

Messrs.

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## APPROVAL SHEET

Product Name : Safety Certified Multilayer Ceramic Chip Capacitors

Part No. : FK/FH Series

Description : X1/Y2 & X2/Y3 Class, Size 1808~2220, C0G(NPO)/X7R, 250VAC  
& UL E231248 Certified, Size 1206, X7R, 1000pF, 2KVDC/2.5KVDC

PREPARED BY	APPROVED BY

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PROSPERITY DIELECTRICS CO., LTD.

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SPECIFICATION FOR

SAFETY CERTIFIED MULTILAYER CERAMIC CHIP CAPACITORS

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Description : X1/Y2 & X2/Y3 Class, Size 1808~2220, C0G(NPO)/X7R, 250VAC  
& UL E231248 Certified, Size 1206, X7R, 1000pF, 2KVDC/2.5KVDC

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## 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, Third edition, 2005,  
EN60384-14:2005 and UL60950  
UL 60384-14
- e. Certificate number:  
R 500416666 and R 50118381 by TUV  
E231248 by UL, E346791 by UL(FOWX2/8)
- f. HALOGEN compliant



## 3. APPLICATIONS

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

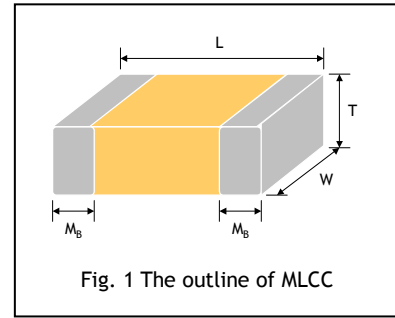
## 4. HOW TO ORDER

<b>FH</b>	<b>20</b>	<b>X</b>	<b>103</b>	<b>K</b>	<b>302</b>	<b>E</b>	<b>G</b>	<b>G</b>
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 & Structure

Size Inch (mm)	L (mm)	W (mm)	Thickness Spec	M <sub>B</sub> min (mm)
			T(mm) code	
1206 (3216)	3.20±0.20	1.60±0.20	See No.11 Reference Table	0.26
1808 (4520)	4.70±0.30	2.00±0.20		0.26
1812 (4532)	4.70±0.30	3.20±0.30		0.26
2211 (5728)	5.70±0.40	2.80±0.30		0.30
2220 (5750)	5.70±0.40	5.00±0.40		0.30



## 6. GENERAL ELECTRICAL DATA

Dielectric	C0G(NPO)		X7R		X7R
Size	1808, 1812, 2211		1808, 1812, 2211, 2220		1206
Rated voltage	250VAC				2.5KVDC 2.0KVDC
Capacitance range*	X1/Y2 Class(Impulse 6KV)	4pF ~ 100pF	X1/Y2 Class	100pF ~ 4700pF	1000pF
	X1/Y2 Class(Impulse 5KV)	3pF ~ 720pF	X2/Y3 Class	150pF ~ 23,000pF	
	X2/Y3 Class	3pF ~ 1000pF			
Capacitance tolerance	Reference to Table5		Reference to Table5	Reference to Table5	
Tan δ*(Tangent of loss angle)	Cap. Rang	Q Spec.	≤2.5%		
	Cap<30pF:	Q≥400+20C			
	Cap≥30pF:	Q≥1000			
Capacitance & Tan δ Test Condition	Measured at the condition of 30~70% related humidity.				
	for 25°C at ambient temperature		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.		
	Cap. Rang	Test Condition	1.0±0.2Vrms, 1.0kHz±10%, at 25°C ambient temperature.		
	Cap≤1000pF	1.0±0.2Vrms, 1.0MHz±10%			
Cap>1000pF,	1.0±0.2Vrms, 1.0kHz±10%				
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°C				
Capacitance characteristic	±30ppm / °C		±15%		
Termination	(Cu or Ag) / Ni / Sn (lead-free termination)				

