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Date:

APPROVAL SHEET

Product Name ：Ultra High Voltage Multilayer Ceramic Chip Capacitors

Part No. ：FV Series

Description ：Size 0805~2225, C0G/X7R, ≧1KVdc, RoHS Compliant

PREPARED BY	APPROVED BY

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SPECIFICATION FOR

ULTRA HIGH VOLTAGE MULTILAYER CERAMIC CHIP CAPACITORS

Part No. ：FV Series

Description ：Size 0805~2225, C0G/X7R, ≧1KVdc, RoHS Compliant

DRAWN BY	CHECKED BY	APPROVED BY
蕭敏珍	蔡永承	巫宏俊

1. INTRODUCTION

PDC FV Series green type capacitors are manufactured by using environmental friendly material without lead or cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. This special design can distribute voltage gradients throughout the entire capacitor, so as to prevent short circuit failure. It is a safety design for LCD back-lighting inverter application.

2. FEATURES

a. Special interior design offers high voltage rating in a given case size.
b. High reliability and stability.
c. RoHS compliant

3. APPLICATIONS

a. DC to DC converter.
b. High voltage coupling/DC blocking.
c. Back-lighting inverters.
d. LAN/WLAN interface.
e. Modem.
f. Power supplies.

4.HOW TO ORDER

FV	42	X	153	K	152	E	F	G
PDC Family	**Size**	**Dielectric**	**Capacitance**	**Tolerance**	**Rated voltage**	**Packaging**	**Thickness**	**Control Code**
Table1.	Table2	Table3	Table4	Table5	Table6	Table7	Table8	Table9

Reference document with No.11 reference table detail.

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Thickness Spec T(mm) code	M_B min (mm)
0805 (2012)	2.10±0.20	1.25±0.20	See No.11 Reference Table	0.50±0.20
1206 (3216)	3.30±0.30	1.60+0.30/-0.10		0.60±0.20
1210 (3225)	3.30±0.40	2.50±0.30		0.75±0.35
1808 (4520)	4.60±0.50	2.00±0.20		0.75±0.35
1812 (4532)	4.60±0.50	3.20±0.30		0.75±0.35
1825 (4563)	4.60±0.50	6.30±0.40		0.75±0.35
2211 (5728)	5.70±0.50	2.80±0.30		0.85±0.35
2220 (5750)	5.70±0.50	5.00±0.40		0.85±0.35
2225 (5763)	5.70±0.50	6.30±0.40		0.85±0.35

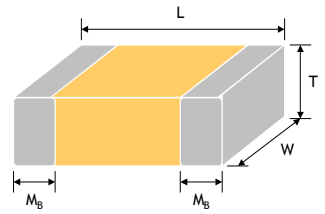


Fig. 1 The outline of MLCC

6.GENERAL ELECTRICAL DATA

Dielectric	C0G(NPO)	X7R
Size	0805,1206, 1210, 1808, 1812, 1825, 2211, 2220, 2225	0805,1206, 1210, 1808, 1812, 1825, 2211, 2220, 2225
Rated voltage (WVDC)	1KV, 1.5KV, 2KV, 3KV,4KV	1KV, 1.5KV, 2KV, 3KV,4KV
Capacitance range*	0.5pF ~ 12nF	100pF ~ 330nF
Capacitance tolerance	Reference to Table5	Reference to Table5
Tan δ*	Cap. Rang / Q Spec. Cap<30pF: Q≥400+20C Cap≥30pF: Q≥1000	≤2.5%
Capacitance & Tan δ Test Condition	Measured at the condition of 30~70% related humidity. for 25℃ at ambient temperature	Preconditioning for Class II MLCC: Perform a heat treatment at 150±10℃ for 1 hour, then leave in ambient condition for 24±2 hours before measurement.
	Cap. Rang / Test Condition Cap≤1000pF: 1.0±0.2Vrms, 1.0MHz±10% Cap>1000pF,: 1.0±0.2Vrms, 1.0kHz±10%	Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25℃ ambient temperature.
Insulation resistance	≥100GΩ or R•C≥ 500Ω-F whichever is smaller	≥10GΩ or R•C≥100Ω-F whichever is smaller
Operating temperature	-55 to +125℃	
Temperature coefficient	±30ppm / ℃	±15%
Termination	Ag (or Cu)/Ni/Sn (lead-free termination)	

7.CAPACITANCE RANGE(Con.)

