

Data Sheet

Customer: _____

Product: Safety Certified Multilayer Ceramic Chip Capacitors. FK / FHseries _____

Size : 1206/1808/1812/2220/2211 _____

Issued Date: 24-Dec.-2018 _____

Edition: Ver. 3 _____

Record of change

Date	Ver.	Description	Page
1-Mar.-2017	1		
21-May.-2018	2		
24-Dec-2018	3		

VENDOR :

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1. INTRODUCTION

SAFETY CERTIFIED CAPACITORS are designed for surge or lightning immunity in modem facsimile and other equipments. The capacitors of FK series are class X1/Y2 compliant, and the capacitors of FH series are class X2 compliant respectively.

The green type capacitors in FK/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 :
 EN 60384-14 : 2013
 IEC 60384-14 : 2013
 UL 60384-14 (Ed 2.0)
 UL 62368-1 (2nd Edition)
- e. Certificate number :
 R 50041666 & R 50359148 by TUV.
 E346791 (FOWX2/8) by UL, E231248 by UL.
- f. HALOGEN compliant.

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	N	100	J	502	E	E	G
SERIES	Size	Dielectric	Capacitance	Tolerance	Impulse Voltage	Packaging	Thickness	Customer Code
Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 9

Code	Description
FK	Safety X1 & Y2 series
FH	Safety X2 series

Code	Description	Code	Description	Code	Description
252 (FH06X)	2.5KV	302 (FH series)	2.5KV	502	5KV
				602	6KV

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

Code	Description	Code	Description
B	Bulk	E	Embossed Tape

Code	Description	Code	Description
N	C0G	X	X7R

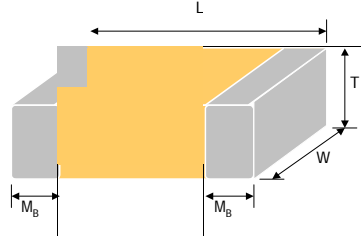
Code	Description	Code	Description	Code	Description
C	1.25±0.10 mm	E	1.60±0.20 mm	G	2.50±0.30 mm
D	1.40±0.15 mm	F	2.00±0.20 mm	H	2.80±0.30 mm

Code	Description	Code	Description
0R5	0.5pF	104	104=10x10 ⁴ =100nF

Code	Description	Code	Description	Code	Description
G	RoHS compliant	Q	Anti-Arcing	E	Anti-Bending
H	High reliability	Z	Anti-Arcing+Anti-Bending		

Code	Description	Code	Description	Code	Description
D	±0.50 pF	G	±2 %	K	±10 %
F	±1 %	J	±5 %	M	±20 %

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Code / T (mm)	M _B (mm)	
1206(3216)	3.30±0.40	1.60±0.20	See No.4 Reference Table 8	0.50±0.25	
1808(4520)	4.50+0.6/-0.3	2.00±0.30		0.50±0.25	
1812(4532)	4.50+0.6/-0.3	3.20±0.40		0.50±0.25	
2211(5728)	5.70±0.50	2.80±0.40		0.60±0.30	
2220(5750)	5.70±0.50	5.00±0.50		0.60±0.30	
					Fig. 5.1 The outline of MLCC

6. GENERAL ELECTRICAL DATA

Dielectric	C0G		X7R	
Size	1808, 1812, 2211		1808, 1812, 2211, 2220	1206
Rated voltage	250Vac			2.5KVdc
Capacitance range	X1/Y2 Class (Impulse 6KV) : 4pF ~ 100pF X1/Y2 Class (Impulse 5KV) : 3pF ~ 720pF X2 Class : 3pF ~ 1000pF		X1/Y2 Class : 100pF ~ 4700pF X2 Class : 150pF ~ 22000pF	100pF ~ 1000pF
Capacitance tolerance	Cap. Rang	Tolerance Spec.		
	Cap.<10pF	D (±0.5pF)		
	10pF≤Cap.	F (±1%), G (±2%), J (±5%), K (±10%), M (±20%)		
Tan δ	Cap. Range	Q Spec.		
	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		
	Cap.≤1000pF	1.0±0.2Vrms, 1.0MHz±10%		
Cap.>1000pF	1.0±0.2Vrms, 1.0KHz±10%			
Insulation resistance	≥100GΩ or RxC≥1000Ω-F, whichever is smaller		≥10GΩ or RxC≥500Ω-F, whichever is smaller	
Operating temperature	-55°C to +125°C			
Temperature coefficient	±30ppm /°C		±15%	
Termination	Cu or Ag/Ni/Sn (lead-free termination)			

