

1. INTRODUCTION

MA Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. Reliable performances are built-in through exact formulation of dielectric powders, preparation of conductive paste, advanced automatic manufacturing, and strict quality control to assure excellent control in dielectric thickness, electrode integrity, and electrode-to-termination continuity.

2. FEATURES

- a. High Voltage in a given case size.
- b. High reliability and stability.

3. APPLICATIONS

- a. DC to DC converter.
- b. High voltage coupling/DC blocking.
- c. Back-lighting inverters.
- d. Sunbbers in high frequency power convertors.

4.HOW TO ORDER

<u>MA</u>	<u>1808</u>	<u>XR</u>	-	<u>104</u>	<u>K</u>	-	<u>251</u>	<u>ER</u>	<u>G</u>
<u>PDC Family</u>	<u>Size</u>	<u>Dielectric</u>		<u>Capacitance</u>	<u>Tolerance</u>		<u>Rated voltage</u>	<u>Packaging</u>	<u>Control Code</u>
	Inch (mm) 0402 (1005) 0603 (1608) 0805 (2012) 1206 (3216) 1210 (3225) 1808 (4520) 1812 (4532) 2220 (5750) 2225 (5763)	CG: C0G XR: X7R YV: Y5V		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	B =±0.1pF C =±0.25pF D =±0.5pF F =±1% G =±2% J =±5% K =±10% M =±20% Z =-20/+80%		Two significant digits followed by no. of zeros. And R is in place of decimal point. 101 =100 VDC 201 = 200 VDC 251 =250 VDC 501 =500 VDC 631 =630 VDC	PR: Tape and Reel, Paper Tape ER: Tape and Reel, Embossed Tape No Code: Bulk	G: RoHS compliant

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Tmax (mm)	M _b min (mm)
0402 (1005)	1.00±0.05	0.50±0.05	0.55	0.15
0603 (1608)	1.60±0.10	0.80±0.10	0.95	0.20
	1.60+0.15/-0.10	0.80±0.15		
0805 (2012)	2.00±0.20	1.25±0.20	1.45	0.30
1206 (3216)	3.20±0.20	1.60±0.20	1.80	0.30
1210 (3225)	3.20±0.40	2.50±0.30	2.80	0.30
1812 (4532)	4.50±0.40	3.20±0.30	2.80	0.26
1825 (4563)	4.60±0.30	6.30±0.40	3.00	0.26
2220 (5750)	5.70±0.40	5.00±0.40	3.00	0.30
2225 (5763)	5.70±0.40	6.30±0.40	3.00	0.30

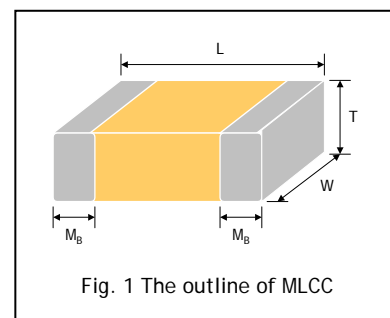


Fig. 1 The outline of MLCC

6. GENERAL ELECTRICAL DATA

Dielectric	NPO	X7R	Y5V
Size	0402, 0603, 0805, 1206, 1210, 1812	0402, 0603, 0805, 1206, 1210, 1808, 1812, 2220, 2225	0402, 0603, 0805, 1206, 1210, 1812
Capacitance range*	0.5pF to 33nF	100pF to 1.0μF	10nF to 1.0μF
Capacitance tolerance	Cap≤5pF: B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%), K (±10%)	J (±5%), K (±10%), M (±20%)	Z (-20/+80%)
Rated voltage (WVDC)	100V, 200V, 250V, 500V, 630V	100V, 200V, 250V, 500V, 630V	100V, 200V, 250V
Tan δ*	Cap<30pF: Q≥400+20C Cap≥30pF: Q≥1000	≤2.5%	≤5%
Insulation resistance at Ur**	≥100GΩ or R•C≥1000 whichever is smaller	≥10GΩ or R•C≥100Ω•F whichever is smaller	
Operating temperature	-55 to +125°C		-25 to +85°C
Capacitance characteristic	±30ppm /	±15%	+30/-80%
Termination	Cu (or Ag)/Ni/Sn (lead-free termination)		

* Measured at the condition of 30~70% related humidity.

NPO: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25°C at ambient temperature

X7R: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25°C ambient temperature.

Y5V: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 20°C ambient temperature.

