

# SMD Multilayer Ceramic Capacitors **multicomp** PRO

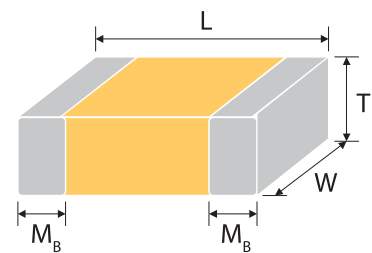
RoHS  
Compliant



## External Dimensions:

Size Inch (mm)	L (mm)	W (mm)	T (mm)/Symbol	MB min (mm)
2220 (5750)	5.7 ±0.4	5 ±0.4	2.5 ±0.3 (M)	0.85 ±0.35

# Reflow soldering only is recommended.



The outline of MLCC

## General Electrical Data:

Dielectric	X7R
Size	2220
Capacitance*	1000pF to 47µF
Capacitance tolerance	J (±5%), K (±10%), M (±20%)
Rated voltage (WVDC)	25V, 50V, 100V, 200V, 250V, 500V, 630V, 1000V, 1500V, 2000V, 2500V, 3000V, 4000V
Tanδ*	Cap<4.7µF:≤2.5% Cap≥4.7µF:≤3.5%
Operating temperature	-55°C to +125°C
Capacitance characteristic	±15%
Termination	Ni/Sn (lead-free termination)

\* Measured at 1 ±0.2Vrms, 1MHz ±10% for Cap≤1,000pF and 1 ±0.2Vrms, 1kHz ±10% for Cap>1,000pF, 25°C at ambient temperature for NPO.

\*Measured at 1.0±0.2Vrms, 1.0kHz±10% for C≤10µF; 0.5±0.2Vrms, 120Hz±20% for C>10µF, 30~70% related humidity, 25°C ambient temperature for X7R.

\*\* 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.

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## Capacitance Range (X7R Dielectric)

Dielectric		X7R											
Size		2220											
Rated Voltage (VDC)		25	50	100	200 250	500	630	1000	1500	2000	2500	3000	4000
Capacitance	1,000pF (102)	K	K	K	K	K	K	K	K	K	K	K	K
	1,200pF (122)	K	K	K	K	K	K	K	K	K	K	K	M
	1,500pF (152)	K	K	K	K	K	K	K	K	K	K	K	M
	1,800pF (182)	K	K	K	K	K	K	K	K	K	K	K	M
	2,200pF (222)	K	K	K	K	K	K	K	K	K	K	K	
	2,700pF (272)	K	K	K	K	K	K	K	K	K	K	K	
	3,300pF (332)	K	K	K	K	K	K	K	K	K	K	K	
	3,900pF (392)	K	K	K	K	K	K	K	K	K	K	K	
	4,700pF (472)	K	K	K	K	K	K	K	K	K	K	K	
	5,600pF (562)	K	K	K	K	K	K	K	K	K	K	K	
	6,800pF (682)	K	K	K	K	K	K	K	K	K	M	M	
	8,200pF (822)	K	K	K	K	K	K	K	M	M	M	M	
	0.010μF (103)	K	K	K	K	K	K	K	M	M	M	M	
	0.012μF (123)	K	K	K	K	K	K	K	M	M	U	U	
	0.015μF (153)	K	K	K	K	K	K	K	M	M	U	U	
	0.018μF (183)	K	K	K	K	K	K	K	U	U	U	U	
	0.022μF (223)	K	K	K	K	K	K	K	U	U			
	0.027μF (273)	K	K	K	K	K	K	K	U	U			
	0.033μF (333)	K	K	K	K	K	K	K	U	U			
	0.039μF (393)	K	K	K	K	K	K	K	U	U			
	0.047μF (473)	K	K	K	K	K	K	K	U	U			
	0.056μF (563)	K	K	K	K	K	K	K	U	U			
	0.068μF (683)	K	K	K	K	K	K	M					
	0.082μF (823)	K	K	K	K	K	K	M					
	0.10μF (104)	K	K	K	K	K	K	M					
	0.12μF (124)	K	K	K	K	K	K	M					
	0.15μF (154)	K	K	K	K	K	K	U					
	0.18μF (184)	K	K	K	K	K	K	U					
0.22μF (224)	K	K	K	K	K	K	U						
0.27μF (274)	K	K	K	K	K	K							
0.33μF (334)	K	K	K	K	K	K							
0.39μF (394)	K	K	K	K	K	K							
0.47μF (474)	K	K	K	K	K	K							
0.56μF (564)	K	K	K	K	M	M							
0.68μF (684)	K	K	K	K	M	M							

