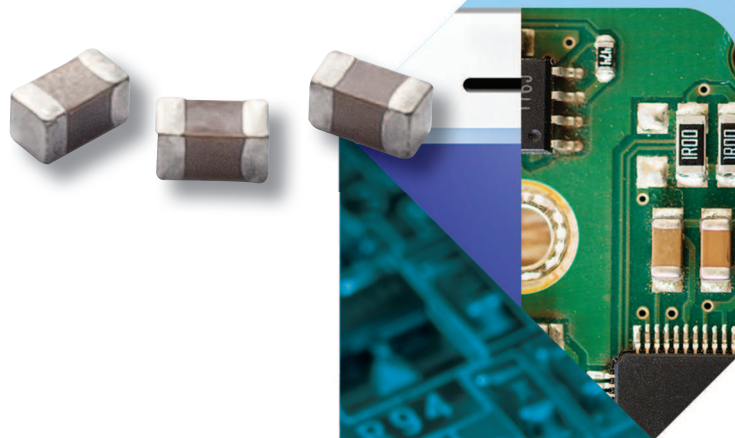


# Multilayer Ceramic Capacitor

User Guide





# ***Table of Contents***

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<b>Company Introduction</b>	<b>4p</b>
<b>General Information</b>	<b>5p</b>
<b>Products Line-up</b>	<b>7p</b>
<b>Reliability Test Condition</b>	<b>8p</b>
<b>Packaging Information</b>	<b>12p</b>
<b>Precaution</b>	<b>16p</b>
<b>Contact</b>	<b>24p</b>

## AVATEC

Founded in 2000, AVATEC has entered the MLCC field in 2018, along with its existing coating and etching business, and is developing a variety of MLCC products at an unprecedented speed based on talent recruitment and bold facility investment.

We are striving to overcome the disadvantages of being a start-up company through the best quality management and to maximize customer satisfaction.

AVATEC's full-time employees promise to do their best until the customer's trust in our products has been extended to the MLCC area and we can hear the voice of "AVATEC MLCC that we can trust and use".



## History

- 2000. 08. Establishment (AVATEC)
- 2001. 12. Mass production of ARAS(Anti-Reflection & Anti-Statics) glass (EEF: Easy Eye Filter) for LG Philips Display
- 2005. 05. ISO-14001 certificate
- 2007. 12. Establishment of Yantai Corporation in China (AVATEC Electronics Yantai Co., Ltd)
- 2009. 08. Mass production of PDP EMI Filter for LGE
- 2011. 09. Completion of Gumi plant
- 2012. 11. Listed on KOSDAQ
- 2013. 01. Mass production 10.1" Cover Glass for LGD
- 2013. 08. Mass production of ITO touch panel index matching glass for LGD
- 2016. 11. OLED GLS slimming(65Inch, LGD)
- 2018. 11. MLCC business primary investment
- 2019. 05. MLCC mass production line set-up (Capa. 3 billion/ month)
- 2019. 09. Start of mass production of MLCC 1005 1uF 10V
- 2019. 12. Product Model X5R Line up
- 2020. 04. Start customer promotion ('L' company completed evaluation in July)
- 2020. 05. Product Model X7R Line up
- 2020. 07. IATF 16949 certification
- 2020. 08. Line up for electrical equipment (AEC-Q200 approved)
- 2021. 01. MLCC Business Second Investment



# General Information

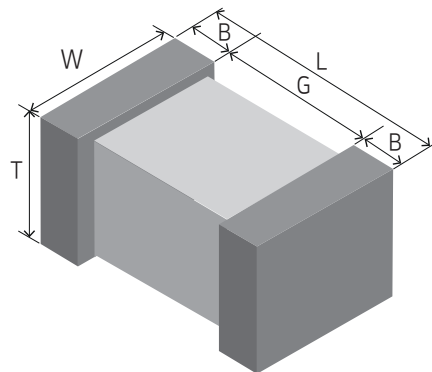
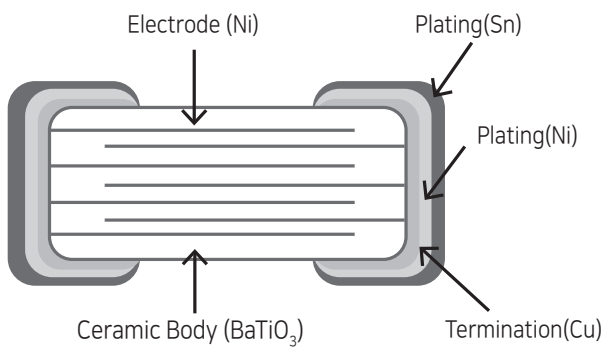
## ● Feature & Application

- Wide choice of size, capacity and rated voltage
- Higher reliability and narrow characteristic tolerance
- Excellent DC-Bias characteristics
- Clean and good appearance
- Easy mounting on PCBs

### Application

- PC (Laptop & Desktop)
- Tablet Devices
- Display
- Mobile Phone
- DC-DC Converter
- Memory Module
- Game Machine
- Etc.

## ● Structure & Dimension

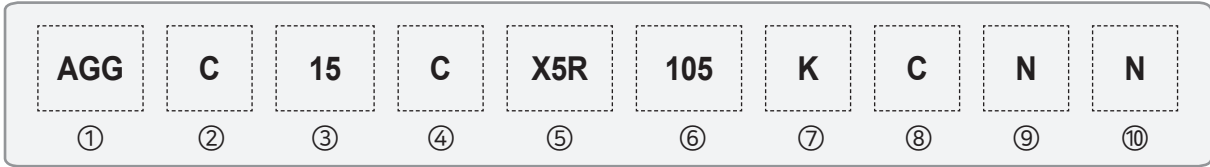


Size (mm/inch)	Dimension (mm)				
	Length	Width	Thickness	G	B
0603/0201	0.60±0.03	0.30±0.03	0.30±0.03	0.2 min.	0.10~0.20
0603/0201	0.60±0.05	0.30±0.05	0.30±0.05	0.2 min.	0.10~0.20
1005/0402	1.00±0.05	0.50±0.05	0.50±0.05	0.3 min.	0.15~0.35
1005/0402	1.00±0.20	0.50±0.20	0.50±0.20	0.3 min.	0.15~0.35
1608/0603	1.60±0.10	0.80±0.10	0.80±0.10	0.6 min.	0.20~0.55
1608/0603	1.60±0.20	0.80±0.20	0.80±0.20	0.6 min.	0.20~0.55
2012/0805	2.00±0.15	1.25±0.15	1.25±0.15	0.7 min.	0.20~0.70
2012/0805	2.00±0.20	1.25±0.20	1.25±0.20	0.7 min.	0.20~0.70
3216/1206	3.20±0.20	1.60±0.20	1.60±0.20	1.5 min.	0.30~0.80
3216/1206	3.20±0.30	1.60±0.30	1.60±0.30	1.5 min.	0.30~0.90



# General Information

## Part No Construction



### ① Product Series

Symbol	Series	Application
AGG	General	General

### ② External Terminal

Symbol	External Terminal
C	Cu
S	Soft Termination

### ③ Product Size

Symbol	mm/inch
02	0402 / 01005
03	0603 / 0201
15	1005 / 0402
18	1608 / 0603
22	2012 / 0805
36	3216 / 1206
35	3225 / 1210

### ④ Thickness

Symbol	Thickness(mm)
A	0.20
B	0.30
C	0.50
D	0.60
E	0.80
F	0.85
G	1.15
H	1.25
I	1.30
J	1.60
K	2.00
L	2.30
M	2.50