7.1 C0G(NPO)

Dimension		0805	1206		1210		1808				1812				1825			
Cap(pF)	code	1KV	1KV	2KV	1KV	2KV	1KV	2KV	3KV	4KV	1KV	2KV	3KV	4KV	1KV	2KV	3KV	4KV
0.5	0R5	C																
1.0	1R0	C																
1.2	1R2	C																
1.5	1R5	C	X	X														
1.8	1R8	C	X	X														
2.2	2R2	C	X	X			C	C	C	C								
2.7	2R7	C	X	X			C	C	C	C								
3.3	3R3	C	X	X			C	C	C	C								
3.9	3R9	C	X	X			C	C	C	C								
4.7	4R7	C	X	X			C	C	C	C								
5.6	5R6	C	X	X			C	C	C	C								
6.8	6R8	C	X	X			C	C	C	C								
8.2	8R2	C	X	X			C	C	C	C								
10	100	C	X	X	M	M	C	C	C	C	C	C	C	C	F	F	F	F
12	120	C	X	X	M	M	C	C	C	C	C	C	C	C	F	F	F	F
15	150	C	X	X	M	M	C	C	C	C	C	C	C	C	F	F	F	F
18	180	C	X	X	M	M	C	C	C	C	C	C	C	C	F	F	F	F
22	220	C	X	X	M	M	C	C	C	E	C	C	C	C	F	F	F	F
27	270	C	X	X	M	M	C	C	C	E	C	C	C	C	F	F	F	F
33	330	C	X	M	M	M	C	C	C	F	C	C	C	C	F	F	F	F
39	390	C	X	M	M	M	C	C	C	F	C	C	C	C	F	F	F	F
47	470	C	M	M	M	M	C	C	C		C	C	C	E	F	F	F	F
56	560	C	M	C	M	C	C	C	C		C	C	C	E	F	F	F	F
68	680	C	M	C	M	C	C	C	C		C	C	C	F	F	F	F	F
82	820	C	C	C	M	C	C	C	C		C	C	C	F	F	F	F	F
100	101	C	C	C	C	C	C	C	F		C	C	C		F	F	F	F
120	121	C	C	E	C	C	C	C	F		C	C	C		F	F	F	F
150	151	C	C	E	C	E	C	F	F		C	C	C		F	F	F	F
180	181	C	E	E	C	E	C	F	F		C	C	F		F	F	F	F
220	221	C	E	E	E	E	C	F	F		C	C	F		F	F	F	
270	271	C	E	E	E	E	F	F	F		C	F	F		F	F	F	
330	331	C	E	E	E	E	F	F	F		C	F	F		F	F	F	
390	391	C	E	E	E	E	F	F	F		C	F	F		F	F	F	
470	471		E	E	E	E	F	F	F		F	F	F		F	F	F	
560	561		E		E	E	F	F	F		F	F	F		F	F	F	
680	681		E		E	E	F	F			F	F	F		F	F	G	
820	821		E		E	E	F	F			F	F	G		F	F	G	
1000	102		E		E	F	F	F			F	F	G		F	F	G	
1200	122		E		E	F	F	F			F	F			F	F	G	
1500	152				F	G	F	F			F	F			F	G	G	
1800	182				G	G	F	F			F	F			F	G	G	
2200	222				G		F				F	F			F	G	G	
2700	272				G		F				F	G			F	G	G	
3300	332				G		F				F	G			F	G		
3900	392				G						G				G	G		
4700	472										G				G	G		
5600	562										G				G	G		
6800	682														G	G		
8200	822														G	G		
10000	103														G			
12000	123														G			

7.CAPACITANCE RANGE(Con.)

7.1 C0G(NPO)

Dimension		2220				2225			
Cap(pF)	code	1KV	2KV	3KV	4KV	1KV	2KV	3KV	4KV
0.5	0R5								
1.0	1R0								
1.5	1R5								
1.8	1R8								
2.2	2R2								
2.7	2R7								
3.3	3R3								
3.9	3R9								
4.7	4R7								
5.6	5R6								
6.8	6R8								
8.2	8R2								
10	100	F	F	F	F	F	F	F	F
12	120	F	F	F	F	F	F	F	F
15	150	F	F	F	F	F	F	F	F
18	180	F	F	F	F	F	F	F	F
22	220	F	F	F	F	F	F	F	F
27	270	F	F	F	F	F	F	F	F
33	330	F	F	F	F	F	F	F	F
39	390	F	F	F	F	F	F	F	F
47	470	F	F	F	F	F	F	F	F
56	560	F	F	F	F	F	F	F	F
68	680	F	F	F	F	F	F	F	F
82	820	F	F	F	F	F	F	F	F
100	101	F	F	F	F	F	F	F	F
120	121	F	F	F	F	F	F	F	F
150	151	F	F	F	F	F	F	F	F
180	181	F	F	F	F	F	F	F	F
220	221	F	F	F	F	F	F	F	F
270	271	F	F	F	G	F	F	F	F
330	331	F	F	G	G	F	F	F	G
390	391	F	F	G		F	F	F	
470	471	F	F	G		F	F	F	
560	561	F	F	G		F	F	F	
680	681	F	F	G		F	F	F	
820	821	F	F	G		F	G	G	
1000	102	F	F	G		F	G	G	
1200	122	G	G	G		F	G	G	
1500	152	G	G	G		F	G	G	
1800	182	G	G	G		F	G	G	
2200	222	G	G	G		F	G	G	
2700	272	G	G	G		F	G	G	
3300	332	G	G			F	G	G	
3900	392	G	G			F	G		
4700	472	G	G			F	G		
5600	562	G	G			G	G		
6800	682	G	G			G	G		
8200	822	G	G			G	G		
10000	103	G				G	G		
12000	123	G				G			