# 7. CAPACITANCE RANGE

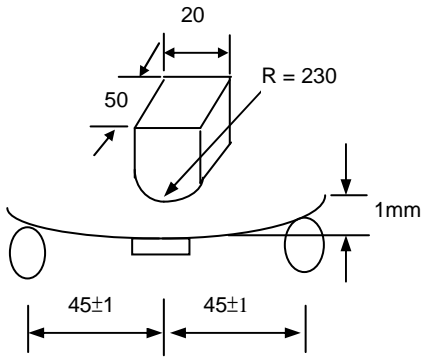
Cap (pF)	Class	X1/Y2 (FK Series)								X2/Y3 (FH Series)						
	Rated Voltage	250Vac														2KVDC 2.5KVDC
	DIELECTRIC	C0G				X7R				C0G		X7R				
	Certificated	TUV / UL	TUV	TUV	TUV	TUV	TUV / UL	TUV / UL	UL	TUV / UL	TUV	TUV / UL	TUV / UL	UL	UL	
	Size	1808	1812	2211	2211	1808	1812	2211	2220	1808	1812	1808	1812	2220	1206	
	Impulse	5KV			6KV	5KV				2.5KV						---
3.0	3R0	D								D						
3.3	3R3	D								D						
4.0	4R0	D		F	F					D						
4.7	4R7	D		F	F					D						
5.0	5R0	D		F	F					D						
5.6	5R6	D		F	F					D						
6.8	6R8	D		F	F					D						
8.2	8R2	D		F	F					D						
10	100	D	C	F	F					D	C					
12	120	D	C	F	F					D	C					
15	150	D	C	F	F					D	C					
18	180	D	C	F	F					D	C					
22	220	D	C	F	F					D	C					
27	270	D	C	F	F					D	C					
33	330	D	C	F	F					D	C					
39	390	E	C	F	F					E	C					
47	470	E	C	F	F					E	C					
56	560	E	C	F	F					E	C					
68	680	E	C	F	G					E	C					
82	820	E	C	F	G					E	C					
100	101	F	C	F	H	E				F	C					
120	121	F	C	G		E				F	C					
130	131	F	C/E	G		E	E			F	C					
150	151	F	C/F	G		E	E	E		F	C	E				
160	161	F	C	G		E	E	E	F	F	C	E				
180	181	F	C/F	G		E	E	E	F	F	C	E				
220	221	F	C/F	G		E	E	E	F	F	C	E				
270	271	F	F	G		F	E	E	F	F	C/E	E	E			
300	301		F	G		F	E	E	F	F	C/E	E	E			
330	331		F	G		F	E	E	F	F	C/E	E	E			
390	391		F	G		F	E	E	F	F	C/E	E	E			
470	471		F	G		F	E	F	F	F	C/E	E	E			
560	561			G		F	E	F	F	F	C/E	E	E			
680	681			G		F	F	F	F	F	C/E	E	E			
720	721			G		F	F	F	F	F	E	E	E			
820	821					F	F	F	F	F	E	E	E			
1,000	102					F	G	G	F	F	E/F	F	E	C		
1,200	122							G	G			F	E			
1,500	152							G	G			F	F			
1,800	182							G	G			F	F			
2,200	222							G	G			F	G			
2,700	272								G				G			
3,300	332								G				G			
3,900	392								G				G			
4,700	472								G				F/G			
5,600	562												G			
6,800	682															
8,200	822															
10,000	103													G		
12,000	123													G		
15,000	153													G		
18,000	183													G		
22,000	223													H		