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Dielectric		X7R											
Size		2220											
Rated Voltage (VDC)		25	50	100	200 250	500	630	1000	1500	2000	2500	3000	4000
Capacitance	0.82μF (824)	K	K	K	K	U	U						
	1.0μF (105)	K	K	K	K	U	U						
	1.5μF (155)	K	K	K	M								
	2.2μF (225)	K	K	K	M								
	3.3μF (335)	K	K	K									
	4.7μF (475)	K	K	M									
	6.8μF (685)	M	M	M									
	10μF (106)	M	M	M									
	15μF (156)	U	U										
	22μF (226)	U	U										
	47μF (476)	R											

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

## Packaging Style And Quantity

Size	Thickness/Symbol (mm)		Paper tape	
			7" reel	13" reel
2220 (5750)	2.5 ±0.3	M	500	--

## Reliability Test Conditions And Requirements

No	Item	Test Condition	Requirements
1	Visual and Mechanical	-	<ul style="list-style-type: none"> <li>No remarkable defect.</li> <li>Dimensions to conform to individual specification sheet.</li> </ul>
2	Capacitance	*Test temp.: Room Temperature.	* Q/DF:
3	Q/ D.F. (Dissipation Factor)	C≤1000pF, 1.0±0.2Vrms, 1MHz±10% C>1000pF, 1.0±0.2Vrms, 1KHz±10% Class II: (X7R) C10μF, 1.0±0.2Vrms, 1KHz±10% C>10μF, 0.5±0.2Vrms, 120Hz±20% *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: Cap<4.7μF: ≤2.5% Cap4.7μF: ≤3.5%
4	Dielectric Strength	To apply voltage (≤100V) 250%. Duration: 1 to 5 sec. Charge and discharge current less than 50mA.  *To apply voltage: 200V ~ 300V ≥2 times V DC 500V ~ 999V ≥1.5 times V DC 1000V ~ 3000V ≥1.2 times V DC 4000V ≥1.1 times V DC *Duration: 1 to 5 sec. *Charge & discharge current less than 50mA.	No evidence of damage or flash over during test.

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No	Item	Test Condition	Requirements															
5	Insulation Resistance	*Test temp.: Room Temperature. UR100V: To apply voltage at UR for max. 120 sec. UR>100V: To apply voltage at UR (500V max.) for 60 sec	* $\geq 10G\Omega$ or $R \cdot C \geq 100\Omega \cdot F$ whichever is smaller.															
6	Temperature Coefficient	With no electrical load. <table border="1"> <tr> <td>T.C.</td> <td>Operating Temp</td> </tr> <tr> <td>X7R</td> <td>-55°C to 125°C at 25°C</td> </tr> </table>	T.C.	Operating Temp	X7R	-55°C to 125°C at 25°C	* Capacitance change: X7R: Within $\pm 15\%$ .											
T.C.	Operating Temp																	
X7R	-55°C to 125°C at 25°C																	
7	Adhesive Strength of Termination	* Pressurizing force: 10N * Test time: 10 $\pm$ 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.)	* No remarkable damage. * Cap change and Q/D.F.: To meet initial spec.															
9	Solderability	Solder temperature: 235 $\pm$ 5°C Dipping time: 2 $\pm$ 0.5 sec.	75% 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 $\pm$ 1 sec. * Measurement to be made after keeping at room temp. for 24 $\pm$ 2 hrs.	* No remarkable damage. X7R: within $\pm 12.5\%$ . (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°C * Dipping time: 10 $\pm$ 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 $\pm$ 2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24 $\pm$ 2 hrs	* No remarkable damage. * X7R: within $\pm 7.5\%$ . * Q/D.F., I.R. and dielectric strength: To meet initial requirements. * 25% max. leaching on each edge.															
12	Temperature Cycle	Conduct the five cycles according to the temperatures and time. <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<math>\pm</math>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<math>\pm</math>3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 24 $\pm$ 2 hrs at room temp. Measurement to be made after keeping at room temp. for 24 $\pm$ 2 hrs.	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	* No remarkable damage. * Cap change: X7R: within $\pm 7.5\%$ . * Q/D.F.: X7R: 1.5 $\times$ Initial requirements. * I.R.: To meet initial requirements.
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																
13.	Humidity (Damp Heat) Steady State	* Test temp.: 40 $\pm$ 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 $\pm$ 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 $\pm$ 2 hrs at room temp.	* No remarkable damage. * Cap change: X7R: within $\pm 12.5\%$ . * Q/D.F.: X7R: 2 $\times$ Initial requirements. * I.R.: 1G<?> or R•C50<?>-F whichever is smaller.															

