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EYANG TECHNOLOGY DEVELOPMENT CO.,LTD

High-Q Multi-layer Ceramic Chip Capacitors Model selection reference book

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Mark：The Model selection reference book is for design reference only.

High-Q Multilayer Ceramic Chip Capacitors

1.Scope

This specification is applicable to the High-Q Multilayer Ceramic Chip Capacitors (MLCC) .

1.1 Type of Dielectrics (Temperature Characteristics): Class1 (Temperature Compensating Type)-HQC(C0G)

1.2 Size Code: 0105(01005)\0201\0402

1.3 Capacitance: 0.1pF~ 33pF

2.Part Number System

C	0402	HQC	100	J	250	N	T	B
① Series Code	② Size Code	③Type of Dielectrics (Temperature Characteristics)	④Nominal Capacitance	⑤Capacitance Tolerance	⑥Rated Voltage	⑦Termination Type	⑧Packaging Code	⑨Thickness Code

① Series Code C - Multilayer Ceramic Chip Capacitors for General Purpose

② Size Code (Unit:mm)

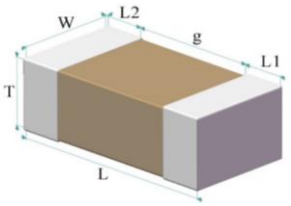


Fig.1 Structure & Dimension

Size Code	L	W	L1,L2	g	T	Thickness Code
0105	0.40±0.02	0.20±0.02	0.07~0.13	0.13min.	0.20±0.02	Z
0201	0.60±0.03	0.30±0.03	0.10~0.20	0.20min.	0.30±0.03	A
0402	1.00±0.05	0.50±0.05	0.15~0.35	0.30min.	0.50±0.05	B

③Type of Dielectrics (Temperature Characteristics)

Type of Dielectrics	Temperature Characteristics	Operating Temp. Range	Temperature Characteristics		
			Temp. coeff. or Cap. Change	Temp. Range	Ref. Temp.
HQC	C0G	-55℃~ 125℃	0±30ppm/℃	25℃~125℃	25℃

④ Nominal Capacitance (Unit: pF) 1pF=10^{-3}nF =10^{-6}μF

Example :R47=0.47 pF ,2R2=2.2 pF ,120=12×10^{0}=12pF, 104=10×10^{4}=100000 pF=100 nF,

Class1(HQC) Capacitance Step in E24 series. Capacitance: See Table3

⑤ Capacitance Tolerance

Code	Capacitance Tolerance	Code	Capacitance Tolerance
A	±0.05 pF	F	±1%
B	±0.1pF	G	±2%
C	±0.25pF	J	±5%
D	±0.5pF	K	±10%

⑥ Rated Voltage

Code	Voltage Values	Code	Voltage Values
2R5	2.5V	250	25V
4R0	4.0V	350	35V
6R3	6.3V	500	50V
100	10V	101	100V
160	16V		

⑦ Termination Type

Code	Terminal Electrodes	Plating Material
N	Cu	Ni/Sn

⑧ Packaging Code See Table 4.

⑨ Thickness Code See ② Size Code

Table 3-1 Capacitance Table (Class1-HQC)

NO.	Series Code	Temperature Characteristics	Size Code	Rated Voltage	Thickness code	Capacitance
1	C	HQC	0105	50V	Z	0.2pF~22pF
2	C	HQC	0105	25V	Z	0.2pF~22pF
3	C	HQC	0105	16V	Z	0.2pF~22pF
4	C	HQC	0201	100V	A	0.1pF~33pF
5	C	HQC	0201	50V	A	0.1pF~33pF
6	C	HQC	0201	25V	A	0.1pF~33pF
7	C	HQC	0402	100V	B	0.1pF~33pF
8	C	HQC	0402	50V	B	0.1pF~33pF
9	C	HQC	0402	25V	B	0.1pF~33pF
10	C	HQC	0402	16V	B	0.1pF~33pF