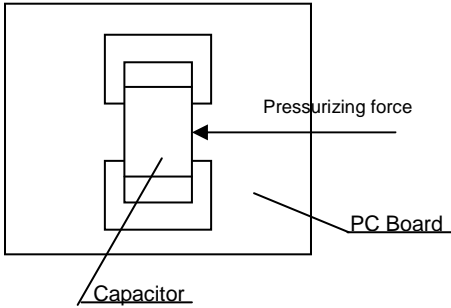
# 8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Standard Methods	Test Condition	Requirements																										
1.	Visual examination and Dimensions	IEC 60384-1 4.1		* No remarkable defect. * Dimensions to confirm to individual specification sheet.																										
2.	Capacitance	IEC 60384-1 4.2.2	Class I: C0G(NP0) Cap≤1000pF, 1.0±0.2Vrms, 1MHz±10% Cap>1000pF, 1.0±0.2Vrms, 1KHz±10%	* Capacitance is within specified tolerance * C <sub>R</sub> means rated capacitance for conform to the E6 series of preferred values given in IEC 60063.																										
3.	D.F. (Dissipation Factor) Tangent of loss angle	IEC 60384-1 4.2.3	Class II: (X7R, Y5V) 1.0±0.2Vrms, 1kHz±10%	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Q/D.F.</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I(NPO)</td> <td>Q≥1000</td> <td>Cap≥30pF</td> </tr> <tr> <td>Q≥400+20C</td> <td>Cap&lt;30pF</td> </tr> <tr> <td>Class II(X7R)</td> <td>D.F. &lt; 2.5%</td> <td></td> </tr> </tbody> </table>	Dielectric	Q/D.F.	Remark	Class I(NPO)	Q≥1000	Cap≥30pF	Q≥400+20C	Cap<30pF	Class II(X7R)	D.F. < 2.5%																
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4.	Temperature Coefficient	IEC 60384-21/22 4.6	With no electrical load. <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp</th> </tr> </thead> <tbody> <tr> <td>C0G(NPO)</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> </tbody> </table>	T.C.	Operating Temp	C0G(NPO)	-55~125°C at 25°C	X7R	-55~125°C at 25°C	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance C ange</th> </tr> </thead> <tbody> <tr> <td>C0G(NPO)</td> <td>Within ±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> </tbody> </table>	T.C.	Capacitance C ange	C0G(NPO)	Within ±30ppm/°C	X7R	Within ±15%														
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5.	Insulation Resistance	IEC 60384-21/22 4.5.3	* To apply voltage at 500VDC for 60 sec. * The charge current shall not exceed 0.05A.	Class I (NP0) : ≥ 100GΩ or RxC ≥ 1000 Ω-F whichever is smaller. Class II (X7R) : ≥ 10GΩ or RxC ≥ 500 Ω-F whichever is smaller.																										
6.	Voltage proof (Dielectric Strength)	IEC 60384-14 4.2.1	* To apply voltage: X Capacitor: 1075Vdc (4.3U <sub>R</sub> ) Y Capacitor: 1500Vac * Duration: 60 sec. * The charge current shall not exceed 0.05A.	* No evidence of damage or flashover during test. * The voltage shall be raised from the near zero to the test voltage a rate not exceeding 150V(r.m.s.)/sec.																										
7.	Solderability	IEC 60384-21/22 4.10	* Solder temperature: 245±5°C * Dipping time: 2±0.2 sec.	75% min. coverage of all metalized area.																										
8.	Resistance to Soldering Heat	IEC 60384-14 4.4 IEC 60384-21/22 4.9	* Solder temperature: 260±5°C * Dipping time: 10±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±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)	* No visible damage. <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td>≥ 1GΩ</td> <td>Within ±2.5% or ±0.25pF whichever is larger.</td> <td rowspan="2">≤ 1.0 × Initial requirement</td> </tr> <tr> <td>Class II(X7R)</td> <td>≥ 1GΩ</td> <td>within ±7.5%</td> </tr> </tbody> </table>	Dielectric	I.R	Cap Change	Q/D.F	Class I(NPO)	≥ 1GΩ	Within ±2.5% or ±0.25pF whichever is larger.	≤ 1.0 × Initial requirement	Class II(X7R)	≥ 1GΩ	within ±7.5%															
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Class II(X7R)	≥ 1GΩ	within ±7.5%																												
9	Temperature Cycle	IEC 60384-21/22 4.11	For FH06X series product * Conduct the five cycles according to the temperatures and time. <table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time</th> </tr> </thead> <tbody> <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> </tbody> </table> * Before initial measurement: Perform 150+0/-10°C for 1 hr and then set for 48±4 hrs at room temp. * Measurement to be made after keeping at room temp. for 48±4 hrs.	Step	Temp. (°C)	Time	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2~3	3	Max. Operating temp. +3/-0	30±3	4	Room temp.	2~3	* No remarkable damage. <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td rowspan="2">0.25 × initial requirements.</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> </tbody> </table>	Dielectric	I.R	Cap Change	Q/D.F	Class I(NPO)	0.25 × initial requirements.	Within ±2.5% or ±0.25pF whichever is larger.	≤ 1.0(Q) × Initial requirement	Class II(X7R)	within ±7.5%	≤ 1.5(D.F.) × Initial requirement
Step	Temp. (°C)	Time																												
1	Min. operating temp. +0/-3	30±3																												
2	Room temp.	2~3																												
3	Max. Operating temp. +3/-0	30±3																												
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Class II(X7R)		within ±7.5%	≤ 1.5(D.F.) × Initial requirement																											
10.	Humidity (Damp Heat) Steady State	IEC 60384-14 4.12	* Test temp.: 40±2°C * Humidity: 90~95% RH * Test time: 500+24/-0hrs. * Applied Voltage:250Vac For FH06X series product no load voltage. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II)	* No remarkable damage. <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td rowspan="2">≥1GΩ or RxC≥ 25Ω-F whichever is smaller.</td> <td>within ±3.0% or ±2pF whichever is larger</td> <td rowspan="2">≤ 0.25 %</td> </tr> <tr> <td>Class II(X7R)</td> <td>within ±15%</td> <td>D.F. ≤ 2 × Initial requirement</td> </tr> </tbody> </table>	Dielectric	I.R	Cap Change	Q/D.F	Class I(NPO)	≥1GΩ or RxC≥ 25Ω-F whichever is smaller.	within ±3.0% or ±2pF whichever is larger	≤ 0.25 %	Class II(X7R)	within ±15%	D.F. ≤ 2 × Initial requirement															
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Class II(X7R)		within ±15%		D.F. ≤ 2 × Initial requirement																										