PSA
PASSIVE SYSTEM ALLIANCE

7.CAPACITANCE RANGE(Con.)

7.2 X7R

Dimension		0805	1206			1210			1808					1812				
Cap(pF)	code	1KV	1KV	1.5KV	2KV	1KV	1.5KV	2KV	1KV	1.5KV	2KV	3KV	4KV	1KV	1.5KV	2KV	3KV	4KV
100	101	X	C	C	C													
120	121	X	C	C	C													
150	151	X	C	C	C				C	C	C	C	F					
180	181	X	C	C	C				C	C	C	C	F					
220	221	X	C	C	C	C	C	E	C	C	C	C	F					
270	271	X	C	C	C	C	C	E	C	C	C	C	F	C	C	C	E	F
330	331	X	C	C	C	C	C	E	C	C	C	F	F	C	C	C	E	F
390	391	X	C	C	C	C	C	E	C	C	C	F	F	C	C	C	E	F
470	471	X	C	C	C	C	C	E	C	C	C	F	F	C	C	C	E	F
560	561	X	C	C	C	C	C	E	C	C	C	F	F	C	C	C	E	F
680	681	X	C	C	C	C	C	E	C	C	C	F	F	C	C	C	F	F
820	821	X	C	C	C	C	C	E	C	C	C	F	F	C	C	C	F	F
1000	102	X	C	C	C	C	C	E	C	C	C	F	F	C	C	C	F	F
1200	122	X	C	E	E	C	F	F	C	F	F	F		C	C	C	F	G
1500	152	C	C	E	E	C	F	F	C	F	F	F		C	C	C	F	G
1800	182	C	C	E	E	C	F	F	C	F	F	F		C	C	E	G	G
2200	222	C	C	E	E	C	F	F	C	F	F	F		C	C	E	G	
2700	272	C	C	E	E	C	G	G	C	F	F			C	C	E	G	
3300	332	C	C	E	E	C	G	G	C	F	F			C	F	F	G	
3900	392	C	C	E		E	G	G	C	F	F			C	F	F	G	
4700	472	C	C	E		E	G	G	C	F	F			C	F	F	G	
5600	562	C	C	E		E	G	G	F	F	F			C	G	G		
6800	682	C	C	E		E	G	G	F	F	F			C	G	G		
8200	822	C	C			E	G	G	F					C	G	G		
10000	103		C			E			F					E	G	G		
12000	123		E			E			F					F				
15000	153		E			E			F					F				
18000	183		E			E			F					G				
22000	223		E			E			F					G				
27000	273					E			F					G				
33000	333					E			F					G				
39000	393					F			F					G				
47000	473					G			F					G				
56000	563					G			F					G				
68000	683					G			F					G				
82000	823													G				
100000	104													G				
120000	124																	
150000	154																	

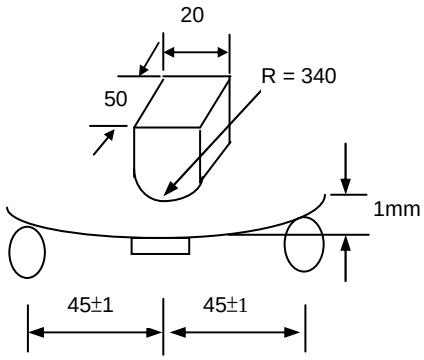
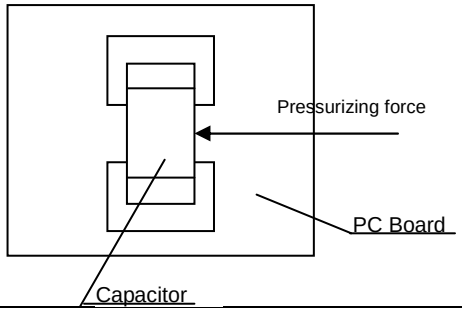
7.CAPACITANCE RANGE(Con.)
7.2 X7R