Table 4 Packaging (Minimum Quantity)

NO.	Size Code	Thickness Code	Square hole spacing	Disc Size	Carrier Tape Type	QTY (Kpcs)	Packaging Code
1	0105	Z	2mm	7〃	Paper	20	T
2	0105	Z	2mm	7〃	Paper	15	H
3	0105	Z	1mm	7〃	Plastic	40	P
4	0201	A	2mm	7〃	Paper	15	T
5	0201	A	2mm	13〃	Paper	50	J
6	0201	A	1mm	13〃	Paper	100	D
7	0201	A	2mm	7〃	Paper	10	H
8	0201	A	1mm	7〃	Paper	30	L
9	0402	B	2mm	7〃	Paper	10	T
10	0402	B	2mm	13〃	Paper	50	J

First packaging: Each multi-disc material is packed into a box.

The second packaging: the first packaged packaging box is loaded into the paper packaging box,and the remaining space in the box is filled with light auxiliary materials.

The above packaging forms can also be packaged according to user needs.

3.Technical Specifications and Test Methods

3.1 Operating Environment

Type of Dielectrics	Temp. Range	Relative Humidity	Atmospheric Pressure
HQC	-55℃～125℃	≤95% (25℃)	86 KPa~106KPa

3.2 Reliablility Test Specifications and Methods

Without specific note, the "test method" in Table 5 is based on GB/T 21041/21042 IDT IEC60384 .

Table 5: Specifications and Methods

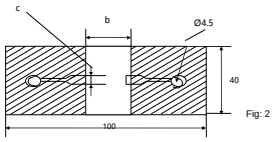
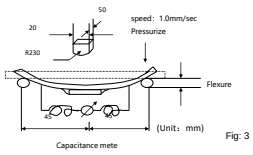
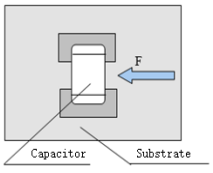
No.	Item	Specification	Test Method
1	Appearance	No obvious defects on ceramic body and termination.	Visual examination under a microscope
2	Size Code	See Fig.1 and ② Size Code	Measuring by gages which precision is not less than 0.01 mm.
3	Capacitance	Within the specified tolerance	Measurement Temperature 18～28℃
4	Q	C≥30pF, Q≥1000 C＜30pF, Q≥400+20C C: Nominal Capacitance (pF)	Relative Humidity ≤RH 80% Measurement Frequency C≤1nF, f=1.0±0.1MHz C＞1nF, f=1.0±0.1KHz Measurement Voltage 1.0±0.2Vrms
5	Insulation Resistance (I.R.)	≥10000MΩ or 500Ω•F,(Whichever is smaller)	Measurement Temperature 18～28℃ Relative Humidity ≤RH 80% Measurement Voltage Rated Voltage Charging Time 1min Charge/discharge current 50mA or lower
6	Voltage proof	No defects or abnormalities.	Test Voltage ≥3.0×U_R Applied Time t=1s~5s Charge/discharge current 50mA or lower
7	Temperature Characteristics of Capacitance	C0G: αc≤±30ppm/℃ (125℃); -72≤αc≤+30ppm/℃ (-55℃);	Pre-drying 16-24 hours Measure the capacitance separately in 25℃、θ1、25℃、θ2、25℃, should satisfied relatived Temperature Coefficient of Capacitance (αc) . C0G θ1=-55℃, θ2=125℃ T.C Measurement Voltage 1.0±0.2Vrms
8	Resistance to Soldering Heat	Appearance No visible damage and terminations uncovered shall be less than 25%. Cap. Change ΔC/C≤±2.5% or ±0.25pF, (Whichever is larger) I.R. initial specification Q initial specification Voltage proof No defects or abnormalities.	Pre-heating 120℃~150℃,Time:60s Test Method Solder bath Solder alloy Sn-Ag-Cu(Lead Free Solder) Temperature (270±5)℃ Duration of immersion (10±1)s Depth of immersion 10 mm Post-treatment Let sit for 24±2 hours at room temperature, then measure.
9	Solderability	Appearance 95% of the terminations is to be soldered evenly and continuously	Pre-heating 80℃~120℃,Time:10s~30s Test Method Solder bath Flux Solution of rosin ethanol Solder alloy Sn-Ag-Cu(Lead Free Solder) Temperature (245±5)℃ Duration of immersion (2.0±0.5)s Depth of immersion 10 mm
10	Substrate Bending test	Appearance No defects or abnormalities Cap. Change ΔC/C≤±5% or ±0.5pF, (Whichever is larger)	Mounting method Solder the capacitor on the test substrate shown in Fig.2 Pressurization Method Shown in Fig.3 Flexure 1mm Holding Time (5±1)s  Fig: 2  Fig: 3
11	Adhesive Strength of Termination	Appearance No defects or abnormalities	Perform heat treament 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treament is more than 30 minutes. Mounting method Solder the capacitor on the test substrate shown in Fig.4 Apply a pushing force of F for 10±1secs. Pushing force 0105:F=1N 0201:F=2N 0402:F=5N  Fig: 4
12	Vibration	Appearance No defects or abnormalities Cap. Change initial specification I.R. initial specification Q initial specification	Mounting method Solder the capacitor on the test substrate Amplitude 1.5mm Kind of Vibration A simple harmonic motion Frequency 10Hz-55Hz-10Hz Vibration Time 1 min Repeat this for 2hrs each in 3 perpendicular directions X, Y, Z, total 6hrs.

