1. INTRODUCTION

PROSPERITY's 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 and HALOGEN compliant.
d. AEC-Q200 qualified

3. APPLICATIONS

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

4. HOW TO ORDER

FH	20	X	103	K	302	E	G	A
PDC Family	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

Table 1 PDC Family

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

Table 2 Size

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

Table 3 Dielectric Material Characteristics

Code	Description	Code	Description
N	C0G	X	X7R

Table 4 Capacitance Rule Code

Code	Description	Code	Description
0R5	0.5pF	104	$104=10\times10^4=100nF$

Table 5 Tolerance

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

Table 6 Impulse Voltage

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

Table 7 Packaging Type

Code	Description	Code	Description
B	Bulk	E	Embossed Tape

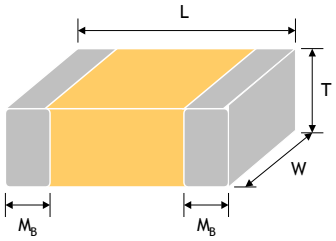
Table 8 Thickness Description

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

Table 9 Customer Code

Code	Description	Code	Description	Code	Description
G	RoHs compliant	Q	Anti-Arcing	E	Anti-Bending
H	Anti-Arcing+Anti-Bendin AEC-Q200 qualified	Z	Anti-Arcing+Anti-Bendin		
M	Automotive Capacitor Qualified to AEC-Q200			A	AEC-Q200(No Anti-Arcing)

5. EXTERNAL DIMENSIONS

Size Inch (mm)	2220(5750)	
L (mm)	5.70±0.50	
W (mm)	5.00±0.50	
Code / T(mm)	G / 2.50±0.30	
M_B min.(mm)	0.60±0.30	Fig. 5.1 The outline of MLCC

6. GENERAL ELECTRICAL DATA

Dielectric	X7R
Size	2220
Rated voltage	250Vac
Capacitance range	10nF
Capacitance tolerance	K (±10%)
Tan δ	≤2.5%
Capacitance & Tan δ Test condition	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 for 24±2 hours before measurement
	1.0±0.2Vrms, 1.0KHz±10%, at 25°C ambient temperature
Insulation resistance	≥10GΩ or RxC≥500Ω-F, whichever is smaller
Operating temperature	-55°C to +125°C
Temperature coefficient	±15%
Termination	Cu /Ni/Sn (lead-free termination)

7. 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.	**Destructive Physical Analysis EIA-469**		Per EIA-469.	* No defects or abnormalities.
3.	**Electrical Characterization**		* Capacitance. * D.F. (Dissipation Factor). X7R : Apply 1.0±0.2Vrms, 1.0KHz±10%, at 25°C ambient temperature.	* Capacitance within the specified tolerance. * D.F. value : Dielectric / Q/D.F. / Remark Class II (X7R) / D.F.≤2.5% / -
			* Insulation Resistance. Rated Vol.(V) / Apply Voltage / Charge Time >500 / 500Vdc / 60 sec.	* I.R. : ≥10GΩ or RxC≥500Ω-F, whichever is smaller.
			* To apply voltage : X capacitor : 1075Vdc (4.3UR). 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.	* No evidence of damage or flash over during test.
			* Temperature Coefficient (With no electrical load) Operation temperature : -55~125°C at 25°C.	* Capacitance Change : X7R within ±15%.
4.	**Biased Humidity** **Ref. MIL-STD-202 Method 103**		* Test temperature : 85±3°C. * Humidity : 85±5%RH. * Test time : 1000 +24/-0 hrs. * To apply voltage : Rated voltage (Max. 500Vdc) and 1.3~1.5Vdc (add 100k ohm resistor). Add apply 250Vac. * Before initial measurement (Class II only) : To apply test voltage for 1hr at test temp. and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap. Change : X7R : Within ±12.5%. * Q/D.F. : X7R : D.F.≤200% of initial requirement. * I.R. : ≥500MΩ or RxC≥25Ω-F, whichever is smaller.
5.	**Resistance to Soldering Heat Ref. MIL-STD-202 Method 210**	IEC 60384-14 4.4 IEC 60384-21/22 4.9	* Solder temperature : 260±5°C. * Dipping time : 10±1 sec. * Reflow Soldering : Peak 260 +0/-5°C profile for Mega cap. * Before initial measurement (X7R only) : Perform 150 +0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* Appearance : No remarkable damage. * Cap. change : X7R within ±7.5%. * D.F. value : X7R to meet initial requirement. * I.R. : To meet the initial requirement..

7. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Standard Methods	Test Condition	Requirements
6.	**ESD** **Ref. AEC-Q200-002**		* Per AEC-Q200-002.	* No remarkable damage. * Cap. : Within the specified tolerance. * Q/D.F. value : To meet the initial requirement. * I.R. : To meet the initial requirement.
7.	**Temperature Cycle** **Ref. JESD22 Method JA-104**	IEC 60384-21/22 4.11	* Conduct 1000 cycles according to the temp. and time. 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 * Measurement to be made after keeping at room temperature for 24±2 hrs	* Appearance : No remarkable damage. * Cap. change : X7R within ±10.0%. * D.F. value : X7R≤200% of initial requirement. * I.R. : To meet initial requirement.
8.	**Moisture Resistance** **Ref. MIL-STD-202 Method 106**	IEC 60384-14 4.12	* Test temp. : 25~65°C * Humidity : 80~100% RH. * Test time : 10 cycles, t=24hrs/cycle. * Measurement to be made after keeping at room temp. for 48±4 hrs (Class II).	* Appearance : No remarkable damage. * Cap. change : X7R within ±12.5%. * D.F. value : X7R : D.F.≤200% of initial requirement. * I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller.
9.	**Passive Flammability**	IEC 60384-14 4.17 IEC 60384-1 4.38	* Volume sample : 21.56 mm^3. * Flame exposure time : 5 sec. Max. * Category of flammability : C.	* Capacitor didn't burn at all.
10.	**Active Flammability**	IEC 60384-14 4.17 IEC 60384-1 4.38	* 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 Ui 2500V for X2, 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.
11.	**Thermal shock** **Ref. MIL-STD-202 Method 107**		* Conduct 300 cycles according to the temp. and time. Step / Temp.(°C) / Time(min.) 1 / Min. operating temp. +0/-3 / 15±3 2 / Max. operating temp. +3/-0 / 15±3 * Max. transfer time : 20 sec. * Before initial measurement (X7R only) : Perform 150 +0/-10°C for 1 hr and then set for 24±2 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* Appearance : No remarkable damage. * Cap. change : X7R within ±10.0%. * D.F. value : X7R≤200% of initial requirement. * I.R. : To meet initial requirement.

7. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Standard Methods	Test Condition	Requirements
12.	**High Temperature Load (Endurance) Ref. MIL-STD-202 Method 108**	IEC 60384-14 4.14	* Impulse Voltage : Each individual capacitor shall be subjected to a Vp = 5.0KV (X1Y2 Class Impulse 5KV) or Vp = 2.5KV (X2 Class Impulse 2.5KV) impulse for three times before applied to endurance test. * 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 48±4 hrs (Class II) * An additional test of 750Vdc (120% of the rated DC voltage) is added for safety-related automotive products.	* Appearance : No mechanical damage. * Cap. change : X7R within ±20%. * D.F. value : X7R : D.F.≤200% of initial requirement. * I.R. : ≥1GΩ.
13.	**Resistance to Solvents Ref. MIL-STD-202 Method 215**		* Temperature : 25±5°C. * Time : 3 +0.5/-0 min. * Solvent : Iso-propyl alcohol.	* No remarkable damage. * Cap. : Within the specified tolerance. * Q/D.F. value : To meet the initial requirement. * I.R. : To meet the initial requirement.
14.	**Mechanical Shock Ref. MIL-STD-202 Method 213**		* Peak value : 1500g's. * Wave : 1/2 sine. * Velocity : 15.4 ft/sec. * Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks).	* No remarkable damage. * Cap. : Within the specified tolerance. * Q/D.F. value : To meet the initial requirement. * I.R. : To meet the initial requirement.
15.	**Solderability** **Ref. J-STD-002 JESD22-B102E**		* Condition A Un-mounted chips 4hrs / 155°C*dry then completely immersed for 5±0.5 sec in solder bath at 245±5°C. (4hrs / 155°C*dry and peak 260 +0/-5°C reflow profile for Mega cap) * Condition B Un-mounted chips steam 8 hrs then completely immersed for 10±1sec in solder bath at 220 +5/-0°C. * Condition C Un-mounted chips steam 8 hrs then completely immersed for 10±1 sec. in solder bath at 260 +0/-5°C.	* All terminations shall exhibit a continuous solder coating free from defects from a minimum of 95% of the critical surface area of any individual termination.

7. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Standard Methods	Test Condition	Requirements
16.	**Board Flex** **Ref. AEC-Q200-005**		* 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 3mm and then the pressure shall be maintained for 60±1 sec. * Measurement to be made after keeping at room temp. for 24±2 hrs.	* No remarkable damage. * Cap. : Within the specified tolerance. * Q/D.F. value : To meet the initial requirement. * I.R. : To meet the initial requirement. (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)
17.	**Adhesive Strength of Termination Ref. AEC-Q200-006**	IEC 60384-21/22 4.15 IEC 60384-1 4.13	* Pressurizing force : 2N(0402), 5N(0603), 10N(0805), 17.7N(≥1206). * Test time : 60±1 sec.	* No remarkable damage or removal of the terminations.
18.	**Vibration Ref. MIL-STD-202 Method 204**	IEC 60384-1 4.17	* Vibration frequency : 10~2000 Hz/min. (5g's for 20 min.). * Total amplitude : 1.5mm. * 12 cycles each of 3 orientations (36 times)	* No remarkable damage. * Cap. : Within the specified tolerance. * Q/D.F. value : To meet the initial requirement. * I.R. : To meet the initial requirement.
19.	**Beam Load Test** **Ref. AEC-Q200-003**		* Break strength test. * Beam speed : 2.5±0.25 mm/sec.	The chip endure following force : Chip length ≤2.5mm : Thickness >0.5mm (20N), ≤0.5mm (8N). Chip length ≥3.2mm : Thickness ≥1.25mm (54.5N), <1.25mm (15N).

8. PACKAGE DIMENSION AND QUANTITY

Size	Thickness (mm)	Plastic tape	
		7" reel	13" reel
1206(3216)	1.25±0.10	3k	10k
1808(4520)	1.25±0.10	2k	10k
	1.40±0.15	2k	10k
	1.60±0.20	2k	8k
	2.00±0.20	1k	6k
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	-
	2.80±0.30	0.5k	-
2220(5750)	2.00±0.20	1k	-
	2.50±0.30	0.5k	2k

REEL DIMENSIONS

Size	1206	1808, 1812, 2211, 2220
Reel size	7"	7"
C	13.0 +0.5/-0.2	13.0 +0.5/-0.2
W_1	8.4 +1.5/-0	12.4 +2.0/-0
W	14.4max	shall accommodate tape width without interference
A	178.0 ±0.1	178.0 ±0.1
N	60.0 +1.0/-0	60.0 +1.0/-0

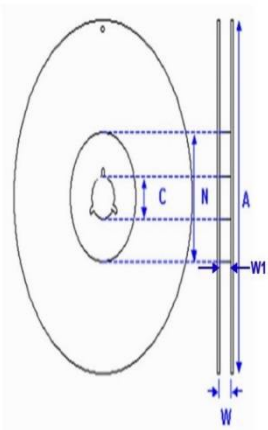


Fig. 8.1 The dimension of reel

8.1. EMBOSSED TAPE DIMENSIONS

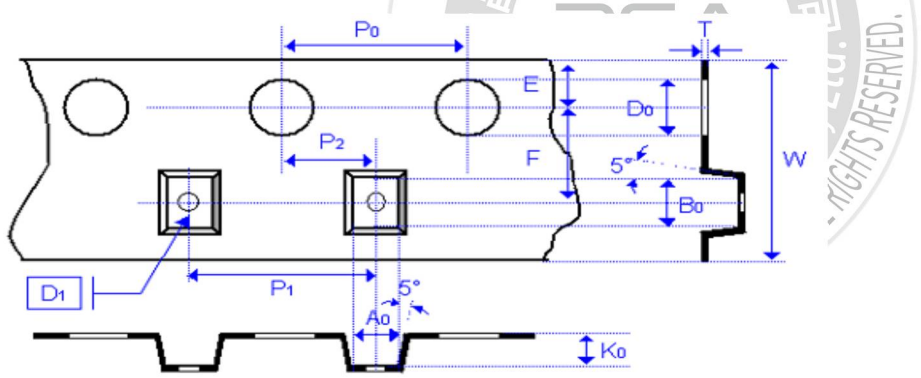


Fig. 8.2 The dimension of plastic tape

Size	1206	1808		1812		2211		2220	
Chip Thickness	1.25±0.10	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 2.80±0.30	2.00±0.20	2.50±0.30 2.80±0.30
A_0	<2.00	<2.50	<2.50	<3.90	<3.90	<3.30	<3.30	<5.80	<5.80
B_0	<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_0	<2.50	<2.50	<2.50	<2.50	<3.00	<2.50	<3.10	<2.50	<3.10
W	8.00±0.10	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20	12.00±0.20	12.00±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
$10xP_0$	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20
P_1	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_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	1.50+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_1	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±0.10	1.75±0.10	1.75±0.10	1.75±0.10	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
Unit :	mm	mm	mm	mm	mm	mm	mm	mm	mm

