MULTI LAYER CERAMIC CAPACITORS
- GML SERIES -

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.
- CCE GML series MLCC is used in product having thickness concerned generally have high capacitance and thinner product thickness. The high dielectric constant material X7R and X5R are used for this series product.

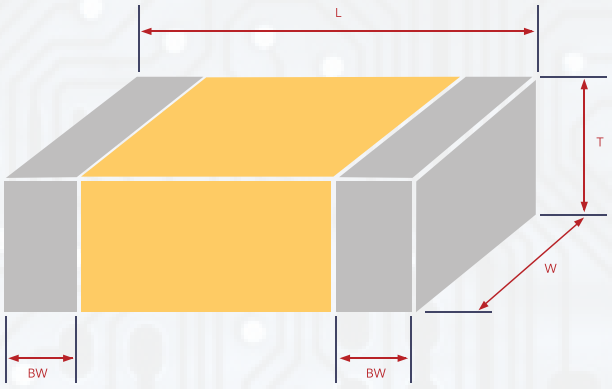
FEATURES

- Standard size with thin thickness.
- Small size with high capacitance.
- Capacitor with lead-free termination (pure Tin).

APPLICATIONS

- For LCD panels.
- For PCMCA cards.
- For IC packaging and modules.
- Any thickness concerned products.

DIMENSIONS



SIZE INCH (MM)	L (MM)	W (MM)	T (MM) SYMBOL		BW (MM)
0402 (1005)	1.00 ± 0.2	0.5 ± 0.2	0.30 ± 0.03	L	0.25 ± 0.10
0603 (1608)	1.6 + -.15 / -0.10	0.8+ 0.15 / - 0.10	0.50 ± 0.10	H	0.40 ± 0.15
0805 (2012)	2.00 ± 0.20	1.25±0.20	0.85 ± 0.10	T	0.50 ± 0.20
1206 (3216)	3.20 ± 0.20	1.60 ± 0.20	0.85 ± 0.10	T	0.60 ± 0.20
			1.15 ± 0.15	J	
1210 (3225)	3.20 ± 0.30	2.50±0.20	0.85 ± 0.10	T	0.75 ± 0.25
			1.25 ± 0.10	U	
			2.00 ± 0.20	K	

ORDERING INFORMATION

GML	21	X5R	475	K	6R3	N	T
SERIES	SIZE	DIELECTRIC	CAPACITANCE	TOLERANCE	VOLTAGE	TERMINATION	PACKAGING
GML - Low Profile	04 - 0402 (1005) 10 - 0603 (1608) 21 - 0805 (2012) 31 - 1206 (3216) 32 - 1210 (3225)	X7R X5R	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: 475 =47x105 =4,700,000 pF =4.7μF	K: ±10% M: ±20%	Two significant digits followed by no. of zeros. And R is in place of decimal point. 6R3: 6.3 VDC 10: 10 VDC 16: 16 VDC 25: 25 VDC 50: 50 VDC 100: 100 VDC 200: 200 VDC	N: Cu / Ni / Sn	T: 7" reeled G: 13" reeled

GENERAL ELECTRICAL DATA

DIELECTRIC	X7R	X5R
SIZE	0402, 0603, 0805, 1206, 1210	
CAPACITANCE RANGE*	0.1μF to 10μF	0.22μF to 47μF
CAPACITANCE TOLERANCE**	K (±10%), M (±20%)	
RATED VOLTAGE	10V, 16V, 25V, 50V, 100V, 200V	6.3V, 10V, 16V, 25V
OPERATING TEMPERATURE	-55 to +125°C	-55 to +85°C
CAPACITANCE CHARACTERISTIC	±15%	
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.
** Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition for 24±2 hours before measurement