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No	Item	Test Condition	Requirements
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 (MAX. 500V) *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.	* No remarkable damage. * Cap change: X7R: within ±12.5% * Q/D.F.: X7R: 2 × Initial requirements. * I.R.: 500M<?> or R•C5<?>-F whichever is smaller.
15.	High Temperature Load (Endurance)	* Test temp.:125±3°C * To apply voltage: (1) Cap.1µF: 150% of rated voltage. (2) Ur250V: 200% of rated voltage. (3) 250V<Ur500V: 150% of rated voltage. (4) 500V<Ur3000V: 120% of rated voltage. (5) 4000V: 110% of rated voltage. *Test time: 1000+24/-0 hrs. *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.	* No remarkable damage. * Cap change: X7R: within ±12.5%. * Q/D.F.: Less than 10pF Q200+10C X7R: 2 × Initial requirements. * I.R.: 1G<?> or R•C50<?>-F whichever is smaller.

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

## Appendixes

No.	Name	X7R
1	Ceramic material	BaTiO <sub>3</sub> based
2	Inner electrode	Ni
3	Termination	Inner layer
4		Middle layer
5		Outer layer

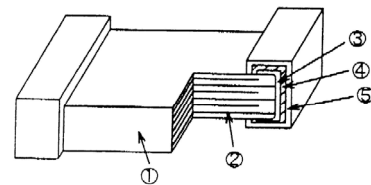


Fig. 2 The construction of MLCC

## Tape & Reel Dimensions

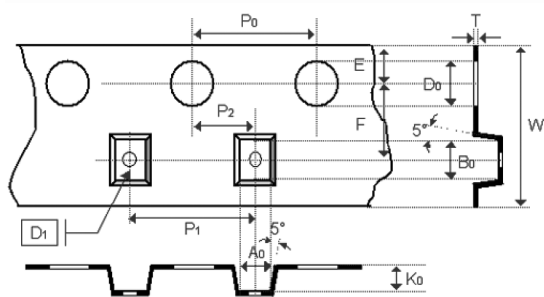


Fig. 3 The dimension of plastic tape

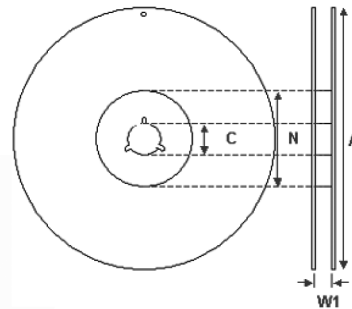


Fig. 4 The dimension of reel

Size	2220		
Chip Thickness	K(2.00)	M(2.50) U(2.80)	R(3.10)
A <sub>0</sub>	< 5.8		
B <sub>0</sub>	< 6.5		
T	0.3 +/-0.1		
K <sub>0</sub>	< 2.5	< 3.5	< 4.2
W	12. +/-0.3		
P <sub>0</sub>	4 +/-0.1		
10xP <sub>0</sub>	40 +/-0.2		
P <sub>1</sub>	8 +/-0.1		
P <sub>2</sub>	2 +/-0.1		
D <sub>0</sub>	1.5 +0.1/-0		
D <sub>1</sub>	1.5 +/-0.1		
E	1.75 +/-0.1		
F	5.5 +/-0.05		

Size	2220
Reel size	7"
C	13 +0.5/-0.2
W <sub>1</sub>	12.2+2/-0
A	178 ±1
N	60 +1/-0

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## Application Notes

### Storage

To prevent the damage of solderability of terminations, the following storage conditions are recommended:

Indoors under 5°C to 40°C and 20% to 70% RH.

No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.

Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The capacitors should be used within 6 months and checked the solderability before use.

