1. INTRODUCTION

PROSPERITY's SAFETY CERTIFIED CAPACITORS are designed for surge or lightning immunity in modem facsimile and other equipments. The capacitors of series FK are class X1/Y2 compliant respectively.

The green type capacitors in FK and FH series are manufactured by using environmentally friendly materials without lead or cadmium.

The terminations are composed of plated nickel and pure tin to feature the superior leaching resistance during soldering.

2. FEATURES

a. High reliability and stability.
b. Small size and high capacitance
c. RoHS compliant
d. Safety standard approval by EN132400:1994+A2+A3+A4, IEC60384-14, EN60384-14:2005 and UL60950
e. Certificate number:
R 500416666 and R 50118381 by TUV
E231248 by UL

3. APPLICATIONS

a. Modem.
b. Facsimile.
c. Telephone.
d. Other electronic equipment for lighting or surge protection and isolation.

4.HOW TO ORDER

FK	08	X	102	K	502	E	F	G
PDC Family	**Size**	**Dielectric**	**Capacitance**	**Tolerance**	**Safety Class**	**Packaging**	**Thickness**	**Control Code**
FK: X1Y2 **FH:** X2Y3	Inch (mm) **08:** 1808(4520) **12:** 1812(4532) **21:** 2211(5728) **20:** 2220(5750)	**N:** C0G **X:** X7R	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=** ±1.0% **G**= ±2.0% **J**= ±5.0% **K**= ±10% **M**= ±20%	**302:** X2Y3 (Impulse 2.5KV) **502:** X1Y2 (Impulse 5.0KV) **602:** X1Y2 (Impulse 6.0KV)	**E:** Tape and Reel, Embossed Tape **B:** Bulk	**C:** 1.25±0.10mm **D:** 1.40±0.15mm **E:** 1.60±0.20 mm **F:** 2.00±0.20 mm **G:** 2.50±0.30 mm	**G:** RoHS compliant

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Tmax (mm)	M_B min (mm)
1808 (4520)	4.60±0.30	2.00±0.20	2.20	0.26
1812 (4532)	4.60±0.30	3.20±0.30	2.80	0.26
2211 (5728)	5.70±0.40	2.80±0.30	2.80	0.30
2220 (5750)	5.70±0.40	5.00±0.40	2.80	0.30

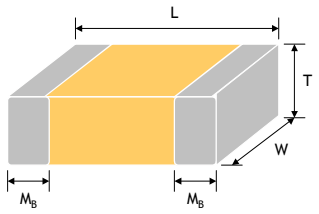


Fig. 1 The outline of MLCC

6.GENERAL ELECTRICAL DATA

Dielectric	NP0		X7R	
Size	1808, 1812, 2211		1808, 1812, 2211, 2220	
Rated voltage (WVDC)	250Vac		250Vac	
Capacitance range*	X1Y2 Class(Impulse 6KV)	4pF ~ 100pF	X1Y2 Class	100pF ~ 4700pF
	X1Y2 Class(Impulse 5KV)	3pF ~ 720pF	X2Y3 Class	150pF ~ 4700pF
	X2Y3 Class	3pF ~ 1000pF		
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%)		K (±10%), M (±20%)	
Tan δ*	Cap<30pF : D.F≤1/(400+20C) Cap≥30pF : D.F≤0.10%		≤2.5%	
Insulation resistance at 500Vdc for 60 seconds	≥100GΩ or R•C≥1000 whichever is smaller		≥10GΩ or R•C≥500Ω-F whichever is smaller	
Operating temperature	-55 to +125℃			
Capacitance characteristic	±30ppm / ℃		±15%	
Termination	Ag/Ni/Sn (lead-free termination)			

* NP0: Apply 1.0±0.2Vrms, 1.0MHz±10%, at 25℃ ambie nt temperature

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

7.CAPACITANCE RANGE

7.1 X1Y2 (FK) Class

	SIZE	1808	1812	2211	2211	1808	1812	2211	2220
	DIELECTRIC	NPO	NPO	NPO	NPO	X7R	X7R	X7R	X7R
	RATED VOLTAGE	250Vac	250Vac	250Vac	250Vac	250Vac	250Vac	250Vac	250Vac
	CERTIFICATED	TUV / UL	TUV	TUV	TUV	TUV	TUV / UL	TUV / UL	TUV / UL
	CLASS	X1Y2	X1Y2	X1Y2	X1Y2	X1Y2	X1Y2	X1Y2	X1Y2
	Impulse	5KV	5KV	5KV	6KV	5KV	5KV	5KV	5KV
Capacitance	3.0pF (3R0)								
	3.3pF (3R3)								
	4.0pF (4R0)								
	4.7pF (4R7)								
	5.0pF (5R0)								
	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)								
	130pF (131)								
	160pF (161)								
	180pF (181)								
	220pF (221)								
	270pF (271)								
	330pF (331)								
	390pF (391)								
	470pF (471)								
	560pF (561)								
	680pF (681)								
	720pF (721)								
	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)								