Dimension		1825					2220					2225				
Cap(pF)	code	1KV	1.5KV	2KV	3KV	4KV	1KV	1.5KV	2KV	3KV	4KV	1KV	1.5KV	2KV	3KV	4KV
100	101															
120	121															
150	151															
180	181															
220	221															
270	271					F					F					F
330	331					F					F					F
390	391					F					F					F
470	471					F					F					F
560	561					F					F					F
680	681					F					F					F
820	821					F					F					F
1000	102	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1200	122	F	F	F	F	G	F	F	F	F	G	F	F	F	F	G
1500	152	F	F	F	F	G	F	F	F	F	G	F	F	F	F	G
1800	182	F	F	F	F	G	F	F	F	F	G	F	F	F	F	G
2200	222	F	F	F	F		F	F	F	F		F	F	F	F	
2700	272	F	F	F	F		F	F	F	F		F	F	F	F	
3300	332	F	F	F	F		F	F	F	F		F	F	F	F	
3900	392	F	F	F	F		F	F	F	F		F	F	F	F	
4700	472	F	F	F	F		F	F	F	F		F	F	F	F	
5600	562	F	F	F	G		F	F	F	F		F	F	F	G	
6800	682	F	F	F	G		F	F	F	G		F	F	F	G	
8200	822	F	F	F	G		F	G	G	G		F	F	F	G	
10000	103	F	F	F	G		F	G	G	G		F	F	F	G	
12000	123	F	G	G	H		F	G	G	H		F	G	G	G	
15000	153	F	G	G	H		F	G	G	H		F	G	G	G	
18000	183	F	G	G	H		F	H	H	H		F	G	G	H	
22000	223	F	G	G			F	H	H			F	G	G		
27000	273	F	H	H			F	H	H			F	G	G		
33000	333	F	H	H			F	H	H			F	G	G		
39000	393	F	H	H			F	H	H			F	M	H		
47000	473	F	H	H			F	H	H			F	M	H		
56000	563	F	H	H			F	H	H			F	M	H		
68000	683	F					G					F	M			
82000	823	G					G					F	M			
100000	104	G					G					G	M			
120000	124	H					G					H				
150000	154	H					H					H				
180000	184	H					H					H				
220000	224	H					H					H				
270000	274	H					H					H				
330000	334	H					H					H				
390000	394						H					H				

8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>1.</td><td>Visual and Dimensions</td><td>---</td><td>* No remarkable defect.
* Dimensions to conform to individual specification sheet.</td></tr>
<tr><td>2.</td><td>Capacitance</td><td>Class I: (NPO)</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>Cap≤1000pF, 1.0±0.2Vrms, 1MHz±10%
Cap>1000pF, 1.0±0.2Vrms, 1KHz±10%
Class II: (X7R)
1.0±0.2Vrms, 1kHz±10%</td><td><table><tr><th>Dielectric</th><th>Rated vol.(V)</th><th>Q/D.F.</th><th>Remark</th></tr><tr><td rowspan="2">Class I(NPO)</td><td rowspan="2">All</td><td>Q≥1000</td><td>Cap≥30pF</td></tr><tr><td>Q≥400+20C</td><td>Cap<30pF</td></tr><tr><td>Class II(X7R)</td><td>≥ 50</td><td>D.F. < 3.0%</td><td></td></tr></table></td></tr>
<tr><td>4.</td><td>Temperature Coefficient</td><td>With no electrical load.<table><tr><th>T.C.</th><th>Operating Temp</th></tr><tr><td>NPO</td><td>-55~125℃ at 25℃</td></tr><tr><td>X7R</td><td>-55~125℃ at 25℃</td></tr></table></td><td><table><tr><th>T.C.</th><th>Capacitance Change</th></tr><tr><td>NPO</td><td>Within ±30ppm/℃</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr></table></td></tr>
<tr><td>5.</td><td>Insulation Resistance</td><td>* To apply voltage at 500VDC for 60 sec.</td><td><table><tr><th>Dielectric</th><th>Requirements</th></tr><tr><td>Class I(NPO)</td><td>≥100GΩ or RxC≥ 500Ω-F whichever is smaller</td></tr><tr><td>Class II(X7R)</td><td>≥10GΩ or RxC≥ 100Ω-F whichever is smaller.</td></tr></table></td></tr>
<tr><td>6.</td><td>Dielectric Strength</td><td><table><tr><th>Rated vol.(V)</th><th>Condition</th></tr><tr><td>1000 ≤ V <3000</td><td>1.2 times of U_R</td></tr><tr><td>3000 ≤ V ≤5000</td><td>1.1 times of U_R</td></tr><tr><td>> 5000</td><td>1.0 times of U_R</td></tr></table>* Duration: 1 to 5 sec.</td><td>* No evidence of damage or flashover during test.</td></tr>
<tr><td>7.</td><td>Solderability</td><td>* Solder temperature: 235±5℃ for (0805~1210)
* Solder temperature: 245±5℃ for (1808~2225)
* Dipping time: 2±0.5 sec.</td><td>75% min. coverage of all metalized area.</td></tr>
<tr><td>8.</td><td>Resistance to Soldering Heat</td><td>* Solder temperature: 260±5℃
* Dipping time: 10±1 sec
* Preheating: 120 to 150℃ for 1 minute before immerse the capacitor in a eutectic solder.
* Before initial measurement (Class II only): Perform 150+0/-10℃ for 1 hr and then set for 48±4 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.<table><tr><th>Dielectric</th><th>Cap Change</th><th>Q/D.F & IR</th></tr><tr><td>Class I(NPO)</td><td>Within ±2.5% or ±0.25pF whichever is larger.</td><td rowspan="2">To meet Initial requirement</td></tr><tr><td>Class II(X7R)</td><td>within ±7.5%</td></tr></table>* 25% max. leaching on each edge.</td></tr>
<tr><td>9.</td><td>Temperature Cycle</td><td>* Conduct the five cycles according to the temperatures and time.<table><tr><th>Step</th><th>Temp. (℃)</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℃ for 1 hr and then set for 48±4 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.<table><tr><th>Dielectric</th><th>I.R</th><th>Cap Change</th><th>Q/D.F</th></tr><tr><td>Class I(NPO)</td><td rowspan="2">To meet Initial requirement .</td><td>Within ±2.5% or ±0.25pF whichever is larger.</td><td>≤ 1.0(Q) × Initial requirement</td></tr><tr><td>Class II(X7R)</td><td>within ±7.5%</td><td>≤ 1.5(D.F.) × Initial requirement</td></tr></table></td></tr>
<tr><td>10.</td><td>Humidity (Damp Heat) Steady State</td><td>* Test temp.: 40±2℃
* Humidity: 90~95% RH
* Test time: 500+24/-0hrs.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.<table><tr><th>Dielectric</th><th>I.R</th><th>Cap Change</th><th colspan="2">Q/D.F</th></tr><tr><td rowspan="3">Class I(NPO)</td><td rowspan="3">≥1GΩ or RxC≥ 50Ω-F whichever is smaller.</td><td rowspan="3">within ± 5.0% or±0.5pF whichever is larger</td><td>Cap ≥30pF</td><td>Q≥350;</td></tr><tr><td>10pF ≤ Cap < 30pF</td><td>Q≥275+2.5C</td></tr><tr><td>Cap < 10pF</td><td>Q≥200+10C</td></tr><tr><td>Class</td><td>within ±12.5%</td><td colspan="2">D.F. ≤ 200% × Initial requirement</td></tr></table></td></tr>
</table>