### ⑤ Temperature Characteristics

Symbol[EIA]	Temp range	Cap Tol.(%)
X5R	-55 to 85°C	±15
X6R	-55 to 105°C	±15
X7R	-55 to 125°C	±15
X7S	-55 to 125°C	±22

### ⑥ Capacitance

Symbol	Capacitance
101	100pF
102	1nF
103	10nF
104	100nF
105	1uF
106	10uF

Ex) 103 = 10,000pF = 10nF = 0.01uF

### ⑦ Capacitance Tolerance

Symbol	Cap Tol. (%)
F	±1
G	±2
R	±2.5
J	±5
K	±10
M	±20

### ⑧ Rated Voltage

Symbol	Rate Voltage
A	4
B	6.3
C	10
D	16
E	25
F	35
G	50

### ⑨ Packaging Method

Symbol	Packaging
B	Bulk
N	Φ178mm Reel Taping
L	Φ330mm Reel Taping

### ⑩ AVATEC Internal Code



# Product Line-up

## X5R SERIES

[Unit : mm]

Size	0603					1005					1608					2012					3216									
Cap./Vdc	6.3	10	16	25	35	50	6.3	10	16	25	35	50	6.3	10	16	25	35	50	6.3	10	16	25	35	50	6.3	10	16	25	35	50
10 nF	█	█	█	█	█	█																								
22 nF	█	█	█	█	█	█	█	█	█	█	█	█																		
47 nF	█	█	█	█	█	█	█	█	█	█	█	█																		
100 nF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█												
220 nF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█												
470 nF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█							
1.0 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
2.2 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
4.7 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
10 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
22 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
47 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
100 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	

█ Available    █ Under development

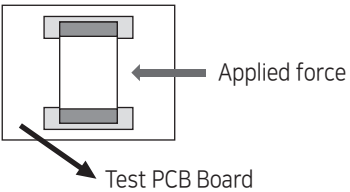
## X7R SERIES

[Unit : mm]

Size	0603					1005					1608					2012					3216									
Cap./Vdc	6.3	10	16	25	35	50	6.3	10	16	25	35	50	6.3	10	16	25	35	50	6.3	10	16	25	35	50	6.3	10	16	25	35	50
10 nF	█	█	█	█	█	█																								
22 nF	█	█	█	█	█	█																								
47 nF	█	█	█	█	█	█	█	█	█	█	█	█																		
100 nF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
220 nF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
470 nF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
1.0 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
2.2 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
4.7 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
10 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	
22 μF	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	

█ Available    █ Under development

## Test Condition for High Dielectric Type – X5R / X7R

No.	Item	Specification	Test & Measurement Conditions												
1	Appearance	No abnormal appearance	<ul style="list-style-type: none"> <li>• Visual inspection (Microscope x10)</li> </ul>												
2	Withstanding Voltage	No dielectric breakdown or abnormalities	<ul style="list-style-type: none"> <li>• Applied Voltage : Rated Voltage * 2.5</li> <li>• Applied Time : 1 to 5 sec</li> <li>• Charge/Discharge Current : 50mA Max</li> </ul>												
3	Insulation Resistance	Refer to individual Spec Standard	<ul style="list-style-type: none"> <li>• Applied Voltage : Rated Voltage</li> <li>• Applied Time : 60 sec</li> <li>• Charge/Discharge Current : 50mA Max</li> </ul>												
4	Capacitance	Refer to individual Spec Standard	<ul style="list-style-type: none"> <li>• Frequency : <math>C \leq 10\mu\text{F}</math> - <math>1.0 \pm 0.1\text{kHz}</math>, <math>C &gt; 10\mu\text{F}</math> - <math>120 \pm 24\text{Hz}</math></li> <li>• Voltage : <math>C \leq 10\mu\text{F}</math> - <math>1 \pm 0.2\text{Vrms}</math>, <math>C &gt; 10\mu\text{F}</math> - <math>0.5 \pm 0.1\text{Vrms}</math></li> <li>• Pre-treatment Condition for measurement before test - heat treatment <math>150^\circ\text{C}</math> for 1 hour and keeping it normal temperature for 24hours</li> </ul>												
5	Dissipation Factor	Refer to individual Spec Standard	<ul style="list-style-type: none"> <li>• Frequency : <math>C &gt; 10\mu\text{F}</math> - <math>1.0 \pm 0.1\text{kHz}</math>, <math>C \leq 10\mu\text{F}</math> - <math>120 \pm 24\text{Hz}</math></li> <li>• Voltage : <math>C &gt; 10\mu\text{F}</math> - <math>0.5 \pm 0.1\text{Vrms}</math>, <math>C \leq 10\mu\text{F}</math> - <math>1 \pm 0.2\text{Vrms}</math></li> <li>• Pre-treatment Condition for measurement before test - heat treatment <math>150^\circ\text{C}</math> for 1 hour and keeping it normal temperature for 24hours</li> </ul>												
6	Temperature Characteristics	Capacitance change : X5R : $\pm 15\%$ ( $-55$ to $85^\circ\text{C}$ ) X7R : $\pm 15\%$ ( $-55$ to $125^\circ\text{C}$ )	<ul style="list-style-type: none"> <li>• The capacitance should be measured after holding for 5minutes in each temperature step with reference to the table below.</li> <li>• Capacitance change should be calculated with Step3 Reference.</li> </ul> <table border="1"> <thead> <tr> <th>Step.</th> <th>Temperature(<math>^\circ\text{C}</math>)</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Normal Temp <math>\pm 3</math></td> <td rowspan="4">Normal Temp : <math>25^\circ\text{C}</math></td> </tr> <tr> <td>2</td> <td>Min Operating Temp <math>\pm 3</math></td> </tr> <tr> <td>3</td> <td>Normal Temp <math>\pm 3</math></td> </tr> <tr> <td>4</td> <td>Max Operating Temp <math>\pm 3</math></td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>• Pre-treatment Condition for measurement before test - heat treatment <math>150^\circ\text{C}</math> for 1 hour and keeping it normal temperature for 24hours</li> </ul>	Step.	Temperature( $^\circ\text{C}$ )	Remark	1	Normal Temp $\pm 3$	Normal Temp : $25^\circ\text{C}$	2	Min Operating Temp $\pm 3$	3	Normal Temp $\pm 3$	4	Max Operating Temp $\pm 3$
Step.	Temperature( $^\circ\text{C}$ )	Remark													
1	Normal Temp $\pm 3$	Normal Temp : $25^\circ\text{C}$													
2	Min Operating Temp $\pm 3$														
3	Normal Temp $\pm 3$														
4	Max Operating Temp $\pm 3$														
7	Adhesive Strength of Termination	No terminal disconnection or other abnormal should be occur	<ul style="list-style-type: none"> <li>• Solder the capacitor on the test PCB Board shown in Fig.3.</li> <li>• Apply force to the center of the capacitor in the horizontal direction of the test PCB board.</li> <li>• Applied Force : 5N (0603 Size : 2N)</li> <li>• Applied Time : <math>10 \pm 1</math> sec</li> </ul> 												