Table 5: Specifications and Methods

<table>
<tr><th>No.</th><th>Item</th><th colspan="2">Specification</th><th>Test Method</th></tr>
<tr><td>13</td><td>Rapid Change of Temperature</td><td colspan="2">Appearance: No defects or abnormalities
Cap. Change: ΔC/C≤±2.5% or ±0.25pF, (Whichever is larger)
I.R.: initial specification
Q: initial specification
Voltage proof: No defects or abnormalities.</td><td>Perform heat treament 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treament is more than 30 minutes.
Mounting method: Solder the capacitor on the test substrate
The number of cycles: 5 cycles
Temperature Step
Step 1: -55, 30±3
Step 2: 25, 2~5
Step 3: 125, 30±3
Step 4: 25, 2~5
Post-treatment: Let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>14</td><td>Damp Heat, Steady State</td><td colspan="2">Appearance: No defects or abnormalities
Cap. Change: ΔC/C≤±7.5% or 0.75pF, (Whichever is larger)
I.R.: ≥500MΩ or 25Ω•F,(Whichever is smaller)
Q: C≥30pF, Q≥200
C＜30pF，Q≥100+10C/3
C: Nominal Capacitance (pF)</td><td>Perform heat treament 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treament is more than 30 minutes.
Mounting method: Solder the capacitor on the test substrate
Test Temperature: 40±2℃
Test Humidity: RH 90～95%
Test Time: 500±12h
Post-treatment: Let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>15</td><td>High Temperature High Humidity (Steady)</td><td colspan="2">Appearance: No defects or abnormalities
Cap. Change: ΔC/C≤±7.5% or 0.75pF, (Whichever is larger)
I.R.: ≥500MΩ or 25Ω•F,(Whichever is smaller)
Q: C≥30pF, Q≥200
C＜30pF，Q≥100+10C/3
C: Nominal Capacitance (pF)</td><td>Perform heat treament 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treament is more than 30 minutes.
Mounting method: Solder the capacitor on the test substrate
Test Temperature: 40±2℃
Test Humidity: RH 90～95%
Test Voltage: $1.0\times U_R$
Test Time: 500±12h
Charge/discharge curren: 50mA or lower
Post-treatment: Let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>16</td><td>Endurance</td><td colspan="2">Appearance: No defects or abnormalities
Cap. Change: ΔC/C≤±2% or ±0.2pF， (Whichever is larger)
I.R.: ≥1000MΩ or 50Ω•F,(Whichever is smaller)
Q: C≥30pF, Q≥350
10pF＜C＜30pF，Q≥275+5C/2
C≤10pF,Q≥200+10C
C: Nominal Capacitance (pF)</td><td>Perform heat treament 3 times according to Lead-free reflow soldering profiles, the peak temperature is 260℃, and the time gap between each heat treament is more than 30 minutes.
Mounting method: Solder the capacitor on the test substrate
Test Temperature: 125℃±3℃
Test Voltage: $2\times U_R$
Test Time: 1000±12h
Charge/discharge curren: 50mA or lower
Post-treatment: Let sit for 24±2 hours at room temperature, then measure.</td></tr>
</table>