**Measured at 500VDC for 60 sec, for UR>500VDC

7.CAPACITANCE RANGE

7-1. NP0 Dielectric

DIELECTRIC		NP0															
SIZE		0402				0603				0805				1206			
RATED VOLTAGE (VDC)		100	100	200	250	100	200	250	500	630	100	200	250	500	630		
Capacitance	0.5pF (0R5)																
	0.6pF (0R6)																
	0.7pF (0R7)																
	0.8pF (0R8)																
	0.9pF (0R9)																
	1.0pF (1R0)																
	1.2pF (1R2)																
	1.5pF (1R5)																
	1.8pF (1R8)																
	2.2pF (2R2)																
	2.7pF (2R7)																
	3.3pF (3R3)																
	3.9pF (3R9)																
	4.7pF (4R7)																
	5.6pF (5R6)																
	6.8pF (6R8)																
	8.2pF (8R2)																
	10pF (100)																
	12pF (120)																
	15pF (150)																
	18pF (180)																
	22pF (220)																
	27pF (270)																
	33pF (330)																
	39pF (390)																
	47pF (470)																
	56pF (560)																
	68pF (680)																
	82pF (820)																
	100pF (101)																
	120pF (121)																
	150pF (151)																
	180pF (181)																
	220pF (221)																
	270pF (271)																
	330pF (331)																
	390pF (391)																
	470pF (471)																
	560pF (561)																
	680pF (681)																
820pF (821)																	
1,000pF (102)																	
1,200pF (122)																	
1,500pF (152)																	
1,800pF (182)																	
2,200pF (222)																	
2,700pF (272)																	
3,300pF (332)																	
3,900pF (392)																	
4,700pF (472)																	
5,600pF (562)																	
6,800pF (682)																	
8,200pF (822)																	
0.010μF (103)																	

DIELECTRIC	NP0										
	SIZE	1210					1812				
	RATED VOLTAGE (VDC)	100	200	250	500	630	100	200	250	500	630
1.0pF (1R0)											
1.2pF (1R2)											
1.5pF (1R5)											
1.8pF (1R8)											
2.2pF (2R2)											
2.7pF (2R7)											
3.3pF (3R3)											
3.9pF (3R9)											
4.7pF (4R7)											
5.6pF (5R6)											
6.8pF (6R8)											
8.2pF (8R2)											
10pF (100)											
12pF (120)											
15pF (150)											
18pF (180)											
22pF (220)											
27pF (270)											
33pF (330)											
39pF (390)											
47pF (470)											
56pF (560)											
68pF (680)											
82pF (820)											
100pF (101)											
120pF (121)											
150pF (151)											
180pF (181)											
220pF (221)											
270pF (271)											
330pF (331)											
390pF (391)											
470pF (471)											
560pF (561)											
680pF (681)											
820pF (821)											
1,000pF (102)											
1,200pF (122)											
1,500pF (152)											
1,800pF (182)											
2,200pF (222)											
2,700pF (272)											
3,300pF (332)											
3,900pF (392)											
4,700pF (472)											
5,600pF (562)											
6,800pF (682)											
8,200pF (822)											
0.010μF (103)											
0.012μF (123)											
0.015μF (153)											
0.018μF (183)											
0.022μF (223)											
0.027μF (273)											
0.033μF (333)											
0.039μF (393)											

Capacitance

7.2 X7R Dielectric

DIELECTRIC		X7R															
SIZE	0603			0805				1206					1210				
RATED VOLTAGE (VDC)	100	200	250	100	200	250	500	100	200	250	500	630	100	200	250	500	630
100pF (101)																	
120pF (121)																	
150pF (151)																	
180pF (181)																	
220pF (221)																	
270pF (271)																	
330pF (331)																	
390pF (391)																	
470pF (471)																	
560pF (561)																	
680pF (681)																	
820pF (821)																	
1,000pF (102)																	
1,200pF (122)																	
1,500pF (152)																	
1,800pF (182)																	
2,200pF (222)																	
2,700pF (272)																	
3,300pF (332)																	
3,900pF (392)																	
4,700pF (472)																	
5,600pF (562)																	
6,800pF (682)																	
8,200pF (822)																	
0.010μF (103)																	
0.012μF (123)																	
0.015μF (153)																	
0.018μF (183)																	
0.022μF (223)																	
0.027μF (273)																	
0.033μF (333)																	
0.039μF (393)																	
0.047μF (473)																	
0.056μF (563)																	
0.068μF (683)																	
0.082μF (823)																	
0.10μF (104)																	
0.12μF (124)																	
0.15μF (154)																	
0.18μF (184)																	
0.22μF (224)																	
0.27μF (274)																	
0.33μF (334)																	
0.39μF (394)																	
0.47μF (474)																	
0.56μF (564)																	
0.68μF (684)																	
0.82μF (824)																	
1.0μF (105)																	