## ● Test Condition for High Dielectric Type – X5R / X7R

No.	Item	Specification	Test & Measurement Conditions															
8	Solderability	More than 75% of the terminal area is to be soldered with new solder.	<ul style="list-style-type: none"> <li>Solder : Sn-3.0Ag-0.5Cu</li> <li>Pre-heating : 80 ~ 120°C</li> <li>Pre-heating Time : 10 ~ 30 sec</li> <li>Solder Temperature : 245±5°C</li> <li>Holding Time : 2±0.5 sec</li> </ul>															
9	Vibration	Appearance	No abnormality															
		Capacitance Change	Within ±5.0%															
		DF	Within the initial spec															
10	Bending Test	Capacitance Change	Within ±12.5% 															
		DF	Within the initial spec															
11	Resistance to Soldering Heat	Appearance	No abnormality															
		Capacitance Change	Within ±7.5%															
		DF	Within the initial spec															
		IR	Within the initial spec															
12	Temperature Cycle	Appearance	No abnormality															
		Capacitance Change	Within ±7.5%															
		DF	Within the initial spec															
		IR	Within the initial spec															
			<ul style="list-style-type: none"> <li>Solder : Sn-3.0Ag-0.5Cu</li> <li>Pre-heating : 120 ~ 150°C</li> <li>Pre-heating Time : 1min</li> <li>Solder Temperature : 260±5°C</li> <li>Holding Time : 10±0.5 sec</li> </ul> Refer to 12(Temperature Cycle) below for Pre-treatment and Post-treatment conditions															
			<ul style="list-style-type: none"> <li>Solder the capacitor on the test PCB Board shown in Fig.3.</li> <li>Test Cycle : 5 Cycles</li> </ul> <table border="1"> <thead> <tr> <th>Step.</th> <th>Temperature(°C)</th> <th>Time(min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp ±3</td> <td>30 ±3</td> </tr> <tr> <td>2</td> <td>Normal Temp ±3</td> <td>2 to 3</td> </tr> <tr> <td>3</td> <td>Max Operating Temp ±3</td> <td>30 ±3</td> </tr> <tr> <td>4</td> <td>Normal Temp ±3</td> <td>2 to 3</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>Pre-treatment Condition for measurement before test               <ul style="list-style-type: none"> <li>- heat treatment 150°C for 1 hour and keeping it at normal temperature for 24hours</li> </ul> </li> <li>Post-treatment Condition for measurement after test               <ul style="list-style-type: none"> <li>- Measure after keeping at normal temperature for 24 hours</li> </ul> </li> </ul>	Step.	Temperature(°C)	Time(min)	1	Min. operating temp ±3	30 ±3	2	Normal Temp ±3	2 to 3	3	Max Operating Temp ±3	30 ±3	4	Normal Temp ±3	2 to 3
Step.	Temperature(°C)	Time(min)																
1	Min. operating temp ±3	30 ±3																
2	Normal Temp ±3	2 to 3																
3	Max Operating Temp ±3	30 ±3																
4	Normal Temp ±3	2 to 3																

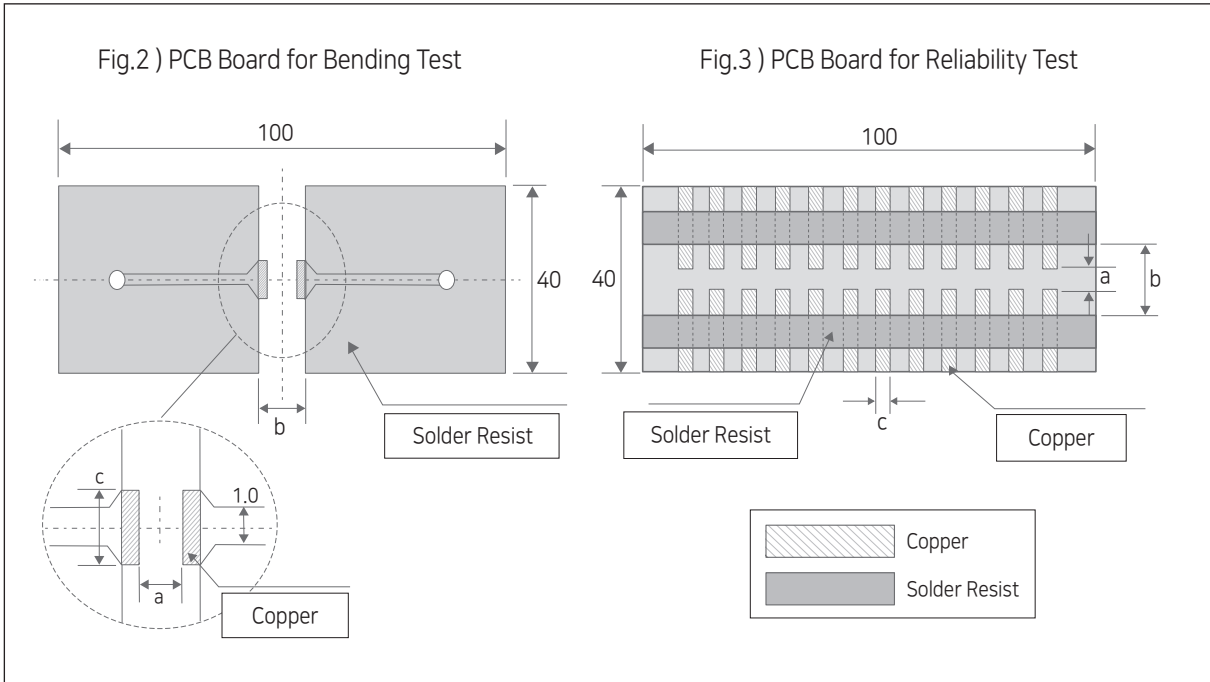
## ● Test Condition for High Dielectric Type – X5R / X7R

No.	Item	Specification	Test & Measurement Conditions
13	Moisture Resistance Load	Appearance	No abnormality
		Capacitance Change	Within $\pm 12.5\%$
		DF	Refer to individual Spec Standard
		IR	Refer to individual Spec Standard
14	High Temperature Resistance Load	Appearance	No abnormality
		Capacitance Change	Within $\pm 12.5\%$
		DF	Refer to individual Spec Standard
		IR	Refer to individual Spec Standard

※ Reliability specifications are for reference only and are typical standard specifications.  
 All product specifications are subject to change or discontinuation without prior notice.  
 If you have any questions regarding product specifications, please contact our sales representative

## ● Test PCB Board Design & Dimensions

Recommendation for PCB Board Design & Dimensions

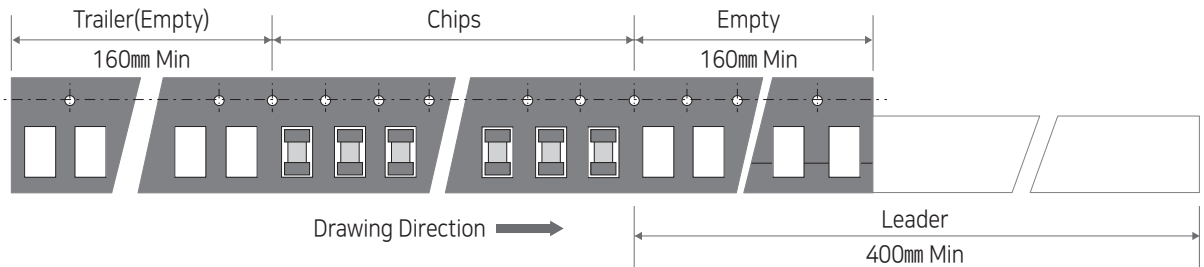


Size (mm/inch)	Dimensions(mm)		
	a	b	c
0603 / 0201	0.3	0.9	0.3
1005 / 0402	0.4	1.5	0.5
1608 / 0603	1.0	3.0	1.2
2012 / 0805	1.2	4.0	1.65
3216 / 1206	2.2	5.0	2.0

