

**1. Scope**

This specification is applies to Commercial Size Switchmode Stack Capacitor for use in electric equipment for the voltage is ranging from 50V to 1000V.

The MLCC support for Lead-Free reflow soldering, and electrical characteristic and reliability are same as before. **(This product compliant with the RoHS.)**

**2. Parts Number Code**

SMC	17	J	X	474	K	631	T	-	-
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

**(1)Product**

Product Code
SMC Commercial Size Switchmode Stack Capacitor

**(2)Stack and Size**

Code	No. of Chips in Stack	Chip Size
15	1	5 : 1210
26	2	6 : 1812
<b>17</b>	<b>1</b>	<b>7 : 2220</b>
38	3	8 : 1825
49	4	9 : 2225

**(3)Lead Configuration**

Unit : mm[inches]

Code	Lead Configuration
<b>J</b>	<b>J Style Lead</b> h =1.78 [0.070] <b>h =1.30 [0.051]</b>
L	L Style Lead h =1.78 [0.070] h =1.30 [0.051]
N	N Style Lead Straight Lead
P	J Style Lead h =1.14 [0.045]
S	L Style Lead h =1.14 [0.045]

**(4)Temperature Characteristics**

Code	Temperature Characteristic	Temperature Range	Temperature Coefficient
N	NPO	-55℃~+125℃	30 ppm/℃
<b>X</b>	<b>X7R</b>	<b>-55℃~+125℃</b>	<b>± 15%</b>

**(5)Capacitance**

unit :pico farads(pF)

Code	Nominal Capacitance (pF)
103	10,000.0
<b>474</b>	<b>470,000.0</b>
885	8,800,000.0
106	10,000,000.0

**(6)Capacitance Tolerance**

Code	Tolerance	Nominal Capacitance
F	± 1.00 %	
G	± 2.00 %	
J	± 5.00 %	
<b>K</b>	<b>± 10.0 %</b>	
M	± 20.0 %	

**(7)Rated Voltage**

Code	Rated Voltage (Vdc)
050	50
101	100
251	250
501	500
<b>631</b>	<b>630</b>
102	1,000

**(8)Packaging**

Code	Type
<b>T</b>	<b>Tape &amp; Reel</b>
B	Bulk
W	Waffle Pack

**(9)Test**

Code	Type
<b>Blank</b>	<b>Normal Type</b>
H	Hi Reliability Type

**(10)Special Requirement Code**

Code	Type
<b>Blank</b>	<b>Standard</b>
01~	Customer Special Requirement
99	

### 3. Nominal Capacitance and Tolerance

#### 3.1 Standard Combination of Nominal Capacitance and Tolerance

Class	Characteristic	Tolerance		Nominal Capacitance
I	NPO	More Than 10 pF	F ( $\pm 1.00\%$ )	E-12, E-24 series
			G ( $\pm 2.00\%$ )	
			J ( $\pm 5.00\%$ )	
			K ( $\pm 10.0\%$ )	
II	X7R	K ( $\pm 10.0\%$ ), M ( $\pm 20.0\%$ )		E-3, E-6 series

#### 3.2 E series(standard Number)

Standard No.	Application Capacitance											
E-3	1.0			2.2				4.7				
E-6	1.0		1.5		2.2		3.3		4.7		6.8	
E-12	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2
E-24	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2
	1.1	1.3	1.6	2.0	2.4	3.0	3.6	4.3	5.1	6.2	7.5	9.1

### 4. Operation Temperature Range

Class	Characteristic	Temperature Range	Reference Temp.
I	NPO	-55°C ~ +125°C	25°C
II	X7R	-55°C ~ +125°C	25°C

