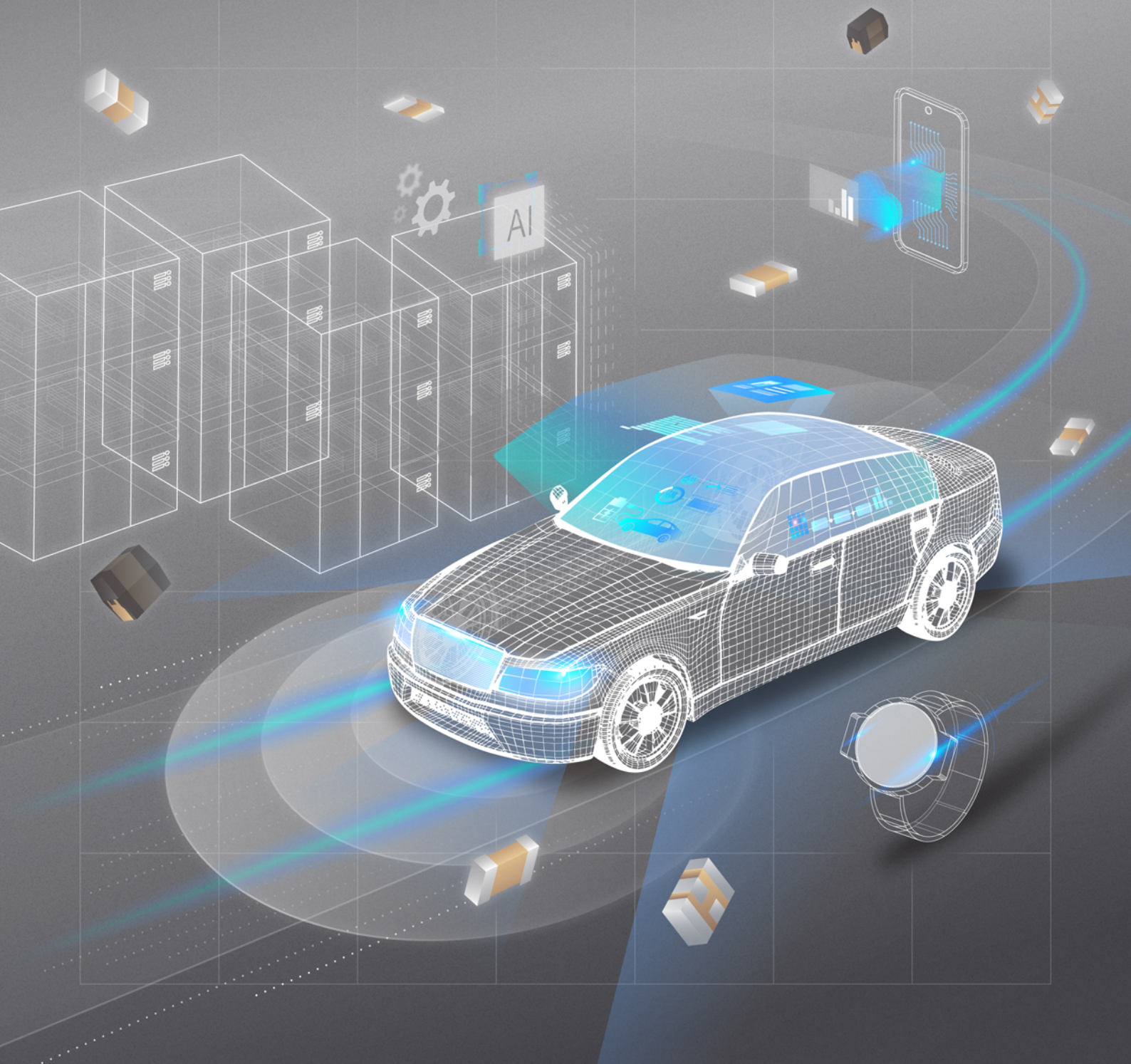
SAMSUNG
ELECTRO-MECHANICS

December 2025

MULTILAYER CERAMIC CAPACITORS

Part II. Automotive



Interactive User Guide

Samsung Electro-Mechanics' MLCC Catalog was produced as an INTERACTIVE PDF that allows transferring to related webpages for better understanding of the content.

Click 'HOME,' 'CONTENTS,' OR 'GO BACK TO PAGE' as needed, and it is also possible to 'PRINT' the pages.

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Contents

Part Numbering

CL	10	B	105	K	B	9	V	P	N	C
1	2	3	4	5	6	7	8	9	10	11

1 SERIES CODE

CL = Multilayer Ceramic Capacitors

2 SIZE CODE

Code	Inch(mm)
03	0201(0603)
L5	0204(0510)
05	0402(1005)
10	0603(1608)
21	0805(2012)

Code	Inch(mm)
31	1206(3216)
32	1210(3225)
43	1812(4532)
55	2220(5750)

3 DIELECTRIC CODE

Class Ⅰ (Temperature Compensation)

Symbol	EIA Code	Operation Temperature Range (℃)	Temperature Coefficient Range (ppm/℃)
C	C0G	-55 ~ +125	0 ±30
G	X8G	-55 ~ +150	0 ±30

Class Ⅱ (High Dielectric Constant)

Symbol	EIA Code	Operation Temperature Range (℃)	Capacitance Change (△℃%)
A	X5R	-55 ~ +85	±15
X	X6S	-55 ~ +105	±22
B	X7R	-55 ~ +125	±15
Y	X7S	-55 ~ +125	±22
Z	X7T	-55 ~ +125	-33 ~ +22
D	X8R	-55 ~ +150	±15
E	X8L	-55 ~ +150	-40 ~ +15
M	X8M	-55 ~ +150	-50 ~ +15

4 CAPACITANCE CODE

Capacitance expressed in pF. 2 significant digits plus number of zeros. example) 107=10×10^7=100,000,000pF
For values < 10pF, Letter R denotes decimal point example) 1R5 =1.5pF

5 CAPACITANCE TOLERANCE CODE

Code	Tolerance	Dielectric	Capacitance series	Remark
B	±0.1pF	Class Ⅰ	E-12 series*	≤2pF
C	±0.25pF	Class Ⅰ	E-12 series*	≤5pF
D	±0.5pF	Class Ⅰ	E-12 series*	5pF<Cp<10pF
J	±5%	Class Ⅰ	E-12 series	≥10pF
K	±10%	Class Ⅱ	E-6 series	
M	±20%	Class Ⅱ	E-6 series	

* E-24 series is also available (necessary to be checked with Sales or Marketing department.)
※ This code has only typical specifications. Please refer to individual specifications.
※ Please contact us for tolerance which are not indicated the above table. (A: ±0.05pF F: 1% G: 2%)

Part Numbering

Code	Capacitance Step											
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

6 RATED VOLTAGE CODE

S = 2.5V R = 4V Q = 6.3V P = 10V O = 16V A = 25V L = 35V B = 50V T = 75V C = 100V
D = 200V E = 250V G = 500V H = 630V I = 1000V X = 1250V V = 1500V J = 2000V

7 THICKNESS CODE

Size inch/mm	Code	Thickness*	Tolerance
0201/0603	3	0.30	± 0.03
	S	0.30	± 0.05
	R	0.30	± 0.09
0204/0510	2	0.20	± 0.02
	4	0.43	± 0.10
0402/1005	4	0.40	± 0.10
	5	0.50	± 0.05
	D	0.50	± 0.10
	Q	0.50	± 0.15
	6	0.50	± 0.20
0603/1608	6	0.60	± 0.10
	8	0.80	± 0.10

Size inch/mm	Code	Thickness*	Tolerance
0603/1608	Q	0.80	± 0.15
	9	0.80	± 0.20
0805/2012	6	0.60	± 0.10
	9	0.80	± 0.20
	C	0.85	± 0.10
	F	1.25	± 0.10
0805/2012	Q	1.25	± 0.15
	Y	1.25	± 0.20
	B	1.25	± 0.25
1206/3216	C	0.85	± 0.15
	W	1.05	± 0.20
	P	1.15	± 0.10

Size inch/mm	Code	Thickness*	Tolerance
1206/3216	F	1.25	± 0.15
	H	1.60	± 0.20
	K	1.60	± 0.30
1210/3225	H	1.60	± 0.20
	U	1.80	± 0.20
	I	2.00	± 0.20
	J	2.50	± 0.20
	V	2.50	± 0.30
1812/4532	R	1.30	± 0.20
	U	1.80	± 0.20
2220/5750	U	1.80	± 0.20

* In case of High Bending Strength, ESD protection capacitors, Please refer to individual specifications.
※ This code has only typical specifications. Please refer to individual specifications.

8 DESIGN CODE

Code	Inner electrode	Termination	Plating material	Design
1	Ni	Cu	Ni / Sn	Standard
2	Ni	Cu	Ni / Sn	Open Mode
3	Ni	Cu	Ni / Sn	Float Mode
4	Ni	Cu/Metal Epoxy	Ni / Sn	Standard
5	Ni	Cu/Metal Epoxy	Ni / Sn	Open Mode
6	Ni	Cu/Metal Epoxy	Ni / Sn	Standard
P	Ni	Cu/Metal Epoxy	Ni / Sn	Open Mode
R	Ni	Cu/Metal Epoxy	Ni / Sn	Float Mode
V	Ni	Cu/Metal Epoxy	Ni / Sn	Standard
W	Ni	Cu/Metal Epoxy	Ni / Sn	Open Mode
X	Ni	Cu/Metal Epoxy	Ni / Sn	Float Mode

9 PRODUCT CODE OR SIZE CONTROL CODE

P = Automotive product meet AEC - Q200 I = Automotive product meet AEC-Q200 for IVI application.

10 CONTROL CODE

N, O = Standard J, L = High Bending Strength E = ESD Protection T = 3-Terminal

11 PACKAGING CODE

Code	Type
C	Cardboard Tape, 7"reel
D/L	Cardboard Tape, 13"reel (Quantity option)*

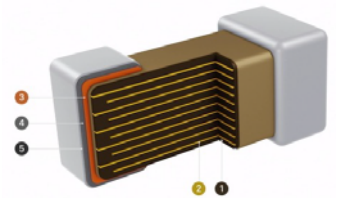
Code	Type
E	Embossed Tape, 7"reel
F	Embossed Tape, 13"reel

* Refer to the packaging specsheet

Normal Capacitors

Features

- Manufactured by state-of-the-art facilities, recommended for registration of ISO 9001 & IATF 16949
- AEC-Q200 and JEDEC-020 qualified products.
- RoHS compliant products.
- X7R dielectric components have BME and metal-epoxy terminations with a Ni/Sn plated overcoat.
- C0G dielectric components contain BME and copper terminations with a Ni/Sn plated overcoat.

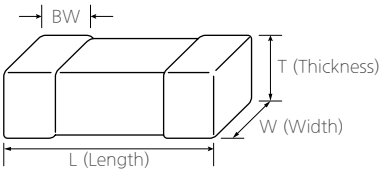


1. Ceramic Body
2. Electrode(Ni)
3. Termination(Cu or Cu+Metal Epoxy)
4. Plating(Ni)
5. Plating(Sn)

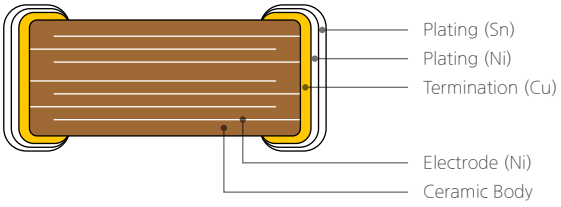
Applications

- Powertrain, Safety, Body & Chassis, Convenience, Infotainment, ADAS and Electric Vehicle

Structure and Dimensions

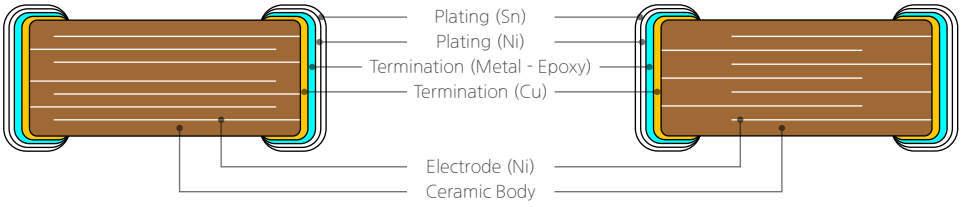


C0G



X7R Standard Design

X7R Open mode Design



Normal Capacitors

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
03	3	0.60±0.03	0.30±0.03	0.30±0.03	0.15±0.05	0201
	S	0.60±0.05	0.30±0.05	0.30±0.05	0.15±0.05	
	R	0.60±0.09	0.30±0.09	0.30±0.09	0.15±0.05	
05	5	1.00±0.05	0.50±0.05	0.50±0.05	0.25±0.10	0402
	D	1.00±0.10	0.50±0.10	0.50±0.10	0.25±0.10	
	6	1.00±0.20	0.50±0.20	0.50±0.20	0.25±0.10	
10	8	1.60±0.10	0.80±0.10	0.80±0.10	0.30±0.20	0603
	9	1.60±0.20	0.80±0.20	0.80±0.20	0.30±0.20	
21	6	2.00±0.10	1.25±0.10	0.60±0.10	0.50+0.20/-0.30	0805
	9	2.00±0.20	1.25±0.20	0.90±0.20	0.50+0.20/-0.30	
	C	2.00±0.10	1.25±0.10	0.85±0.10	0.50+0.20/-0.30	
	F	2.00±0.10	1.25±0.10	1.25±0.10	0.50+0.20/-0.30	
	Q	2.00±0.15	1.25±0.15	1.25±0.15	0.50+0.20/-0.30	
	Y	2.00±0.20	1.25±0.20	1.25±0.20	0.50+0.20/-0.30	
	B	2.00±0.25	1.25±0.25	1.25±0.25	0.50+0.20/-0.30	
31	C	3.20±0.15	1.60±0.15	0.85±0.15	0.50±0.30	1206
	W	3.20±0.20	1.60±0.20	1.05±0.20	0.50±0.30	
	P	3.20±0.15	1.60±0.15	1.15±0.10	0.50±0.30	
	F	3.20±0.15	1.60±0.15	1.25±0.15	0.50±0.30	
	H	3.20±0.20	1.60±0.20	1.60±0.20	0.50±0.30	
	K	3.20±0.30	1.60±0.30	1.60±0.30	0.50±0.30	
32	I	3.20±0.30	2.50±0.20	2.00±0.20	0.60±0.30	1210
	J	3.20±0.30	2.50±0.20	2.50±0.20	0.60±0.30	
	V	3.20±0.40	2.50±0.30	2.50±0.30	0.60±0.30	

※ This code has only typical specifications. Please refer to individual specifications.