8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Cont.)

<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>11</td><td>Humidity (Damp Heat) Load</td><td>* Test temp.: 40±2℃
* Humidity: 90~95% RH
* Test time: 500+24/-0hrs.
*To apply voltage :rated voltage
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
<table>
<tr><th>Dielectric</th><th>I.R</th><th>Cap Change</th><th colspan="2">Q/D.F</th></tr>
<tr><td rowspan="3">Class I(NPO)</td><td rowspan="4">≥1GΩ or RxC≥ 50Ω-F whichever is smaller.</td><td rowspan="3">within ±7.5% or ±0.75pF whichever is larger</td><td>Cap ≥30pF</td><td>Q≥350;</td></tr>
<tr><td>10pF ≤ Cap < 30pF</td><td>Q≥275+2.5C</td></tr>
<tr><td>Cap < 10pF</td><td>Q≥200+10C</td></tr>
<tr><td>Class II(X7R)</td><td>within ±12.5%</td><td colspan="2">D.F. ≤ 200% × Initial requirement</td></tr>
</table></td></tr>
<tr><td>12.</td><td>High Temperature Load (Endurance)</td><td>* Test temp.:
125±3℃
<table>
<tr><th>Rated vol.(V)</th><th>Apply Voltage</th></tr>
<tr><td>1000</td><td>1.2 times of U_R</td></tr>
<tr><td>1000 < V ≤ 5000</td><td>1.1 times of U_R</td></tr>
<tr><td>> 5000</td><td>1.0 times of U_R</td></tr>
</table>
* 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).</td><td>* No remarkable damage.
<table>
<tr><th>Dielectric</th><th>I.R</th><th>Cap Change</th><th>Q/D.F</th></tr>
<tr><td>Class I(NPO)</td><td rowspan="2">≥1GΩ or RxC≥ 50Ω-F whichever is smaller.</td><td>within ±3.0% or ±0.3pF whichever is larger</td><td rowspan="2">D.F. ≤ 200% × Initial requirement</td></tr>
<tr><td>Class II(X7R)</td><td>within ±12.5%</td></tr>
</table></td></tr>
<tr><td>13.</td><td>Resistance to Flexure of Substrate</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.
 