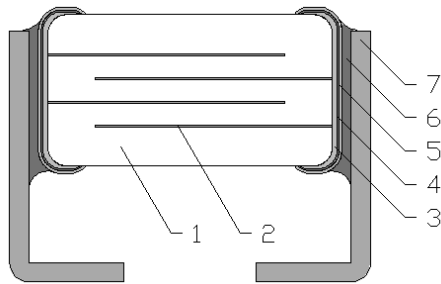
### 5. Storage Condition

Storage Temperature : 5 to 40°C

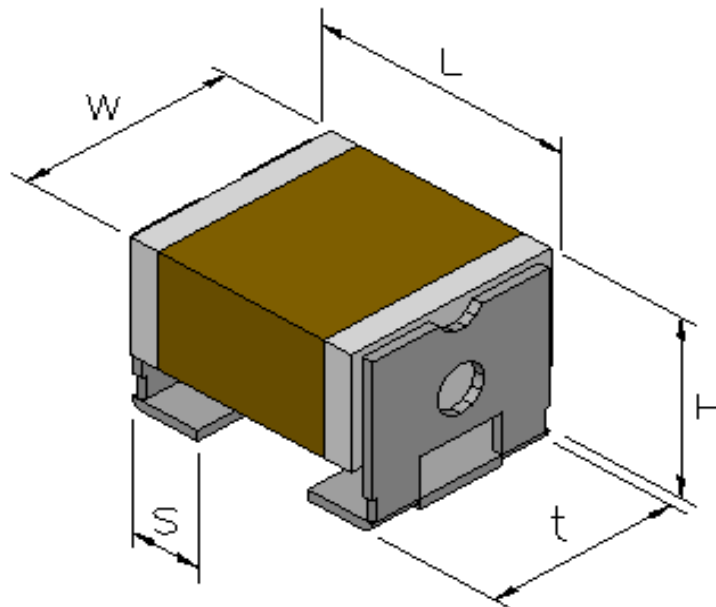
Relative Humidity : 20 to 70 %

Storage Time : 12 months max.

**6. Structure and Dimensions**



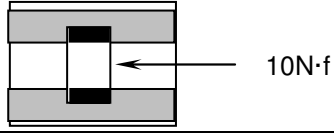
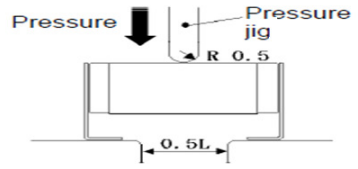
No.	Part	Material
1	Ceramic	
2	Electrode	Ni
3	Termination	Cu
4		Ag
5		Ni
6	Joint	75~85% Ag
7	Lead	Cu Alloy