## 8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Cont.)

No.	Item	Standard Methods	Test Condition	Requirements						
11.	Passive Flammability	IEC 60384-14 4.17 IEC 60384-1 4.38	* Volume sample: 21.56 mm <sup>3</sup> * Flame exposure time: 5 sec Max. * Category of flammability : C.	* Capacitor didn't burn at all (FH06X series not include)						
12.	Active Flammability	IEC 60384-14 4.17 IEC 60384-1 4.38	* The capacitors applied U <sub>R</sub> (250Vac). Then each sample shall be subjected to 20 discharges from a tank capacitor, charge to a voltage that, when discharged, plase U <sub>i</sub> 2500V for X2Y3, U <sub>i</sub> 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. (FH06X series not include)						
12.	Endurance	IEC 60384-14 4.14	* Impulse Voltage: Each individual capacitor shall be subjected to a V <sub>p</sub> = 5.0KV (X1Y2 Class Impulse 5KV) & V <sub>p</sub> = 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°C * Test time:: 1000+48/-0 hrs. * Applied Voltage: X capacitor: 1.25U <sub>R</sub> (312.5Vac) Y capacitor: 1.70U <sub>R</sub> (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)  For FH06X series * Test temp.: 125±3°C * To apply voltage: 100% of rated voltage. * Test time: 1000+24/-0 hrs. * Measurement to be made after keeping at room temp. for 48±4 hrs.	* 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						
13.	Resistance to Flexure of Substrate	IEC 60384-21/22 4.8	* Capacitors mounted on a substrate. The board shall be bent 1mm with a rate of 1mm/sec.  	* No remarkable damage. <table border="1" data-bbox="925 1164 1492 1265"> <thead> <tr> <th>Dielectric</th> <th>Cap Change</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td>within ±3.0% or ±2pF whichever is larger</td> </tr> <tr> <td>Class II(X7R)</td> <td>within ±12.5%</td> </tr> </tbody> </table> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</p>	Dielectric	Cap Change	Class I(NPO)	within ±3.0% or ±2pF whichever is larger	Class II(X7R)	within ±12.5%
Dielectric	Cap Change									
Class I(NPO)	within ±3.0% or ±2pF whichever is larger									
Class II(X7R)	within ±12.5%									