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

CAPACITANCE RANGE

- X7R Dielectric

DIELECTRIC			X7R											
SIZE			0805				1206				1210			
RATED VOLTAGE			10	16	25	50	10	16	25	50	10	16	100	200
CAP. RANGE	0.10 µF	104												U
	0.22 µF	224												
	0.33 µF	334												
	0.47 µF	474												
	0.68 µF	684												
	0.82 µF	824												
	1.0 µF	105							T					
	1.5 µF	155												
	2.2 µF	225		T	T					T			K	
	3.3 µF	335												
	4.7 µF	475	T						T					
	6.8 µF	685												
	10 µF	106	N				T							
	22 µF	226						M	M					

- X5R Dielectric

DIELECTRIC			X5R																	
SIZE			0402			0603			0805				1206					1210		
RATED VOLTAGE			6.3	10	25	6.3	10	16	6.3	10	16	25	6.3	10	16	25	50	10	16	25
CAP. RANGE	0.22 µF	224			L		H	H												
	0.47 µF	474	F		L															
	1.0 µF	105	L				H	H		T	T	T		T	T	T	T			
	1.5 µF	155								T	T			T	T	T				
	2.2 µF	225	L						T	T	T	T		T	T	T	T			
	3.3 µF	335												T	T	T		T		
	4.7 µF	475	L				H		T	T	T	T		T	T	T		T		
	6.8 µF	685																		
	10 µF	106				G			T	T	T	T	J	J/T		T		T		T
	22 µF	226	A						T	T	T	T	T		T				T	
	47 µF	476							T				T							

PACKAGING STYLE AND REEL SIZE

SIZE	THICKNESS MASS (MM) / SYMBOL		7" REEL	
			PAPER TAPE	PLASTIC TAPE
0402 (1005)	0.22	F	10K	-
0402 (1005)	0.33	L	15K	-
0402 (1005)	0.7	A	10K	-
0603 (1608)	0.50	G	4K	-
0603 (1608)	0.60	H	4K	-
0805 (2012)	0.95	T	4K	-
0805 (2012)	1.32	N		-
1206 (3216)	0.95	T	4K	-
	1.30	J	-	3K
	1.65	M	-	2K
1210 (3225)	0.95	T	-	3K
	1.35	U	-	3K
	2.00	K	-	1K

MS LEVEL 1

Cal-Chip Electronics Inc.
59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>NO.</th><th>ITEMS</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 confirm to individual specification sheet.</td></tr>
<tr><td>2.</td><td>Capacitance</td><td rowspan="2">- Test temp.: Room Temperature.
Cap≤10μF, 1.0±0.2Vrms, 1kHz±10%
Cap>10μF, 0.5±0.2Vrms, 120Hz±20%**