7. CAPACITANCE RANGE

Class		X1/Y2 (FK series)								X2 (FH series)						
Rated voltage		250Vac													2.5KVdc	
Certificated		TUV IEC60384-14 / UL 60384														UL 62368
Dielectric		C0G				X7R				C0G		X7R			X7R	
Cap.(pF)	EIA Size	1808	1812	2211	2211	1808	1812	2211	2220	1808	1812	1808	1812	2220	1206	
	Impulse	5KV (502)			6KV (602)	5KV (502)				2.5KV (302)					(252)	
3.0	3R0	D								D						
3.3	3R3	D														
4.0	4R0	D		F	F					D						
4.7	4R7	D		F	F											
5.0	5R0	D		F	F					D						
5.6	5R6	D		F	F											
6.0	6R0	D		F	F					D						
6.8	6R8	D		F	F											
7.0	7R0	D		F	F					D						
8.0	8R0	D		F	F					D						
8.2	8R2	D		F	F											
9.0	9R0	D								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				C	
120	121	F	C	G		E*				F	C				C	
130	131	F	C					E*							C	
150	151	F	C	G		E*	E*	E*		F	C	E			C	
160	161	F	C	G		E*			F*			E			C	
180	181	F	C	G		E*	E*	E*	F*	F	C	E			C	
220	221	F	F	G		E*	E*	E*	F*	F	C	E			C	
270	271	F	F	G		F*	E*	E*	F*	F	C	E	E		C	
300	301		F									E	E		C	
330	331		F	G		F*	E*	E*	F*	F	C	E	E		C	
390	391		F	G		F*	E*	E*	F*	F	C	E	E		C	
470	471		F	G		F*	E*	F*	F*	F	C	E	E		C	
560	561			G		F*	E*	F*	F*	F	C	E	E		C	
680	681			G		F*	F*	F*	F*	F	F	E	E		C	
720	721								F*	F			E		C	
820	821					F*	F*	F*	F*	F	F	E	E		C	
1000	102					F*	G*	G*	F*	F	F	F	E		C	
1200	122							G*	G*			F	E			
1500	152							G*	G*			F	F			
1800	182							G*	G*			F	F			
2200	222							G*	G*			F	G			
2700	272								G*				G			
3300	332								G*				G			
3900	392								G*				G			
4700	472								G*				G			
5600	562												G			
6800	682															
8200	822															
10000	103														G	
12000	123														G	
15000	153														G	
18000	183														G	
22000	223														H	

** Surface coating only.

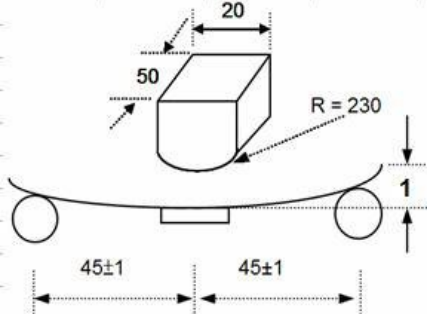
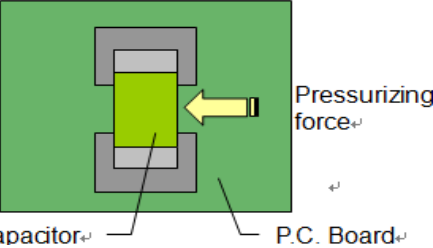
8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

