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Messrs. : 一般共用

Date : 2020/02/11

APPROVAL SHEET

Product Name : Stacked Capacitors

Part No. : FE Series

Description : Size 1210~2225, C0G/X7R, 50~630Vdc

PREPARED BY	APPROVED BY

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SPECIFICATION

FOR

Product Name : Stacked Capacitors

Part No. : FE Series

Description : Size 1210~2225, C0G/X7R, 50~630Vdc

SPEC. No. : FE-000-001-09
DATE : 2020/02/11

DRAWN BY	CHECEKED BY	APPROVED BY
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Prosperity Dielectrics Co., Ltd.

1. INTRODUCTION

FE Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors to achieve a unique structure of high reliability. The use of metal lead frame, can absorb the heat and mechanical stress. ESR (equivalent series resistance), ESL (equivalent series inductance) is small, the most suitable for high frequency operation of the rectifier power supply.

2. FEATURES

a. High reliability and stability.
b. Higher mechanical endurance.
c. Anti thermal stress and mechanical stress.
d. Improved vibration performance.
e. More capacitance without changing footprint.
f. RoHS & HALOGEN Compliant.

3. APPLICATIONS

a. DC to DC converter.
b. High voltage coupling/DC blocking.
c. Back-lighting inverters.
d. Snubbers in high frequency power converters.
e. Power supplies.
f. Surge protection.
g. Filtering, smoothing, and decoupling application.

4. HOW TO ORDER

FE	2H	X	106	K	500	L	G	K	M
PDC Family	Size	Dielectric	Capacitance	Tolerance	Rated Voltage	Packaging	Thickness	Control Code	Special Code
Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 9	Table 10

Table 1 PDC Family

Code	Description
FE	Stacked Capacitors Series

Table 2 Stack chip quantity and chip size

The first digit : # of chips in stack

Second digit code : chip size (below)

Code	Description	Code	Description	Code	Description
A	1210 (3225)	G	1825 (4563)	I	2225 (5763)
C	1812 (4532)	H	2220 (5750)		

Table 3 Dielectric Material Characteristics

Code	Description	Code	Description
N	C0G	X	X7R

Table 4 Capacitance Rule Code

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

Table 5 Tolerance

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

Table 6 Rated Voltage

Code	Description	Code	Description	Code	Description
500	50Vdc	251	250Vdc		
101	100Vdc	501	500Vdc		
201	200Vdc	631	630Vdc		

Table 7 Packaging Type

Code	Description	Code	Description
B	Bulk	T	Tray package
L	Tape and 13" Reel, Embossed Tape		

Table 8 Thickness Description

Code	Description	Code	Description	Code	Description
A	3.00±0.35 mm	J	7.80±0.35 mm	S	12.60±0.35 mm
B	3.60±0.35 mm	K	8.40±0.35 mm	T	13.20±0.35 mm
C	4.20±0.35 mm	L	9.00±0.35 mm	U	1.70±0.25 mm
D	4.80±0.35 mm	M	9.60±0.35 mm	V	2.10±0.25 mm
E	5.40±0.35 mm	N	10.20±0.35 mm	W	2.50±0.25 mm
F	6.00±0.35 mm	P	10.80±0.35 mm		
G	6.60±0.35 mm	Q	11.40±0.35 mm		
H	7.20±0.35 mm	R	12.00±0.35 mm		

Table 9 Control Code

Code	Description	Code	Description
L	L type lea	K	K type lead
J	J type lead	B	B type lead
S	Straight type lead	F	Straight type lead

Table 10 Special Code

Blank	---	M	Automotive

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Code / T (mm)	E (mm)
1210 (3225)	3.50±0.40	2.50±0.40	Reference Table 8	1.70±0.15
1812 (4532)	4.80±0.40	3.20±0.40		1.70±0.15
1825 (4563)	4.80±0.40	6.30±0.50		1.70±0.15
2220 (5750)	6.00±0.50	5.00±0.50		1.70±0.15
2225 (5763)	6.00±0.50	6.30±0.50		1.70±0.15