## 8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Cont.)

No.	Item	Standard Methods	Test Condition	Requirements
14.	<b>Robustness of terminations (Adhesive Strength of Termination)</b>	IEC 60384-21/22 4.15 IEC 60384-1 4.13	<p>* 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.</p> 	* No remarkable damage or removal of the terminations.
15.	<b>Impulse Voltage</b>	IEC 60384-14 4.13	<p>* X1 : 4.0KV, X2 : 2.5KV. * Y2 : 5.0KV, Y3 : None. * Number of impulse : 24 max.</p>	*There shall be no permanent breakdown or flashover. (FH06X series not include)



## 9. PACKAGE DIMENSION AND QUANTITY

Size	Thickness (mm)	Plastic tape	
		7" reel	13" reel
1206 (3216)	1.25±0.10	3k	10k
	1.60±0.20	2k	-
1808 (4520)	1.25±0.10	2k	10k
	1.40±0.15	2k	-
	1.60±0.20	2k	8k
1812 (4532)	2.00±0.20	1k	6k
	1.25±0.10	1k	-
	1.60±0.20	1k	-
2211 (5728)	2.00±0.20	1k	-
	2.50±0.30	0.5k	3k
	1.60±0.20	1k	-
2220 (5750)	2.00±0.20	1k	-
	2.50±0.30	0.5k	-
	2.00±0.20	1k	-

Unit: pieces

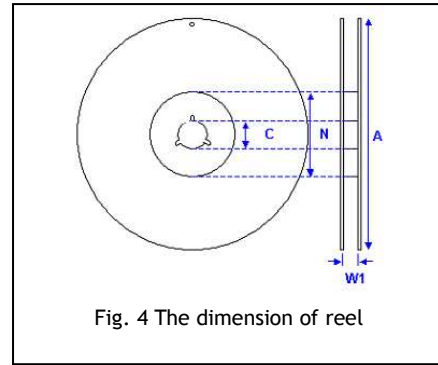


Fig. 4 The dimension of reel

Size	1808, 1812, 2211, 2220	1206
Reel	7"	13"
C	13.0+0.5/-0.2	13.0+0.5/-0.2
W <sub>1</sub>	12.4+2.0/-0	8.4+1.5/-0
A	178.0±0.10	330.0±1.0
N	80.0±1.0	100±1.0

### 9.1 EMBOSSED TAPE DIMENSIONS

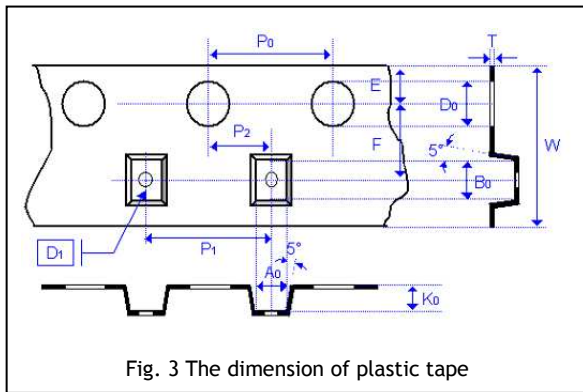


Fig. 3 The dimension of plastic tape

Size	1206	1808		1812		2211		2220	
Chip Thickness	1.25±0.10 1.60±0.20	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 <sub>0</sub>	< 2.00	<2.50	<2.50	<3.90	<3.90	<3.30	<3.30	<3.30	<3.30
B <sub>0</sub>	< 3.60	<5.30	<5.30	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.23±0.05	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 <sub>0</sub>	< 2.50	<2.50	<2.50	<2.50	<3.00	<2.50	<3.10	<2.50	<3.10
W	8.0±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 <sub>0</sub>	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 <sub>0</sub>	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	40.0±0.20
P <sub>1</sub>	4.00±0.10	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 <sub>2</sub>	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 <sub>0</sub>	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	1.50+0.10/-0
D <sub>1</sub>	1.00±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±0.10	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	3.50±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°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 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°C per second and the final preheat temperature should be within 50 °C of the soldering temperature for bigger chips such as 1808, 1812, 2211, 2220 etc.