Size (mm/inch)	Material	Thickness(mm)		
		PCB Board for Bending Test	PCB Board for Reliability Test	Copper
0603 / 0201	Glass Epoxy	0.8	1.6	0.035
1005 / 0402	Glass Epoxy	0.8	1.6	0.035
1608 / 0603	Glass Epoxy	1.6	1.6	0.035
2012 / 0805	Glass Epoxy	1.6	1.6	0.035
3216 / 1206	Glass Epoxy	1.6	1.6	0.035

## ● Packaging General Information

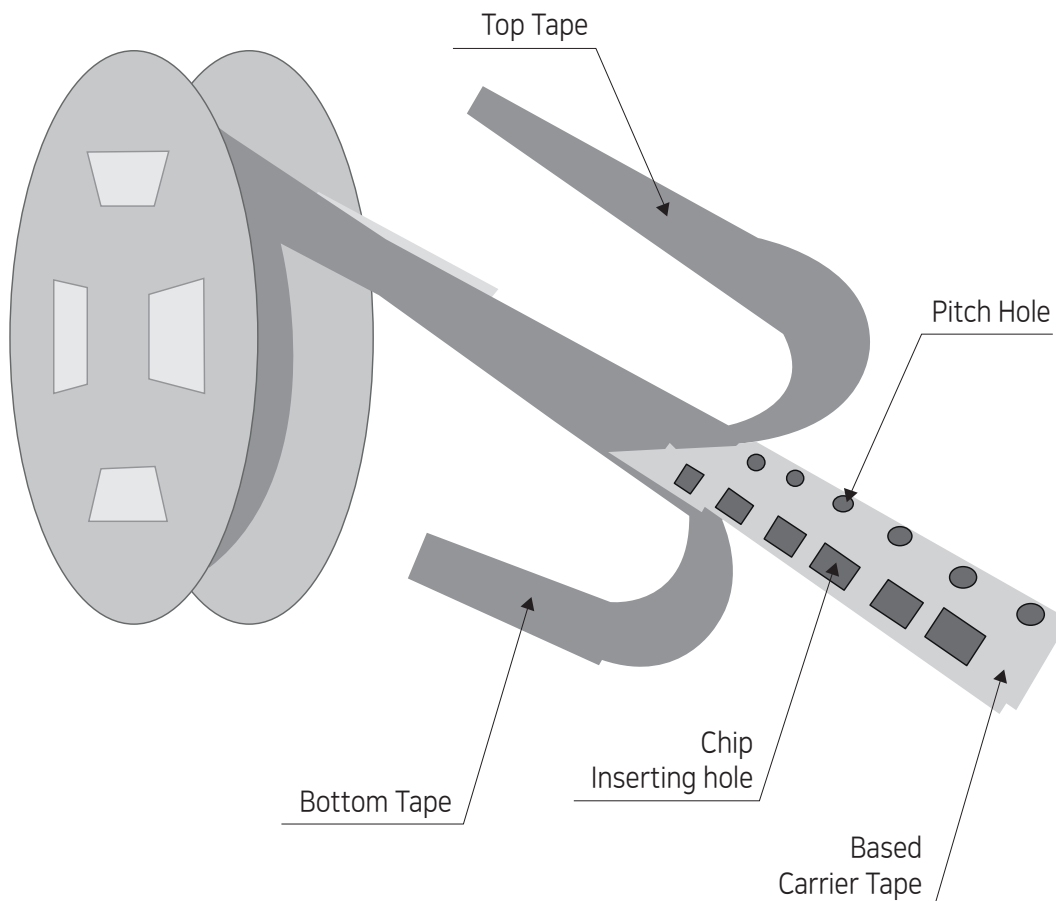
### 1. Bulk part and leader of taping



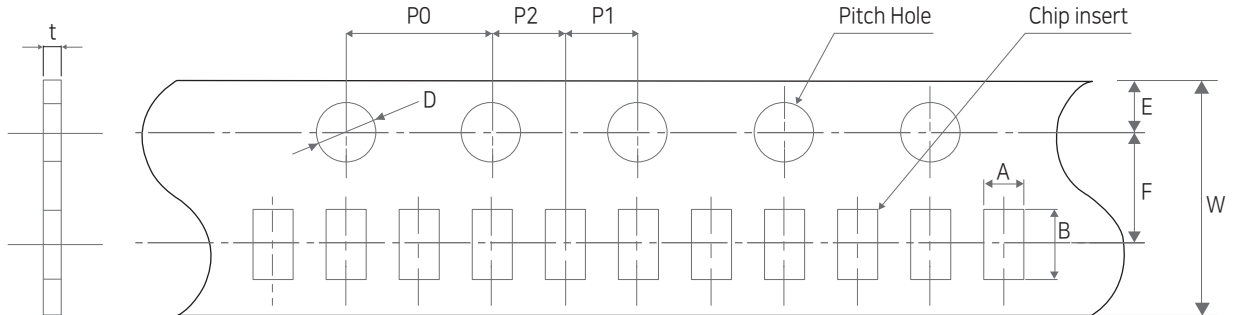
### 2. Dimensions of reel

Dimensions of  $\phi 178$  reel shall be according to Fig.1.