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) Cap. ≤ 1000pF, 1.0±0.2Vrms, 1MHz±10%. Cap. > 1000pF, 1.0±0.2Vrms, 1KHz±10%.	* Capacitance is within specified tolerance. * C _R means rated capacitance for conform to the E6 series of preferred values given in IEC 60063.														
3.	Q/D.F. (Dissipation Factor)	IEC 60384-1 4.2.3	* Class II : (X7R) 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 (C0G)</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>D.F. ≤ 2.5%</td> <td>-</td> </tr> </tbody> </table>	Dielectric	Q/D.F.	Remark	Class I (C0G)	Q ≥ 1000	Cap. ≥ 30pF	Q ≥ 400+20C	Cap. < 30pF	Class II (X7R)	D.F. ≤ 2.5%	-			
Dielectric	Q/D.F.	Remark																
Class I (C0G)	Q ≥ 1000	Cap. ≥ 30pF																
	Q ≥ 400+20C	Cap. < 30pF																
Class II (X7R)	D.F. ≤ 2.5%	-																
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</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	-55~125°C at 25°C	X7R	-55~125°C at 25°C	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>±15%</td> </tr> </tbody> </table>	T.C.	Capacitance Change	C0G	±30ppm/°C	X7R	±15%		
T.C.	Operating Temp.																	
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X7R	-55~125°C at 25°C																	
T.C.	Capacitance Change																	
C0G	±30ppm/°C																	
X7R	±15%																	
5.	Voltage proof (Dielectric Strength)	IEC 60384-14 4.2.1	* To apply voltage : X Capacitor : 1075Vdc (4.3U _R). Y Capacitor : 1500Vac. * Duration : 60 sec. * The charge current shall not exceed 0.05A. * The voltage shall be raised from the near zero to the test voltage a rate not exceeding 150V(r.m.s.)/sec. * For FH06X series : 1500Vac / 1~5 sec.	* No evidence of damage or flash over during test.														
6.	Insulation Resistance	IEC 60384-21/22 4.5.3	<table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> <th>Charge Current</th> <th>Charge Time</th> </tr> </thead> <tbody> <tr> <td>>500</td> <td>500Vdc</td> <td>≤50mA</td> <td>60 sec.</td> </tr> </tbody> </table>	Rated Vol.(V)	Apply Voltage	Charge Current	Charge Time	>500	500Vdc	≤50mA	60 sec.	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>Requirements</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td>≥100GΩ or RxC ≥ 1000Ω-F, whichever is smaller</td> </tr> <tr> <td>Class II (X7R)</td> <td>≥10GΩ or RxC ≥ 500Ω-F, whichever is smaller</td> </tr> </tbody> </table>	Dielectric	Requirements	Class I (C0G)	≥100GΩ or RxC ≥ 1000Ω-F, whichever is smaller	Class II (X7R)	≥10GΩ or RxC ≥ 500Ω-F, whichever is smaller
Rated Vol.(V)	Apply Voltage	Charge Current	Charge Time															
>500	500Vdc	≤50mA	60 sec.															
Dielectric	Requirements																	
Class I (C0G)	≥100GΩ or RxC ≥ 1000Ω-F, whichever is smaller																	
Class II (X7R)	≥10GΩ or RxC ≥ 500Ω-F, whichever is smaller																	
7.	Solderability	IEC 60384-21/22 4.10	* Solder temperature : 235±5°C (1206). * Solder temperature : 245±5°C (1808~2220). * Dipping time : 2.0±0.5 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. * Measurement to be made after keeping at room temperature for 24±2 hrs (Class I) and 48±4 hrs (Class II).	* Appearance : No remarkable damage. * Cap. change : C0G within ±2.5% or ±0.25pF, whichever is larger. X7R within ±7.5%. * D.F. value : C0G to meet initial requirement. X7R to meet initial requirement. * I.R. : ≥1GΩ.														