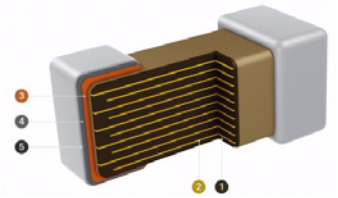
※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

Linup Search Product Search

Mid/High Voltage Capacitors

Features

- Manufactured by state-of-the-art facilities, recommended for registration of ISO 9001 & IATF 16949
- Meet AEC-Q200 and JEDEC-020 qualified products.
- RoHS compliant products.
- Voltage rating of 200V ~ 2000V.
- 3mm Bending Strength guaranteed.
- Operating temperature range : -55 to 125°C.
- X7R dielectric components have BME and metal-epoxy terminations with a Ni/Sn plated overcoat.
- C0G dielectric components contain BME and copper terminations with a Ni/Sn plated overcoat.



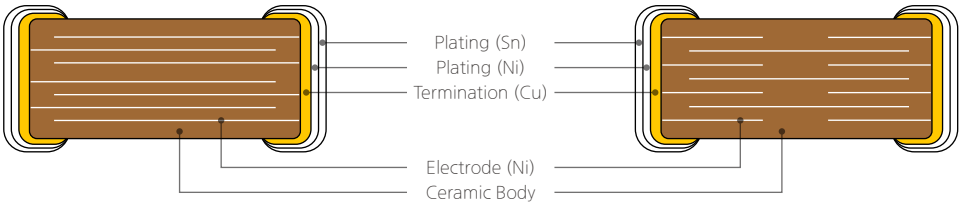
1. Ceramic Body
2. Electrode(Ni)
3. Termination(Cu or Cu+Metal Epoxy)
4. Plating(Ni)
5. Plating(Sn)

Applications

- Powertrain, Safety, Body & Chassis, Convenience, Infotainment, ADAS, EV

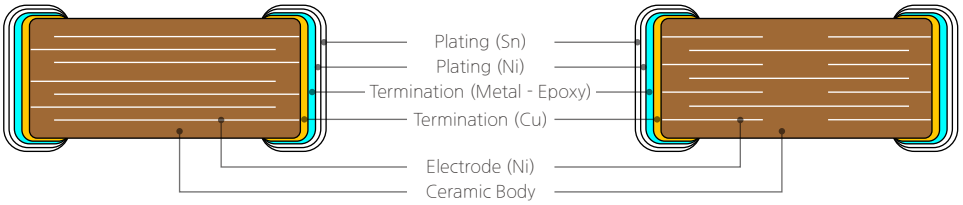
Structure and Dimensions

C0G Standard Design



C0G Float mode Design

X7R Standard Design



X7R Float mode Design

Mid/High Voltage Capacitors

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
10	8	1.60±0.10	0.80±0.10	0.80±0.10	0.30±0.20	0603
21	C	2.00±0.10	1.25±0.10	0.85±0.10	0.50+0.20/-0.30	0805
	F	2.00±0.10	1.25±0.10	1.25±0.10	0.50+0.20/-0.30	
	9	2.00±0.20	1.25±0.20	0.80±0.20	0.50+0.20/-0.30	
	Y	2.00±0.20	1.25±0.20	1.25±0.20	0.50+0.20/-0.30	
31	C	3.20±0.15	1.60±0.15	0.85±0.15	0.50±0.30	1206
	W	3.20±0.20	1.60±0.20	1.05±0.20	0.50±0.30	
	F	3.20±0.15	1.60±0.15	1.25±0.15	0.50±0.30	
	H	3.20±0.20	1.60±0.20	1.60±0.20	0.50±0.30	
32	H	3.20±0.20	1.60±0.20	1.60±0.20	0.50±0.30	1210
	U	3.20±0.30	2.50±0.20	1.80±0.20	0.60±0.30	
	I	3.20±0.30	2.50±0.20	2.00±0.20	0.60±0.30	
	J	3.20±0.30	2.50±0.20	2.50±0.20	0.60±0.30	
	V	3.20±0.40	2.50±0.30	2.50±0.30	0.60±0.30	
43	R	4.50±0.40	3.20±0.30	1.30±0.20	0.65±0.30	1812
	U	4.50±0.40	3.20±0.30	1.80±0.20	0.65±0.30	
55	U	5.70±0.40	5.00±0.40	1.80±0.20	1.00±0.30	2220

※ This code has only typical specifications. Please refer to individual specifications.

※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

Linup Search	Linup Search	Linup Search	Product Search	Product Search	Product Search
Normal	High Bending Strength	MFC	Lineup Normal	High Bending Strength	MFC

High Bending Strength Capacitors

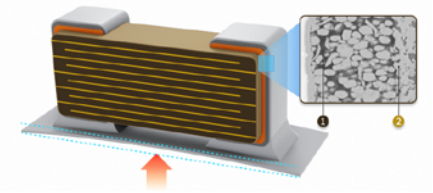
Features

MLCC with Increased Durability

It is a product that applies stress-management technology against external deformation to prevent MLCC defects from taking place when mechanical and thermal deformation of the PCB occurs. With greater durability than existing products, it can be used in applications that require safety.

- **Bending Crack Prevention**
  Use of Conductive Epoxy Material Technology that can absorb deformation stress to prevent Bending Cracks caused by PCB deformation
- **5mm Bending Guarantee**
  Board Flex 5mm Guarantee*

* Excluding large-sized products. Please be sure to refer to individual specifications for case sizes 43 and 55.

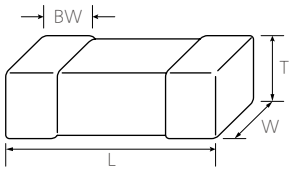


❶ Metal Epoxy
❷ Cu Termination

Applications

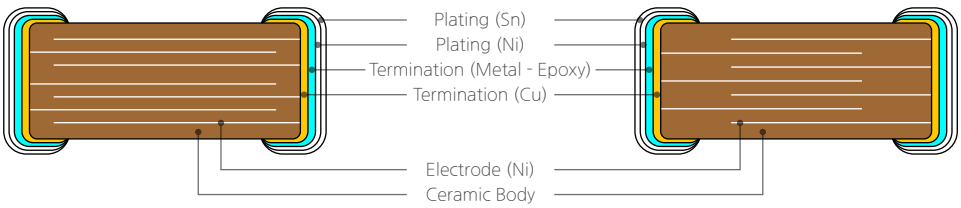
- Critical circuits and battery line circuits.
  (Cracks caused by bending stress after board mounting are minimized.)

Structure and Dimensions



Standard Design

Open mode Design



High Bending Strength Capacitors

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
05	5	1.00±0.10	0.50±0.05	0.50±0.05	0.25±0.10	0402
	D	1.00±0.10	0.50±0.10	0.50±0.10	0.25±0.10	
	6	1.00±0.20	0.50±0.20	0.50±0.20	0.25±0.10	
10	8	1.60±0.20	0.80±0.10	0.80±0.10	0.30±0.20	0603
	9	1.60±0.30	0.80±0.20	0.80±0.20	0.30±0.20	
21	C	2.00±0.30	1.25±0.20	0.85±0.10	0.50+0.20/-0.30	0805
	F	2.00±0.30	1.25±0.20	1.25±0.20	0.50+0.02/-0.30	
	Q	2.00±0.35	1.25±0.25	1.25±0.25	0.50+0.20/-0.30	
	Y	2.00±0.20	1.25±0.20	1.25+0.20/-0.15	0.50+0.20/-0.30	
	B	2.00±0.25	1.25±0.25	1.25+0.25/-0.20	0.50+0.20/-0.30	
31	H	3.20±0.30	1.60±0.30	1.60±0.30	0.60+0.40/-0.30	1206
	K	[1] 3.20±0.30	1.60±0.30	1.60+0.30/-0.25	0.60+0.40/-0.30	
32	I	3.20±0.40	2.50±0.30	2.00±0.30	0.60+0.40/-0.30	1210
	J	3.20±0.40	2.50±0.30	2.50±0.30	0.60+0.40/-0.30	
	V	3.20±0.40	2.50±0.35/-0.30	2.50+0.35/-0.30	0.60+0.40/-0.30	
43	R	4.50±0.40	3.20±0.30	1.30±0.20	0.65±0.30	1812
	U	4.50±0.40	3.20±0.30	1.80±0.20	0.65±0.30	
55	U	5.70±0.40	5.00±0.40	1.80±0.20	1.00±0.30	2220

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Linup Search Product Search

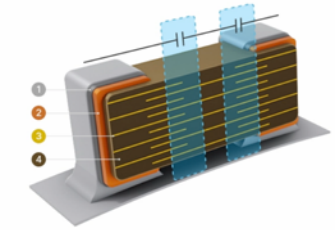
Fail Safe Capacitors (Soft Termination 5mm)

Features

MLCC with The Highest Degree of Safety

Designed to prevent circuit malfunction even if the MLCC product is cracked and a short circuit occurs inside.In addition, the product guarantees Board Flex 5mm and is the MLCC product with the highest degree of safety among other products to prevent defects caused by PCB deformation.

- **5mm Bending Guarantee**
  Board Flex 5mm Guarantee
- **Series Design**
  Designed to operate like two MLCCs in a series even if a defect such as a crack occurs on one side, the circuit can be protected on the other side

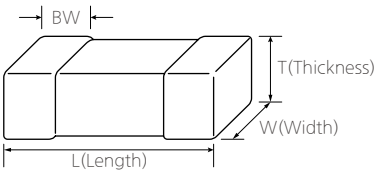


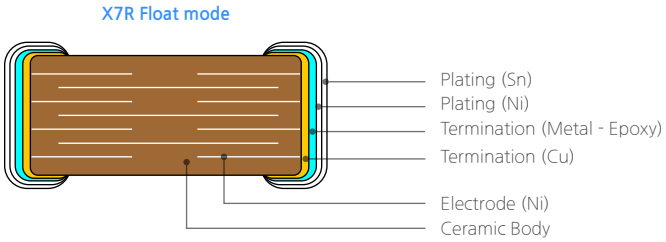
1 Plating layer(Ni/Sn)
2 Outer electrode(Cu & Metal-epoxy:X7R)
3 Inner electrode(Ni)
4 Ceramic

Applications

- All automotive applications, including battery lines, circuits near holes, and connectors.

Structure and Dimensions





Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
10	8	1.60±0.20	0.80±0.10	0.80±0.10	0.30±0.20	0603
21	F	2.00±0.30	1.25±0.20	1.25±0.20	0.5+0.2/-0.3	0805

※ This code has only typical specifications. Please refer to individual specifications.

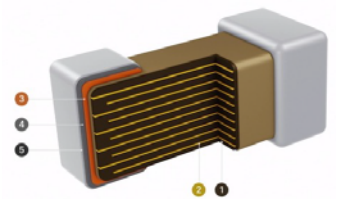
※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

Linup Search Product Search

High Temperature Capacitors

Features

- Manufactured by state-of-the-art facilities, recommended for registration of ISO 9001 & IATF 16949
- Meet AEC-Q200 and JEDEC-020 qualified products.
- RoHS compliant products.
- Operating temperature range : -55 to 150°C.
- High Reliability MLCC that ensures the heating environment of Powertrain network and EV High Temperature products.



1. Ceramic Body
2. Electrode(Ni)
3. Termination(Cu or Cu+Metal Epoxy)
4. Plating(Ni)
5. Plating(Sn)

Applications

- Used in places with High Power Consumption and High Operating Temperature like Powertrain, Engine Oil, Inverter, Lighting etc.

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
03	3	0.60±0.03	0.30±0.03	0.30±0.03	0.15±0.05	0201
	R	0.60±0.09	0.30±0.09	0.30±0.09	0.15±0.05	
05	5	1.00±0.05	0.50±0.05	0.50±0.05	0.25±0.10	0402
10	8	1.60±0.10	0.80±0.10	0.80±0.10	0.30±0.20	0603
	9	1.60±0.20	0.80±0.20	0.80±0.20	0.30±0.20	
21	C	2.00±0.10	1.25±0.10	0.85±0.10	0.50+0.20/-0.30	0805
	F	2.00±0.10	1.25±0.10	1.25±0.10	0.50+0.20/-0.30	
	Q	2.00±0.15	1.25±0.15	1.25±0.15	0.50+0.20/-0.30	
	Y	2.00±0.20	1.25±0.20	1.25±0.20	0.50+0.20/-0.30	
	B	2.00±0.25	1.25±0.25	1.25±0.25	0.50+0.20/-0.30	
31	H	3.20±0.20	1.60±0.20	1.60±0.20	0.50±0.30	1206
	K	3.20±0.30	1.60±0.30	1.60±0.30	0.50±0.30	
32	I	3.20±0.30	2.50±0.20	2.00±0.20	0.60±0.30	1210
	J	3.20±0.30	2.50±0.20	2.50±0.20	0.60±0.30	
	V	3.20±0.40	2.50±0.30	2.50±0.30	0.60±0.30	

※ This code has only typical specifications. Please refer to individual specifications.

※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

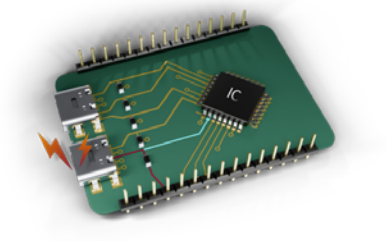
Linup Search	Linup Search	Product Search	Product Search
Normal	High Bending Strength	Lineup Normal	High Bending Strength

ESD Protection Capacitors

Features

Higher ESD Level
ESD Protection Series guarantees higher ESD Levels than general MLCC products.

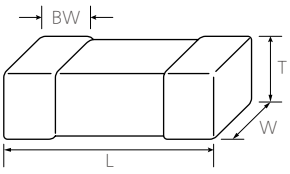
- **Compliant with the IEC 61000-4-2**
  ESD Testing according to the IEC 61000-4-2 Standard
- **0603 1nF~10nF (X7R, C0G)**
  X7R ESD protection capacitors are designed to have improved DC-Bias and Withstand Voltage compared to general X7R products. There are also C0G ESD Protection capacitors that can cover up to 10nF capacitance range.

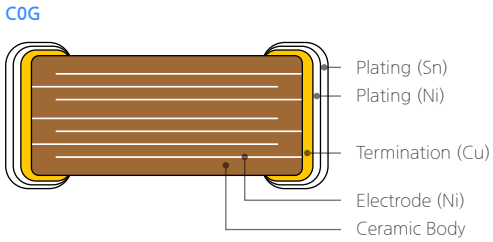


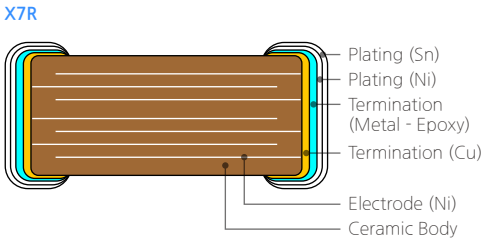
Applications

- Input and output sections in a wide range of automotive electronics.

Structure and Dimensions







X7R

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
10	8	1.70±0.10	0.90±0.10	0.90±0.10	0.30±0.20	0603

C0G

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
10	8	1.60±0.10	0.80±0.10	0.80±0.10	0.30±0.20	0603

※ This code has only typical specifications. Please refer to individual specifications.