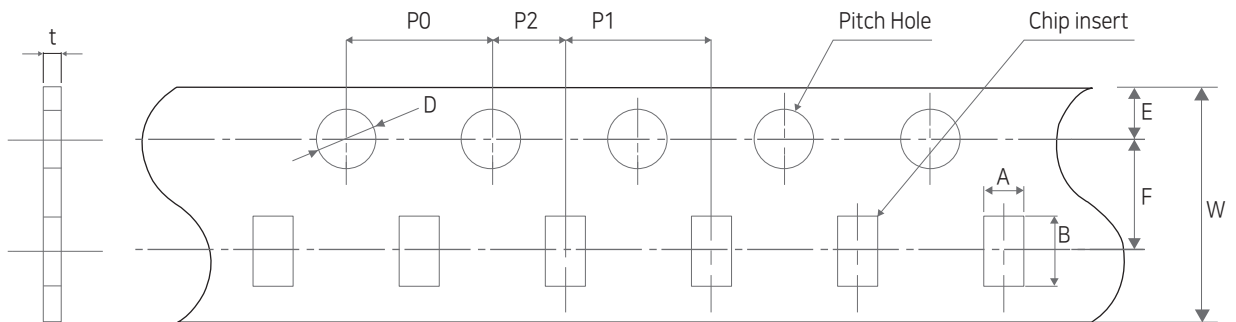
### 3. Structure of taping



## ● Packaging Tape Specification

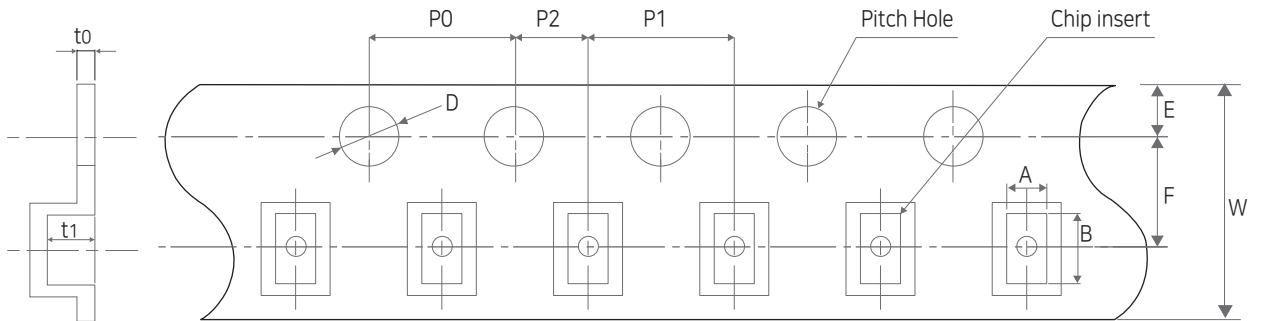


Size (mm/inch)	Dimensions (mm)									
	t	W	A	B	D	F	P2	P1	E	Po
0603 / 0201	0.42 $\pm 0.03$	8.00 $\pm 0.30$	0.38 $\pm 0.03$	0.68 $\pm 0.03$	1.50 $+0.1/-0$	3.50 $\pm 0.05$	2.00 $\pm 0.05$	2.00 $\pm 0.05$	1.75 $\pm 0.10$	4.00 $\pm 0.10$
1005 / 0402	0.60 $\pm 0.05$	8.00 $\pm 0.30$	0.58 $\pm 0.07$	1.12 $\pm 0.05$	1.55 $\pm 0.03$	3.50 $\pm 0.05$	2.00 $\pm 0.05$	2.00 $\pm 0.05$	1.75 $\pm 0.10$	4.00 $\pm 0.10$



Size (mm/inch)	Dimensions (mm)									
	t	W	A	B	D	F	P2	P1	E	Po
1608 / 0603	1.10 max	8.00 $\pm 0.30$	0.95 $\pm 0.10$	1.80 $\pm 0.10$	1.55 $\pm 0.03$	3.50 $\pm 0.05$	2.00 $\pm 0.05$	4.00 $\pm 0.10$	1.75 $\pm 0.10$	4.00 $\pm 0.10$
2012 / 0805	1.10 max	8.00 $\pm 0.30$	1.55 $\pm 0.10$	2.30 $\pm 0.10$	1.55 $\pm 0.03$	3.50 $\pm 0.05$	2.00 $\pm 0.05$	4.00 $\pm 0.10$	1.75 $\pm 0.10$	4.00 $\pm 0.10$

### ● Packaging Tape Specification



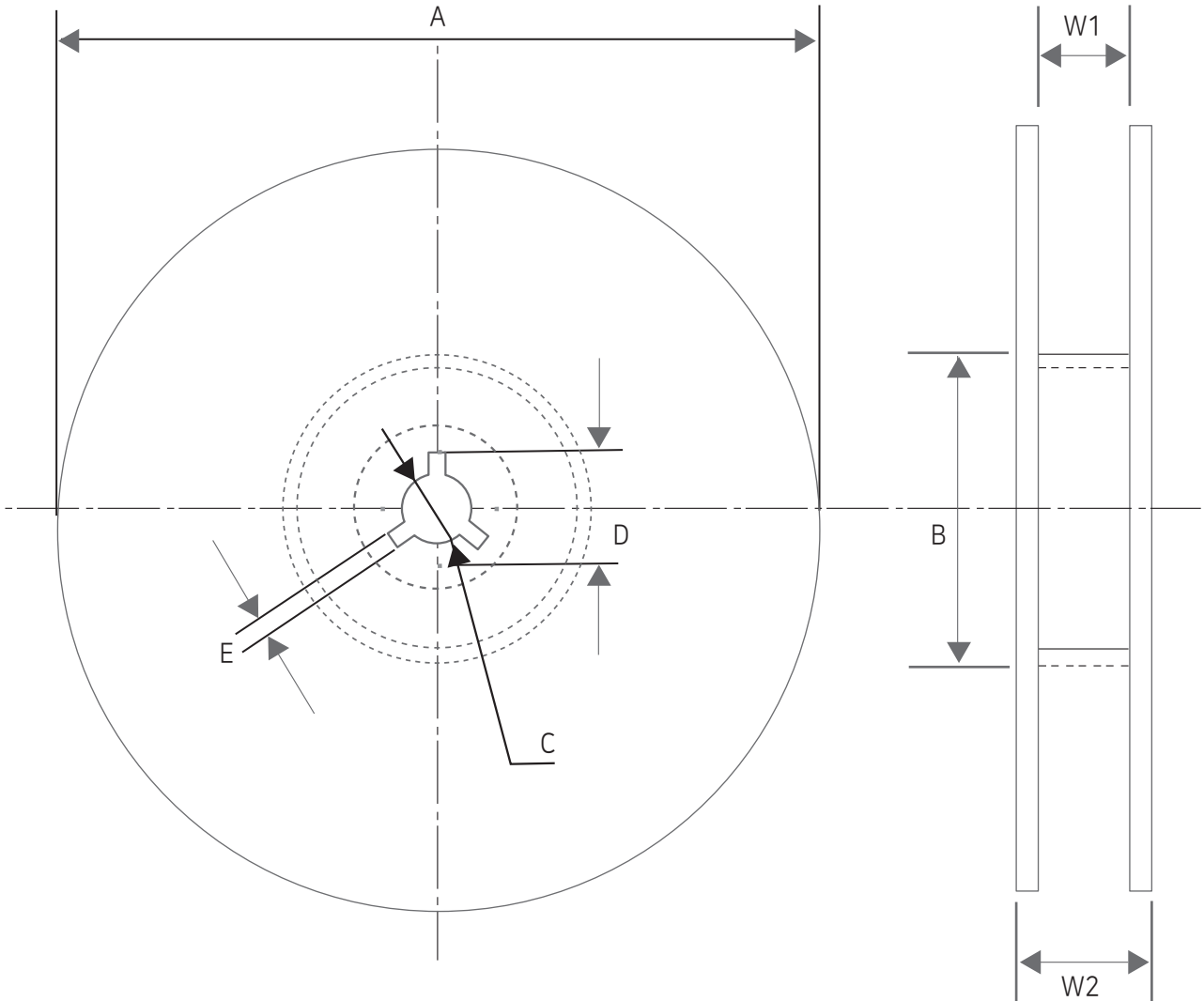
Size (mm/inch)	Dimensions (mm)										
	$t_1$	$t_0$	W	A	B	D	F	P2	P1	E	Po
2012 / 0805	2.50	0.60	8.00	1.53	2.25	1.50	3.50	2.00	4.00	1.75	4.00
	max	max	$\pm 0.30$	$\pm 0.20$	$\pm 0.20$	$+0.1/-0$	$\pm 0.05$	$\pm 0.05$	$\pm 0.10$	$\pm 0.10$	$\pm 0.10$
3216 / 1206	2.50	0.60	8.00	1.80	3.40	1.50	3.50	2.00	4.00	1.75	4.00
	max	max	$\pm 0.30$	$\pm 0.20$	$\pm 0.20$	$+0.1/-0$	$\pm 0.05$	$\pm 0.05$	$\pm 0.10$	$\pm 0.10$	$\pm 0.10$

※Packaging tape specifications are general packaging tape specifications by product size, and may vary depending on the customer.

In addition, the packaging specifications of special products may differ from the general products.