### Handling

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

### Preheat

In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

### Soldering

Use mildly activated rosin fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

Hand soldering:

- \* Soldering iron tip diameter  $\leq 1.0$  mm and wattage max. 20W.
- \* The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.
- \* The required amount of solder shall be melted on the soldering tip.
- \* The tip of iron should not contact the ceramic body directly.
- \* The Capacitors shall be cooled gradually at room temperature after soldering.
- \* Forced air cooling is not allowed.

For bigger chips such as 1210, 1808, 1812, 2220 and 2225, etc. wave soldering and hand soldering are no recommended.

Refer IPC/JEDEC J-STD-020D Method recommended soldering profiles:

Reflow not sooner than 15 minutes and not longer than 4 hrs after removal from the temperature/humidity chamber, subject the sample to 3 cycle of the appropriate reflow conditions as defined as blow Table description.

Profile Feature	Pb-Free Assembly
Preheat/Soak	150°C
Temperature Min.(Ts min)	200°C
Temperature Max.(Ts max)	60 to 120 seconds
Time(ts) from (Ts min to Ts max)	
Ramp-up rate(T <sub>L</sub> to T <sub>P</sub> )	3°C/second max.
Liquidous temperature(T <sub>L</sub> )	217°C
Time(t <sub>L</sub> ) maintained above T <sub>L</sub>	60 to 150 seconds
Peak package body temperature(T <sub>P</sub> )	For user T <sub>P</sub> must not exceed the Classification temp 260°C For suppliers T <sub>P</sub> must equal or exceed the Classification temp 260°C
Time(T <sub>P</sub> )* within 5°C of the specified classification temperature(T <sub>C</sub> )	30* second
Ramp-down rate (T <sub>P</sub> to T <sub>L</sub> )	6°C/second max.
Time 25°C to peak temperature 260°C	8 minutes max.

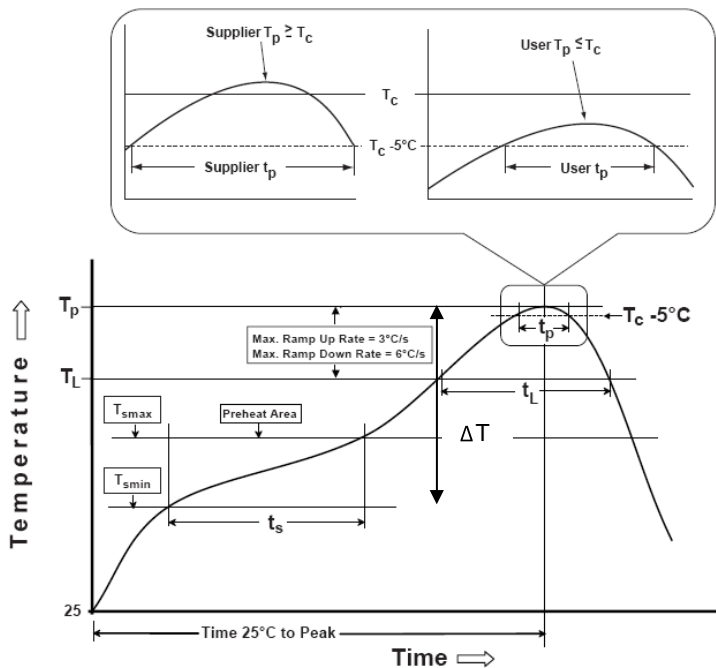
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Lead-free: Soldering temperature = 235 to 260°C, depending on product.

Maximum temperature = Minimum temperature (235°C) +  $\Delta T$  + Tolerance for oven process and measurement (57°C to 7°C)

Time at peak temperature = 10sec, Dwell above 217°C = 90sec, Ramping rate = 3°C/sec (heating) and 6°C/sec (cooling).

## Classification Reflow Profiles



Chip Size	$\Delta T$
2220	50°C

Soldering	Solder Temp. (Tc)	Soldering Time (tp)
Reflow	235 – 260 °C	< 15 sec.

Note: For example, Tc is 260°C and time tp is 15 seconds.

For user: The peak temperature must not exceed 260°C. The time above 255°C must not exceed 15 seconds.

### Cooling

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint.

### Cleaning

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.

## Part Number Table

Description	Part Number
SMD Multilayer Ceramic Capacitors, 2220, X7R, 10nF, 10%, 3KV	MC2220B103K302CT

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