Capacitance

DIELECTRIC		X7R																			
SIZE		1812					1825					2220					2225				
RATED VOLTAGE		100	200	250	500	630	100	200	250	500	630	100	200	250	500	630	100	200	250	500	630
Capacitance	100pF (101)																				
	120pF (121)																				
	150pF (151)																				
	180pF (181)																				
	220pF (221)																				
	270pF (271)																				
	330pF (331)																				
	390pF (391)																				
	470pF (471)																				
	560pF (561)																				
	680pF (681)																				
	820pF (821)																				
	1,000pF (102)																				
	1,200pF (122)																				
	1,500pF (152)																				
	1,800pF (182)																				
	2,200pF (222)																				
	2,700pF (272)																				
	3,300pF (332)																				
	3,900pF (392)																				
	4,700pF (472)																				
	5,600pF (562)																				
	6,800pF (682)																				
	8,200pF (822)																				
	0.010μF (103)																				
	0.012μF (123)																				
	0.015μF (153)																				
	0.018μF (183)																				
	0.022μF (223)																				
	0.027μF (273)																				
	0.033μF (333)																				
	0.039μF (393)																				
	0.047μF (473)																				
	0.056μF (563)																				
	0.068μF (683)																				
0.082μF (823)																					
0.10μF (104)																					
0.12μF (124)																					
0.15μF (154)																					
0.18μF (184)																					
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0.27μF (274)																					
0.33μF (334)																					
0.39μF (394)																					
0.47μF (474)																					
0.56μF (564)																					
0.68μF (684)																					
0.82μF (824)																					
1.0μF (105)																					

7-3. Y5V Dielectric

DIELECTRIC		Y5V											
SIZE		0805			1206			1210			1812		
RATED VOLTAGE(VDC)		100	200	250	100	200	250	100	200	250	100	200	250
Capacitance	0.010μF (103)												
	0.015μF (153)												
	0.022μF (223)												
	0.033μF (333)												
	0.047μF (473)												
	0.068μF (683)												
	0.10μF (104)												
	0.15μF (154)												
	0.18μF (184)												
	0.22μF (224)												
	0.33μF (334)												
	0.47μF (474)												
	0.68μF (684)												
	1.0μF (105)												

8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																
1.	Visual and Mechanical	---	* No remarkable defect. * Dimensions to conform to individual specification sheet.																
2.	Capacitance	Class I: (NP0)	* Shall not exceed the limits given in the detailed spec.																
3.	Q/ D.F. (Dissipation Factor)	Cap \leq 1000pF, 1.0 \pm 0.2Vrms, 1MHz \pm 10% Cap $>$ 1000pF, 1.0 \pm 0.2Vrms, 1KHz \pm 10% Class II: (X7R, Y5V) 1.0 \pm 0.2Vrms, 1KHz \pm 10%	NP0: Cap \geq 30pF, Q \geq 1000; Cap $<$ 30pF, Q \geq 400+20C X7R: \leq 2.5% Y5V: \leq 5.0%																
4.	Temperature Coefficient	With no electrical load. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>T.C.</th> <th>Operating Temp</th> </tr> </thead> <tbody> <tr> <td>NP0</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>Y5V</td> <td>-25~85°C at 20°C</td> </tr> </tbody> </table>	T.C.	Operating Temp	NP0	-55~125°C at 25°C	X7R	-55~125°C at 25°C	Y5V	-25~85°C at 20°C	<table border="1" style="margin-left: 20px;"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>NP0</td> <td>Within \pm30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within \pm15%</td> </tr> <tr> <td>Y5V</td> <td>Within +30%/-80%</td> </tr> </tbody> </table>	T.C.	Capacitance Change	NP0	Within \pm 30ppm/°C	X7R	Within \pm 15%	Y5V	Within +30%/-80%
T.C.	Operating Temp																		
NP0	-55~125°C at 25°C																		
X7R	-55~125°C at 25°C																		
Y5V	-25~85°C at 20°C																		
T.C.	Capacitance Change																		
NP0	Within \pm 30ppm/°C																		
X7R	Within \pm 15%																		
Y5V	Within +30%/-80%																		
5.	Insulation Resistance	U _R =100V: To apply voltage at U _R for max. 120 sec. U _R $>$ 100V: To apply voltage at U _R (500V max.) for 60 sec.	Class I (NP0) : \geq 100G Ω or Rx $C\geq$ 1000 Ω -F whichever is smaller. Class II (X7R, Y5V) : \geq 10G Ω or Rx $C\geq$ 100 Ω -F whichever is smaller.																
6.	Dielectric Strength	* To apply voltage: 100V =2.5 times of U _R 200V/250V =2 times of U _R 500V/630V =1.5 times of U _R * Duration: 1 to 5 sec.	* No evidence of damage or flashover during test.																
7.	Solderability	* Solder temperature: 235 \pm 5°C * Dipping time: 2 \pm 0.5 sec.	75% min. coverage of all metalized area.																
8.	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 48 \pm 4 hrs at room temp. * Measurement to be made after keeping at room temp. for 24 \pm 2 hrs (Class I) or 48 \pm 4 hrs (Class II).	* No remarkable damage. * Cap change: NP0: within \pm 2.5% or \pm 0.25pF whichever is larger. X7R: within \pm 7.5% Y5V: within \pm 20% * 25% max. leaching on each edge.																
9.	Temperature Cycle	* Conduct the five cycles according to the temperatures and time. <table border="1" style="margin-left: 20px;"> <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\pm3</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\pm3</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 48 \pm 4 hrs at room temp. * Measurement to be made after keeping at room temp. for 24 \pm 2 hrs (Class I) or 48 \pm 4 hrs (Class II).	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 : NP0: within \pm 2.5% or \pm 0.25pF whichever is larger. X7R: within \pm 15% Y5V: within \pm 20% * Q/D.F.: NP0: \leq 2.0 x Initial requirement X7R: \leq 1.5 x Initial requirement Y5V: \leq 1.5 x Initial requirement * I.R. \geq 0.25 x 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																	
10.	Humidity (Damp Heat) Steady State	* Test temp.: 40 \pm 2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * Measurement to be made after keeping at room temp. for 24 \pm 2 hrs (Class I) or 48 \pm 4 hrs (Class II).	* No remarkable damage. * Cap change: NP0 : within \pm 5% or \pm 2pF whichever is larger X7R : within \pm 15% Y5V : within \pm 30% * Q/D.F Value: NP0: Cap \geq 30pF :Q \geq 350; 10pF \leq Cap $<$ 30pF :Q \geq 275+2.5C; Cap $<$ 10pF :Q \geq 200+10C X7R: \leq 7.0% Y5V: \leq 7.5% * I.R.: \geq 1G Ω or Rx $C\geq$ 50 Ω -F whichever is smaller.																