※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

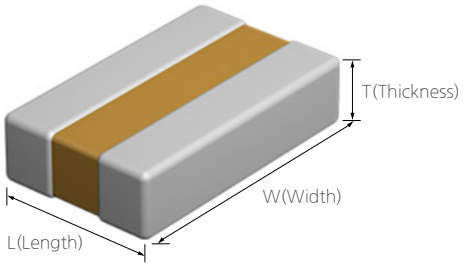
Linup Search Product Search

Low ESL Capacitors

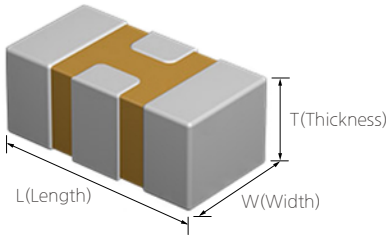
Features

- MLCCs with Low Equivalent Series Inductance (ESL) can be used in circuits with limited mounting area, as a small quantity of such MLCCs can sufficiently replace High-Speed IC MLCCs.
- AEC-Q200 and JEDEC-020 qualified products.

Reversed Type



3-Terminal type



Applications

- ADAS, Infortainment, In-Vehicle Networking(IVN), Powertrain, Safety System

Dimensions

Reversed Type

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
L5	2	0.65+0.05/-0.10	1.15+0.05/-0.10	0.20±0.02	0.20±0.06	0204
	4	0.58±0.10	1.10±0.10	0.43±0.10	0.20±0.06	

3-Terminal Type

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
05	4	1.00±0.20	0.50±0.20	0.40±0.10	0.20±0.10	0402
10	6	1.60±0.10	0.80±0.10	0.60±0.10	0.35±0.10	0603

※ This code has only typical specifications. Please refer to individual specifications.

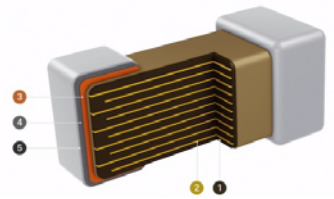
※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

Linup Search Product Search

Capacitors for In-Vehicle Infotainment

Features

- Manufactured by state-of-the-art facilities, recommended for registration of ISO 9001.
- AEC-Q200 and JEDEC-020 qualified products.
- RoHS compliant products.
- X5R/ X6S, C0G dielectric components contain BME and copper terminations with a Ni/Sn plated overcoat.



1. Ceramic Body
2. Electrode(Ni)
3. Termination(Cu)
4. Plating(Ni)
5. Plating(Sn)

Applications

- In-Vehicle Infotainment (Car Multimedia, Car Interior, Car Comport, etc.)

※ Do not use these products in safety and underhood applications (ex. Driving, Steering, Braking, Safety equipment, etc.)

Dimensions

Size Code	Thickness Code	Dimension (mm)				EIA (inch)
		L	W	T	BW	
03	3	0.60±0.03	0.30±0.03	0.30±0.03	0.15±0.05	0201
	R	0.60±0.09	0.30±0.09	0.30±0.09	0.15±0.05	
05	5	1.00±0.05	0.50±0.05	0.50±0.05	0.25±0.10	0402
	D	1.00±0.10	0.50±0.10	0.50±0.10	0.25±0.10	
	Q	1.00±0.15	0.50±0.15	0.50±0.15	0.25±0.10	
	6	1.00±0.20	0.50±0.20	0.50±0.20	0.25±0.10	
10	8	1.60±0.10	0.80±0.10	0.80±0.10	0.30±0.20	0603
	Q	1.60±0.15	0.80±0.15	0.80±0.15	0.30±0.20	
	9	1.60±0.20	0.80±0.20	0.80±0.20	0.30±0.20	
21	F	2.00±0.10	1.25±0.10	1.25±0.10	0.50+0.20/-0.30	0805
	Q	2.00±0.15	1.25±0.15	1.25±0.15	0.50+0.20/-0.30	
	Y	2.00±0.20	1.25±0.20	1.25±0.20	0.50+0.20/-0.30	
31	H	3.20±0.20	1.60±0.20	1.60±0.20	0.50±0.30	1206
	K	3.20±0.30	1.60±0.30	1.60±0.30	0.50±0.30	
32	J	3.20±0.30	2.50±0.20	2.50±0.20	0.60±0.30	1210
	V	3.20±0.40	2.50±0.30	2.50±0.30	0.60±0.30	

※ This code has only typical specifications. Please refer to individual specifications.

※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

Linup Search Product Search

New Product Introduction

※ For the product data sheet and related articles, please visit the Samsung Electro-Mechanics website by clicking the link below.

Automotive MLCC

Type	Part Number	Specifications					Data sheet	Related Article
		Size Code (inch/mm)	Capacitance	TCC	Rated Voltage (Vdc)	Tolerance (%)		
Normal	CL03C221JB31PN#	0201/0603	220pF	C0G	50	±5	→	→
	CL03C151JB31PN#	0201/0603	150pF	C0G	50	±5	→	→
	CL03C101JB31PN#	0201/0603	100pF	C0G	50	±5	→	→
	CL03Z105MQR6PN#	0201/0603	1.0μF	X7T	6.3	±20	→	→
	CL05C102JC51PN#	0402/1005	1.0nF	C0G	100	±5	→	→
	CL05Y105KO66PN#	0402/1005	1.0μF	X7S	16	±10	→	→
	CL05Y225KP66PN#	0402/1005	2.2μF	X7S	10	±10	→	→
	CL10C102JE81PN#	0603/1608	1.0nF	C0G	250	±5	→	→
	CL10C103JC81PN#	0603/1608	10nF	C0G	100	±5	→	→
	CL10X226MQ91IN#	0603/1608	22μF	X6S	6.3	±20	→	→
	CL10X226MP91IN#	0603/1608	22μF	X6S	10	±20	→	→
	CL10Z106MP96PN#	0603/1608	10μF	X7T	10	±20	→	→
	CL10Z226MR96PN#	0603/1608	22μF	X7T	4.0	±20	→	→
	CL21C222JHY3PN#	0805/2012	2.2nF	C0G	630	±5	→	→
	CL21C333JBQ1PN#	0805/2012	33nF	C0G	50	±5	→	→
	CL21C223JBQ1PN#	0805/2012	22nF	C0G	50	±5	→	→
	CL21Z104KEY6PJ#	0805/2012	100nF	X7T	250	±10		→
	CL31Y475KCK6PN#	1206/3216	4.7μF	X7S	100	±10	→	→
	CL32B226KLV6PN#	1210/3225	22μF	X7R	35	±10	→	→
	CL32Z227MSV6PN#	1210/3225	220μF	X7T	2.5	±20	→	→
	CL55B105KEU6PN#	2220/5750	1.0μF	X7R	250	±10	→	→
Mid/High Voltage	CL31B102KJHRPN#	1206/3216	1.0nF	X7R	2000	±10	→	→
	CL31B222KJHRPN#	1206/3216	2.2nF	X7R	2000	±10	→	→
	CL31B223KIHRPN#	1206/3216	22nF	X7R	1000	±10	→	→
	CL32C223JIV1PN#	1210/3225	22nF	C0G	1000	±5	→	→
	CL32B104KHU6PN#	1210/3225	100nF	X7R	630	±10	→	→
High Bending Strength	CL05Y334KOD6PJ#	0402/1005	330nF	X7S	16	±10	→	→
	CL05Y474KOD6PJ#	0402/1005	470nF	X7S	16	±10	→	→
	CL31B106KBK6PJ#	1206/3216	10μF	X7R	50	±10	→	→
	CL31Y226MOK6PJ#	1206/3216	22μF	X7S	16	±20	→	→
	CL32Y106KCJ6PJ#	1210/3225	10μF	X7S	100	±10	→	→
	CL32B226KLV6PJ#	1210/3225	22μF	X7R	35	±10	→	→
	CL43B222KJRRPJ#	1812/4532	2.2nF	X7R	2000	±10	→	→
	CL43B104KIU6PJ#	1812/4532	100nF	X7R	1000	±10	→	→
	CL43B224KHU6PJ#	1812/4532	220nF	X7R	630	±10	→	→
	CL43B474KEU6PJ#	1812/4532	470nF	X7R	250	±10	→	→
High Temperature	CL03M105MRR6PN#	0201/0603	1.0μF	X8M	4	±20	→	→
	CL05G102JC51PN#	0402/1005	1.0nF	X8G	100	±5	→	→
Low ESL (Reverse)	CLL5Z105MS21PN#	0204/0510	1.0μF	X7T	2.5	±20	→	→
	CLL5Z105MR41PN#	0204/0510	1.0μF	X7T	4.0	±20	→	→

Reliability Test Conditions

No.	Item			Performance	Test condition
1	Pre-and Post-Stress Electrical Test			-	
2	High Temper-ature Exposure	Appearance		No abnormal exterior appearance	Unpowered, 1000hrs@T = Max Temp. Initial Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
		Capacitance Change	Class Ⅰ	Within±2.5% or ±0.25pF, (Whichever is larger)	
			Class Ⅱ	Within±10%	
		Q	Class Ⅰ	Capacitance ≥ 30pF : Q ≥ 1,000 < 30pF : Q ≥ 400 + 20 × C (C : Capacitance)	
		Tanδ	Class Ⅱ	Rated Voltage ≥ 250V : 0.050 max ≥ 25V : 0.030 max ≥ 16V : 0.050 max ≤ 10V : 0.075 max (X8L : 0.050 max) *1)	
		IR		Rated Voltage ≥ 250V : More than 10,000MΩ or 100MΩ × μF ≤ 200V : More than 10,000MΩ or 500MΩ × μF (Whichever is smaller) *1)	
3	Temper-ature Cycling	Appearance		No abnormal exterior appearance	1000Cycles Initial Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Step / Temperature (℃) / Time (min.) 1 / Min. operating, Temp.+0/-3 / 30±3 2 / 25±2 / 1 3 / Max. operating, Temp.+3/-0 / 30±3 4 / 25±2 / 1
		Capacitance Change	Class Ⅰ	Within±2.5% or ±0.25pF, (Whichever is larger)	
			Class Ⅱ	Within±10%	
		Q	Class Ⅰ	Capacitance ≥ 30pF : Q ≥ 1,000 < 30pF : Q ≥ 400 + 20 × C (C : Capacitance)	
		Tanδ	Class Ⅱ	Rated Voltage ≥ 250V : 0.050 max ≥ 25V : 0.030 max ≥ 16V : 0.050 max ≤ 10V : 0.075 max (X8L : 0.050 max) *1)	
		IR		Rated Voltage ≥ 250V : More than 10,000MΩ or 100MΩ × μF ≤ 200V : More than 10,000MΩ or 500MΩ × μF (Whichever is smaller) *1)	
4	Destructive Physical Analysis			No defects or abnormalities	Per EIA 469
5	Biased Humidity	Appearance		No abnormal exterior appearance	1000hrs 85℃/85%RH, Rated voltage and 1.3 ~ 1.5V (add 100kohm resistor) If the rated voltage is 1000V or higher, it is evaluated as a maximum of 1000V. Initial Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
		Capacitance Change	Class Ⅰ	Within±2.5% or ±0.25pF, (Whichever is larger)	
			Class Ⅱ	Within±12.5%	
		Q	Class Ⅰ	Capacitance ≥ 30pF : Q ≥ 200 < 30pF : Q ≥ 100 + (10/3) × C (C : Capacitance)	
		Tanδ	Class Ⅱ	Rated Voltage ≥ 250V : 0.050 max ≥ 25V : 0.030 max ≥ 16V : 0.050 max ≤ 10V : 0.075 max *1) (*X8L - ≥ 35V : 0.035 max ≥ 10V : 0.050 max)	
		IR		Rated Voltage ≥ 250V : More than 10,000MΩ or 10MΩ × μF ≤ 200V : More than 500MΩ or 25MΩ × μF (*X8L/X8G : More than 1,000MΩ or 10MΩ × μF) (Whichever is smaller) *1)	
6	High Temper-ature Operating Life	Appearance		No abnormal exterior appearance	1000hrs @ TA = Max temp., Rated Voltage *2) Initial Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
		Capacitance Change	Class Ⅰ	Within±3.0% or ±0.3pF, (Whichever is larger)	
			Class Ⅱ	Within±12.5%	
		Q	Class Ⅰ	Capacitance ≥ 30pF : Q≥ 350 ≥ 10pF : Q≥ 275 + (5 / 2) × C < 10pF : Q≥ 200 + 10 × C (C : Capacitance)	
		Tanδ	Class Ⅱ	Rated Voltage ≥ 250V : 0.050 max ≥ 25V : 0.030 max ≥ 16V : 0.050 max ≤ 10V : 0.075 max *1) (*X8L - ≥ 35V : 0.035 max ≥ 10V : 0.050 max)	
		IR		Rated Voltage ≥ 250V : More than 10,000MΩ or 10MΩ × μF ≤ 200V : More than 1,000MΩ or 50MΩ × μF (Whichever is smaller) *1)	

※ *1) : Indicates typical specification. Please refer to individual specifications.
*2) : Some of the parts are applicable in rated voltage × 150% or × 120%, Please refer to individual specifications.