</td><td>* No remarkable damage.
<table>
<tr><th>Dielectric</th><th>Cap Change</th></tr>
<tr><td>Class I(NPO)</td><td>within ±3.0% or ±0.3pF whichever is larger</td></tr>
<tr><td>Class II(X7R)</td><td>within ±12.5%</td></tr>
</table>
(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</td></tr>
<tr><td>14.</td><td>Adhesive Strength of Termination</td><td>* Capacitors mounted on a substrate. A force of 10N applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 sec.
 
</td><td>* No remarkable damage or removal of the terminations.</td></tr>
<tr><td>15.</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.)</td><td>* No remarkable damage.
* Cap change and Q/D.F.: To meet initial spec.</td></tr>
</table>

9.PACKAGE DIMENSION AND QUANTITY

Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
0805 (2012)	0.80±0.10	4K	15k	-	-
	1.25±0.10	-	-	3k	10k
1206 (3216)	0.80±0.10	4k	15k	-	-
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
1210 (3225)	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	1k	-
1808 (4520)	1.25±0.10	-	-	2k	-
	1.40±0.15	-	-	2k	-
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	1k	-
1812 (4532)	1.25±0.10	-	-	1k	-
	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	3k
1825 (4563)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
2211 (5728)	1.25±0.10	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	3k
2220 (5750)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
2225 (5763)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-

Unit: pieces

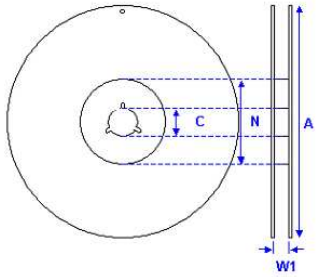


Fig. 4 The dimension of reel

Size	0805,1206, 1210, 1812			1808, 1812, 1825, 2220, 2225	2211
Reel size	7"	10"	7"	7"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W_1	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0	12.4+2.0/-0	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	178.0±0.10	178.0±0.10	178.0±0.10
N	60.5±1.0	100.0±1.0	80.0±1.0	60.5±1.0	80.0±1.0

9-1. CARDBOARD TAPE DIMESIONS

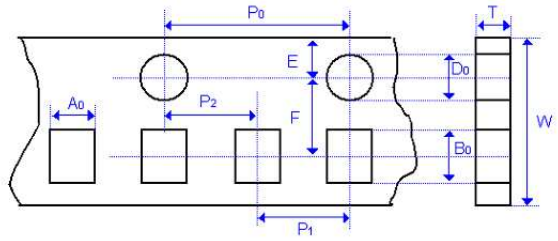


Fig. 2 The dimension of paper tape

9-2. EMBOSSED TAPE DIMENSIONS

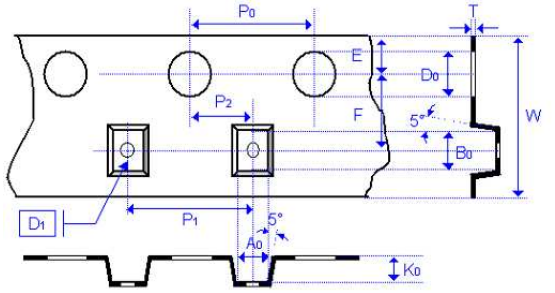


Fig. 3 The dimension of plastic tape

Size	0805		1206			1210		1808	
Chip Thickness	0.80±0.10	1.25±0.10	0.80±0.10	0.95±0.10 1.25±0.10	1.60±0.20 1.60+0.3/-0.1	0.95±0.10 1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30	1.25±0.10 1.40±0.15 1.60±0.20	2.00±0.20
A_0	1.50±0.10	<1.65	2.00±0.10	<2.00	<2.00	<3.05	<3.10	<2.50	<2.50
B_0	2.30±0.10	<2.40	3.50±0.10	<3.60	<3.70	<3.80	<4.00	<5.30	<5.30
T	0.95±0.05	0.23±0.05	0.95±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.25±0.05	0.25±0.05
K_0	-	<2.50	-	<2.50	<2.50	<2.50	<3.50	<2.50	<2.50
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	12.0±0.20	12.0±0.20
P_0	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.100	4.00±0.10	4.00±0.10	4.00±0.10
$10xP_0$	40.00±0.20	40.00±0.20	40.0±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.0±0.20	40.0±0.20	40.0±0.20
P_1	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	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	2.00±0.05	2.00±0.05
D_0	1.55±0.05	1.50±0.10/-0	1.50±0.05	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50+0.10/-0
D_1	-	1.00±0.10	-	1.00±0.10	1.00±0.10	1.00±0.10	1.00±0.10	1.50±0.10	1.50±0.10
E	1.75±0.05	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	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	5.50±0.05	5.50±0.05