### SOLDERING

Use mildly 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°C.

For bigger chips such as 1808, 1812, 2211, 2220 etc. wave soldering and hand soldering are not 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 below Table description.

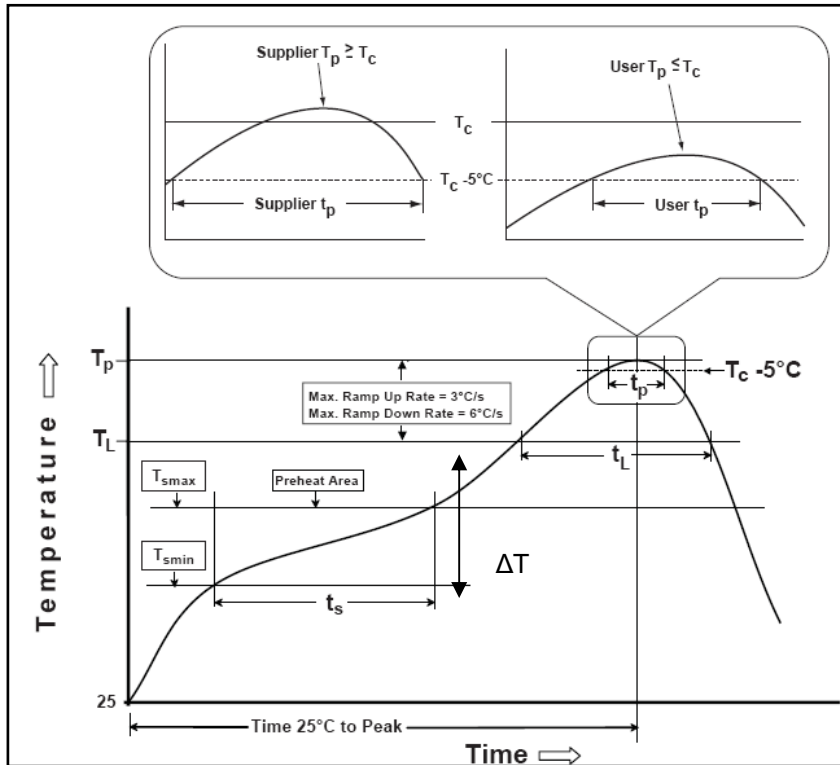
Profile Feature	Pb-Free Assembly
Preheat/Soak	
Temperature Min.(T <sub>smin</sub> )	150°C
Temperature Max.(T <sub>smax</sub> )	200°C
Time(t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> )	60 to 120 seconds
Ramp-up rate(T <sub>L</sub> to T <sub>p</sub> )	3°C/second max.
Liquidous temperature(T <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.

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

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

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

## Classification Reflow Profiles



Chip Size	$\Delta T$
1206	100 °C
1808, 1812, 2211, 2220	50 °C

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

Note : For example ,  $T_c$  is 260°C and time  $t_p$  is 15sec.  
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. A cooling rate not exceeding 4°C 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

<u>FH</u>	<u>20</u>	<u>X</u>	<u>103</u>	<u>K</u>	<u>302</u>	<u>E</u>	<u>G</u>	<u>G</u>
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
FH	Safety X2 & Y3 series	FK	Safety X1 & Y2 series

FK/FH series	
Code	Description
06	1206 (3216)
08	1808 (4520)
12	1812 (4532)
21	2211 (5728)
20	2220 (5750)

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 <sup>0</sup> =10pF	104	104=10x10 <sup>4</sup> =100nF
0R5	0.5pF	102	102=10x10 <sup>2</sup> =1000pF	106	106=10x10 <sup>6</sup> =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%

<b>Table 6 Rated voltage FK/FH series</b>	
Code	Description
302	2.5KV IMPULSE
502	5KV IMPULSE
602	6KV IMPULSE

<b>Table 7 Packaging Type</b>			
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

<b>Table 8 Thickness Description</b>					
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

<b>Table 9 Special Control Code</b>			
Code	Description	Code	Description
G	RoHS Compliant		