Unit : mm

Size Code	L (Max)	W (Max)	H (Max)	S	t
17	6.50	5.50	4.30	1.65±0.50	4.50±0.10

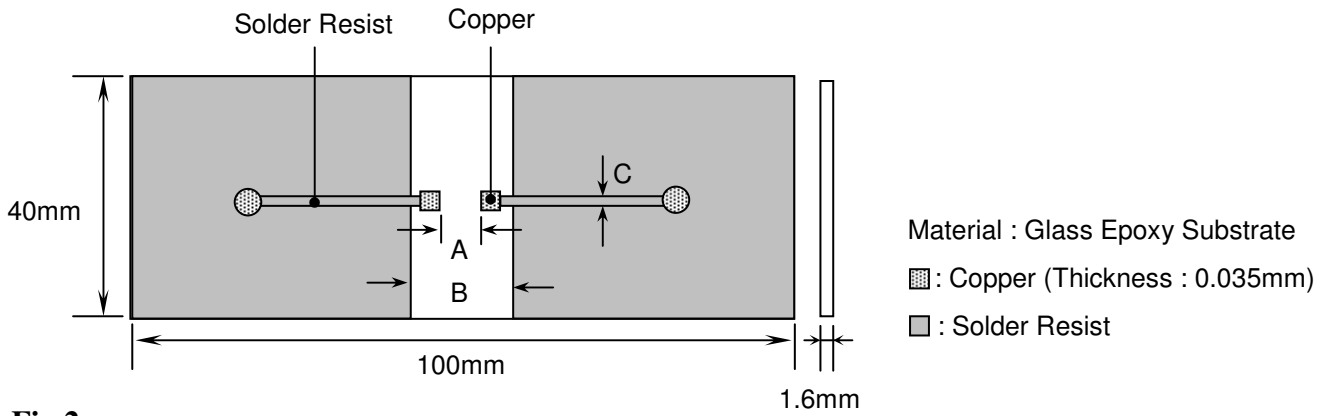
**7. Performance**

No.	Item		Specification		Test Condition																	
1	Visual		No abnormal exterior appearance		Visual inspection																	
2	Dimension		See Page 3		Visual inspection																	
3	Insulation Resistance		100MΩ min.		V ≤ 500V, Rated Voltage V > 500V, Applied 500Vdc Charge Time : 60sec. Is applied less than 50mA current.																	
4	Capacitance	Class I NPO	Within The Specified Tolerance		Class I (NPO): <table border="1" style="margin-left: 20px;"> <tr> <th>Capacitance</th> <th>Frequency</th> <th>Voltage</th> </tr> <tr> <td>C ≤ 1000pF</td> <td>1MHz±10%</td> <td rowspan="2">1.0±0.2Vrms</td> </tr> <tr> <td>C &gt; 1000pF</td> <td>1KHz±10%</td> </tr> </table> Class II : <table border="1" style="margin-left: 20px;"> <tr> <th colspan="2">Frequency</th> <th>Voltage</th> </tr> <tr> <td>C ≤ 10uF</td> <td>1KHz±10%</td> <td>1.0±0.2Vrms</td> </tr> <tr> <td>C &gt; 10uF</td> <td>120Hz±20%</td> <td>0.5±0.2Vrms</td> </tr> </table> Perform a heat temperature at 150±5°C for 30min. then place room temp. for 24±2hr.	Capacitance	Frequency	Voltage	C ≤ 1000pF	1MHz±10%	1.0±0.2Vrms	C > 1000pF	1KHz±10%	Frequency		Voltage	C ≤ 10uF	1KHz±10%	1.0±0.2Vrms	C > 10uF	120Hz±20%	0.5±0.2Vrms
		Capacitance	Frequency	Voltage																		
C ≤ 1000pF	1MHz±10%	1.0±0.2Vrms																				
C > 1000pF	1KHz±10%																					
Frequency		Voltage																				
C ≤ 10uF	1KHz±10%	1.0±0.2Vrms																				
C > 10uF	120Hz±20%	0.5±0.2Vrms																				
5	Q	Class I	Char.	Maximum																		
			NPO	Q ≥ 1000																		
	Tan δ	Class II	Char.	Maximum																		
			X7R	2.5%																		
6	Withstanding Voltage		No dielectric breakdown or mechanical breakdown		V < 500V : 200% Rated Voltage 500V ≤ V < 1000V: 150% Rated Voltage 1000 ≤ V :120% Rated Voltage Voltage ramp up rate ≤ 500v/sec for 1~5 sec. charge/discharge Current is less than 50mA.  ※ Withstanding voltage testing requires immersion of the element in a isolation fluid prevent arcing on the chip surface, at voltage over 1000Vdc.																	
7	Temperature Capacitance Coefficient	Class I	Char.	Temp. Range	Cap. Change(%)	Class I : [C2-C1/C1(T2-T1)] × 100% Class II : (C2-C1)/C1 × 100% T1: Standard temperature (25°C) T2: Test temperature C1:Capacitance at standard temperature(25°C) C2: Capacitance at test temperature (T2)																
			NPO	-55°C ~ +125°C	± 30 ppm/°C																	
		Class II	Char.	Temp. Range	Cap. Change(%)																	
			X7R	-55°C ~ +125°C	± 15%																	
8	Adhesive Strength of Termination		No indication of peeling shall occur on the terminal electrode.		A 10N·f (≒ 1.0Kg·f) pull force shall be applied for 10± 1 second.  																	
9	Strength of metal terminal		Termination not to be broken or loosened.		A static load of 10N using a pressure jig should be applied to the center in the direction of the arrow and held for 10 s.  																	