Reliability Test Conditions

No.	Item		Performance	Test condition
7	External Visual		No abnormal exterior appearance	Microscope (×10)
8	Physical Dimensions		Within the specified dimensions	Using the calipers
9	Mechanical Shock	Appearance	No abnormal exterior appearance	Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks) Peak value: 1,500G / Duration: 0.5ms / Wave: Half sine / Velocity: 4.7m / sec Initial Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
		Capacitance Change – Class Ⅰ	Within±2.5% or ±0.25pF, (Whichever is larger)	
		Capacitance Change – Class Ⅱ	Within±10%	
		Q – Class Ⅰ	Capacitance ≥ 30pF : Q ≥ 1,000 < 30pF : Q ≥ 400 + 20 × C (C : Capacitance)	
		Tanδ – Class Ⅱ	Rated Voltage ≥ 250V : 0.050 max ≥ 25V : 0.030 max ≥ 16V : 0.050 max ≤ 10V : 0.075 max (X8L : 0.035 max) *1)	
		IR	Rated Voltage ≥ 250V : More than 10,000MΩ or 100MΩ × μF ≤ 200V : More than 10,000MΩ or 500MΩ × μF (Whichever is smaller) *1)	
10	Vibration	Appearance	No abnormal exterior appearance	5g's for 20min., 12cycles each of 3 orientations, Use 8"× 5" PCB 0.031" Thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10~2000Hz. Initial Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
		Capacitance Change – Class Ⅰ	Within±2.5% or ±0.25pF, (Whichever is larger)	
		Capacitance Change – Class Ⅱ	Within±10%	
		Q – Class Ⅰ	Capacitance ≥ 30pF : Q ≥ 1,000 < 30pF : Q ≥ 400 + 20 × C (C : Capacitance)	
		Tanδ – Class Ⅱ	Rated Voltage ≥ 250V : 0.050 max ≥ 25V : 0.030 max ≥ 16V : 0.050 max ≤ 10V : 0.075 max (X8L : 0.035 max) *1)	
		IR	Rated Voltage ≥ 250V : More than 10,000MΩ or 100MΩ × μF ≤ 200V : More than 10,000MΩ or 500MΩ × μF (Whichever is smaller) *1)	
11	Resistance to Solder Heat	Appearance	No abnormal exterior appearance	Solder pot : 260±5℃, 10±1sec. Initial Measurement Perform the heat treatment at 150℃ +0/-10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
		Capacitance Change – Class Ⅰ	Within±2.5% or ±0.25pF, (Whichever is larger)	
		Capacitance Change – Class Ⅱ	Within±10%	
		Q – Class Ⅰ	Capacitance ≥ 30pF : Q ≥ 1,000 < 30pF : Q ≥ 400 + 20 × C (C : Capacitance)	
		Tanδ – Class Ⅱ	Rated Voltage ≥ 250V : 0.050 max ≥ 25V : 0.025 max ≥ 16V : 0.035 max ≤ 10V : 0.050 max (X8L : 0.035 max) *1)	
		IR	Rated Voltage ≥ 250V : More than 10,000MΩ or 100MΩ × μF ≤ 200V : More than 10,000MΩ or 500MΩ × μF (Whichever is smaller) *1)	
12	ESD	Appearance	No abnormal exterior appearance	AEC - Q200 - 002 Initial Measurement Perform the heat treatment at 150℃ +0 / -10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Perform the heat treatment at 150℃ +0 / -10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
		Capacitance Change – Class Ⅰ	Within±2.5% or ±0.25pF, (Whichever is larger)	
		Capacitance Change – Class Ⅱ	Within±10%	
		Q – Class Ⅰ	Capacitance ≥ 30pF : Q ≥ 1,000 < 30pF : Q ≥ 400 + 20 × C (C : Capacitance)	
		Tanδ – Class Ⅱ	Rated Voltage ≥ 250V : 0.050 max ≥ 25V : 0.025 max ≥ 16V : 0.035 max ≤ 10V : 0.050 max (X8L : 0.035 max) *1)	
		IR	Rated Voltage ≥ 250V : More than 10,000MΩ or 100MΩ × μF ≤ 200V : More than 10,000MΩ or 500MΩ × μF (Whichever is smaller) *1)	
13	Solderability		95% of the terminations is to be soldered evenly and continuously	a) Preheat at 155℃ for 4 hrs, Immerse in solder for 5s at 245±5℃ b) Steam aging for 8 hrs, Immerse in solder for 5s at 245±5℃ c) Steam aging for 8 hrs, Immerse in solder for 120s at 260±5℃ solder : a solution ethanol and rosin

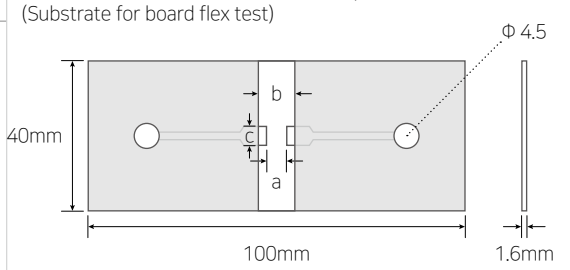
※ *1) : Indicates typical specification. Please refer to individual specifications.

Reliability Test Conditions

<table>
<tr><th>No.</th><th colspan="3">Item</th><th>Performance</th><th>Test condition</th></tr>
<tr><td rowspan="8">14</td><td rowspan="8">Electrical Characteri-zation</td><td colspan="2">Capacitance</td><td>Within specified tolerance</td><td rowspan="8">The Capacitance / D.F. should be measured at 25℃.

Class | Capacitance | Frequency | Voltage
Ⅰ | ≤1,000pF | 1㎒±10% | 0.5 ~ 5.0Vrms
Ⅰ | >1,000pF | 1㎑±10% | 1.0±0.2Vrms
Ⅱ | ≤10㎌ | 1㎑±10% | 1.0±0.2Vrms
Ⅱ | >10㎌ | 120㎐±20% | 0.5±0.1Vrms

I.R. should be measured with a DC voltage not exceeding Rated Voltage @25℃, @125℃ for 60 ~ 120 sec.

Dielectric Strength : 250% of the rated voltage for 1 ~ 5 seconds
The charge / discharge current is less than 50mA.</td></tr>
<tr><td>Q</td><td>Class Ⅰ</td><td>Capacitance ≥ 30pF : Q ≥ 1,000
< 30pF : Q ≥ 400 + 20 × C
(C : Capacitance)</td></tr>
<tr><td>Tanδ</td><td>Class Ⅱ</td><td>Rated Voltage ≥ 25V : 0.025 max
≥ 16V : 0.035 max
≤ 10V : 0.050 max (X8L : 0.035 max) *1)</td></tr>
<tr><td rowspan="2">IR @25℃</td><td>Class Ⅰ</td><td>More than 100,000MΩ or 1,000MΩ × ㎌
(Whichever is smaller)</td></tr>
<tr><td>Class Ⅱ</td><td>More than 10,000MΩ or 500MΩ × ㎌
(Whichever is smaller)</td></tr>
<tr><td rowspan="2">IR @Max temp.</td><td>Class Ⅰ</td><td>More than 10,000MΩ or 100MΩ × ㎌
(Whichever is smaller)</td></tr>
<tr><td>Class Ⅱ</td><td>More than 1,000MΩ or 10MΩ × ㎌
(*X8L: More than 1,000MΩ or 10MΩ × ㎌)
(Whichever is smaller)</td></tr>
<tr><td colspan="2">Dielectric Strength</td><td>No dielectric breakdown or mechanica breakdown</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">Board Flex</td><td colspan="2">Appearance</td><td>No abnormal exterior appearance</td><td rowspan="4">Bending to the limit for 60 seconds.
Limit : Class Ⅰ : 3mm, Class Ⅱ : 2mm or 3mm *1)
Products for Infotainment Class Ⅰ : 2mm, Class Ⅱ : 1mm or 2mm *1)
(Substrate for board flex test)
 

[unit : mm]

Code (inch) | Dimension (mm) | a | b | c
03 (0201) | 0.6 × 0.3 | 0.3 | 0.9 | 0.3
05 (0402) | 1.0 × 0.5 | 0.5 | 1.5 | 0.6
10 (0603) | 1.6 × 0.8 | 0.6 | 2.2 | 0.9
21 (0805) | 2.0 × 1.25 | 0.8 | 3.0 | 1.3
31 (1206) | 3.2 × 1.6 | 2.0 | 4.4 | 1.7
32 (1210) | 3.2 × 2.5 | 2.0 | 4.4 | 2.6
43 (1812) | 4.5 × 3.2 | 3.0 | 6.0 | 3.3
55 (2220) | 5.7 × 5.0 | 4.2 | 7.2 | 5.1

Material: Glass epoxy substrate
Thickness: T=1.6㎜, *03(0201), 05(0402) T=0.8㎜

Initial Measurement
Perform the heat treatment at 150℃ +0 / -10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.

Final Measurement
Leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.</td></tr>
<tr><td rowspan="2">Capacitance Change</td><td>Class Ⅰ</td><td>Within±5.0% or ±0.5pF,
(Whichever is larger)</td></tr>
<tr><td>Class Ⅱ</td><td>Within±10%</td></tr>
</table>

※ *1) : Indicates typical specification. Please refer to individual specifications.

Reliability Test Conditions

No.	Item			Performance	Test condition
16	Terminal Strength (SMD)	Appearance		No abnormal exterior appearance	18N, for 60±1 sec. * 0402(1005), 0201(0603) _ 2N Initial Measurement Perform the heat treatment at 150℃ +0 / -10℃ for 1 hour and leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement. Final Measurement Leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
		Capacitance Change	Class Ⅰ	Within±2.5% or ±0.25pF, (Whichever is larger)	
			Class Ⅱ	Within±10%	
17	Beam Load			Destruction value should be exceed Chip Length ≤ 2.5mm a) Chip Thickness > 0.5mm : 20N b) Chip Thickness = 0.5mm : 8N c) Chip Thickness = 0.3mm : 5N Chip Length ≥ 3.2mm a) Chip Thickness ≥ 1.25mm : 54.5N b) Chip Thickness < 1.25mm : 15N	Beam speed Chip Length ≤ 2.5mm, 20N, 8N, 0.50±0.05mm / sec. Chip Length ≤ 2.5mm, 5N, 0.10±0.01mm / sec. Chip Length ≥ 3.5mm, 2.50±0.25mm / sec.
18	Capacitance Tempera-ture Character-istics	Capacitance Change	Class Ⅰ	0±30ppm / ℃	Capacitance shall be measured by the steps shown in the following table. Step / Temperature (℃) 1 / 25±2 2 / Min. operating temp.±2 3 / 25±2 4 / Max. operating temp.±2 5 / 25±2 ■ Class Ⅰ Temperature Coefficient shall be calculated from the formula as below Temp. Coefficient = $\frac{C2 - C1}{C1 \times \Delta T} \times 10^6$[ppm /℃] C_1 : Capacitance at step 3 C_2 : Capacitance at step 4 △T : Temp. at step 4 - Temp. at step 3 ■ Class Ⅱ Capacitance change shall be calculated from the formula as below $\Delta C = \frac{C_2 - C_1}{C_1} \times 100$ (%) C_1 : Capacitance at step 3 C_2 : Capacitance at step 2 or step 4
			Class Ⅱ	X*R : ±15% X*S : ±22% X*T : +22/-33% X*L : +15/-40% X*M : +15/-50%	

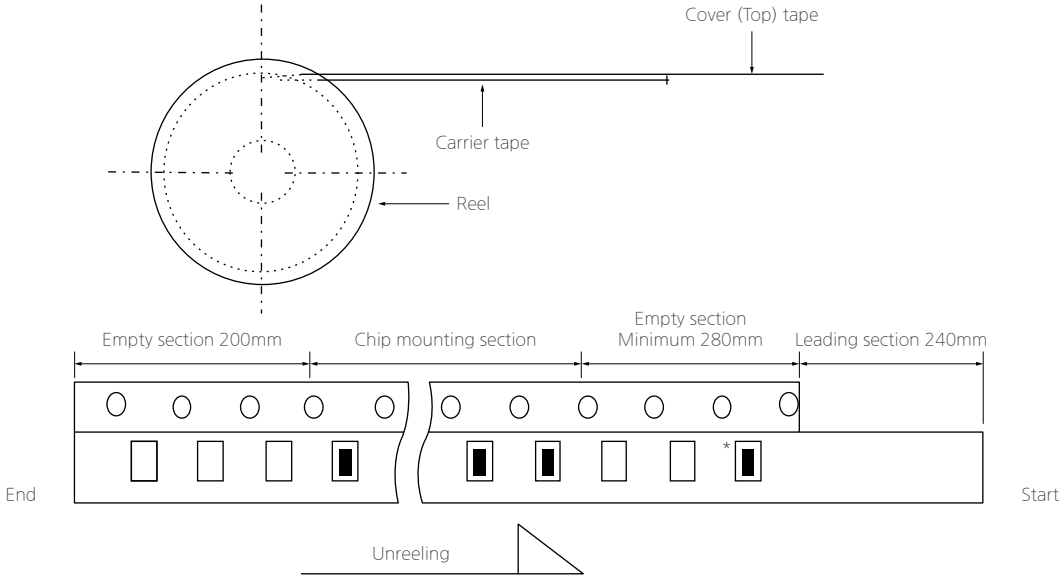
※ *1) : Indicates typical specification. Please refer to individual specifications.
If you want more detaiedl imformation, Please Visit Samsung Electro - mechanics website (www.semlcr.com)

Packaging Specifications

Packaging

This specification applies to taping of MLCC.
When customers require, the specification may be changed under the agreement.

1 Figure



* The chip is only use for identifying the label and packaged products. Please don't use the chip.

2 Quantity

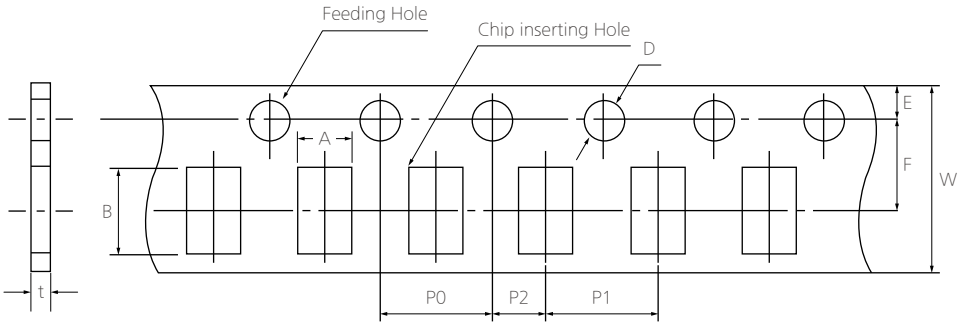
(Unit : pcs)

Type	Size Code (inch/mm)	Chip Thickness (mm)	Taping Type	Pitch (mm)	Plastic 7 inches reel	Plastic 10 inches reel	Plastic 13 inches reel
MLCC	0201/0603	0.3	PAPER	2	10K	-	50K
	0402/1005	0.5	PAPER	2	10K	-	50K
	0603/1608	0.8	PAPER	4	4K	10K	15K/10K
	0805/2012	T ≤ 0.85	PAPER	4	4K	10K	15K/10K
		T ≥ 1.0	EMBOSSED	4	2K	6K	10K
	1206/3216	T ≤ 0.85	PAPER	4	4K	10K	10K
		T ≥ 1.0	EMBOSSED	4	2K	4K	10K
	1210/3225	T ≤ 1.6	EMBOSSED	4	2K	4K	10K
		T ≥ 2.0	EMBOSSED	4	1K	4K	4K
	1808/4520	T ≤ 1.6	EMBOSSED	8	2k	-	8k
		T ≥ 2.0	EMBOSSED	8	1k	-	4k
	1812/4532	T ≤ 2.0	EMBOSSED	8	-	-	4K
		T > 2.0	EMBOSSED	8	-	-	2K
	2220/5750	T ≥ 2.5	EMBOSSED	8	-	-	2K

Packaging Specifications

3 Tape Size

Ⅰ. Cardboard(Paper) tape : 4mm pitch

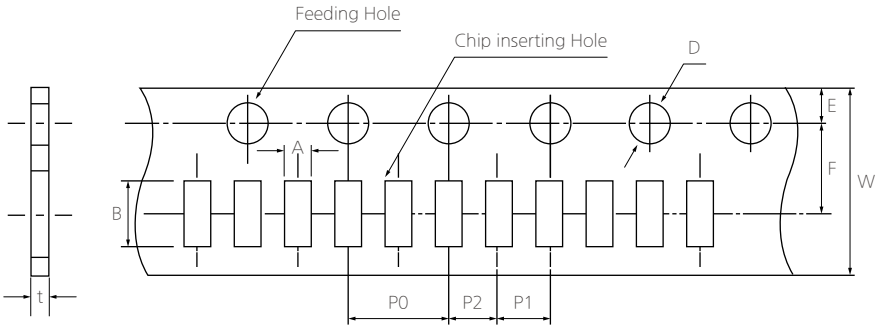


(Unit : mm)

Size Code (inch/mm)	A	B	W	F	E	P1	P2	P0	D	t
0603/ 1608	1.00 ±0.05	1.90 ±0.05	8.00 ±0.30	3.50 ±0.05	1.75 ±0.10	4.00 ±0.10	2.00 ±0.05	4.00 ±0.10	φ1.50 +0.10/-0	1.1 Below
0805/ 2012	1.60 ±0.20	2.40 ±0.20								
1206/ 3216	2.00 ±0.20	3.60 ±0.20								

※ The A, B in the table above are based on normal dimensions. The data may be changed with the special size tolerances.