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS (Cont.)

No.	Item	Test Condition	Requirements									
11.	High Temperature Load (Endurance)	<p>* Test temp.: NP0, X7R: 125±3°C Y5V: 85±3°C</p> <p>* To apply voltage: (1) $U_R \leq 250V$: 200% of rated voltage. Exception item:</p> <table border="1" style="margin-left: 20px; border-collapse: collapse; width: 80%;"> <thead> <tr> <th style="text-align: center;">U_R</th> <th style="text-align: center;">Cap. Range</th> <th style="text-align: center;">To apply voltage</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">200V</td> <td style="text-align: center;">1210, Cap. > 224</td> <td style="text-align: center;">150% of rated voltage</td> </tr> <tr> <td style="text-align: center;">250V</td> <td style="text-align: center;">1812, Cap. > 474</td> <td style="text-align: center;">150% of rated voltage</td> </tr> </tbody> </table> <p>(2) $250 < U_R \leq 500V$: 150% of rated voltage. (3) $U_R > 500V$: 120% of rated voltage.</p> <p>* Test time: 1000+24/-0 hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</p>	U _R	Cap. Range	To apply voltage	200V	1210, Cap. > 224	150% of rated voltage	250V	1812, Cap. > 474	150% of rated voltage	<p>* No remarkable damage.</p> <p>* Cap change: NP0 : within ±5% or ±2pF whichever is larger X7R : within ±15% Y5V : within ±30%</p> <p>* Q/D.F Value: NP0: Cap≥30pF :Q≥350; 10pF≤Cap<30pF :Q≥275+2.5C; Cap<10pF :Q≥200+10C</p> <p>X7R: ≤7.0% Y5V: ≤7.5%</p> <p>* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.</p>
U _R	Cap. Range	To apply voltage										
200V	1210, Cap. > 224	150% of rated voltage										
250V	1812, Cap. > 474	150% of rated voltage										
12.	Resistance to Flexure of Substrate	<p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 1mm.</p> <div style="text-align: center;"> </div>	<p>* No remarkable damage.</p> <p>* Cap change: NP0: within ±10% X7R: within ±12.5% Y5V: within ±30%</p> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</p>									
13.	Adhesive Strength of Termination	<p>* Capacitors mounted on a substrate. A force of 5N applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.</p> <div style="text-align: center;"> </div>	<p>* No remarkable damage or removal of the terminations.</p>									