## Packaging Reel Specification

Fig.1 ) Dimensions of Reel



Reel	Dimensions (mm)						
	A	B	C	D	E	W1	W2
Φ178mm Reel	ø178	ø60	ø13	ø21	2.0	8.0	11.8
	±3.0	+3.0/-0.1	±0.5	±0.8	±0.5	+1.3/-0.0	±0.1
Φ330mm Reel	ø330	ø80	ø13	ø21	2.0	8.4	12.4
	±2.0	+3.0/-0.1	±0.5	±0.8	±0.5	±0.3	±2.0

### ● Reflow Test Condition

1. When sudden heat is applied to the components, the mechanical strength of the components will decrease because a sudden temperature change causes deformation inside the components. In order to prevent mechanical damage to the components, preheating is required for both the components and the PCB.

Preheating conditions are shown in Table 1 Below.

It is required to keep the temperature differential between the solder and the components surface ( $\Delta T$ ) as small as possible.

2. When components are immersed in solvent after mounting, be sure to maintain the temperature difference ( $\Delta T$ ) between the component and the solvent within the range shown in the Table 1 below.

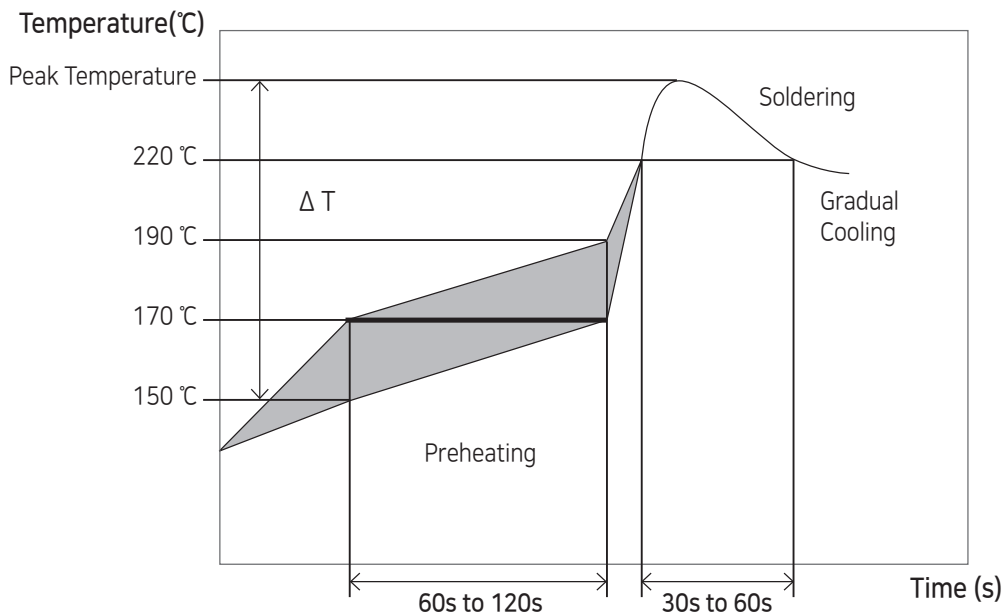


Table 1

Chip Dimension(L/W) Code	Temperature Differential
03 / 15	$\Delta T \leq 190^{\circ}\text{C}$
18 / 22 / 36 / 35	$\Delta T \leq 130^{\circ}\text{C}$

#### Temperature & Atmosphere Condition

	Lead Free Solder
Peak Temperature	240 to 260°C
Atmosphere	Air or N <sub>2</sub>

(Lead Free Solder : Sn-3.0Ag-0.5Cu)

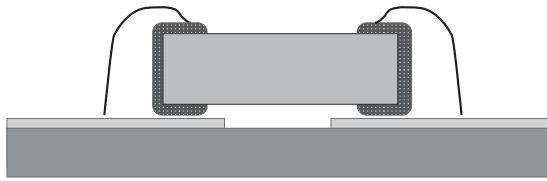
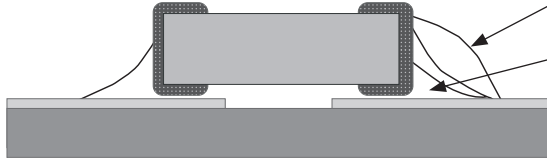
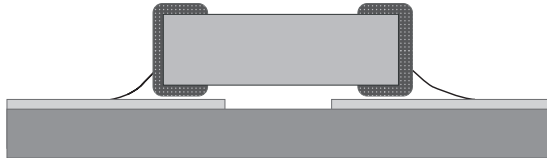


## ● Soldering Recommended Method

### 1. Amount of solder

Excessive solder will induce higher tensile force in chip capacitors when temperature changes and it may result in chip cracking. Insufficient solder may detach the capacitors from the PCB Board.

Fig.4 ) Amount of solder in capacitor

Excessive Solder	 <p data-bbox="1110 723 1401 786">Higher tensile force in chip capacitors to cause crack</p>
Adequate	 <p data-bbox="1098 931 1278 958">Maximum amount</p> <p data-bbox="1098 992 1273 1019">Minimum amount</p>
Insufficient solder	 <p data-bbox="1110 1227 1406 1350">Low robustness may cause contact failure or chip capacitors come off the PCB Board</p>

### 2. Solder repair by solder iron

#### 2-1) Selection of the soldering iron tip

Tip temperature of solder iron varies by its type, PCB Board material and solder land size. The higher the tip temperature, the quicker the operation. However, heat shock may cause a crack in the chip capacitors. Please make sure the tip temp. before soldering and keep the peak temp and time in accordance with following recommended condition.

2-2) Direct contact of the soldering iron with ceramic dielectric of chip capacitors may cause crack. Do not touch the ceramic dielectric and the terminations by solder iron.

#### Recommended solder iron condition

Temp. (°C)	Duration(sec.)	Wattage (W)	Shape (mm)
350 max.	3 max.	20 max.	φ3.0 max.

### Soldering Recommended Method

#### 3. Soldering rework using spot heater

Heat stress during rework may possibly be reduced by using a spot heater rather than a soldering iron. It is applied only to adding solder in the case of insufficient solder amount.

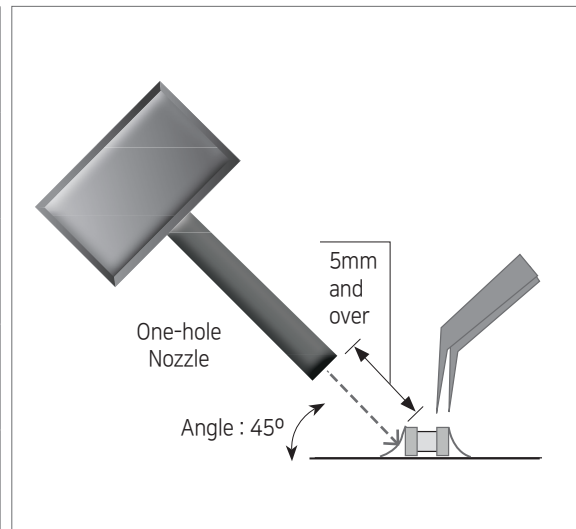
3-1) Reworking using a spot heater may suppress the occurrence of cracks in the capacitor compared to using a soldering iron. A spot heater can heat up a capacitor uniformly with a small heat gradient which leads to lower thermal stress caused by quick heating and cooling or localized heating. Moreover, where ultra-small capacitors are mounted close together on a printed circuit board, reworking with a spot heater can eliminate the risk of direct contact between the tip of a soldering iron and a capacitor.

#### 3-2) Rework condition

If the blower nozzle of a spot heater is too close to a capacitor, a crack in the capacitor may occur due to heat stress. Below are recommendations for avoiding such an occurrence. Keep more than 5mm between a capacitor and a spot heater nozzle. The blower temperature of the spot heater shall be lower than 400°C. The airflow shall be set as weak as possible. The diameter of the nozzle is recommended to be 2mm(one-outlet type).The size is standard and common. The angle between the nozzle and the capacitor is recommended to be 45degrees in order to work easily and to avoid partial area heating.