Size	2211			1812		1825		2220		2225	
Chip Thickness	1.60±0.20	2.00±0.20	2.50±0.20	2.00±0.20	2.50±0.30	2.00±0.20	2.50±0.30	1.40±0.15 1.60±0.20 2.00±0.20	2.50±0.30	2.00±0.20	2.50±0.30
A_0	< 3.30	< 3.30	< 3.30	<3.90	<3.90	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B_0	< 6.50	< 6.50	< 6.50	<5.30	<5.30	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.30±0.10	0.30±0.10	0.30±0.10	0.25±0.05	0.25±0.05	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10
K_0	< 2.50		< 3.10	<2.50	<3.0	<2.50	<3.10	<2.50	<3.10	<2.50	<3.10
W	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20
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	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
$10xP_0$	40.00±0.20	40.00±0.20	40.00±0.20	40.0±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.0±0.20	40.0±0.20	40.0±0.20	40.0±0.20
P_1	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±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	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D_0	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0	1.50+0.10/-0
D_1	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50+/-0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10
E	1.75±0.1	1.75±0.1	1.75±0.1	1.75±0.10	1.75+/-0.1	1.75±0.1	1.75±0.10	1.75±0.1	1.75±0.10	1.75±0.10	1.75±0.10
F	5.50±0.05	5.50±0.05	5.50±0.05		5.50+/-0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05

10.APPLICATION NOTES

STORAGE

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

Indoors under 5 ~ 40℃ and 20% ~ 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 4℃ per second and the final preheat temperature should be within 100℃ of the soldering temperature for small chips such as 0805,1206, within 50℃ of the soldering temperature for bigger chips such as 1210, 1808, 1812, 1825, 2211, 2220 and 2225, etc.

SOLDERING

Use middy activated rosin RA and RMA 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 with temperature-controlled iron not exceeding 30 watts and diameter of tip less than 1.2 mm is recommended, tip of iron should not contact the ceramic body directly, and the temperature of iron should be set to not more than 260℃.

For bigger chips such as 1210, 1808, 1812, 2211, 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.

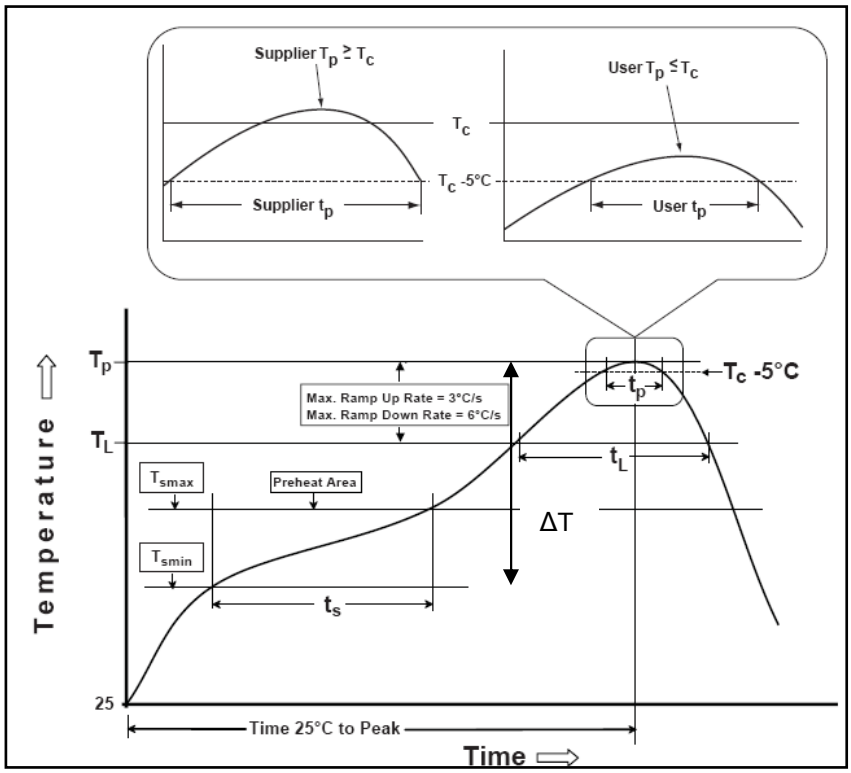
Profile Feature	Pb-Free Assembly
Preheat/Soak Temperature Min.(T_{smin}) Temperature Max.(T_{smax}) Time(t_s) from (T_{smin} to T_{smax})	150℃ 200℃ 60 to 120 seconds
Ramp-up rate(T_L to T_p)	3℃/second max.
Liquidous temperature(T_L) Time(t_L) maintained above T_L	217℃ 60 to 150 seconds
Peak package body temperature(T_p)	For user Tp must not exceed the Classification temp 260℃ For suppliers Tp must equal or exceed the Classification temp 260℃
Time(T_p)* within 5℃ of the specified classification temperature(T_c)	30* second
Ramp-down rate (T_p to T_L)	6℃/second max.
Time 25℃ to peak temperature 260℃	8 minutes max.