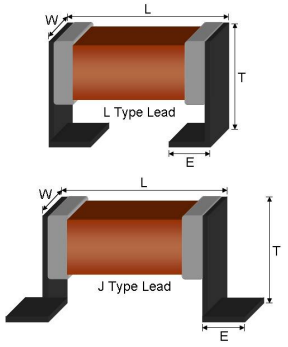


Fig. 5.1 The outline of Stacked Capacitors

6. GENERAL ELECTRICAL DATA

Dielectric	C0G	X7R
Size	1210, 1812, 1825, 2220, 2225	1210, 1812, 1825, 2220, 2225
Rated voltage (WVDC)	50V, 100V, 200V, 250V, 500V, 630V	50V, 100V, 200V, 250V, 500V, 630V
Capacitance range	220nF Max.	47μF Max.
Capacitance tolerance	Reference to Table 5	Reference to Table 5
Tan δ	Cap. Range: Q Spec. Cap.<30pF: Q≥400+20C Cap.≥30pF: Q≥1000	Cap. Range: D.F. Spec. 1210≥3.3μF: ≤5.0% 1812~2225≥10μF: ≤5.0% Other: ≤2.5%
Capacitance & Tan δ Test condition	Measured at the condition of 30~70% related humidity For 25°C at ambient temperature Cap. Range: Test Condition Cap.<1000pF: 1.0±0.2Vrms, 1.0MHz±10% Cap.≥1000pF: 1.0±0.2Vrms, 1.0KHz±10%	Measured at the condition of 30~70% related humidity Preconditioning for Class II MLCC : Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition (25°C) for 24±2 hours before measurement Cap. Range: Test Condition Cap.≤10μF: 1.0±0.2Vrms, 1.0KHz±10% Cap.>10μpF: 0.5±0.2Vrms, 120Hz±20%
Insulation resistance at Ur	≥10GΩ or RxC≥500Ω-F, whichever is smaller	≥10GΩ or RxC≥100Ω-F, whichever is smaller
Operating temperature	-55 to +125°C	-55 to +125°C
Capacitance characteristic	±30ppm / °C	±15%
Termination	L / J / Straight type lead	L / J / Straight type lead

7. CAPACITANCE RANGE (Max.)

7-1. C0G

Dimension	Code	Rated Voltage					
		50V	100V	200V	250V	500V	630V
1210	1A	393	223	103	103	103	103
1812	1C	104	473	273	273	223	223
	2C	224(M)	104	563	563	473(M)	473(M)
1825	1G	104	104	683	683	473	223
	2G	224(M)	224(M)	134	134	104	473(M)
2220	1H	104	104	683	683	473	223
	2H	224(M)	224(M)	134	134	104	473(M)
2225	1I	104	104	104	104	823	683
	2I	224(M)	224(M)	224(M)	224(M)	184(M)	134

7-2. X7R

Dimension	Code	Rated Voltage					
		50V	100V	200V	250V	500V	630V
1210	1A	475	335	684	684	104	104
1812	1C	106	475	105	105	474	224
	2C	226(M)	106	225(M)	225(M)	105	474(M)
1825	1G	106	106	105	105	564	564
	2G	226(M)	226(M)	225(M)	225(M)	125(M)	125(M)
2220	1H	226	106	225	225	474	474
	2H	476(M)	226(M)	475(M)	475(M)	105	105
2225	1I	106	106	275	275	564	564
	2I	226(M)	226(M)	565	565	125(M)	125(M)

(M) means M tolerance only.

7-3. Customizable, Please contact the liaison.

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

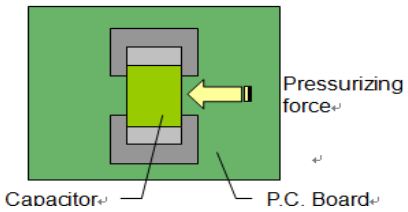
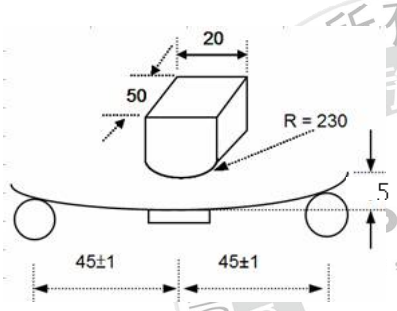
<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>1.</td><td>Visual and Dimensions</td><td>---</td><td>* No remarkable defect.
* Dimensions to confirm to individual specification sheet.</td></tr>
<tr><td>2.</td><td>Capacitance</td><td rowspan="2">* Class I :
Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%.
Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%.