Ⅱ. Cardboard(Paper) tape : 2mm pitch



(Unit : mm)

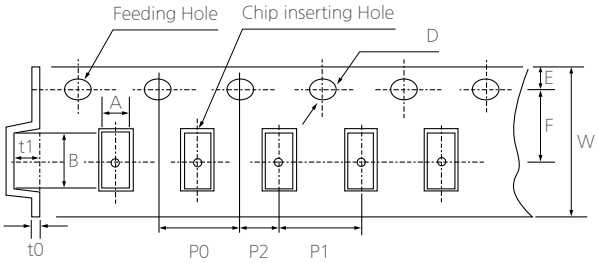
Size Code (inch/mm)	A	B	W	F	E	P1	P2	P0	D	t
01005/ 0402	0.26 ±0.03	0.46 ±0.03	8.00 ±0.30	3.50 ±0.05	1.75 ±0.10	2.00 ±0.05	2.00 ±0.05	4.00 ±0.10	φ1.50 +0.1 /-0.03	0.25 ±0.02
0201/ 0603	0.38 ±0.03	0.68 ±0.03								0.35 ±0.03
0402/ 1005	0.62 ±0.05	1.12 ±0.05								0.60 ±0.05
0204/ 0510	0.62 0.05 /-0.10	1.12 0.05 /-0.10								0.37 ±0.03

※ The A, B in the table above are based on normal dimensions. The data may be changed with the special size tolerances.

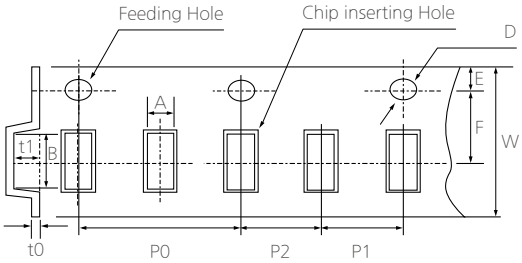
Packaging Specifications

Ⅲ. Embossed (Plastic) tape

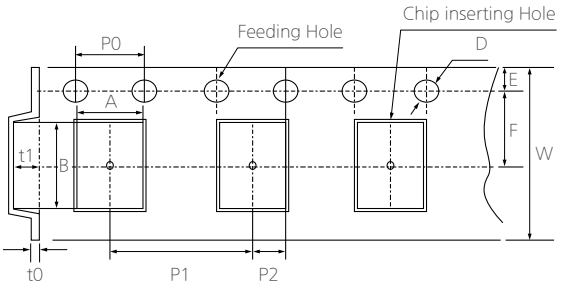
(1) Embossed (Plastic) tape (P1: 4mm pitch)



(2) Embossed (Plastic) tape (P1: 1mm/ 2mm pitch)



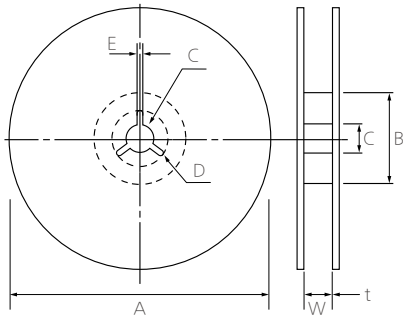
(3) Embossed (Plastic) tape (P1: 8mm pitch)



(Unit : mm)

Size (inch/mm)	A	B	W	F	E	P1	P2	P0	D	t1	t0
01005/0402	0.23±0.02	0.45±0.02	4.00 ±0.05	1.80 ±0.02	0.90 ±0.05	1.00 ±0.02	1.00 ±0.02	2.00 ±0.03	φ0.80 ±0.04	0.35 Below	0.50 Below
015008/05025	0.32±0.03	0.58±0.03	8.00 ±0.30	3.50 ±0.05	1.75 ±0.10	2.00 ±0.05	2.00 ±0.05	4.00 ±0.10	φ1.50 0.1/-0.03		
0603/1608	1.05±0.15	1.90±0.15				4.00 ±0.10			φ1.50 0.1/-0	2.92 Below	0.60 Below
0805/2012	1.45±0.20	2.30±0.20									
1206/3216	1.90±0.20	3.50±0.20									
1210/3225	2.90±0.20	3.70±0.20									
1808/4520	2.30±0.20	4.90±0.20	12.0 ±0.30	5.60 ±0.05		8.00 ±0.10				3.80 Below	
1812/4532	3.60±0.20	4.90±0.20									
2220/5750	5.50±0.20	6.20±0.20									

Ⅳ. Reel Size



(Unit : mm)

Symbol	Tape Width	A	B	C	D	E	W	t
7″Reel	4mm	φ178±2.0	MINφ50	φ13±0.5	21±0.8	2.0±0.5	5±0.5	1.2±0.2
	8mm	φ178±2.0	MINφ50	φ13±0.5	21±0.8	2.0±0.5	10±1.5	0.9±0.2
	12mm	φ178±2.0	MINφ50	φ13±0.5	21±0.8	2.0±0.5	13±0.5	1.2±0.2
10″Reel	8mm	φ258±2.0	MINφ70	φ13±0.5	21±0.8	2.0±0.5	10±1.5	1.8±0.2
13″Reel	8mm	φ330±2.0	MINφ70	φ13±0.5	21±0.8	2.0±0.5	10±1.5	1.8±0.2
	12mm	φ330±2.0	MINφ70	φ13±0.5	21±0.8	2.0±0.5	13±0.5	2.2±0.2

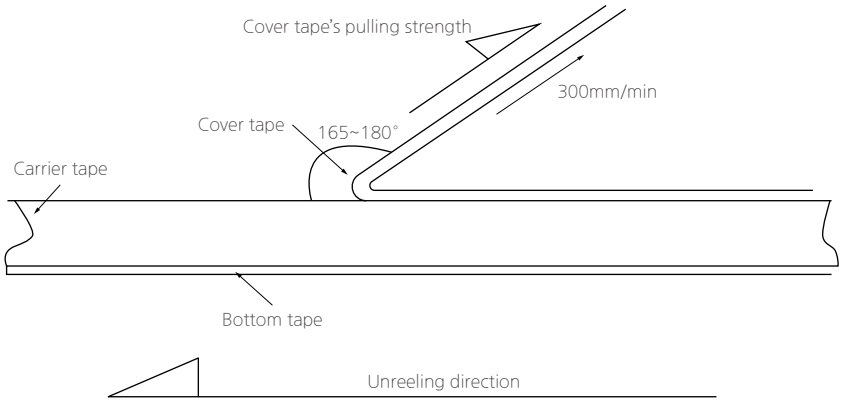
Packaging Specifications

4 Cover tape peel-off force

Ⅰ. Peel-off force

10 g.f ≤ peel-off force ≤ 70 g.f

Ⅱ. Measurement Method



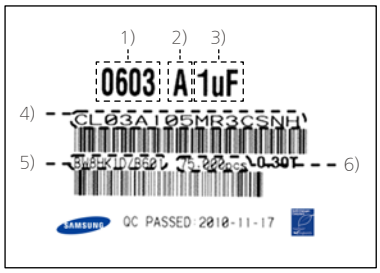
- Taping Packaging design : Packaging design follows IEC 60286-3 standard.
  (IEC 60286-3 Packaging of components for automatic handling - parts 3)

  * If the static electricity of SMT process causes any problems, please contact us.

5 BOX package

Ⅰ. Packaging Label

REEL & Box Type
Label includes the information as below.



1) Chip size
2) Temperature Characteristics
3) Nominal Capacitance
4) Model Name
5) LOT Number & Reel Number
6) Q'ty

Ⅱ. Box Packaging

1) Double packaging with the paper type of inner box and outer box.
2) Avoid any damages during transportation by car, airplane and ship.
3) Remark information of contents on inner box and outer box

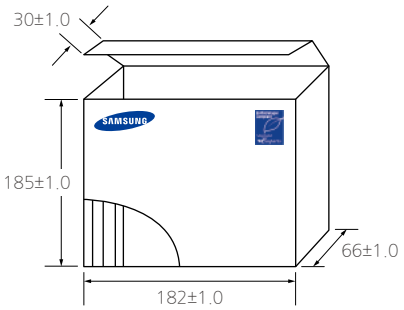
※ If special packaging is required, please contact us.

Packaging Specifications

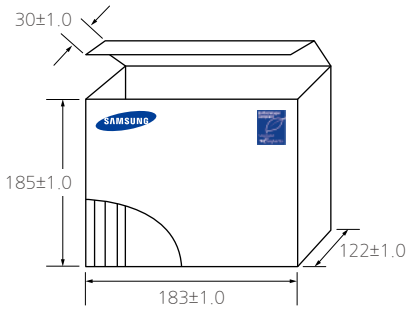
Ⅲ. 7" Box packaging

(Unit : mm)

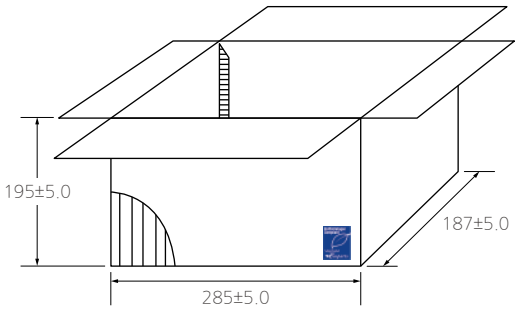
■ Inner Box (7" × 5 REEL)



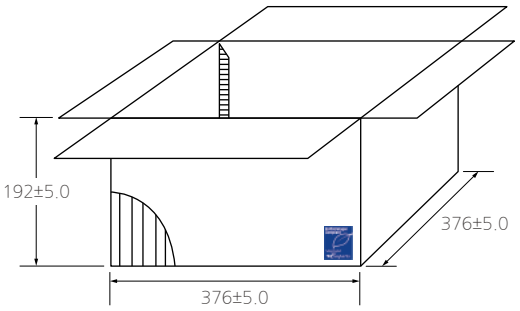
■ Inner Box (7" × 10 REEL)



■ Outer Box (7" × 20 REEL)

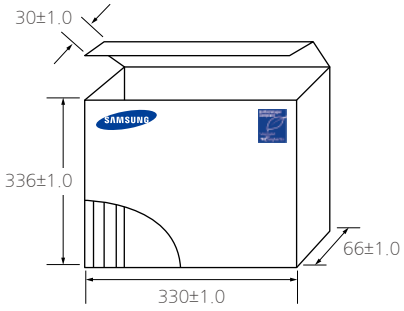


■ Outer Box (7" × 60 REEL)

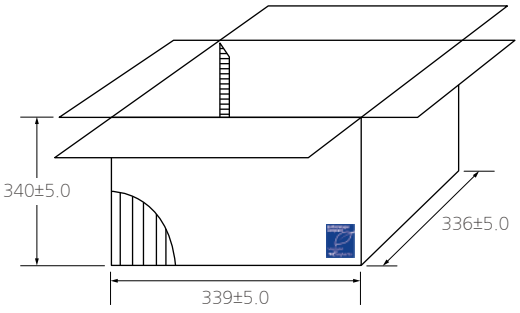


Ⅳ. 13" Box packaging

■ Inner Box (13" × 4 REEL)



■ Outher Box (13" × 20 REEL)



Caution/Notice

Product Characteristic data

1 Capacitance

The capacitance is the ratio of the change in an electric charge according to voltage change. Due to the fact that the capacitance may be subject to change with the measured voltage and frequency, it is highly recommended to measure the capacitance based on the following conditions.

Ⅰ. Measure capacitance with voltage and frequency specified in this document.
Regarding the voltage/frequency condition for capacitance measurement of each MLCC model, please make sure to follow a section “C. Reliability test Condition - Capacitance” in this document.

The following table shows the voltage and frequency condition according to the capacitance range.

[The voltage and frequency condition according to MLCC the capacitance range]

Class Ⅰ

Capacitance	Frequency	Voltage
≤1,000pF	1㎒±10%	0.5~5Vrms
>1,000pF	1㎑±10%	1.0±0.2Vrms

Class Ⅱ

Capacitance	Frequency	Voltage
≤10μF	1㎑±10%	1.0±0.2Vrms
>10μF	120㎐±20%	0.5±0.1Vrms

※ Capacitance shall be measured after the heat treatment of 150+0/-10℃ for 1hr, leaving at room temperature for 24±2hr. (Class Ⅱ)

Ⅱ. It is recommended to use measurement equipment with the ALC (Auto Level Control) option.
The reason is that when capacitance or measurement frequency is high, the output voltage of measurement equipment can be lower than the setting voltage due to the equipment limitation. Note that when capacitance or measurement frequency is excessively high, the measurement equipment may show ALC off warning and provide a lower output voltage than the setting voltage even with ALC option selected. It is necessary to ensure the output voltage of measurement equipment is the same as the setting voltage before measuring capacitance.

Ⅲ. Capacitance value of high dielectric constant (Class Ⅱ) MLCC changes with applied AC and DC voltage. Therefore, it is necessary to take into account MLCC’s AC voltage characteristics and DC-bias voltage characteristics when applying MLCC to the actual circuit.

Ⅳ. The capacitance is in compliance with the EIA RS-198-1-F-2002.

2 Tan δ (DF)

Ⅰ. An ideal MLCC’s energy loss is zero, but real MLCC has dielectric loss and resistance loss of electrode. DF (Dissipation Factor) is defined as the ratio of loss energy to stored energy and typically being calculated as percentage.

Ⅱ. Quality factor (Q factor) is defined as the ratio of stored energy to loss energy. The equation can be described as 1/DF. Normally the loss characteristic of Class Ⅰ MLCC is presented in Q, since the DF value is so small whereas the loss characteristic of Class Ⅱ MLCC is presented in DF.

Ⅲ. It is recommended to use Class Ⅰ MLCC for applications to require good linearity and low loss such as coupling circuit, filter circuit and time constant circuit.

Caution/Notice

3 Insulation Resistance

Ceramic dielectric has a low leakage current with DC voltage due to the high insulating properties.
Insulation resistance is defined as the ratio of a leakage current to DC voltage.