#### Recommended rework condition

Distance from nozzle	5mm and over
Nozzle angle	45°
Nozzle temp.	400°C and less
Nozzle diameter	Ø 2mm
Blowing duration	10s and less



3-3) Amount of solder should be suitable to form a proper fillet shape. Excess solder causes mechanical and thermal stress on a capacitor and results in cracks. Insufficient solder causes weak adherence of the capacitor to the substrate and may result in detachment of a capacitor and deteriorate reliability of the printed wiring board. See the example solder fillet shapes shown in Fig.4 in the "Soldering Recommended method category"

## ● Cautions on Using Circuit

### 1. Operating temperature

Operating temperature should be followed strictly within this specification, especially be careful with maximum temperature.

1-1) Do not use capacitors above the maximum allowable operating temperature.

1-2) Surface temperature including self heating should be below maximum operating temperature. (Due to dielectric loss, capacitors will heat itself when AC is applied. Especially at high frequencies around its SRF, the heat might be so extreme that it may damage itself or the product mounted on. Please design the circuit so that the maximum temperature of the capacitors including the self heating to be below the maximum allowable operating temperature. Temperature rise at capacitor surface shall be below 20°C)

1-3) The electrical characteristics of the capacitors will vary depending on the temperature. The capacitors should be selected and designed in taking the temperature into consideration.

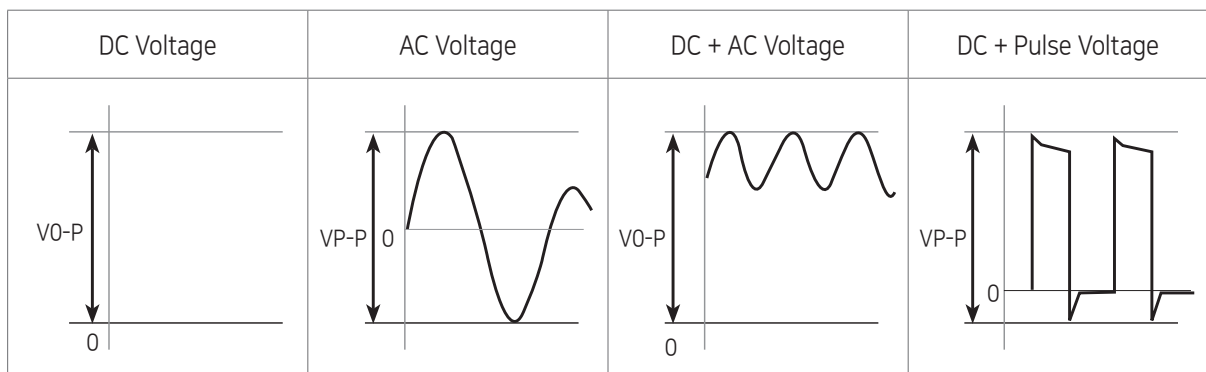
### 2. Operating voltage.

2-1) Do not apply a voltage to the capacitor that exceeds the rated voltage as called out in the specifications. Applied voltage between the terminals of a capacitor shall be less than or equal to the rated voltage.

2-2) When AC voltage is superimposed on DC voltage, the zero-to-peak voltage shall not exceed the rated DC voltage. When AC voltage or pulse voltage is applied, the peak-to-peak voltage shall not exceed the rated DC voltage.

2-3) Abnormal voltages (surge voltage, static electricity, pulse voltage, etc.) shall not exceed the rated DC voltage.

#### Typical Voltage Applied to the DC capacitor

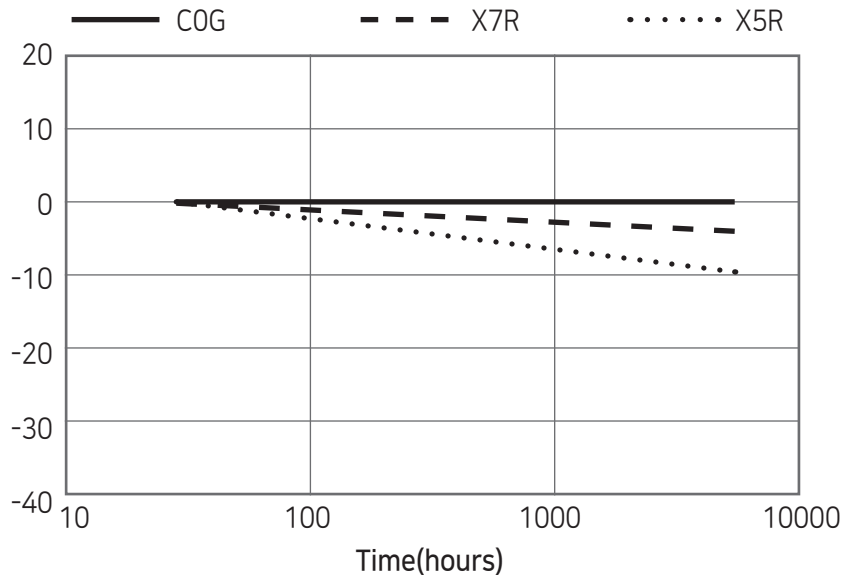


### ● Cautions on Using Circuit

#### 3. Capacitance Aging

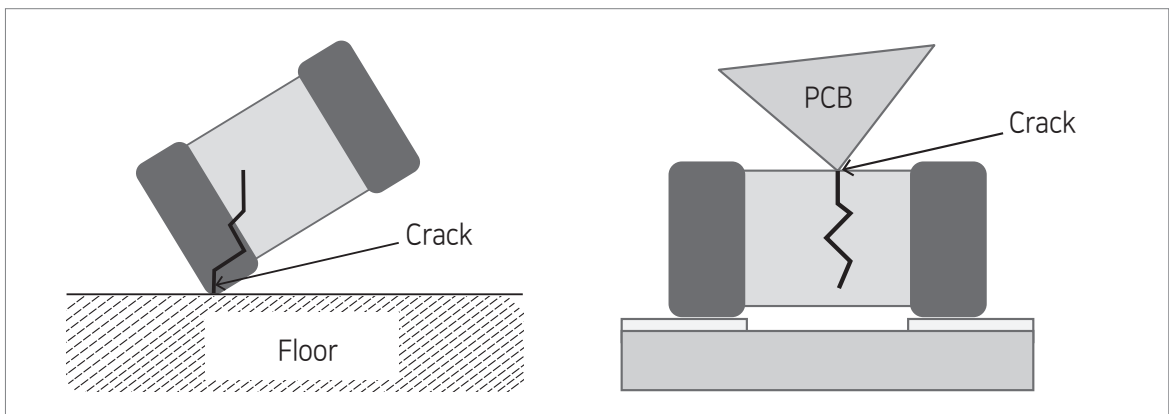
- The high dielectric constant type capacitors have an Aging characteristic in which the capacitance value decreases with the passage of time. When you use a high dielectric constant type capacitors in a circuit that needs a tight (narrow) capacitance tolerance (e.g., a time-constant circuit), please carefully consider the characteristics of these capacitors, such as their aging, voltage, and temperature characteristics.

In addition, check capacitors using your actual appliances at the intended environment and operating conditions.