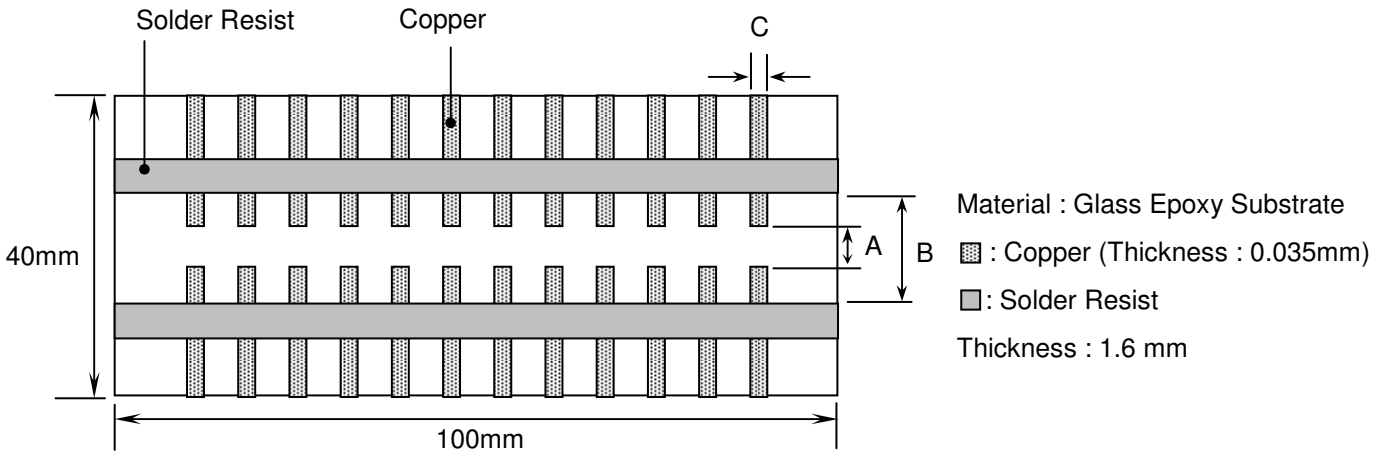
No.	Item	Specification	Test Condition															
10	Solderability	More than 90% of the terminal surface is to be soldered newly, so metal part does not come out or dissolve .	Solder Temperature : 245± 5℃ Dip Time : 5 ± 0.5 sec. Immersing Speed : 25±10% mm/s Solder : Lead Free Solder Flux : Rosin Preheat : At 80~120 °C for 10~30sec.															
11	Resistance To Soldering Heat	Appearance	No mechanical damage of ceramic body shall occur.															
		Capacitance	Characteristic	Cap. Change														
			Class I	NPO	Within ± 2.5% or ±0.25pF whichever is larger of initial value													
			Class II	X7R	Within ± 10%													
		Q Class I	To satisfy the specified initial value															
		Tan δ Class II	To satisfy the specified initial value															
		Insulation Resistance	To satisfy the specified initial value															
Withstand Voltage	To satisfy the specified initial value																	
			Class II capacitor shall be set for 48±4 hours at room temperature after one hour heat treatment at 150 +0/-10℃ before initial measure. Preheat : At 150± 10℃ For 60± 5 sec. Dip : Solder Temperature of 260± 5℃ Dip Time : 10 ± 1sec. Immersing Speed : 25±10% mm/s Flux : Rosin  Measure at room temperature after cooling for Class I : 24 ± 2 Hours Class II : 48 ± 4 Hours															
12	Temperature Cycle	Appearance	No mechanical damage shall occur															
		Capacitance	Characteristic	Cap. Change														
			Class I	NPO	Within ± 2.5% or ±0.25pF whichever is larger of initial value													
			Class II	X7R	Within ± 7.5%													
		Q Class I	To satisfy the specified initial value															
		Tan δ Class II	To satisfy the specified initial value															
		Insulation Resistance	To satisfy the specified initial value															
			Class II capacitor shall be set for 48± 4 hours at room temperature after one hour heat treatment at 150 +0/-10 °C before initial measure.  Capacitor shall be subjected to 100 cycles of the temperature cycle as following: <table border="1" data-bbox="954 1236 1452 1406"> <thead> <tr> <th>Step</th> <th>Temp.(℃)</th> <th>Time(min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min Rated Temp. +0/-3</td> <td>30</td> </tr> <tr> <td>2</td> <td>25</td> <td>3</td> </tr> <tr> <td>3</td> <td>Max Rated Temp. +3/-0</td> <td>30</td> </tr> <tr> <td>4</td> <td>25</td> <td>3</td> </tr> </tbody> </table> Measure at room temperature after cooling for Class I : 24 ± 2 Hrs Class II : 48 ± 4 Hrs Solder the capacitor on P.C. board shown in Fig 2. before testing.	Step	Temp.(℃)	Time(min)	1	Min Rated Temp. +0/-3	30	2	25	3	3	Max Rated Temp. +3/-0	30	4	25	3
Step	Temp.(℃)	Time(min)																
1	Min Rated Temp. +0/-3	30																
2	25	3																
3	Max Rated Temp. +3/-0	30																
4	25	3																
13	Humidity	Appearance	No mechanical damage shall occur															
		Capacitance	Characteristic	Cap. Change														
			Class I	NPO	Within ± 5.0% or ±0.5pF whichever is larger of initial value													
			Class II	X7R	Within ± 15%													
		Q Class I	Char.	Maximum														
		Tan δ Class II	Char.	Maximum														
		Insulation Resistance	10MΩ min.															
			Class II capacitor shall be set for 48± 4 hours at room temperature after one hour heat treatment at 150+0/-10 °C before initial measure. Temperature : 40± 2℃ Relative Humidity : 90 ~ 95%RH Test Time : 500 + 12/—0Hr  Measure at room temperature after cooling for Class I : 24 ± 2Hrs Class II : 48 ± 4Hrs Solder the capacitor on P.C. board shown in Fig 2. before testing.															