4. Packaging,Shipment and storage

4.1 Packaging

4.1.1 packaging type

Reel Packaging (standard carrier tape disc packaging), single disc smallest package See Table 4

4.1.2 Carrier Tape size

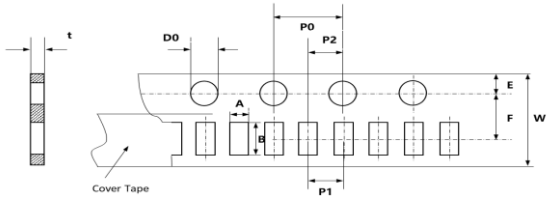


Fig. 5-1: 0402 (Paper tape/ 2mm pitch)

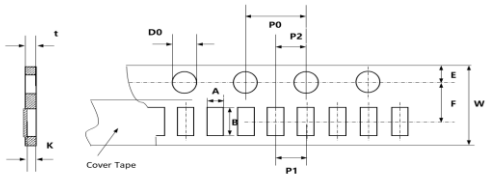


Fig. 5-2: 0105,0201 (Paper tape/ 2mm pitch)

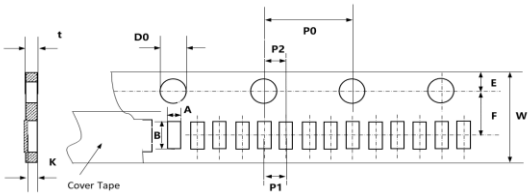


Fig. 5-3: 0201 (Paper tape/ 1mm pitch)

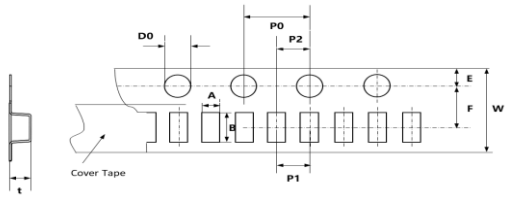


Fig. 5-4: 0105 (Plastic tape/ 1mm pitch)

Table 6: Carrier size (Size Code: 0201,0402) (Unit:mm)