#### 4. External Shock & Handling Precaution

- If dropped the chip capacitors may crack. Once dropped do not use it. Especially, the large case sized chip capacitors are tendency to have cracks easily, so please handle with care.
- Piling the PCB Board after mounting for storage or handling, the corner of the PCB Board may hit the chip capacitors of another board to cause crack.

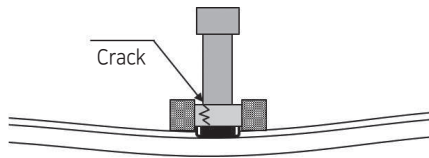
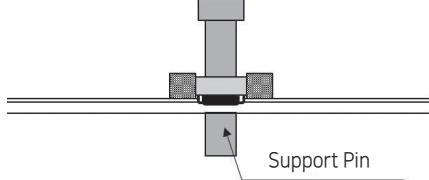
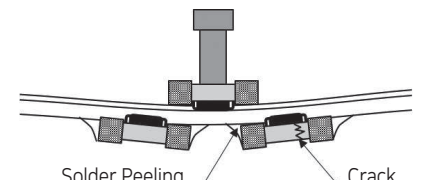
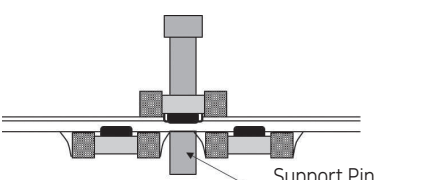


## ● Mounting Recommended Method

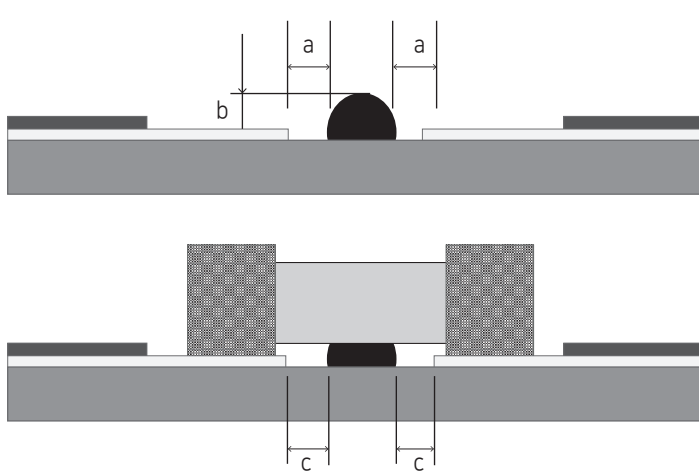
### 1. Stress from mounting head

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

- 1-1) Adjust the bottom dead center of the mounting head to reach on the PCB Board surface and not press it.
- 1-2) Adjust the mounting head pressure to be 1 to 3N of static weight.
- 1-3) To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the PCB Board.

	Not Recommended	Recommended
Single-Sided Mounting		
Double-Sided Mounting		

When the centering jaw is worn out, it may give mechanical impact on the capacitors to cause crack. Please control the close up dimension of the centering jaw and provide sufficient preventive maintenance and replacement of it.

	<table border="1"> <tbody> <tr> <td>a</td> <td>0.2mm min.</td> </tr> <tr> <td>b</td> <td>70 ~ 100 um</td> </tr> <tr> <td>c</td> <td>Do not touch the Solder land</td> </tr> </tbody> </table>	a	0.2mm min.	b	70 ~ 100 um	c	Do not touch the Solder land
a	0.2mm min.						
b	70 ~ 100 um						
c	Do not touch the Solder land						

## ● Storage and Operation Condition

1. The performance of chip capacitor may be affected by the storage conditions. Please use them promptly after delivery.

1-1) Maintain appropriate storage for the capacitors using the following conditions : Room Temperature of 5°C to 40°C and a Relative Humidity of 20% to 70%. 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.

In addition, this may cause oxidation of the electrodes. If more than one year has elapsed since delivery, also check the solderability before use.

1-2) Corrosive gas can react with the 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.).

1-3) Due to moisture condensation caused by rapid humidity changes, or the photochemical change caused by direct sunlight on the terminal electrodes and/or the resin/epoxy coatings, the solderability and electrical performance may deteriorate.

Do not store capacitors under direct sunlight or in high humidity conditions.

### ● Others Caution

#### 1. Caution during operation of equipment

- 1) Do not touch a capacitor directly with bare hands during operation in order to avoid the danger of an electric shock.
- 2) Do not allow the terminals of a capacitor to come in contact with any conductive objects (short-circuit). Do not expose a capacitor to a conductive liquid, inducing any acid or alkali solutions.
- 3) Confirm the environment in which the equipment will operate is under the specified conditions.
- 4) Do not use the equipment under the following environments.
  - ① Being splattered with water or oil.
  - ② Being exposed to direct sunlight.
  - ③ Being exposed to ozone, ultraviolet rays, or radiation.
  - ④ Being exposed to toxic gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas etc.)
  - ⑤ Any vibrations or mechanical shocks exceeding the specified limits.
  - ⑥ Moisture condensing environments.
- 5) Use damp proof countermeasures if using under any conditions that can cause condensation.

#### 2. Others Caution

- 1) The products listed on this specification sheet are intended for use in general electronic equipment. This product is not designed or guaranteed to meet the requirements of the applications listed below. If you want to use the product in the applications listed below or special requirements beyond the range or conditions specified in this specification, Please contact us.
  - ① Aerospace/Aviation equipment
  - ② Military equipment
  - ③ Safety equipment
  - ④ Transportation equipment (Vehicle, Electric trains, etc.)
  - ⑤ Transportation control equipment
  - ⑥ Medical equipment
  - ⑦ Power-generation control equipment
  - ⑧ Atomic energy-related equipment
  - ⑨ Seabed equipment
  - ⑩ Traffic signal control equipment
  - ⑪ Electric heating apparatus, burning equipment
  - ⑫ Disaster prevention/crime prevention equipment
  - ⑬ Other applications not considered universal

## ● Manufacturing Site

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**AVATEC** <http://avatec.co.kr/>

**YouTube** <https://www.youtube.com/channel/UCvRNNJYvw58CwMHiXPYgEKg>

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**facebook** <https://www.facebook.com/AVATECdispaly/>



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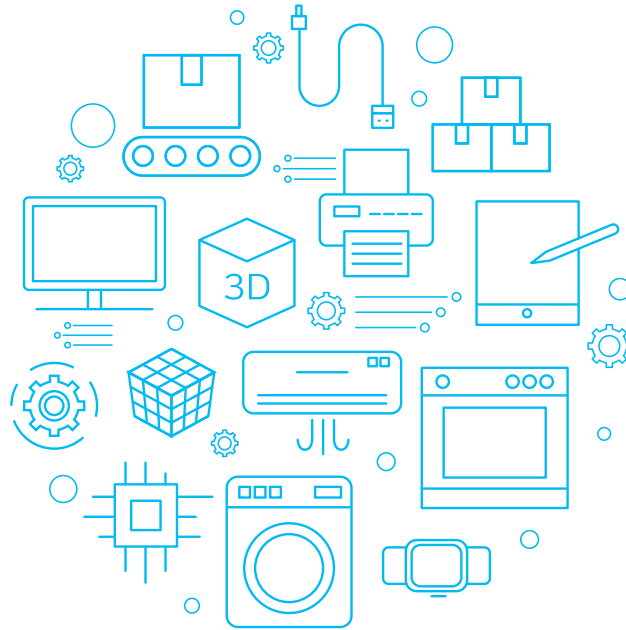
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# Multilayer Ceramic Capacitor User Guide