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

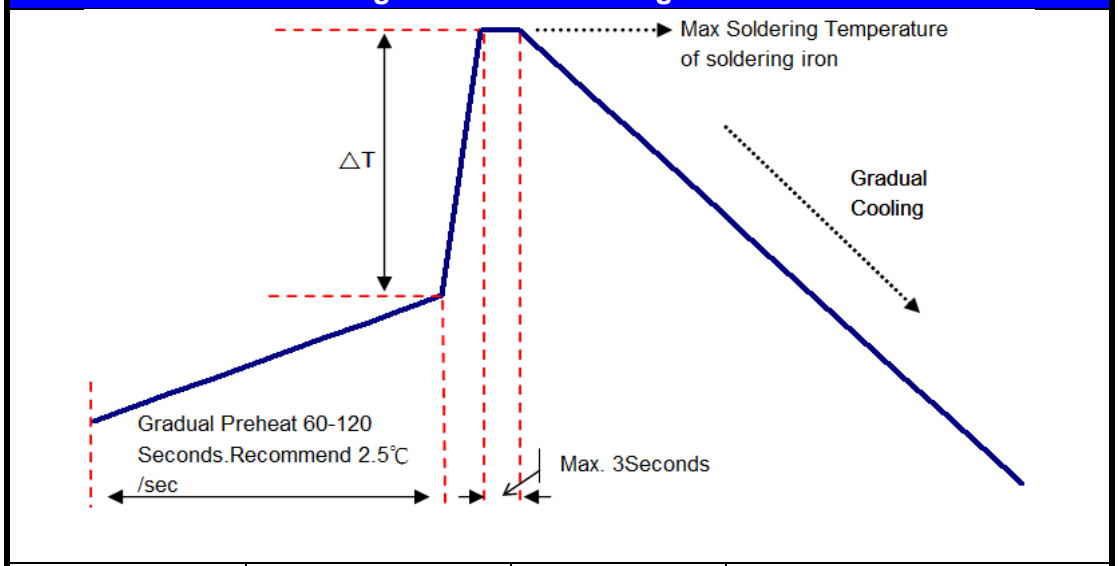
In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

SOLDERING

Use mildly activated rosin 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 :

Fig. 9.1 Hand Soldering Profile



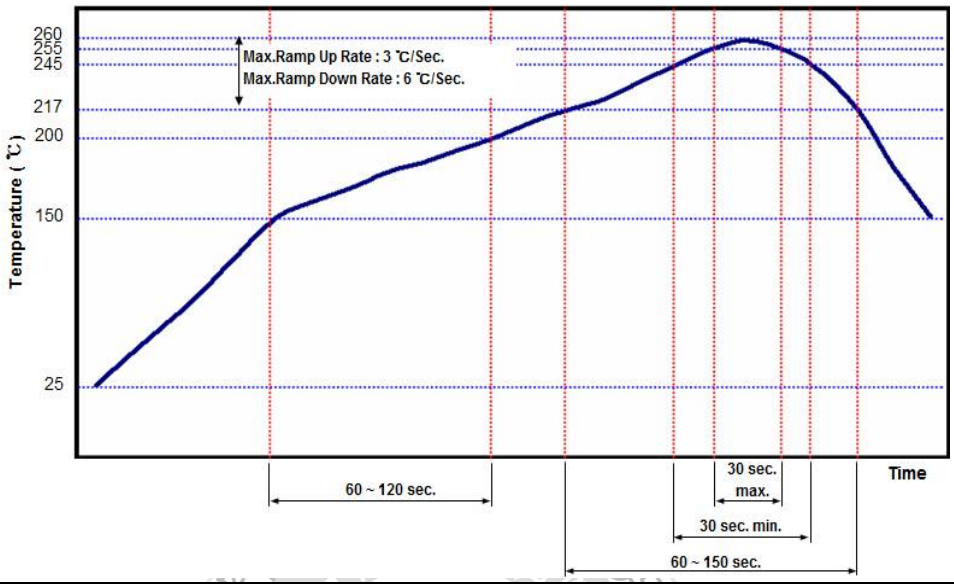
Chip Size	Pre-Heat temp.	ΔT	Max. soldering iron temp.
≤1206	≥150°C	≤150°C	≤350°C
1210~2225	≥150°C	≤130°C	≤280°C

* 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.

9. APPLICATION NOTES

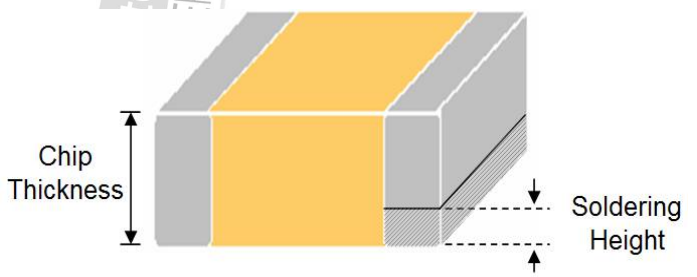
b.) Reflow soldering :

Fig. 10.2 Reflow soldering profile



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

Soldering height :

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

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.

Surface coating products are not suitable cleaning/washing by solvent