

# 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).

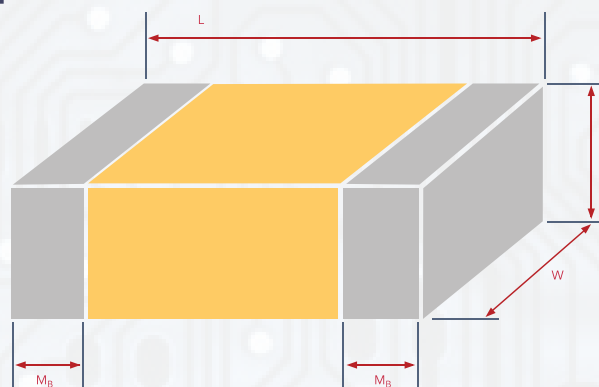
### APPLICATIONS

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

### 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

### DIMENSIONS



SIZE INCH (MM)	L (MM)	W (MM)	T (MM) SYMBOL	MB (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 / -.10	0.8 ± 0.15 / -.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	

### 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



## CAPACITANCE RANGE

- X7R Dielectric

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

- X5R Dielectric

DIAELECTRIC		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 $\mu$ F	224		L		H	H												
	0.47 $\mu$ F	474	F		L														
	1.0 $\mu$ F	105	L			H	H		T	T	T		T	T	T	T			
	1.5 $\mu$ F	155							T	T	T		T	T	T	T			
	2.2 $\mu$ F	225	L						T	T	T	T		T	T	T	T		
	3.3 $\mu$ F	335												T	T	T		T	
	4.7 $\mu$ F	475	L			H			T	T	T	T		T	T	T		T	
	6.8 $\mu$ F	685																	
	10 $\mu$ F	106				G			T	T	T	T	J	J/T		T		T	T
	22 $\mu$ F	226	A						T	T	T	T	T		T			T	
	47 $\mu$ F	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	-
1206 (3216)	0.95	T	4k	-
	1.30	J	-	3k
1210 (3225)	0.95	T	-	3k
	1.35	U	-	3k
	2.00	K	-	1k



## RELIABILITY TEST CONDITIONS AND REQUIREMENTS

NO.	ITEMS	TEST CONDITION	REQUIREMENTS																														
1.	Visual and Mechanical	- - -	- No remarkable defect. - Dimensions to confirm to individual specification sheet.																														
2.	Capacitance	- Test temp.: Room Temperature. Cap≤10μF, 1.0±0.2Vrms, 1kHz±10% Cap>10μF, 0.5±0.2Vrms, 120Hz±20%**	- Shall not exceed the limits given in the detailed spec.																														
3.	Q/ D.F. (Dissipation Factor)	** 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.	X7R / X5R: <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>RATED VOL.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table>	RATED VOL.	D.F.	100V	≤5%	50V, 25V, 16V, 10V	≤10%	6.3V	≤5%																						
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4.	Dielectric Strength	- To apply voltage: 250% rated voltage. - Duration: 1 to 5 sec. - Charge and discharge current less than 50mA.	- No evidence of damage or flash over during test.																														
5.	Insulation Resistance	- Test temp.: Room Temperature. - To apply rated voltage for max. 120 sec.	≥10GΩ or RxC ≥ 100Ω - F whichever is smaller.																														
6.	Temperature Coefficient	With no electrical load. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>T.C.</th> <th>OPERATING TEMPERATURE</th> </tr> </thead> <tbody> <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> </tbody> </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 border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>0402</th> <th>0603</th> </tr> </thead> <tbody> <tr> <td>Cap&lt;1μF: 1V</td> <td>Cap&lt;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&lt;Cap&lt;10μF: 0.2V **0402 X7R 105M6R3V: 0.2V</td> <td>Cap&gt;4.7μF: 0.2V</td> </tr> <tr> <td>Cap≥10μF: 0.1V</td> <td></td> </tr> </tbody> </table> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>0805</th> <th>1206 / 1210</th> </tr> </thead> <tbody> <tr> <td>Cap&lt;10μF: 1V</td> <td>Cap&lt;10μF: 1V</td> </tr> <tr> <td>Cap=10μF: 0.5V 0805 X7R 475/6.3V~25V: 0.5V</td> <td>10μF&lt;Cap≤100μF: 0.5V</td> </tr> <tr> <td>Cap&gt;10μF: 0.2V</td> <td>Cap&gt;100μF: 0.2V 1206 X5R 107-6.3V: 0.2V</td> </tr> </tbody> </table>	T.C.	OPERATING TEMPERATURE	X7R	-55~125°C at 25°C	X5R	-55~85°C at 25°C	0402	0603	Cap<1μF: 1V	Cap<1μF: 1V	Cap=1μF: 0.5V** 0402 X7R 224-16V: 0.5V 0402 X7R 474-10V: 0.5V 0402 X5R 475M6R3: 0.5V	1μF≤Cap≤4.7μF: 0.5V 0603 X5R 106-10V: 0.5V	1μF<Cap<10μF: 0.2V **0402 X7R 105M6R3V: 0.2V	Cap>4.7μF: 0.2V	Cap≥10μF: 0.1V		0805	1206 / 1210	Cap<10μF: 1V	Cap<10μF: 1V	Cap=10μF: 0.5V 0805 X7R 475/6.3V~25V: 0.5V	10μF<Cap≤100μF: 0.5V	Cap>10μF: 0.2V	Cap>100μF: 0.2V 1206 X5R 107-6.3V: 0.2V	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>T.C.</th> <th>CAPACITANCE CHANGE</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> <tr> <td>X5R</td> <td>Within ±15%</td> </tr> </tbody> </table>	T.C.	CAPACITANCE CHANGE	X7R	Within ±15%	X5R	Within ±15%
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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: 10~55 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	- 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. - 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.	- 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.)																														