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Standard Methods	Test Condition	Requirements															
9.	Temperature Cycle	IEC 60384-21/22 4.11	<p>* Conduct the five cycles according to the temperatures and time.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th style="text-align: center;">Step</th> <th style="text-align: center;">Temp.(°C)</th> <th style="text-align: center;">Time(min.)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">Min. operating temp. +0/-3</td> <td style="text-align: center;">30±3</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">Room temp.</td> <td style="text-align: center;">2~3</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">Max. operating temp. +3/-0</td> <td style="text-align: center;">30±3</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">Room temp.</td> <td style="text-align: center;">2~3</td> </tr> </tbody> </table> <p>* Measurement to be made after keeping at room temperature for 24±2 hrs (Class I) and 48±4 hrs (Class II).</p>	Step	Temp.(°C)	Time(min.)	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	<p>* Appearance : No remarkable damage.</p> <p>* Cap. change : C0G within ±2.5% or ±0.25pF, whichever is larger. X7R within ±7.5%.</p> <p>* D.F. value : C0G to meet initial requirement. X7R≤150% of initial requirement.</p> <p>* I.R. : To meet initial requirement.</p>
Step	Temp.(°C)	Time(min.)																	
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																	
10.	Humidity (Damp Heat) Steady State	IEC 60384-14 4.12	<p>* Test temp. : 40±2°C.</p> <p>* Humidity : 90~95% RH.</p> <p>* Test time : 500 +24/-0hrs.</p> <p>* Applied voltage : 250Vac. (FH06X series without the voltage)</p> <p>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II).</p>	<p>* Appearance : No remarkable damage.</p> <p>* Cap. change : C0G within ±3.0% or ±2.0pF, whichever is larger. X7R within ±15%.</p> <p>* D.F. value : C0G≤0.25%. X7R≤5.0%.</p> <p>* I.R. : ≥1GΩ or RxC≥25Ω-F, whichever is smaller.</p>															
11.	Passive Flammability	IEC 60384-14 4.17 IEC 60384-1 4.38	<p>* Volume sample : 21.56mm³.</p> <p>* Flame exposure time : 5 sec. Max.</p> <p>* Category of flammability : C.</p>	<p>* Capacitor didn't burn at all. (FH06X series not include)</p>															
12.	Active Flammability	IEC 60384-14 4.17 IEC 60384-1 4.38	<p>* The capacitors applied UR (250Vac). Then each sample shall be subjected to 20 discharges from a tank capacitor, charge to a voltage that, when discharged, places U_i 2500V for X2, U_i 5000V for X1Y2 across the capacitor under test. The interval between successive discharges shall be 5 sec.</p>	<p>* The cheese cloth shall not burn with a flame. (FH06X series not include)</p>															
13.	High Temperature Load (Endurance)	IEC 60384-14 4.14	<p>* Impulse Voltage: Each individual capacitor shall be subjected to a V_p = 5.0KV (X1Y2 Class Impulse 5KV) or V_p = 2.5KV (X2 Class Impulse 2.5KV) impulse for three times before applied to endurance test.</p> <p>* Test temp. : 125±3°C.</p> <p>* Test time : 1000 +48/-0 hrs.</p> <p>* 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.</p> <p>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II).</p> <p>For FH06X series : * Test temp. : 125±3°C. * To apply voltage : 2.5KVdc. * Test time : 1000 +24/-0 hrs. * Measurement to be made after keeping at room temp. for 48±4 hrs.</p>	<p>* Appearance : No mechanical damage.</p> <p>* Cap. change : C0G within ±5.0% or ±0.5pF, whichever is larger. X7R within ±20%.</p> <p>* D.F. value : C0G≤0.25%. X7R≤5.0%.</p> <p>* I.R. : ≥1GΩ.</p> <p>* Dielectric strength satisfies the specified initial value.</p>															

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Standard Methods	Test Condition	Requirements						
14.	Resistance to Flexure of Substrate	IEC 60384-21/22 4.8	<p>* Capacitors mounted on a substrate. The board shall be bent 1mm with a rate of 1mm/sec.</p>  <p style="text-align: right;">Unit : mm</p>	<p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Change</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td>Within ±3.0% or ±2.0pF, 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 (C0G)	Within ±3.0% or ±2.0pF, whichever is larger	Class II (X7R)	Within ±12.5%
Dielectric	Cap. Change									
Class I (C0G)	Within ±3.0% or ±2.0pF, whichever is larger									
Class II (X7R)	Within ±12.5%									
15.	Adhesive Strength of Termination	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> 	<p>* No remarkable damage or removal of the terminations.</p>						
16.	Vibration	IEC 60384-1 4.17	<p>* Reflow solder the capacitors on P. C. Board before test.</p> <p>* Vibration frequency : 10~55Hz/min.</p> <p>* Total amplitude : 1.5mm.</p> <p>* Repeat the conditions for 2 hours each in 3 perpendicular directions.</p> <p>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II).</p>	<p>* No remarkable damage.</p> <p>* Cap. change and Q/D.F. : To meet initial spec.</p>						

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 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.