Size Code	Thickness code	Carrier Tape Type	Packaging Code	A	B	F	P1	E	D0	P2	K	W	P0	t
0105	Z	Paper	T	0.24±0.02	0.45±0.02	3.50±0.05	2.00±0.05	1.75±0.10	1.55±0.05	2.00±0.05	0.24±0.02	8.00±0.10	4.00±0.10	0.5max
0105	Z	Paper	H	0.24±0.02	0.45±0.02	3.50±0.05	2.00±0.05	1.75±0.10	1.55±0.05	2.00±0.05	0.24±0.02	8.00±0.10	4.00±0.10	0.5max
0105	Z	Paper	P	0.24±0.02	0.45±0.02	1.80±0.05	1.00±0.05	0.90±0.1	0.80±0.05	1.00±0.05	0.24±0.02	4.00±0.10	2.00±0.1	0.5max
0201	A	Paper	T	0.38±0.02	0.68±0.03	3.50±0.05	2.00±0.05	1.75±0.10	1.55±0.05	2.00±0.05	0.36±0.02	8.00±0.10	4.00±0.10	0.5max
0201	A	Paper	J	0.38±0.02	0.68±0.03	3.50±0.05	2.00±0.05	1.75±0.10	1.55±0.05	2.00±0.05	0.36±0.02	8.00±0.10	4.00±0.10	0.5max
0201	A	Paper	D	0.38±0.02	0.68±0.03	3.50±0.05	1.00±0.05	1.75±0.10	1.55±0.05	1.00±0.05	0.36±0.02	8.00±0.10	4.00±0.10	0.5max
0201	A	Paper	H	0.38±0.02	0.68±0.03	3.50±0.05	2.00±0.05	1.75±0.10	1.55±0.05	2.00±0.05	0.36±0.02	8.00±0.10	4.00±0.10	0.5max
0201	A	Paper	L	0.38±0.02	0.68±0.03	3.50±0.05	1.00±0.05	1.75±0.10	1.55±0.05	1.00±0.05	0.36±0.02	8.00±0.10	4.00±0.10	0.5max
0402	B	Paper	T	0.63±0.05	1.13±0.05	3.50±0.05	2.00±0.05	1.75±0.10	1.55±0.05	2.00±0.05	/	8.00±0.10	4.00±0.10	0.8max
0402	B	Paper	J	0.63±0.05	1.13±0.05	3.50±0.05	2.00±0.05	1.75±0.10	1.55±0.05	2.00±0.05	/	8.00±0.10	4.00±0.10	0.8max

4.1.3 Disc size

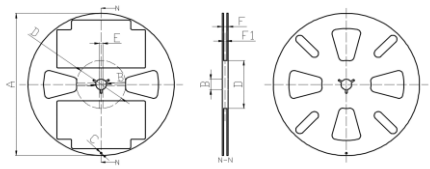


Fig. 6-1: disc (Width of carrier-4mm)

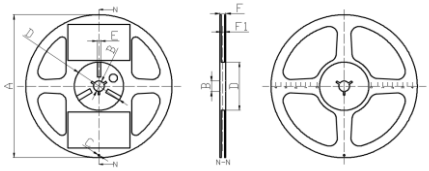


Fig. 6-2: disc (Width of carrier-8mm)

Table 7: Disc size (Unit: mm)

Disc size	Width of carrier	A	B	C	D	E	F	F1	Size Code
7"	8.00±0.10	Φ178±2.0	Φ13±1.0	Φ4.0±0.5	Φ60±2.0	4±1.0	11.5±1.0	10±2	All
13"	8.00±0.10	Φ330±2.0	Φ13±1.0	Φ4.0±0.5	Φ108±2.0	4±1.0	13.5±2.0	10±2	All
7"	4.00±0.10	Φ178±2.0	Φ13±1.0	Φ4.0±0.5	Φ60±2.0	3.5±0.5	7.3±0.5	4.5±1	0105

4.1.4 Carrier Tape specifications

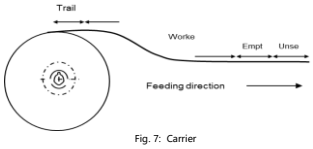


Fig. 7: Carrier

Packaging	The minimum length of the reserved spaces		
Carrier	Trailer	Empty	Unseal
	60 mm	200mm	160mm

4.1.5 Performance of Carrier Taping

4.1.5.1 Strength of Carrier Tape and Top Cover Tape

a. Carrier Tape

When a tensile force 1.02kgf is applied in the direction to unreel the tape, the tape shall withstand this force.

b. Top cover Tape

When a tensile force 1.02kgf is applied to the tape, the tape shall withstand this force.

4.1.5.2 Peeling Strength of Top Cover Tape

Unless otherwise specified, the peeling strength of top cover tape shall be within 10.2 to 71.4 gf when the top cover tape is pulled at a speed of 300mm/min with the angle of 0 to 15°(see Fig.8).