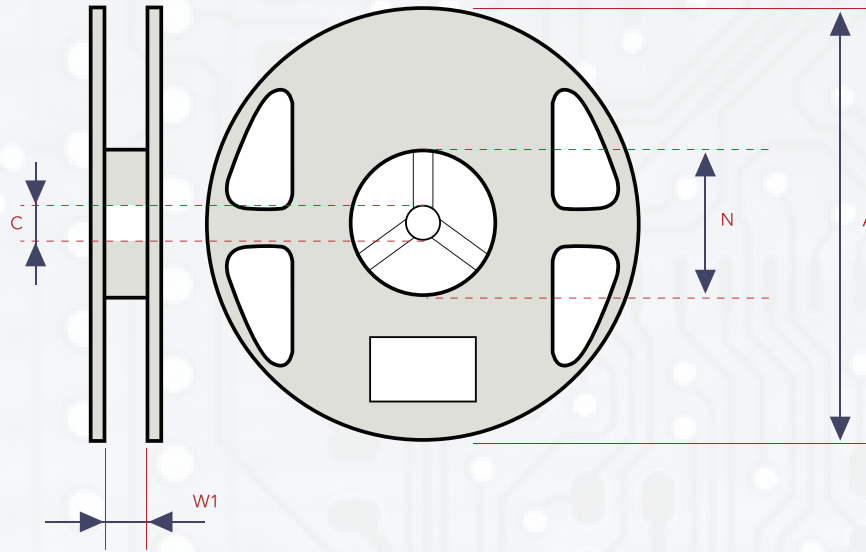
## RELIABILITY TEST CONDITIONS AND REQUIREMENTS