** Test condition: 0.5±0.2Vrms, 1KHz±10%
GML10 X5R ≥475(10V) , GML04 X5R series

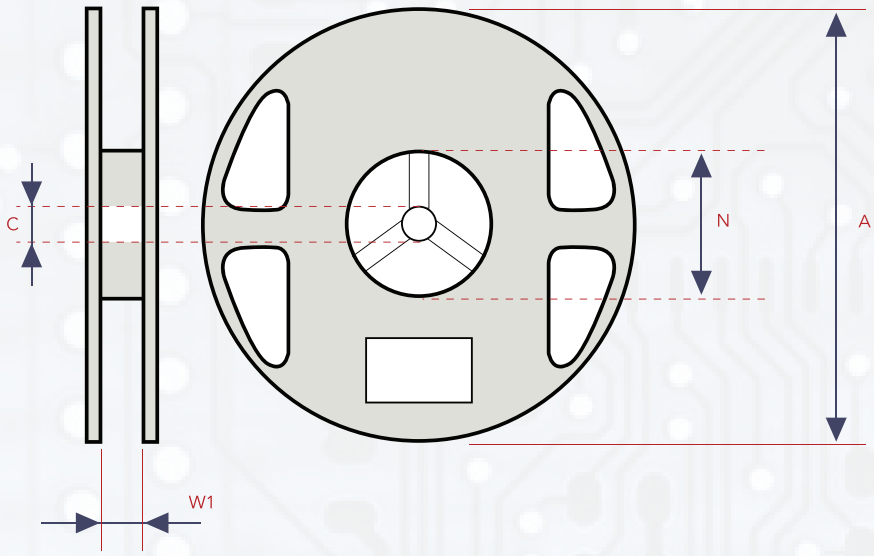
*Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</td><td>- Shall not exceed the limits given in the detailed spec.</td></tr>
<tr><td>3.</td><td>Q/ D.F. (Dissipation Factor)</td><td>X7R / X5R:
<table>
<tr><th>RATED VOL.</th><th>D.F.</th></tr>
<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>≤5%</td></tr>
</table></td></tr>
<tr><td>4.</td><td>Dielectric Strength</td><td>- To apply voltage: 250% rated voltage.
- Duration: 1 to 5 sec.
- Charge and discharge current less than 50mA.</td><td>- No evidence of damage or flash over during test.</td></tr>
<tr><td>5.</td><td>Insulation Resistance</td><td>- Test temp.: Room Temperature.
- To apply rated voltage for max. 120 sec.</td><td>≥10GΩ or RxC ≥ 100Ω - F whichever is smaller.</td></tr>
<tr><td>6.</td><td>Temperature Coefficient</td><td>With no electrical load.
<table>
<tr><th>T.C.</th><th>OPERATING TEMPERATURE</th></tr>
<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>
</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.
- Measurement voltage for Class II:
<table>
<tr><th>0402</th><th>0603</th></tr>
<tr><td>Cap<1μF: 1V</td><td>Cap<1μF: 1V</td></tr>
<tr><td>Cap=1μF: 0.5V**
0402 X7R 224-16V: 0.5V
0402 X7R 474-10V: 0.5V
0402 X5R 475M6R3: 0.5V</td><td>1μF≤Cap≤4.7μF: 0.5V
0603 X5R 106-10V: 0.5V</td></tr>
<tr><td>1μF<Cap<10μF: 0.2V
**0402 X7R 105M6R3V: 0.2V</td><td>Cap>4.7μF: 0.2V</td></tr>
<tr><td>Cap≥10μF: 0.1V</td><td></td></tr>
</table>
<table>
<tr><th>0805</th><th>1206 / 1210</th></tr>
<tr><td>Cap<10μF: 1V</td><td>Cap<10μF: 1V</td></tr>
<tr><td>Cap=10μF: 0.5V
0805 X7R 475/6.3V~25V: 0.5V</td><td>10μF<Cap≤100μF: 0.5V</td></tr>
<tr><td>Cap>10μF: 0.2V</td><td>Cap>100μF: 0.2V
1206 X5R 107-6.3V: 0.2V</td></tr>
</table></td><td>
<table>
<tr><th>T.C.</th><th>CAPACITANCE CHANGE</th></tr>
<tr><td>X7R</td><td>Within ±15%</td></tr>
<tr><td>X5R</td><td>Within ±15%</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.)
- 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</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.
- 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.</td><td>- No remarkable damage.
- Cap change: X7R/X5R: within ±12.5%
(This capacitance change means the change of capacitance underspecified flexure of substrate from the capacitance measured before the test.)</td></tr>
</table>

RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>NO.</th><th>ITEMS</th><th>TEST CONDITION</th><th>REQUIREMENTS</th></tr>
<tr><td>11.</td><td>Resistance to Soldering Heat</td><td>- Solder temperature: 260±5°C
- Dipping time: 10±1 sec
- Preheating: 120 to 150°C for 1 minute before immersing 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.</td><td>- No remarkable damage.
- Cap change: X7R/X5R: within ±7.5%
- Q/D.F., I.R. and dielectric strength: To meet initial requirements.
- 25% max. leaching on each edge.</td></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): 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 .</td><td>- No remarkable damage.
- Cap change: X7R/X5R: within ±7.5%
- 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.
- 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 .</td><td>- No remarkable damage.
- Cap change: X7R/X5R: within ±25%
- Q/D.F. value:
X7R/X5R:
<table><tr><th>RATED VOL.</th><th>D.F.</th></tr><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></table>- I.R.: 1G Ω or RxC≥10 Ω -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.
- 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 .</td><td>No remarkable damage.
*Cap change: X7R/X5R: within ±25%
*Q/D.F. value:
X7R/X5R:
<table><tr><th>RATED VOL.</th><th>D.F.</th></tr><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></table>- I.R.: 500MΩ or RxC≥5 Ω-F whichever is smaller.</td></tr>
<tr><td>15.</td><td>High Temperature Load (Endurance)</td><td>- Test temp.: X7R: 125±3°C I X5R: 85±3°C
- Test time: 1000+24/-0 hrs.
- To apply voltage: 150% of rated voltage.
**100% of rated voltage for below range.
<table><tr><th>SIZE</th><th>DIELECTRIC</th><th>RATED VOLTAGE</th><th>CAPACITANE RANGE</th></tr><tr><td>GML04</td><td>X5R</td><td>6.3V</td><td>C ≥ 1.0 µF</td></tr><tr><td>GML21</td><td>X5R I X7R I X6S</td><td>≤10V</td><td>C ≥ 10 µF</td></tr></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 .
* - Cap. / DF(Q) / I.R. Measurement to ©r de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</td><td>- No remarkable damage.
- Cap change: X7R/X5R: within ±25%
- Q/D.F. value:
X7R/X5R:
<table><tr><th>RATED VOL.</th><th>D.F.</th></tr><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></table>- I.R.: 1GΩ or RxC≥10Ω-F whichever is smaller.</td></tr>
</table>

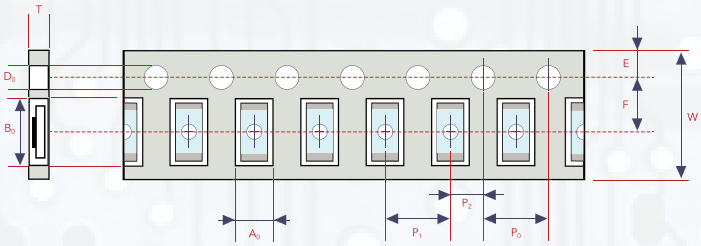
* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.

TAPE AND REEL DIMENSIONS

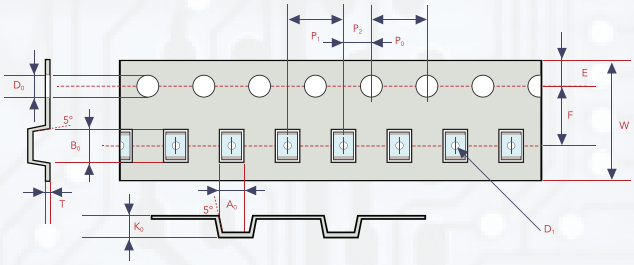


SIZE	0402, 0603, 0805, 1206, 1210		
REEL SIZE	7″	10″	13″
C	13.0 ± 0.5	13.0 ± 0.5	13.0 ± 0.5
W1	10.0 ±1.5	10.0 ± 1.5	10.0 ± 1.5
A	178.0 ± 2.0	250.0 ± 2.0	330.0 ± 2.0
N	60.0+1.0/-0	50 min	50 min

