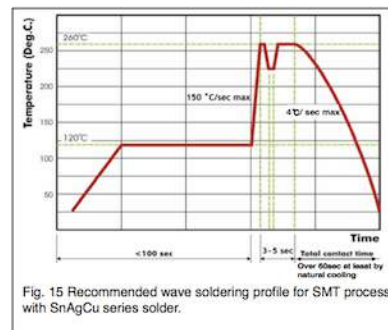


Fig. 15 Recommended wave soldering profile for SMT process with SnAgCu series solder.