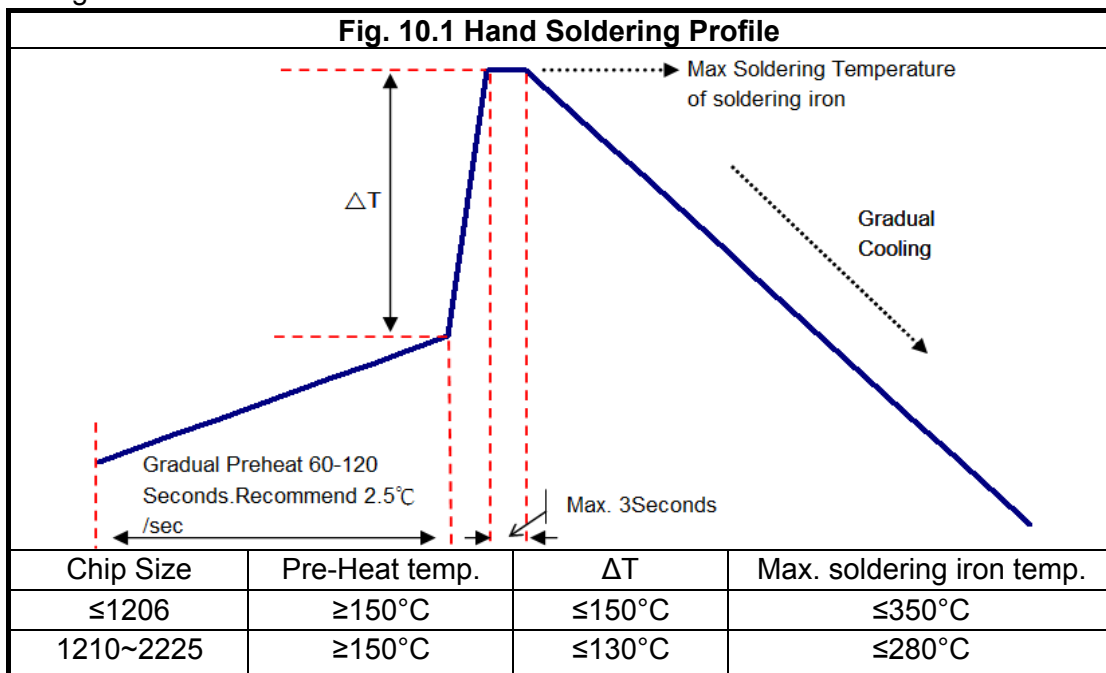
PREHEAT

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.) Hand soldering :



* Soldering iron tip diameter ≤1.0 mm and wattage max. 20W.

* The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.

* The required amount of solder shall be melted on the soldering tip.

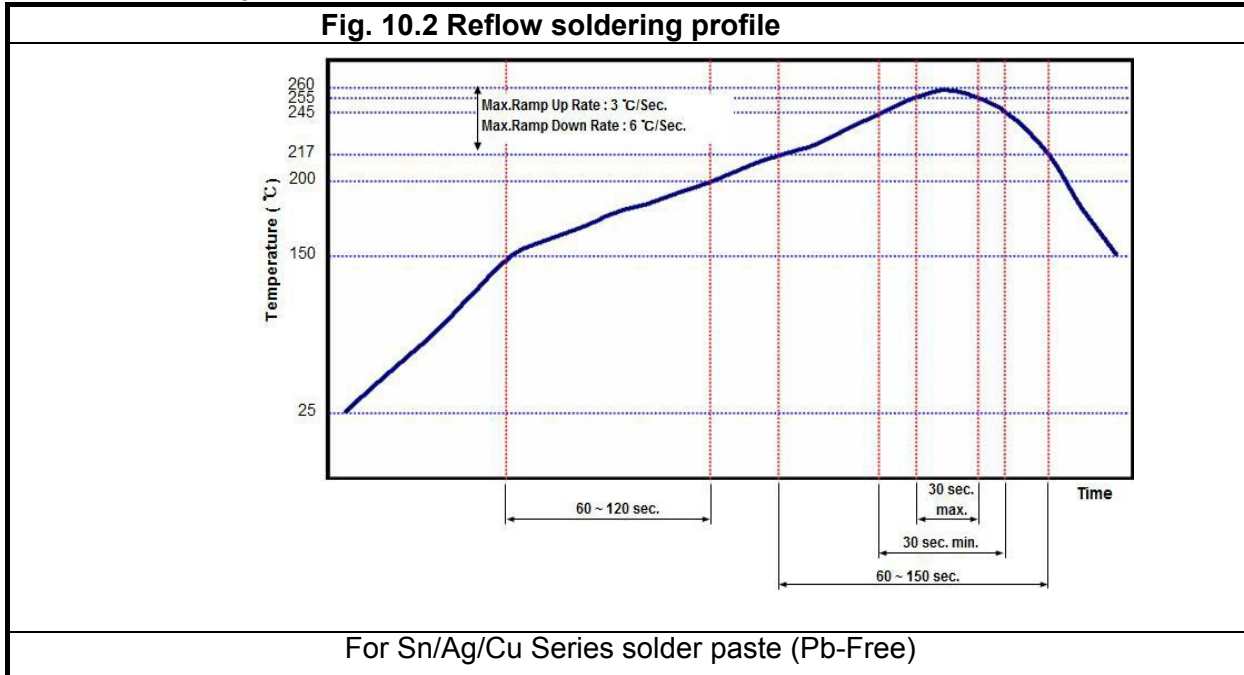
* The tip of iron should not contact the ceramic body directly.

* The Capacitors shall be cooled gradually at room temperature after soldering.

* Forced air cooling is not allowed.

10. APPLICATION NOTES

b.) Reflow soldering :



Soldering height :

<p>The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less. (Reference from IPC-610E)</p>	
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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.