- The dimension of paper tape

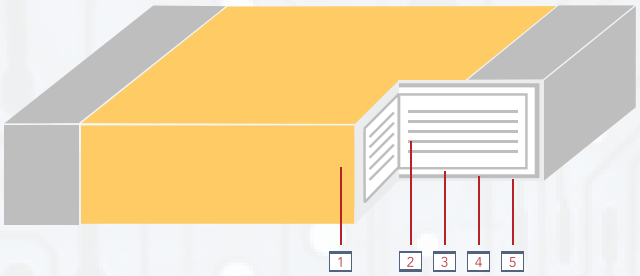


- The dimension of plastic tape



SIZE	0402	0603	0805	1206		1210	
THICKNESS	L	H	T	T	J	T	K
A_0	0.70 ± 0.20	1.05 ± 0.30	1.50 ± 0.20	1.90 ± 0.50	<2.00	<3.05	<3.05
B_0	1.20 ± 0.20	1.80 ± 0.30	2.30 ± 0.20	3.50 ± 0.50	<3.70	<3.80	<3.80
T	≤0.80	≤1.20	≤1.20	≤1.20	0.23 ± 0.1	0.23 ± 0.1	0.23 ± 0.1
K_0	-	-	-	-	<2.00	<1.50	<2.50
W	8.00 ± 0.30	8.00 ± 0.30	8.00 ± 0.30	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	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	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	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	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	1.50 +0.1 / -0	1.50 +0.1 / -0	1.50 +0.1 / -0
D_1	-	-	-	-	1.00 ± 0.10	1.00 ± 0.10	1.00 ± 0.10
E	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

CONSTRUCTION



NO.	NAME		X7R, X5R
1	Ceramic Material		$BaTiO_3$ based
2	Inner Electrode		Ni
3	Termination	Inner Layer	Cu
4		Middle Layer	Ni
5		Outer Layer	Sn (Matt)

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:

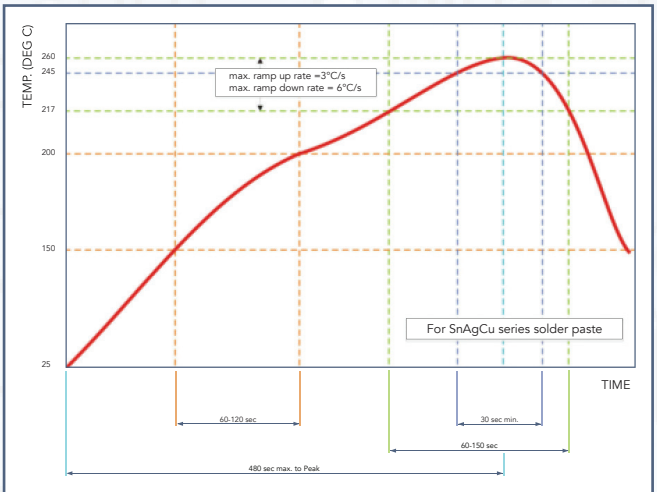
a. The corrosive gas reacts on the terminal electrodes of capacitors, and results in the poor solderability. Do not store the capacitors in the ambience of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)

b. In corrosive atmosphere, solderability might be degraded, and silver migration might occur to cause low reliability.

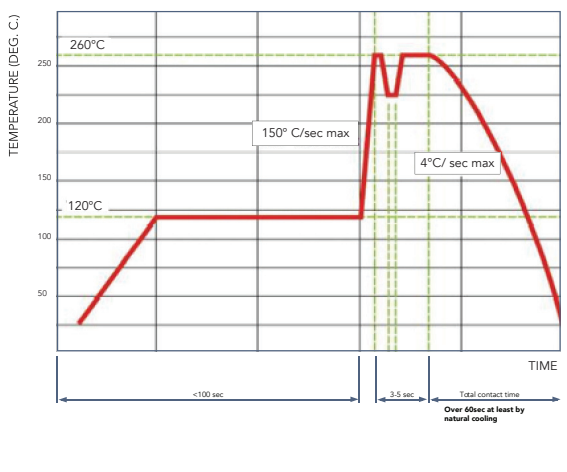
c. Due to the dewing by rapid humidity change, or the photochemical change of the terminal electrode by direct sunlight,the solderability and electrical performance may deteriorate. Do not store capacitors under direct sunlight or dewing condition. To store products on the shelf and avoid exposure to moisture.

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.



Recommeded reflow soldering profile for SMT process with SnAgCu series paste.



Recommeded flow soldering profile for SMT process with SnAgCu series paste.

MS LEVEL 1

59 Steamwhistle Drive, Ivyland, PA 18974 | p. 215.942.8900 | www.calchip.com | quotes@calchip.com

REVISION: MAR '25