7.2 X2Y3(FH) Class

SIZE		1808	1812	1808	1812
DIELECTRIC		NPO	NPO	X7R	X7R
RATED VOLTAGE		250Vac	250Vac	250Vac	250Vac
CERTIFICATED		TUV / UL	TUV	TUV / UL	TUV / UL
CLASS		X2Y3	X2Y3	X2Y3	X2Y3
Capacitance	3.0pF (3R0)				
	3.3pF (3R3)				
	3.9pF (3R9)				
	4.7pF (4R7)				
	5.0pF (5R0)				
	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)				
	130pF (131)				
	150pF (151)				
	180pF (181)				
	220pF (221)				
	270pF (271)				
	300pF (301)				
	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)				

8.PACKAGE DIMENSION AND QUANTITY

Size	Thickness (mm)	Plastic tape	
		7" reel	13" reel
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
2211 (5728)	1.60±0.20	1k	-
	2.00±0.20	1k	
	2.50±0.30	0.5k	-
2220 (5750)	2.00±0.20	1k	
	2.50±0.30	0.5k	

Unit: pieces

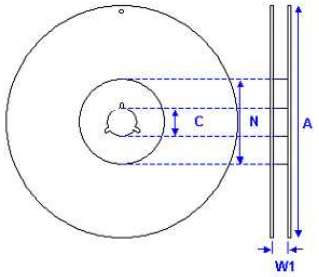


Fig. 4 The dimension of reel

Size	1808, 1812, 2211 2220
Reel size	7"
C	13.0+0.5/-0.2
W_1	12.4+2.0/-0
A	178.0±0.10
N	80.0±1.0

EMBOSSED TAPE DIMENSIONS

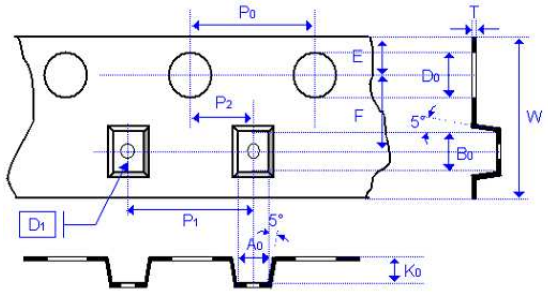


Fig. 3 The dimension of plastic tape

Size	1808		1812		2211		2220	
Chip Thickness	1.25±0.10 1.40±0.15 1.60±0.20	2.00±0.20	1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30	1.60±0.20 2.00±0.20	2.50±0.30	2.00±0.20	2.50±0.30
A_0	<2.50	<2.50	<3.90	<3.90	<3.30	<3.30	<3.30	<3.30
B_0	<5.30	<5.30	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.25±0.05	0.25±0.05	0.25±0.05	0.25±0.05	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10
K_0	<2.50	<2.50	<2.50	<3.00	<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
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
$10xP_0$	40.0±0.20	40.0±0.20	40.0±0.20	40.0±0.20	40.0±0.20	40.0±0.20	40.0±0.20	40.0±0.20
P_1	4.00±0.10	4.00±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
D_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	1.50+0.10/-0	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
E	1.75±0.10	1.75±0.10	1.75±0.10	1.75+/-0.1	1.75±0.1	1.75±0.10	1.75±0.1	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

9.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 50 ℃ of the soldering temperature for bigger chips such as 1808, 1812, 2211, 2220, etc.

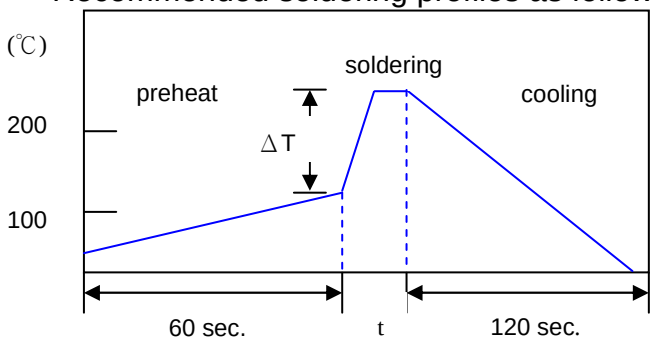
SOLDERING

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 1808, 1812, 2211 and 2220, etc. wave soldering and hand soldering are no recommended.

Recommended soldering profiles as following:



Soldering	Solder Temp.(T)	Soldering Time (t)
Reflow	235 – 250 ℃	< 15 sec.