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

Maximum temperature = Minimum temperature (235℃)+ΔT+ Tolerance for oven process and measurement(5 ~ 7℃)

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

Classification Reflow Profiles



Chip Size	ΔT
0805,1206	100 ℃
1210, 1808, 1812, 1825, 2211, 2220, 2225	50 ℃

Soldering	Solder Temp.(T_c)	Soldering Time (t_p)
Reflow	235 – 260 ℃	< 15 sec.

Note : For example , T_c is 260℃ and time tp is 15sec.
for user : The peak temperature must not exceed 260℃. The time above 255℃ 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. A cooling rate not exceeding 4℃ per second should be used when forced cooling is necessary.

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 is 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.

11.REFERENCE TABLE

FV	42	X	153	K	152	E	F	G
PDC Family	**Size**	**Dielectric**	**Capacitance**	**Tolerance**	**Rated voltage**	**Packaging**	**Thickness**	**Control Code**
Table1.	Table2	Table3	Table4	Table5	Table6	Table7	Table8	Table9

Table 1 PDC family

Code	Description	Code	Description
FV	High voltage application with ≧ 1KVdc		

Table 2 EIA size

General Purpose

Code	Description	Code	Description
15	0402(1005)	43	1812 (4532)
18	0603 (1608)	46	1825 (4563)
21	0805 (2012)	52	2211 (5728)
31	1206 (3216)	55	2220 (5750)
32	1210 (3225)	56	2225 (5763)
42	1808 (4520)		

Table 3 Dielectric Material Characteristics

Code	Description	Code	Description
N	C0G(NPO)	X	X7R
B	X5R	F	Y5V

Table 4 Capacitance Rule Code

Two significant digits followed by no. of zeros. And R is in place of decimal point.

Code	Description	Code	Description	Code	Description
R47	0.47pF	100	$100=10x10^0$ =10pF	104	$104=10x10^4$ =100nF
0R5	0.5pF	102	$102=10x10^2$ =1000pF	106	$106=10x10^6$ =10μF

Table 5 Tolerance

Code	Description	Code	Description	Code	Description	Code	Description
A	±0.05 pF	F	±1 %	J	±5 %	N	-5% ~ +10%
B	±0.10 pF	G	±2 %	K	±10 %	P	±0.02 pF
C	±0.25 pF	H	±3 %	L	0% ~ +10%	Q	±0.03 pF
D	±0.50 pF	I	-10% ~ 0%	M	±20 %	Z	-20% ~ 80%

Table 6 Rated voltage							
General Purpose							
Code	Description	Code	Description	Code	Description	Code	Description
6R3	6.3VDC	101	100VDC	102	1000VDC	402	4000VDC
100	10VDC	201	200VDC	152	1500VDC	502	5000VDC
160	16VDC	251	250VDC	202	2000VDC	602	6000VDC
250	25VDC	501	500VDC	252	2500VDC		
500	50VDC	631	630VDC	302	3000VDC		

Table 7 Packaging Type			
Code	Description	Code	Description
B	Bulk	T	Tray package
E	Tape and 7” Reel, Embossed Tape	P	Tape and 7” Reel, Paper Tape
K	Tape and 10” Reel, Embossed Tape	D	Tape and 10” Reel, Paper Tape
L	Tape and 13” Reel, Embossed Tape	G	Tape and 13” Reel, Paper Tape

Table 8 Thickness Description					
Code	Description	Code	Description	Code	Description
A	0.60 ± 0.10 mm	I	1.25 ± 0.20 mm	Q	0.50 + 0.02/-0.05 mm
B	0.8 + 0.15/-0.10 mm	J	1.15 ± 0.15 mm	R	3.10 ± 0.30 mm
C	1.25 ± 0.10 mm	K	0.50 ± 0.20 mm	S	0.80 ± 0.07 mm
D	1.40 ± 0.15 mm	L	0.30 ± 0.03 mm	T	0.85 ± 0.10 mm
E	1.60 ± 0.20 mm	M	0.95 ± 0.10 mm	U	0.50 ± 0.10 mm
F	2.00 ± 0.20 mm	N	0.50 ± 0.05 mm	V	0.20 ± 0.02 mm
G	2.50 ± 0.30 mm	O	3.50 ± 0.20 mm	X	0.80 ± 0.10 mm
H	2.80 ± 0.30 mm	P	1.60 +0.3/-0.10 mm	Z	0.25 ± 0.03 mm

Table 9 Special Control Code			
Code	Description	Code	Description
G	RoHS Compliant		