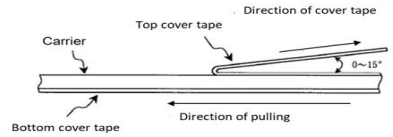


Fig.8: Cover tape peel-off force

4.2 Shipment

Transport packaging products to adapt to the modern means of transport, but the product in the process of transport to prevent rain and acid and alkali corrosion, shall not be whipped extrusion casting and gravity.

4.3 Storage

4.3.1 Storage conditions:

The recommended temperature is less than 30℃.

A temperature is +5℃ to +40℃ and a relative humidity is 20% to 70% as a standard condition.(MSL Level 1)

MLCC may be affected by the storage conditions. Please use them promptly after delivery.

High temperature and humidity conditions and/or prolonged storage may cause deterioration of the packaging materials.

If more than six months have elapsed since delivery, check packaging, mounting, etc. before use.

4.3.2 Corrosive gas can react with the termination (external) electrodes or lead wires of capacitors, and result in poor solderability.

Do not store the capacitors in an atmosphere consisting of corrosive gas (e.g.,hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)

5. MLCC Application of Technical Requirements

5.1 Circuit Design

5.1.1 Operating Temperature

a. Do not use capacitor above the maximum allowable operating temperature.

b. Surface temperature including self-heating should be below maximum operating temperature.

5.1.2Operating Voltage

The operating voltage for capacitors must always be lower than their rated voltage.

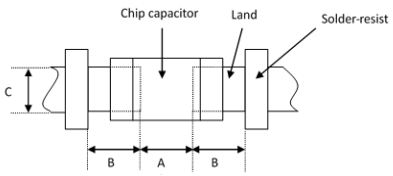
5.2 PCB Design

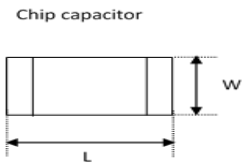
5.2.1 Design of Land-patterns

When the capacitors are mounted on a PCB, the amount of solder at the terminations has a direct effect on the performance of the capacitors.

The greater the amount of solder, the higher the stress on the capacitor. Therefore, when designing land-patterns, it is necessary to consider the appropriate size and configuration of the solder pads.

Size and recommended land dimensions are shown in the following figure and table



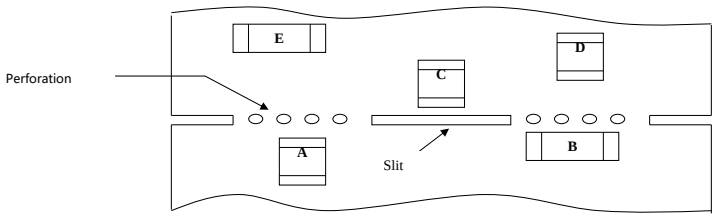


Recommended land dimensions for reflow-soldering (unit: mm)

Size Code	Length	Width	Tolerance	A	B	C
0105	0.4	0.2	General	0.16~0.20	0.12~0.18	0.20~0.23
0201	0.6	0.3	±0.03	0.20~0.25	0.20~0.30	0.20~0.35
0402	1	0.5	±0.05	0.30~0.50	0.35~0.45	0.40~0.60

5.2.2 Capacitor Layout on PC Board

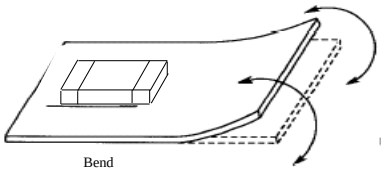
Mechanical stress varies according to the location of capacitors on PC board. The recommendation for better design is as follows

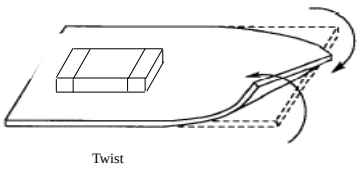


The stress in capacitors is in the following order: A>B=C>D>E

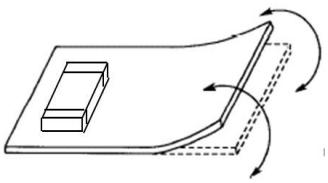
Pay attention not to bend or distort the PC board otherwise the capacitor may crack. Please refer to the following examples of good and bad capacitor layout.