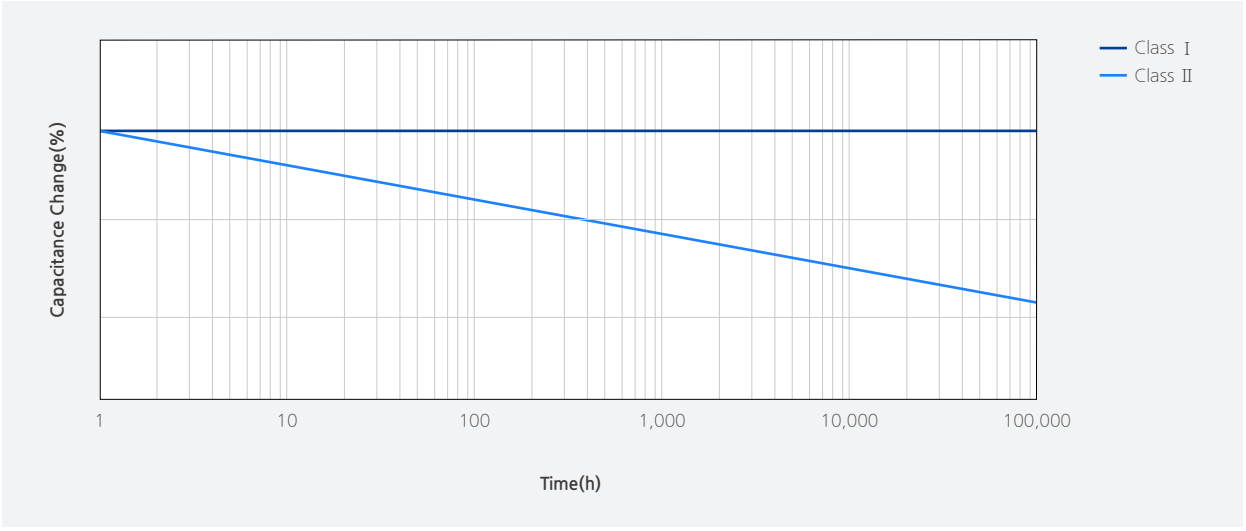
Ⅰ. When applying DC voltage to MLCC, a charging current and a leakage current flow together at the initial stage of measurement. While the charging current decreases, and insulation resistance (IR) in MLCC is saturated by time. Therefore, insulation resistance shall be measured 1 minute after applying the rated voltage.

4 Capacitance Aging

The aging characteristic is that the high dielectric (Class Ⅱ) MLCC decreases capacitance value over time. It is also necessary to consider the aging characteristic with voltage and temperature characteristics when Class Ⅱ MLCC is used in circuitry.

Ⅰ. In general, aging causes capacitance to decrease linearly with the log of time as shown in the following graph. Please check with SEMCO for more details, since the value may vary between different models.

Ⅱ. After heat treatment (150 °C, 1hour), the capacitance decreased by aging is recovered, so aging should be considered again from the time of heat treatment.



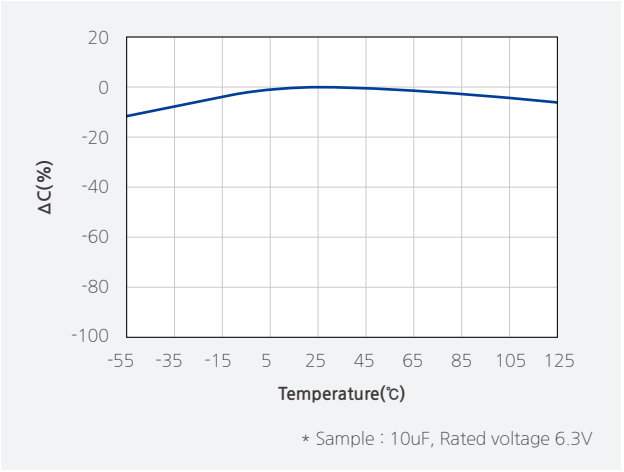
[Example of Capacitance Aging]

Caution/Notice

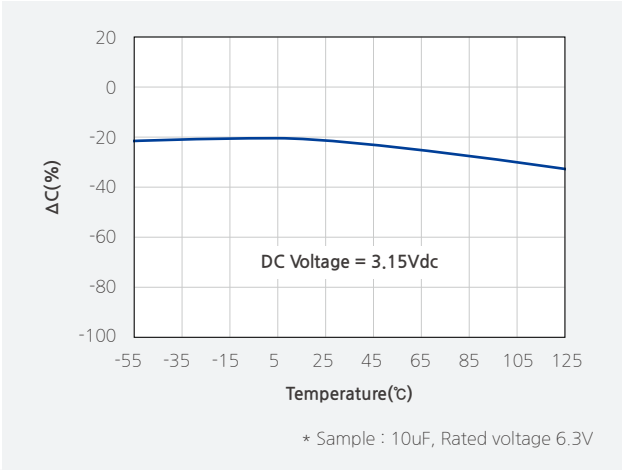
5 Temperature Characteristics of Capacitance (TCC)

Please consider temperature characteristics of capacitance since the electrical characteristics such as capacitance changes which is caused by a change in ceramic dielectric constant by temperature.

Ⅰ. It is necessary to check the values specified in section "C. Reliability test Condition-Temperature Characteristics" for the temperature and capacitance change range of MLCC.



[Example of Temperature Characteristics (X7R)]



[Example of Bias TCC]

Ⅱ. When selecting MLCC, it is necessary to consider the heat characteristics of a system, room temperature and TCC of MLCC, since the applied temperature may change the capacitance of MLCC.

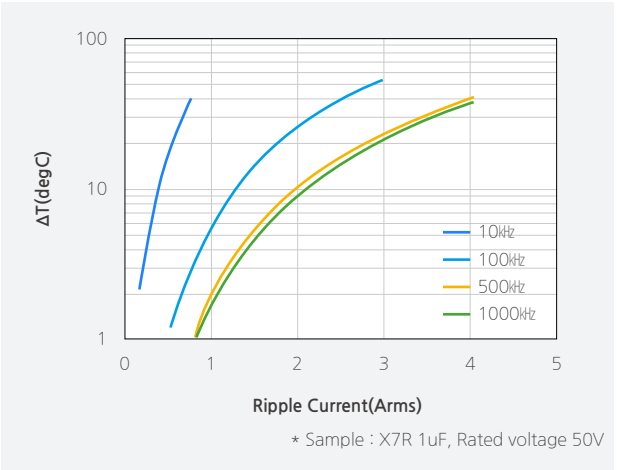
Ⅲ. In addition, Bias TCC of MLCC should be taken into account when DC voltage is applied to MLCC.

6 Self-heating Temperature

It is necessary to design the system, with considering self-heating generated by the ESR (Equivalent Series Resistance) of MLCC when AC voltage or pulse voltage is applied to MLCC.

Ⅰ. When MLCC is used in an AC voltage or pulse voltage circuit, self-heating is generated when AC or pulse current flows through MLCC. Short-circuit may be occurred by the degradation of MLCC's insulating properties.

Ⅱ. The reliability of MLCC may be affected by MLCC being used in an AC voltage or pulse voltage circuit, even the AC voltage or the pulse voltage is within the range of rated voltage. Therefore, make sure to check the following conditions.
1) The surface temperature of MLCC must stay within the maximum operating temperature after AC or Pulse voltage is applied.
2) The rise in increase by self-heating of MLCC must not exceed 20℃
(Applicable to Rated Voltage of less than 100Vdc)



[Example of Ripple current]

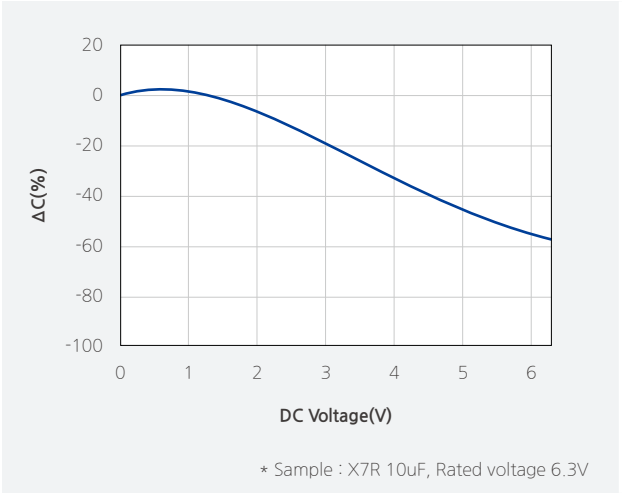
Caution/Notice

7 DC & AC Voltage Characteristics

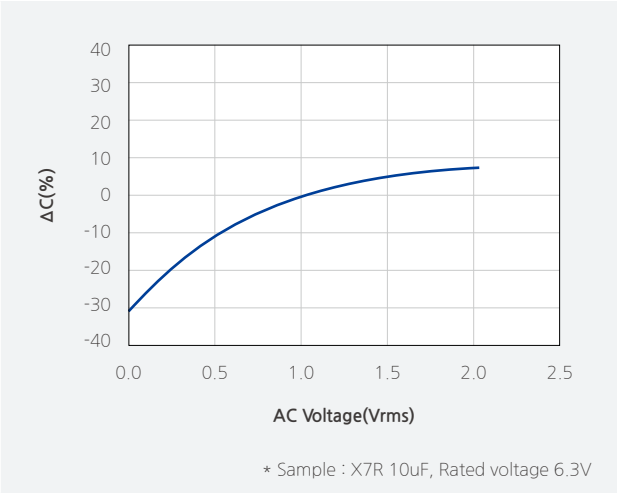
It is required to consider voltage characteristics in the circuit since the capacitance value of high dielectric constant MLCC(ClassⅡ) is changed by applied DC & AC voltage.

Ⅰ. Please ensure the capacitance change is within the allowed operating range of a system. In particular, when high dielectric constant type MLCC (ClassⅡ) is used in circuit with narrow allowed capacitance tolerance, a system should be designed with considering DC voltage, temperature characteristics and aging characteristics of MLCC.

Ⅱ. It is necessary to consider the AC voltage characteristics of MLCC and the AC voltage of a system, since the capacitance value of high dielectric constant type MLCC (ClassⅡ) varies with the applied AC voltage.



[Example of DC Bias characteristics]



[Example of AC voltage characteristics]

Caution/Notice

8 Impedance Characteristic

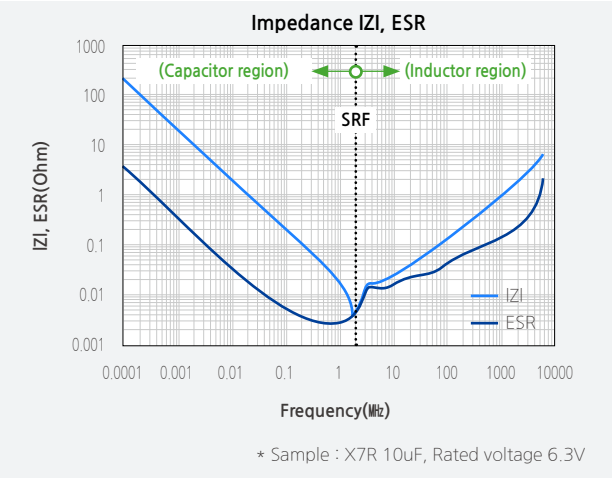
Electrical impedance (Z) of MLCC is the measurement of the opposition that MLCC presents to a current (I) when a voltage (V) is applied. It is defined as the ratio of the voltage to the current (Z=V/I). Impedance extends the concept of resistance to AC circuits and is a complex number consisting of the real part of resistance (R) and the imaginary part of reactance (X) as Z=R+jX. Therefore, it is required to design circuit with consideration of the impedance characteristics of MLCC based on the frequency (Z=R+jX)

Ⅰ. MLCC operates as a capacitor in the low frequency and its reactance (XC) decreases as frequency increases (X_C=1/j2πfC) where f is frequency and C is capacitance. The resistance (ESR; Equivalent Series Resistance) of MLCC in the low frequency mainly comes from the loss of its dielectric material.

Ⅱ. MLCC operates as an inductor in the high frequency and the inductance of MLCC is called ESL (Equivalent Series Inductance). The reactance (XL) of MLCC in the high frequency increases as frequency increases (X_L=j2πf·ESL). The resistance (ESR) of MLCC in the high frequency mainly comes from the loss of its electrode metal.

Ⅲ. SRF (Self Resonant Frequency) of MLCC is the frequency where its capacitive reactance (XC) and inductive reactance (XL) cancel each other and the impedance of MLCC has only ESR at SRF.

Ⅳ. The impedance of MLCC can be measured by a network analyzer or an impedance analyzer. When using the network analyzer, please note that the small-signal input may lead to the impedance of low capacitance caused by the AC voltage characteristic of MLCC.



[Example of Impedance characteristics]

Caution/Notice

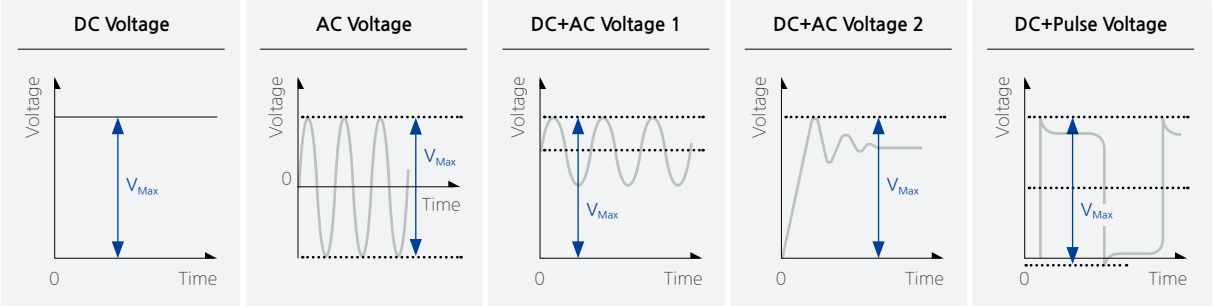
Electrical & Mechanical Caution

1 Applied Voltage

The actual applied voltage on MLCC should not exceed the rated voltage set in the specifications.

Ⅰ. Cautions by types of voltage applied to MLCC

- For DC voltage or DC+AC voltage, DC voltage or the maximum value of DC + AC voltage should not exceed the rated voltage of MLCC.
- For AC voltage or pulse voltage, the peak-to-peak value of AC voltage or pulse voltage should not exceed the rated voltage of MLCC.
- Abnormal voltage such as surge voltage, static electricity should not exceed the rated voltage of MLCC.



[Types of Voltage Applied to the Capacitor]

Ⅱ. Effect of EOS (Electrical Overstress)

- Electrical Overstress can cause damages to MLCC, resulting in the electrical short failure caused by the dielectric breakdown in MLCC.
- Down time of MLCC is varied with the applied voltage and the room temperature and a dielectric shock caused by EOS can accelerate heating on the dielectric. Therefore, it can bring about a failure of MLCC in a market at the early stage.
- Please use caution not to apply excessive electrical overstress including spike voltage MLCC when preparing MLCC for testing or evaluating.

2 Vibration

Please check the types of vibration and shock, and the status of resonance. Manage MLCC not to generate resonance and avoid any kind of impact to terminals. When MLCC is used in a vibration environment, please make sure to contact us for the situation and consider special MLCC such as Soft-term, etc.