* Class II :
Cap.≤10μF, 1.0±0.2Vrms, 1KHz±10%.
Cap.>10μF, 0.5±0.2Vrms, 120Hz±20%.</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>
<table>
<tr><th>Dielectric</th><th>Cap. Range</th><th>Q/D.F.</th></tr>
<tr><td rowspan="2">Class I (C0G)</td><td>Cap.≥30pF</td><td>Q≥1000</td></tr>
<tr><td>Cap.<30pF</td><td>Q≥400+20C</td></tr>
<tr><td rowspan="2">Class II (X7R)</td><td>1210≥3.3μF & 1812~2220≥10μF</td><td>D.F.≤5.0%</td></tr>
<tr><td>Other</td><td>D.F.≤2.5%</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>C0G</td><td>-55~125°C at 25°C</td></tr>
<tr><td>X7R</td><td>-55~125°C at 25°C</td></tr>
</table>
</td><td>
<table>
<tr><th>T.C.</th><th>Capacitance Change</th></tr>
<tr><td>C0G</td><td>Within ±30ppm/°C</td></tr>
<tr><td>X7R</td><td>Within ±15%</td></tr>
</table>
</td></tr>
<tr><td>5.</td><td>Insulation Resistance</td><td>
<table>
<tr><th>Rated Vol. (V)</th><th>Apply Voltage</th><th>Test Time</th></tr>
<tr><td>≤100</td><td>1 times of U_R</td><td>Max. 120 sec.</td></tr>
<tr><td>100<V≤500</td><td>1 times of U_R</td><td>60 sec.</td></tr>
<tr><td>>500</td><td>500Vdc</td><td>60 sec.</td></tr>
</table>
</td><td>
<table>
<tr><th>Dielectric</th><th>Requirements</th></tr>
<tr><td>Class I</td><td>≥10GΩ or RxC≥500Ω-F, whichever is smaller</td></tr>
<tr><td>Class II</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 Voltage</th><th>Condition</th></tr>
<tr><td>≤100</td><td>2.5 times of U_R</td></tr>
<tr><td>100<V≤250</td><td>2.0 times of U_R</td></tr>
<tr><td>250<V≤500</td><td>1.5 times of U_R</td></tr>
<tr><td>=630</td><td>1.2 times of U_R</td></tr>
</table>
* 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>7.</td><td>Temperature Cycle</td><td>* Conduct the 100 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.
* 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.
* Cap. change :
C0G Within ±2.5% or ±0.25pF, whichever is larger.
X7R Within ±7.5%.
* Q/D.F. :
C0G : Q≥100% of initial requirement.
X7R : D.F.≤150% of initial requirement.
* I.R. : To meet the initial requirement.</td></tr>
<tr><td>8.</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.
* 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.
* Cap. change :
C0G Within ±5.0% or ±0.5pF, whichever is larger.
X7R Within ±12.5%.
* Q/D.F. :
C0G : Q≥350.
X7R : D.F.≤200% of initial requirement.
* I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller.</td></tr>
</table>