a. Not recommended



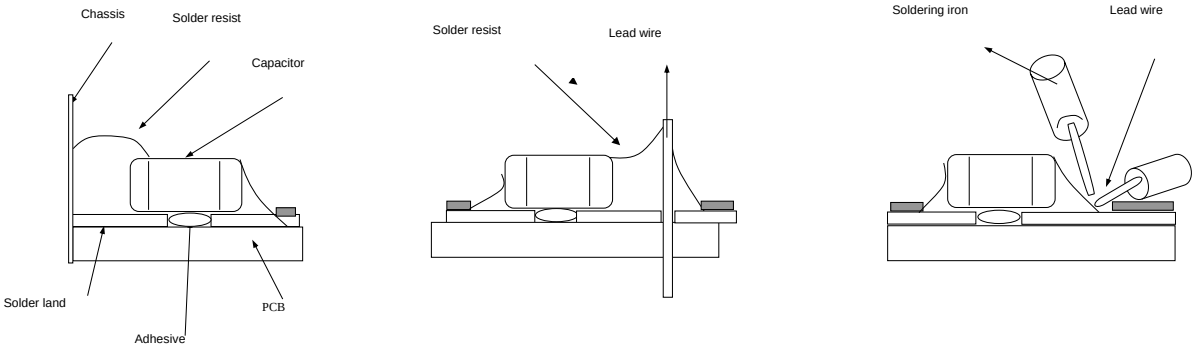


b.Recommended

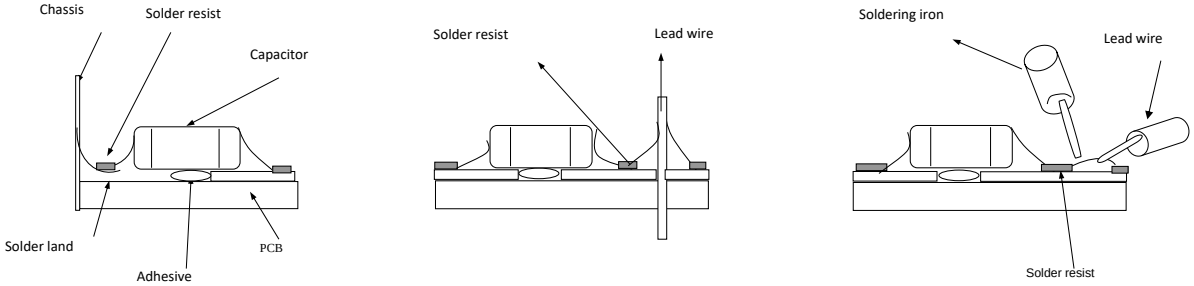


5.2.3Solder Buildup and Soldering

a.Examples of soldering method not recommended



b.Examples of soldering method recommended



5.3 Consideration for Automatic Placement

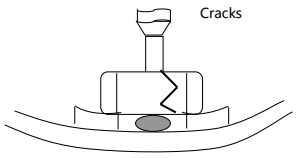
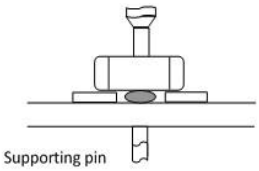
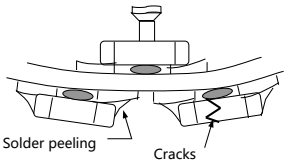
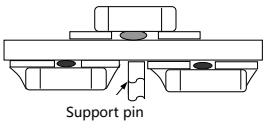
If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions

a.Adjust the bottom dead center of the mounting head to reach on the PC board surface and not press it;

b.Adjust the mounting head pressure to be 1N to 3N of static weight;

c.To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the PC board.