3 Shock

Mechanical stress caused by a drop may cause damages to a dielectric or a crack in MLCC. Do not use a dropped MLCC to avoid any quality and reliability deterioration. When piling up or handling printed circuit boards, do not hit MLCC with the corners of a PCB to prevent cracks or any other damages to the MLCC.

4 Piezo-electric Phenomenon

MLCC may generate a noise due to vibration at specific frequency when using the high dielectric constant MLCC (Class Ⅱ) at AC or Pulse circuits. MLCC may cause a noise if MLCC is affected by any mechanical vibrations or shocks

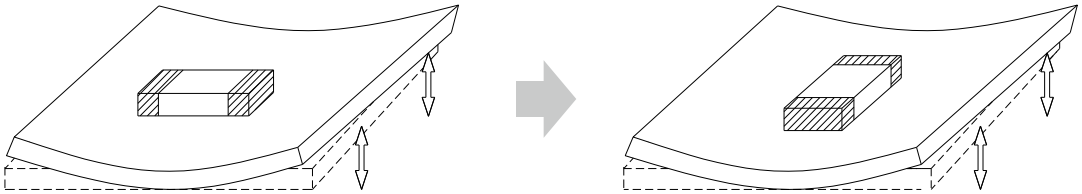
Caution/Notice

Process of Mounting and Soldering

1 Mounting

Ⅰ. Mounting position

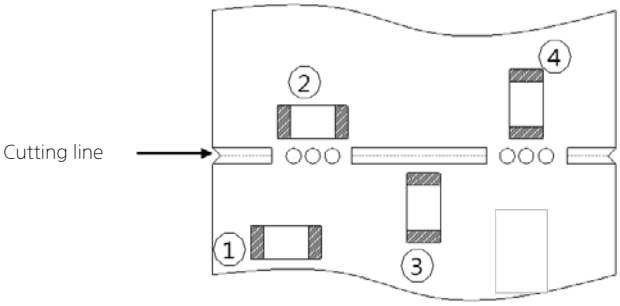
It is recommended to locate the major axis of MLCC in parallel to the direction in which the stress



Not recommended　　Recommended

Ⅱ. Cautions during mounting near the cutout

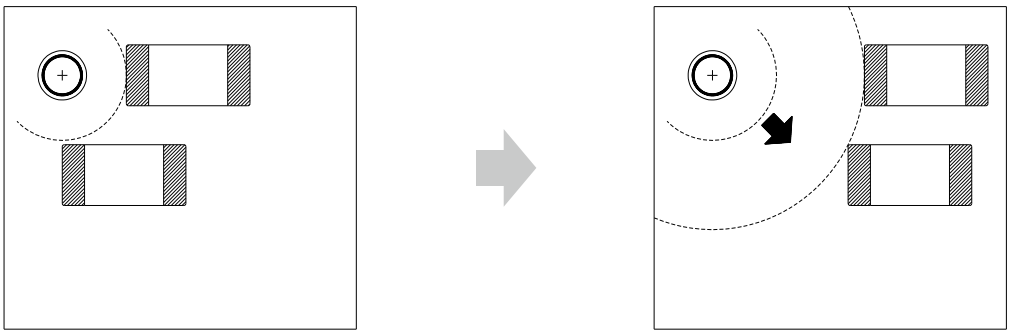
Please take the following measures to effectively reduce the stress generated from the cutting of PCB. Select the mounting location shown below, since the mechanical stress is affected by a location and a direction of MLCC mounted near the cutting line.



※ Relative mechanical stress
② > ①
③ > ①
④ > ①

Ⅲ. Cautions during mounting near screw

If MLCC is mounted near a screw hole, the board deflection may be occurred by screw torque. Mount MLCC as far from the screw holes as possible.



Not recommended　　Recommended

Caution/Notice

2 Caution before Mounting

Ⅰ. It is recommended to store and use MLCC in a reel. Do not re-use MLCC that was isolated from the reel.

Ⅱ. Check the capacitance characteristics under actual applied voltage.

Ⅲ. Check the mechanical stress when actual process and equipment is in use.

Ⅳ. Check the rated capacitance, rated voltage and other electrical characteristics before assembly. Heat treatment must be done prior to measurement of capacitance.

Ⅴ. Check the solderability of MLCC that has passed shelf life before use.

Ⅵ. The use of Sn-Zn based solder may deteriorate the reliability of MLCC.

3 Cautions during Mounting with Mounting (pick-and-place) Machines

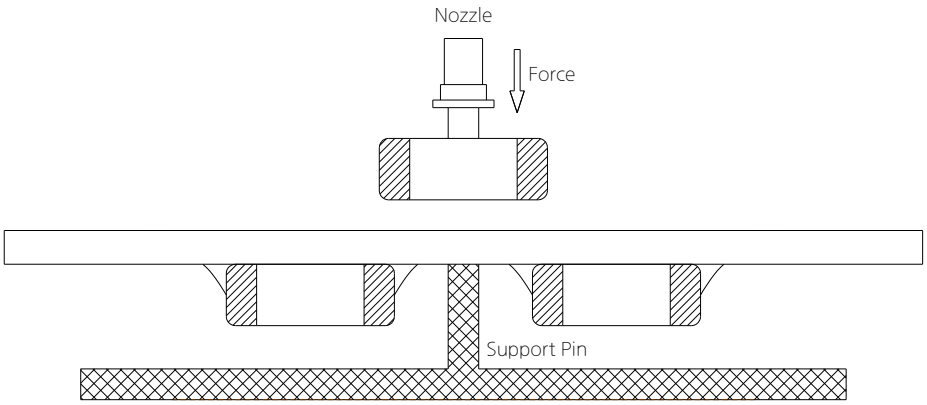
Ⅰ. Mounting Head Pressure

Excessive pressure may cause cracks in MLCC. It is recommended to adjust the nozzle pressure within the maximum value of 300g.f. Additional conditions must be set for both thin film and special purpose MLCC.

Ⅱ. Bending Stress

When using a two-sided substrate, it is required to mount MLCC on one side first before mounting on the other side due to the bending of the substrate caused by the mounting head.

Support the substrate as shown in the picture below when MLCC is mounted on the other side. If the substrate is not supported, bending of the substrate may cause cracks in MLCC.



Ⅲ. Suction nozzle

Dust accumulated in a suction nozzle and suction mechanism can impede a smooth movement of the nozzle. This may cause cracks in MLCC due to the excessive force during mounting. If the mounting claw is worn out, it may cause cracks in MLCC due to the uneven force during positioning. A regular inspection such as maintenance, monitor and replacement for the suction nozzle and mounting claw should be conducted.

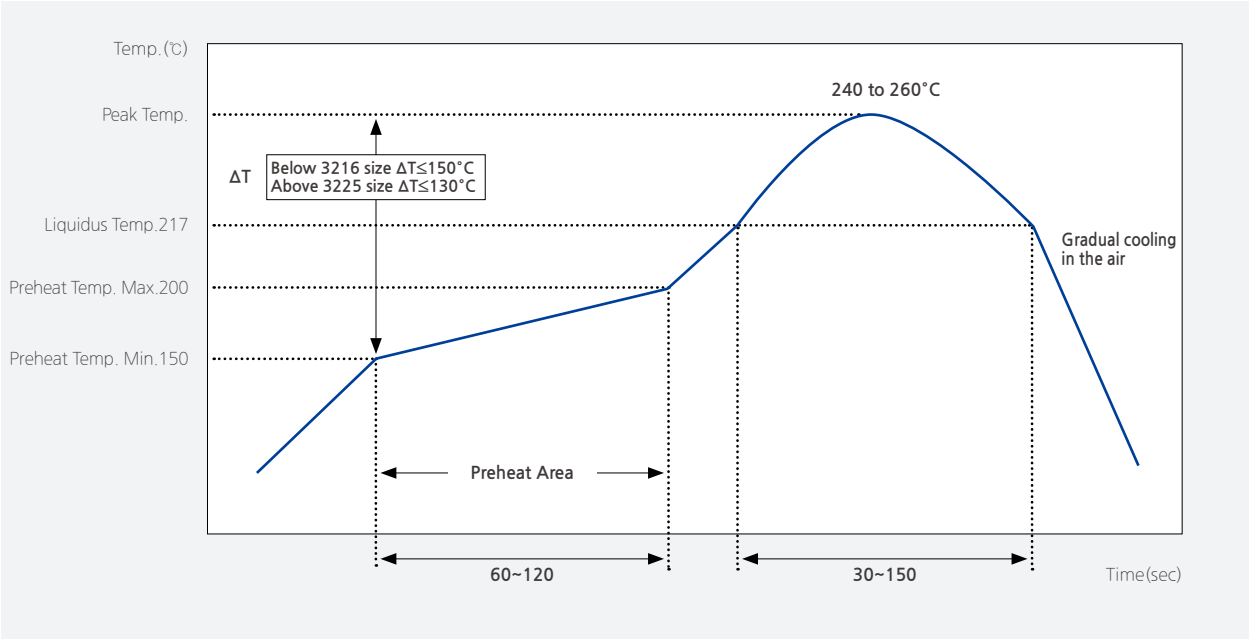
Caution/Notice

4 Reflow soldering

MLCC is in a direct contact with the dissolved solder during soldering, which may be exposed to potential mechanical stress caused by the sudden temperature change. Therefore, MLCC may be contaminated by the location movement and flux. For the reason, the mounting process must be closely monitored.

Method		Classification
Reflow soldering	Overall heating	Infrared rays
		Hot plate
		VPS(Vapor phase)
	Local heating	Air heater
		Laser
		Light beam

Ⅰ. Reflow Profile



[Reflow Soldering Conditions]

Use caution not to exceed the peak temperature as shown. Pre-heating is necessary for all constituents including the PCB to prevent the mechanical damages on MLCC. The temperature difference between the PCB and the component surface must be kept to the minimum.

As for reflow soldering, it is recommended to keep the number of reflow soldering to less than three times. Please check with us when the number of reflow soldering needs to exceed three times. Care must be exercised especially for the ultra-small size, thin film and high capacitance MLCC as they can be affected by thermal stress more easily.

Caution/Notice

Ⅱ. Reflow temperature

The following quality problem may occur when MLCC is mounted with a lower temperature than the reflow temperature recommended by a solder manufacturer. The specified peak temperature must be maintained after taking into consideration the factors such as the placement of peripheral constituent and the reflow temperature.

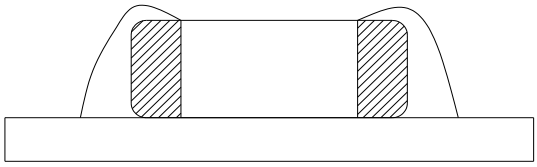
- Drop in solder wettability
- Solder voids
- Potential occurrence of whisker
- Drop in adhesive strength
- Drop in self-alignment properties
- Potential occurrence of tombstones

Ⅲ. Cooling

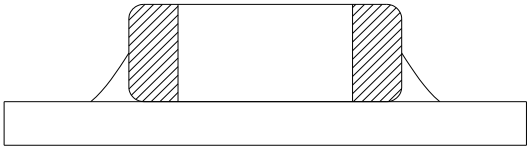
Natural cooling with air is recommended.

Ⅳ. Optimum solder flux for reflow soldering

- Overly the thick application of solder pastes results in an excessive solder fillet height. This makes MLCC more vulnerable to the mechanical and thermal stress from the board, which may cause cracks in MLCC.
- Too little solder paste results in a lack of the adhesive strength, which may cause MLCC to isolate from PCB
- Check if solder has been applied uniformly after soldering is completed.



Too Much Solder
large stress may cause cracks



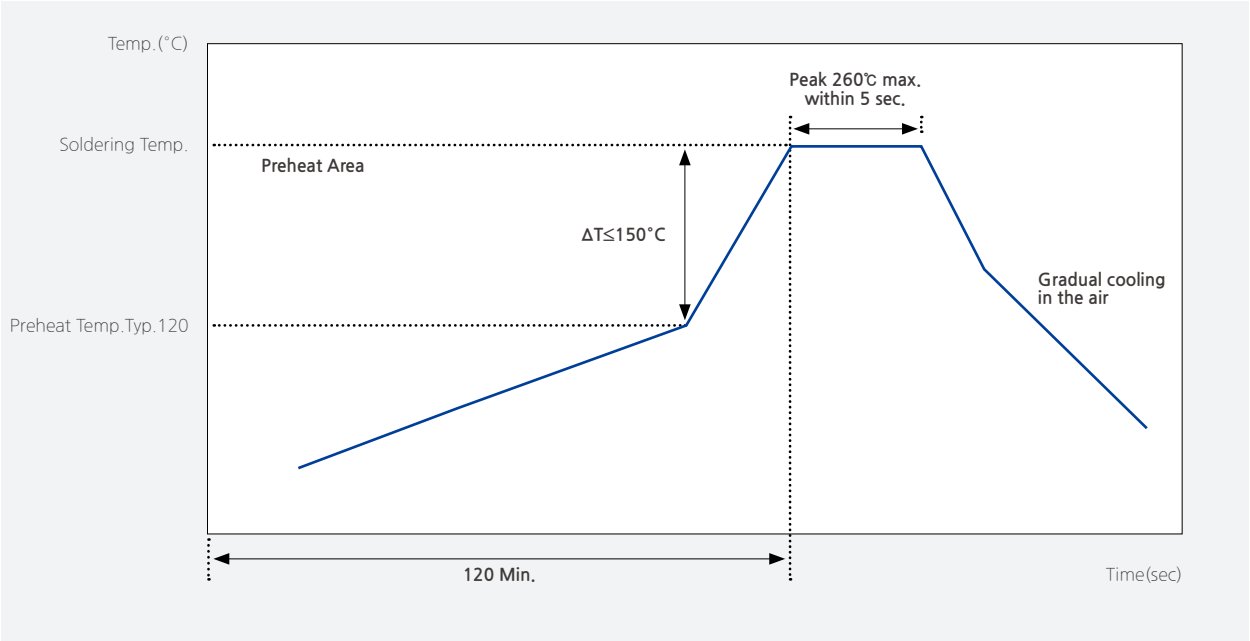
Not enough solder
Weak holding force may cause bad
connections or detaching of the capacitor

- It is required to design a PCB with consideration of a solder land pattern and its size to apply an appropriate amount of solder to MLCC. The amount of the solder at the edge may impact directly on cracks in MLCC.

Caution/Notice

5 Flow soldering

Ⅰ. Flow profile



[Flow Soldering Conditions]

Take caution not to exceed peak temperature (260℃) and time (5sec) as shown.
Please contact us before use the type of high capacitance and thin film MLCC for some exceptions that may be caused.

Ⅱ. Caution before Flow soldering

- When a sudden heat is applied to MLCC, the mechanical rigidity of MLCC is deteriorated by the internal deformation of MLCC. Preheating all the constituents including PCB is required to prevent the mechanical damages on MLCC. The temperature difference between the solder and the surface of MLCC must be kept to the minimum.
- If the flow time is too long or the flow temperature is too high, the adhesive strength with PCB may be deteriorated by the leaching phenomenon of the outer termination, or the capacitance value may be dropped by weak adhesion between the internal termination and the outer termination.