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>9.</td><td>Humidity (Damp Heat) Load</td><td>* Test temp. : 40±2°C.
* Humidity : 90~95%RH.
* Test time : 500 +24/-0hrs.
* To apply voltage : Rated voltage (500V max.).
* 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 (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap. change :
C0G Within ±7.5% or ±0.75pF, whichever is larger.
X7R Within ±12.5%.
* Q/D.F. :
C0G : Q≥200.
X7R : D.F.≤200% of initial requirement.
* I.R. : ≥500MΩ or RxC≥25Ω-F, whichever is smaller.</td></tr>
<tr><td>10.</td><td>High Temperature Load (Endurance)</td><td>* Test temp. : 125±3°C.
* To apply voltage :
<table>
<tr><td>Dielectric</td><td>Rated Vol.(V)</td><td>Apply Voltage</td></tr>
<tr><td rowspan="3">C0G/X7R</td><td>≤100</td><td>2.0 times of U_R</td></tr>
<tr><td>200≤V≤ 500</td><td>1.5 times of U_R</td></tr>
<tr><td>=630</td><td>1.2 times of U_R</td></tr>
</table>
* Exception items (X7R only) :
(1) 150% of rated voltage for below range :
<table>
<tr><td>Rated Vol.(V)</td><td>Size</td><td>Cap. Range</td></tr>
<tr><td>ALL</td><td>ALL</td><td>Cap.≥106</td></tr>
<tr><td>50V & 100V</td><td>1210
1812
1825
2220
2225</td><td>Cap.≥105</td></tr>
</table>
(2) 120% of rated voltage for below range :
<table>
<tr><td>Size</td><td>Dielectric</td><td>Rated Voltage</td><td>Capacitance</td></tr>
<tr><td>2220</td><td>X7R</td><td>≥100V</td><td>Cap.≥15μF</td></tr>
</table>
(3) 100% of rated voltage for below range :
<table>
<tr><td>Size</td><td>Dielectric</td><td>Rated Voltage</td><td>Capacitance</td></tr>
<tr><td>1210</td><td>X7R</td><td>≥100V</td><td>Cap.≥3.3μF</td></tr>
</table>
* 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.
* 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.
* Cap. change :
C0G Within ±3.0% or ±0.3pF, whichever is larger.
X7R Within ±12.5%.
* Q/D.F. :
C0G : Q≥350.
X7R : D.F.≤200% of initial requirement.
* I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller.</td></tr>
</table>

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements
11.	**Adhesive Strength of Termination**	* 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 second. 	* No remarkable damage or removal of the terminations.
14.	**Bending Test**	* 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 5mm.  Unit : mm	* No remarkable damage. Dielectric / Cap. Change C0G: Within ±3.0% or ±2.0pF, whichever is larger X7R: Within ±12.5% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)
15.	**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. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).	* No remarkable damage. * Cap. change and D.F. : To meet initial spec.

9. APPLICATION NOTES

STORAGE

To prevent the damage of solderability of terminations, the following storage conditions are recommended :
Indoors under 5 ~ 40°C 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 product is recommended to be used within 12 months after shipment 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.

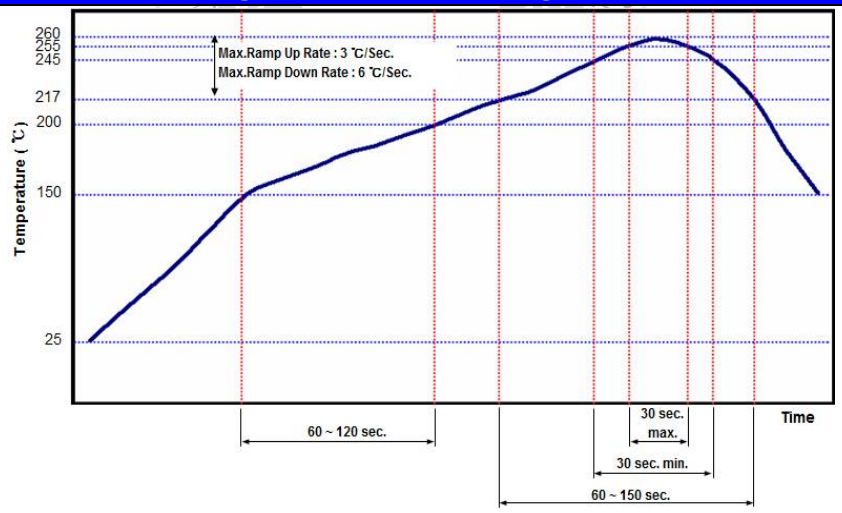
PREHEAT

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 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.
a.) Reflow soldering :

Fig. 9.1 Reflow soldering profile



For Sn/Ag/Cu Series solder paste (Pb-Free)

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 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.