Please refer to the following samples:

Mounting	Not recommended	Recommended
Singel-sided Mounting		
Double-sided Mounting		

5.4 Soldering

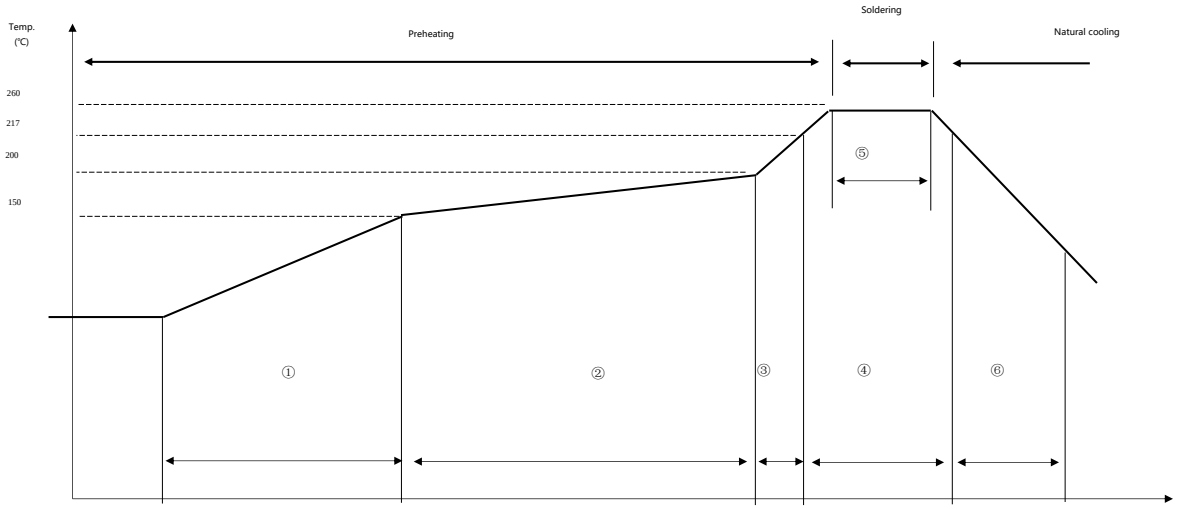
5.4.1 Flux Selection

a.It is recommended to use a mildly activated rosin flux (less than 0.1wt% chlorine). Strong flux is not recommended.

b.Please provide proper amount of flux. Excessive flux must be avoided.

c.When water-soluble flux is used, enough washing is necessary.

5.4.2 Recommended Soldering Profile



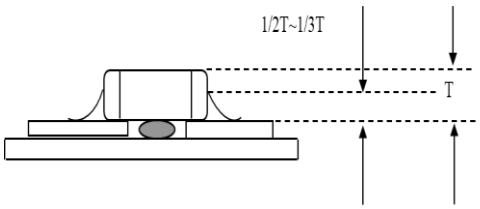
5.4.2.1 Reflow Soldering Condition

NO.	Reflow Soldering zone	Reflow Soldering Condition
①	Preheating 1	≤3℃/s;≥60s
②	Constant temperature	150 ~ 200℃;60~120s;≤1℃/s
③	Preheating 1	1~5℃/s
④	Soldering 1	Above 217℃, 60~150s
⑤	Soldering 1	Above 260℃,over 10s
⑥	Natural cooling	≤6℃/s

Caution:

a.Excessive solder will induce higher tensile force in chip capacitor when temperature changes and result in cracking. Insufficient solder may detach the capacitor from the PC board.

The ideal condition is to have solder mass controlled to 1/2 to 1/3 of the thickness of the capacitor



b.Soldering duration should be kept as close to recommended times as possible, because excessive duration can detrimentally affect solderability.

c.The peak temperature of reflow soldering is 245±15℃。

6. All products in this specification comply with the EU RoHS directive

The EU RoHS Directive refers to the "Directive 2011/65/EU on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment" stipulated by the European Union.