Chip Size	ΔT
1808, 1812, 2211, 2220	50 ℃

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

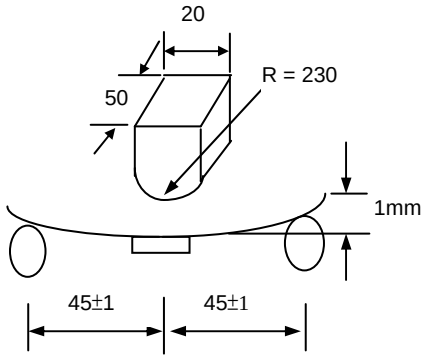
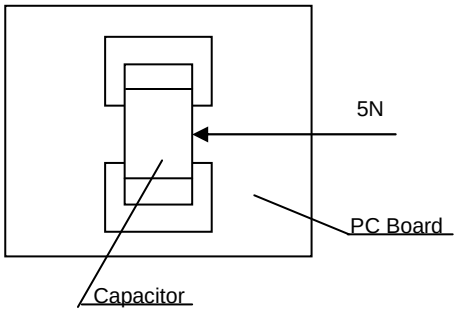
All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors 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.

10.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 Mechanical</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 (NP0): 1.0±0.2Vrms, 1MHz±10%</td><td>* Capacitance is within specified tolerance</td></tr>
<tr><td>3.</td><td>D.F. (Dissipation Factor)</td><td>Class II (X7R): 1.0±0.2Vrms, 1KHz±10%</td><td>Class I (NP0): Cap≥30pF, D.F≤0.1%;
Cap<30pF, D.F≤1/(400+20C)
Class II (X7R): ≤2.5%</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>NP0</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>NP0</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>Class I (NP0) : ≥100GΩ or RxC≥1000Ω-F whichever is smaller.
Class II (X7R) : ≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>6.</td><td>Dielectric Strength</td><td>* To apply voltage:
X Capacitor: 1075Vdc (4.3U_R)
Y Capacitor: 1500Vac
* Duration: 60 sec.</td><td>* No evidence of damage or flashover during test.</td></tr>
<tr><td>7.</td><td>Solderability</td><td>* Solder temperature: 245±5℃
* Dipping time: 5±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) and 48±4 hrs (Class II)</td><td>* No remarkable damage.
* Cap change:
NP0: within ±2.5% or ±0.25pF whichever is larger.
I.R: More than 1GΩ

X7R: within ±10%
I.R: More than 1GΩ</td></tr>
<tr><td>9.</td><td>Humidity (Damp Heat) Steady State</td><td>* Test temp.: 40±2℃
* Humidity: 90~95% RH
* Test time: 500+24/-0hrs.
* Applied Voltage:250Vac
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II)</td><td>* No remarkable damage.
* Cap change:
NP0 within ±5% or ±0.5pF whichever is larger
X7R within ±15%
* D.F Value:
NP0 ≤ 0.25%
X7R: ≤5.0%
* I.R. ≥1GΩ
* Dielectric strength satisfies the specified initial value</td></tr>
<tr><td>10.</td><td>Endurance</td><td>* Impulse Voltage:
Each individual capacitor shall be subjected to a Vp = 5.0KV (X1Y2 Class Impulse 5KV) & Vp = 6.0KV (X1Y2 Class Impulse 6KV) impulse for three times before applied to endurance test.
Additional pulse test 10/700μs before endurance test for Y3 class (IEC60950)
*Test Temp.: 125±3℃
* Test time:: 1000+48/-0 hrs.
* Applied Voltage:
X capacitor: 1.25U_R (312.5Vac)
Y capacitor: 1.70U_R (425Vac)
Once every hour the voltage shall be increased to 1000Vrms for 0.1 sec.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II)</td><td>* Appearance :
No mechanical damage.
* Cap change:
NP0 within ±5% or ±0.5pF whichever is larger
X7R within ±20%
* D.F Value:
NP0 ≤ 0.25%
X7R: ≤5.0%
* I.R. ≥1GΩ
* Dielectric strength satisfies the specified initial value</td></tr>
</table>

10.RELIABILITY TEST CONDITIONS AND REQUIREMENTS (Cont.)

No.	Item	Test Condition	Requirements
11.	**Resistance to Flexure of Substrate**	* Capacitors mounted on a substrate. The board shall be bent 1mm with a rate of 1mm/sec. 	* No remarkable damage. * Cap change is less than 10%. (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)
12.	**Adhesive Strength of Termination**	* 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 sec. 	* No remarkable damage or removal of the terminations.
13.	**Passive Flammability**	* Volume sample: 21.56mm^3 * Flame exposure time: 5 sec Max.	* Capacitor didn't burn at all
14.	**Active Flammability**	* The capacitors applied U_R (250Vac). Then each sample shall be subjected to 20 discharges from a tank capacitor, charge to a voltage that, when discharged, plase Ui 2500V for X2Y3, Ui 5000V for X1Y2 across the capacitor under test. The interval between successive discharges shall be 5 sec.	* The cheese cloth shall not burn with a flame.