NO.	ITEMS	TEST CONDITION	REQUIREMENTS																						
11.	Resistance to Soldering Heat	<ul style="list-style-type: none"> <li>- Solder temperature: 260±5°C</li> <li>- Dipping time: 10±1 sec</li> <li>- Preheating: 120 to 150°C for 1 minute before immersing the capacitor in a eutectic solder.</li> <li>- Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</li> <li>- 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.</li> </ul>	<ul style="list-style-type: none"> <li>- No remarkable damage.</li> <li>- Cap change: X7R/X5R: within ±7.5%</li> <li>- Q/D.F., I.R. and dielectric strength: To meet initial requirements.</li> <li>- 25% max. leaching on each edge.</li> </ul>																						
12.	Temperature Cycle	<ul style="list-style-type: none"> <li>- Conduct the five cycles according to the temperatures and time.</li> </ul> <table border="1"> <thead> <tr> <th>STEP</th> <th>TEMP. (°C)</th> <th>TIME (MIN)</th> </tr> </thead> <tbody> <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> </tbody> </table> <ul style="list-style-type: none"> <li>- Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</li> <li>- 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 .</li> </ul>	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	<ul style="list-style-type: none"> <li>- No remarkable damage.</li> <li>- Cap change: X7R/X5R: within ±7.5%</li> <li>- Q/D.F., I.R. and dielectric strength: To meet initial requirements.</li> </ul>							
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3	Max. operating temp. +3/-0	30±3																							
4	Room Temp	2-3																							
13.	Humidity (Damp Heat) Steady State	<ul style="list-style-type: none"> <li>- Test temp.: 40±2°C</li> <li>- Humidity: 90~95% RH</li> <li>- Test time: 500+24/-0hrs.</li> <li>- Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li> <li>- 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 .</li> </ul>	<ul style="list-style-type: none"> <li>- No remarkable damage.</li> <li>- Cap change: X7R/X5R: within ±25%</li> <li>- Q/D.F. value: X7R/X5R:</li> </ul> <table border="1"> <thead> <tr> <th>RATED VOL.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table> <ul style="list-style-type: none"> <li>- I.R.: 1G Ω or RxC≥10 Ω -F whichever is smaller.</li> </ul>	RATED VOL.	D.F.	100V	≤7.5%	25V, 16V	≤15%	10V	≤20%	50V, 6.3V	≤30%												
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14.	Humidity (Damp Heat) Load	<ul style="list-style-type: none"> <li>- Test temp.: 40±2°C</li> <li>- Humidity: 90~95%RH</li> <li>- Test time: 500+24/-0 hrs.</li> <li>- To apply voltage: Rated voltage.</li> <li>- Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</li> <li>- 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 .</li> </ul>	<ul style="list-style-type: none"> <li>No remarkable damage.</li> <li>*Cap change: X7R/X5R: within ±25%</li> <li>*Q/D.F. value: X7R/X5R:</li> </ul> <table border="1"> <thead> <tr> <th>RATED VOL.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table> <ul style="list-style-type: none"> <li>- I.R.: 500MΩ or RxC≥5 Ω-F whichever is smaller.</li> </ul>	RATED VOL.	D.F.	100V	≤7.5%	25V, 16V	≤15%	10V	≤20%	50V, 6.3V	≤30%												
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15.	High Temperature Load (Endurance)	<ul style="list-style-type: none"> <li>- Test temp.: X7R: 125±3°C   X5R: 85±3°C</li> <li>- Test time: 1000+24/-0 hrs.</li> <li>- To apply voltage: 150% of rated voltage.</li> <li>**100% of rated voltage for below range.</li> </ul> <table border="1"> <thead> <tr> <th>SIZE</th> <th>DIELECTRIC</th> <th>RATED VOLTAGE</th> <th>CAPACITANCE RANGE</th> </tr> </thead> <tbody> <tr> <td>GML04</td> <td>X5R</td> <td>6.3V</td> <td>C ≥ 1.0 μF</td> </tr> <tr> <td>GML21</td> <td>X5R   X7R   X6S</td> <td>≤10V</td> <td>C ≥ 10 μF</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>- Before initial measurement (Class II only): To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp .</li> <li>* - Cap. / DF(Q) / I.R. Measurement to ©r de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</li> </ul>	SIZE	DIELECTRIC	RATED VOLTAGE	CAPACITANCE RANGE	GML04	X5R	6.3V	C ≥ 1.0 μF	GML21	X5R   X7R   X6S	≤10V	C ≥ 10 μF	<ul style="list-style-type: none"> <li>- No remarkable damage.</li> <li>- Cap change: X7R/X5R: within ±25%</li> <li>- Q/D.F. value: X7R/X5R:</li> </ul> <table border="1"> <thead> <tr> <th>RATED VOL.</th> <th>D.F.</th> </tr> </thead> <tbody> <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> </tbody> </table> <ul style="list-style-type: none"> <li>- I.R.: 1GΩ or RxC≥10Ω-F whichever is smaller.</li> </ul>	RATED VOL.	D.F.	100V	≤7.5%	25V, 16V	≤15%	10V	≤20%	50V, 6.3V	≤30%
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\* "Room condition" Temperature: 15 to 35°C, Relative humidity: 25 to 75%, Atmospheric pressure: 86 to 106kPa.



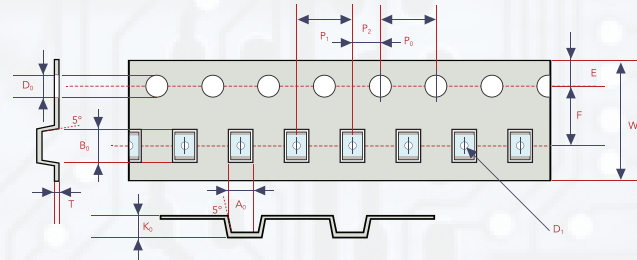
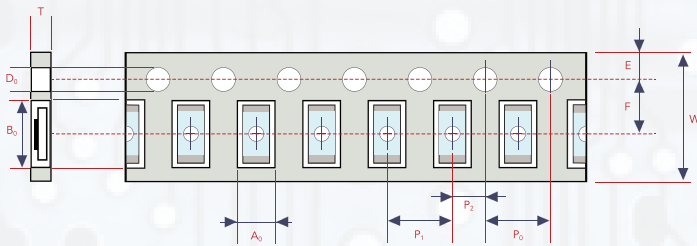
**TAPE AND REEL DIMENSIONS**



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

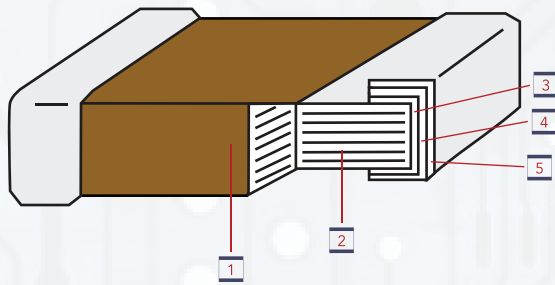
- The dimension of paper tape

- The dimension of plastic tape



SIZE	0402	0603	0805	1206	1210		
THICKNESS	L	H	T	T	J	T	K
A0	0.70 ± 0.20	1.05 ± 0.30	1.50 ± 0.20	1.90 ± 0.50	<2.00	<3.05	<3.05
B0	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
K0	-	-	-	-	<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
P0	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
10XP0	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
P1	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
P2	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
D0	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
D1	-	-	-	-	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 <sub>3</sub> 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 N<sub>2</sub> within oven are recommended.