No.	Item		Specification		Test Condition						
14	High Temperature Load	Appearance	No mechanical damage shall occur		Class II capacitors applied DC voltage (following table) is applied for one hour at maximum operation temperature $\pm 3^{\circ}\text{C}$ then shall be set for $48 \pm 4$ hours at room temperature and the initial measurement shall be conducted. Applied Voltage : <table border="1" style="margin-top: 10px;"> <thead> <tr> <th>Rated Voltage</th> <th>Applied Voltage</th> </tr> </thead> <tbody> <tr> <td><math>V \leq 630\text{Vdc}</math></td> <td>100% Rated Voltage</td> </tr> <tr> <td><math>630\text{Vdc} &lt; V \leq 1000\text{Vdc}</math></td> <td>120% Rated Voltage</td> </tr> </tbody> </table>	Rated Voltage	Applied Voltage	$V \leq 630\text{Vdc}$	100% Rated Voltage	$630\text{Vdc} < V \leq 1000\text{Vdc}$	120% Rated Voltage
		Rated Voltage	Applied Voltage								
		$V \leq 630\text{Vdc}$	100% Rated Voltage								
		$630\text{Vdc} < V \leq 1000\text{Vdc}$	120% Rated Voltage								
		Capacitance	Characteristic			Cap. Change					
			Class I	NPO		Within $\pm 3.0\%$ or $\pm 0.3\text{pF}$ whichever is larger					
			Class II	X7R		Within $\pm 15\%$					
Q Class I	Char.	Maximum									
	NPO	$Q \geq 350$									
Tan $\delta$ Class II	Char.	maximum									
	X7R	5.0%									
Insulation Resistance	10M $\Omega$ min.										
15	Vibration	Appearance	No mechanical damage shall occur		Solder the capacitor on P.C. Board shown in Fig 2. before testing.  Vibrate the capacitor with amplitude of 1.5mm P-P changing the frequencies from 10Hz to 55Hz and back to 10Hz in about 1 min.  Repeat this for 2 hours each in 3perpendicular directions.						
		Capacitance	Characteristic			Cap. Change					
			Class I (NPO)			Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ whichever is larger					
		Q Class I	To satisfy the specified initial value								
Insulation Resistance	To satisfy the specified initial value										

**Fig.1**  
**P.C. Board for Bending Strength Test**



**Fig.2**  
**Test Substrate**



Unit:mm

Size Code	A	B	C
17	4.5	8.0	5.6
27	4.5	8.0	5.6
49	4.5	8.0	7.0
59	4.5	8.0	7.0

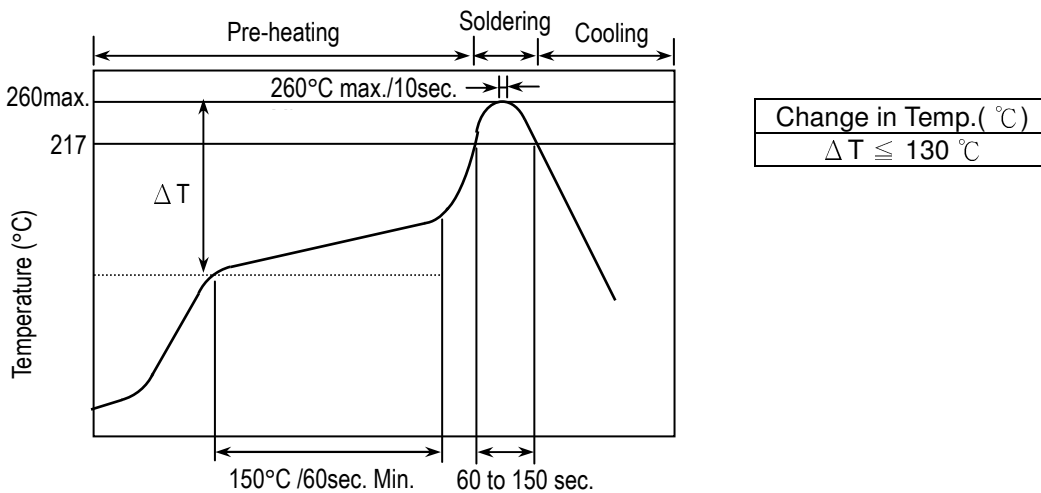
**Precautionary Notes:**

**1. Soldering**

**1.1 Reflow Soldering**

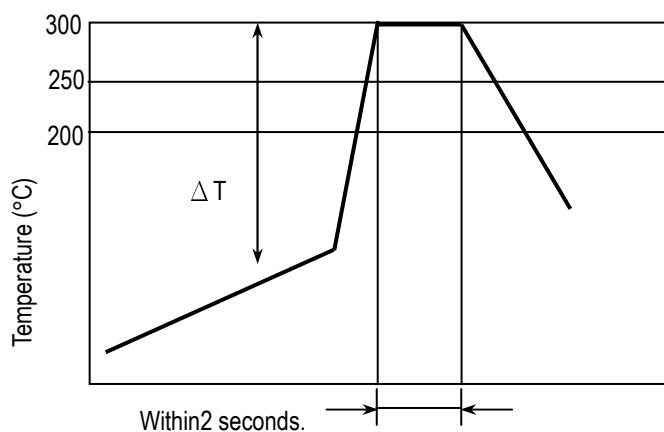
Preheat and gradual increase in temperature to the reflow temperature is recommended to decrease the potential of thermal crack on the components. The recommended heating rate depends on the size of component, however it should not exceed 3°C/Sec.

**Recommend reflow profile for Lead-Free soldering temperature Profile (J-STD-020D)**



**1.2 Hand Soldering**

Sudden temperature change in components, results in a temperature gradient recommended in the following table, and therefore may cause internal thermal cracks in the components. In general a hand soldering method is not recommended unless proper preheating and handling practices have been taken. Care must also be taken not to touch the ceramic body of the capacitor with the tip of solder Iron.



Temp(°C)	Wattage(w)	Shape(mm)	Time(sec)
300 max	20 max	Φ3.0 max	2 max

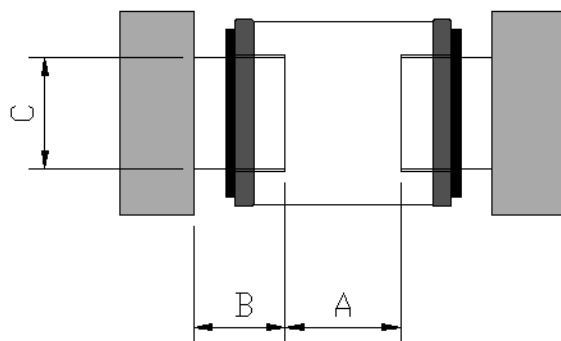


**How to Solder Repair by Solder Iron**

- 1) Selection of the soldering iron tip  
The required temperature of solder iron for any type of repair depends on the type of the tip, the substrate material, and the solder land size.
- 2) recommended solder iron condition
  - a.) Preheat the substrate to (60 °C to 120 °C) on a hot plate. Note that due to the heat loss, the actual setting of the hot plate may have to be higher. (For example 100 °C to 150 °C)
  - b.) Soldering iron power shall not exceed 20 W.
  - c.) Soldering iron tip diameter shall not exceed 3mm.
  - d.) Temperature of iron tip shall not exceed 300 °C., and the process should be finished within 2 seconds. ( refer to MIL-STD-202G)
  - e.) Do not touch the ceramic body with the tip of solder iron. Direct contact of the soldering iron tip to ceramic body may cause thermal cracks.
  - f.) After soldering operation, let the products cool down gradually in the room temperature.

**2.Design of Land Pattern**

Recommended land dimensions are shown below.



Unit:mm

Size Code	A	B	C
17	4.0~4.6	2.0~2.2	3.5~4.8
27	4.0~4.6	2.0~2.2	3.5~4.8
49	4.0~4.6	2.0~2.2	5.1~5.8
59	4.0~4.6	2.0~2.2	5.1~5.8

**3. Safekeeping condition and period**

For safekeeping of the products, we recommend to keep the storage temperature between +5 to +40 °C and under humidity of 20 to 70% RH. The shelf life of capacitors is 12 months.