Caution/Notice

6 Soldering Iron

Manual soldering can pose a great risk on creating thermal cracks in MLCC. The high temperature soldering iron tip may come into a direct contact with the ceramic body of MLCC due to the carelessness of an operator. Therefore, the soldering iron must be handled carefully, and close attention must be paid to the selection of the soldering iron tip and to temperature control of the tip.

Ⅰ. How to use a soldering Iron

- In order to minimize damages on MLCC, preheating MLCC and PCB is necessary. A hot plate and a hot air type preheater should be used for preheating
- Do not cool down MLCC and PCB rapidly after soldering.
- Keep the contact time between the outer termination of MLCC and the soldering iron as short as possible. Long soldering time may cause problems such as adhesion deterioration by the leaching phenomenon of the outer termination.

Case size(Inch)	Variation of Temp.	Soldering Temp.(℃)	Pre-heating Time(sec)	Soldering Time(sec)	Cooling Time(sec)
0201~1206	ΔT≤190	350℃ max	≥60	≤3	-
1210~2220	ΔT≤130	280℃ max	≥60	≤3	-

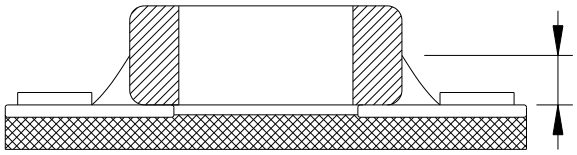
* Control Δ T in the solder iron and preheating temperature.
* The metal epoxy termination product is rated for a 300°C max.

Condition of Iron facilities		
Wattage	Tip diameter	Soldering time
20W max	3㎜ max	3sec max

* Caution - Iron tip should not contact with ceramic body directly
  Lead-free solder: Sn-3.0Ag-0.5CU

Ⅱ. Cautions for re-work

- Too much solder amount will increase the risk of PCB bending or cause other damages.
- Too little solder amount will result in MLCC breaking loose from the PCB due to the inadequate adhesive strength.
- Check if the solder has been applied properly and ensure the solder fillet has a proper shape.



* Soldering wire below ø0.5mm is required for soldering.

7 Cleaning

Ⅰ. In general, cleaning is unnecessary if rosin flux is used.

When acidic flux is used strongly, chlorine in the flux may dissolve into some types of cleaning fluids, thereby affecting the performance of MLCC. This means that the cleansing solution must be carefully selected and should always be new.

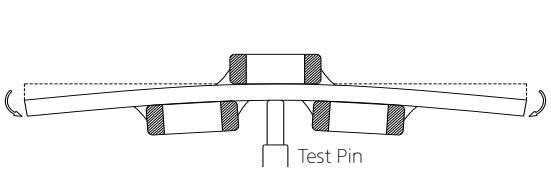
Ⅱ. Cautions for cleaning

MLCC or solder joint may be cracked with the vibration of PCB, if ultrasonic vibration is too strong during cleaning. When high pressure cleaning equipment is used, test should be done for the cleaning equipment and its process before the cleaning in order to avoid damages on MLCC.

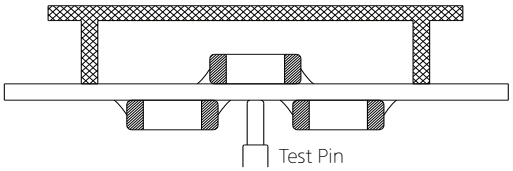
Caution/Notice

8 Cautions for using electrical measuring probes

- Confirm the position of the support pin or jig when checking the electrical performance of MLCC after mounting on the PCB.
- Watch for PCB bending caused by the pressure of a test-probe or other equipment.
- If the PCB is bent by the force from the test probe, MLCC may be cracked or the solder joint may be damaged.
- Avoid PCB flexing by using the support pin on the back side of the PCB.
- Place equipment with the support pin as close to the test-probe as possible.
- Prevent shock vibrations of the board when the test-probe contacts a PCB.



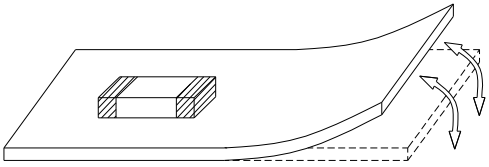
Not recommended



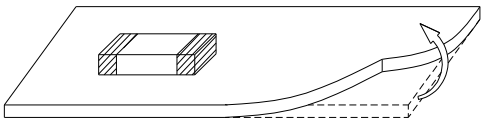
Recommended

9 Printed Circuit Board Cropping

- Do not apply any stress to MLCC such as bending or twisting the board after mounting MLCC on the PCB.
- The stress as shown may cause cracks in MLCC when cutting the board.
- Cracked MLCC may cause degradation to the insulation resistance, thereby causing short circuit.
- Avoid these types of stresses applied to MLCC.



[Bending]



[Twisting]

Ⅰ. Cautions for cutting PCB

Check a cutting method of PCB in advance.

The high density board is separated into many individual boards after the completion of soldering. If the board is bent or deformed during separation, MLCC may be cracked. Carefully select a separation method that minimizes the deformation of the PCB.

Caution/Notice

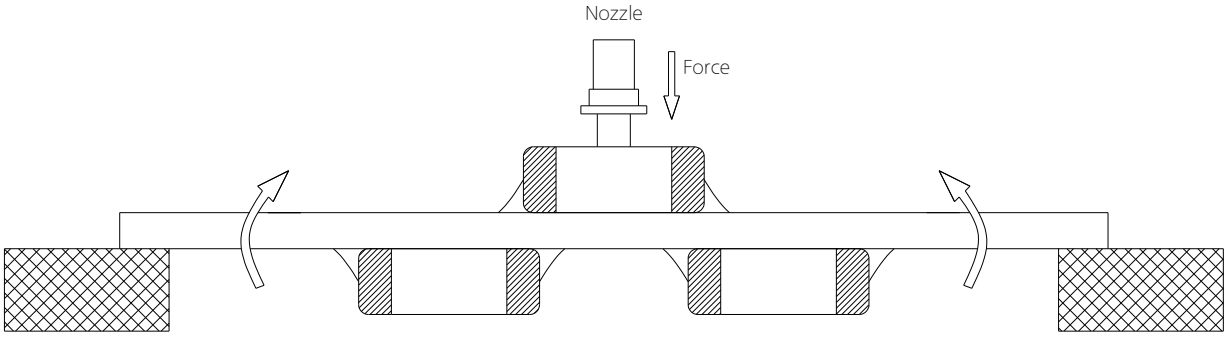
10 Assembly Handling

Ⅰ. Cautions for PCB handling

Hold the edges of the board mounted with MLCC with both hands since holding with one hand may bend the board. Do not use dropped boards, which may degrade the quality of MLCC.

Ⅱ. Mounting other components

Pay attention to the following conditions when mounting other components on the back side of The board after MLCC has been mounted on the front side. When the suction nozzle is placed too close to the board, board deflection stress may be applied to MLCC on the back side, resulting in cracks in MLCC. Check if proper value is set on each chip mounter for a suction location, a mounting gap and a suction gap by the thickness of components.

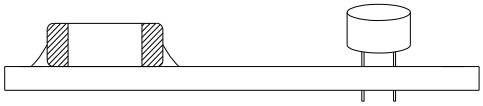


Ⅲ. Board mounting components with leads

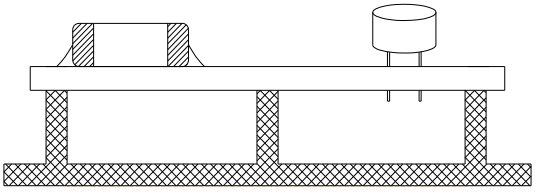
If the board is bent when inserting components (transformer, IC, etc.) into it, MLCC or solder joint may be cracked.

Pay attention to the following:

- Reduce the stress on the board during insertion by increasing the size of the lead insertion hole.
- Insert components with leads into the board after fixing the board with support pins or a dedicated jig.
- Support the bottom side of the board to avoid bending the board.
- Check the status of the height of each support pin regularly when the support pins are used.



Not recommended

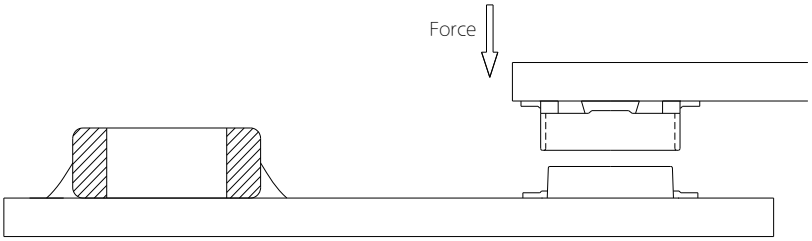


Recommended

Caution/Notice

Ⅳ. Socket and / or connector attach / detach

Since the insertion or removal from sockets and connectors may cause the board to bent, make sure that MLCC mounted on the board should not be damaged in this process.



Ⅴ. Fastening screw

When attaching a shield on a board, the board may be bent during a screw tightening work.

Pay attention to the following conditions before performing the work.

- Plan the work to prevent the board from bending.
- Use a torque driver to prevent over-tightening of the screw.
- Since the board may be bent by soldering, use caution in tightening the screw.

11 Adhesive selection

Pay attention to the following if an adhesive is used to position MLCC on the board before soldering.

Ⅰ. Requirements for Adhesives

- They must have enough adhesive strength to prevent MLCC from slipping or moving during the handling the board.
- They must maintain their adhesive strength when exposed to soldering temperatures.
- They should not spread when applied to the PCB.
- They should have a long pot life.
- They should hardened quickly.
- They should not corrode the board or MLCC materials.
- They should be an insulator type that does not affect the characteristic of MLCC.
- They should be non-toxic, not harmful, and particularly safe when workers touch the adhesives.

Caution/Notice

Ⅱ. Caution before Applying Adhesive

Check the correct application conditions before attaching MLCC to the board with an adhesive. If the dimension of land, the type of adhesives, the amount of coating, the contact surface areas, the curing temperature, or other conditions are not appropriate, it may degrade the MLCC performance.

Ⅲ. Cautions for selecting Adhesive

Depending on the type of the chosen adhesive, MLCC insulation resistance may be degraded. In addition, MLCC may be cracked by the difference in contractile stress caused by the different contraction rate between MLCC and the adhesive.

Ⅳ. Cautions for the amount of applied adhesive and curing temperature

- The inappropriate amount of the adhesive cause the weak adhesive strength, resulting in the mounting defect in MLCC.
- Excessive use of the adhesive may cause a soldering defect, loss of electrical connection, incorrect curing, or slippage of a mounting position, thereby an inflow of the adhesive onto the land section should be avoided.
- If the curing temperature is too high or the curing time is too long, the adhesive strength will be degraded. In addition, oxidation both on the outer termination (Sn) of MLCC and the surface of the board may deteriorate the solderability.

12 Flux

Ⅰ. The excessive amount of flux generates excessive flux gases which may deteriorate solderability. Therefore, apply the flux thin and evenly as a whole.

Ⅱ. Flux with a high ratio of halogen may oxidize the outer termination of MLCC, if cleaning is not done properly. Therefore, use flux with a halogen content of 0.1% max.

Ⅲ. Strong acidic flux can degrade the MLCC performance.

Ⅳ. Check the solder quality of MLCC and the amount of remaining flux surrounding MLCC after the mounting process.

13 Coating

Ⅰ. Crack caused by Coating

A crack may be caused in the MLCC due to amount of the resin and stress of thermal contraction of the resin during coating process. During the coating process, the amount of resin and the stress of thermal contraction of the resin may cause cracks in MLCC. The difference of thermal expansion coefficient between the coating, or a molding resin may cause destruction, deterioration of insulation resistance or dielectric breakdown of MLCC such as cracks or detachment, etc.

Ⅱ. Recommended Coating material

- A thermal expansion coefficient should be as close to that of MLCC as possible.
- A silicone resin can be used as an under-coating to buffer the stress.
- The resin should have a minimum curing contraction rate.
- The resin should have a minimum sensitivity (ex. Epoxy resin).
- The insulation resistance of MLCC can be deteriorated if a high hygroscopic property resin is used in a high humidity condition.
- Do not use strong acid substances due to the fact that coating materials inducing a family of halogen substances and organic acid may corrode MLCC.

Caution/Notice

Design

1 Circuit design

When the board is dropped or bent, MLCC mounted on the board may be short-circuited by the drop in insulation resistance. Therefore, it is required to install safety equipment such as a fuse to prevent additional accidents when MLCC is short-circuited, otherwise, electric short and fire may occur. This product is not a safety guaranteed product.

2 PCB Design

Ⅰ. Unlike lead type components, SMD type components that are designed to be mounted directly on the board are fragile to the stress. In addition, they are more sensitive to mechanical and thermal stress than lead type components.

Ⅱ. MLCC crack by PCB material type

A great difference of the thermal expansion coefficient between PCB and MLCC causes thermal expansion and contraction, resulting in cracks in MLCC. Even though MLCC is mounted on a board with a fluorine resin or on a single-layered glass epoxy, cracks in MLCC may occur.

3 Design system evaluation

Ⅰ. Evaluate the actual design with MLCC to make sure there is no functional issue or violation of specifications of the finished goods.

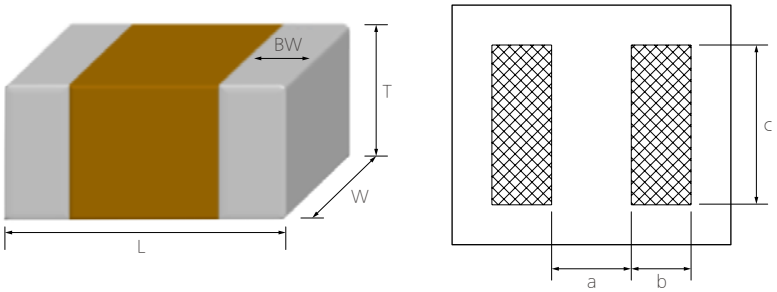
Ⅱ. Please note that the capacitance may differ based on the operating condition of the actual system since Class 2 MLCC capacitance varies with applied voltage and temperature.

Ⅲ. Surge resistance must be evaluated since the excessive surge caused by the inductance of the actual system may apply to MLCC.

Ⅳ. Note the actual MLCC size and the termination shape.

4 Land dimension

The recommended land dimension is determined by evaluating the actual SET and a board.



Caution/Notice

Reflow Footprint

Chip Size (mm)	Chip Tol. (mm)	a (mm)	b (mm)	c (mm)	(a+2b) min	(a+2b) max
0201	± 0.013	0.07~0.08	0.09~0.14	0.125~0.135	0.25	0.36
	± 0.03	0.07~0.09	0.10~0.15	0.135~0.145	0.27	0.39
0402	± 0.02	0.14~0.18	0.19~0.23	0.20~0.24	0.52	0.64
	± 0.05	0.15~0.19	0.20~0.24	0.23~0.27	0.55	0.67
05025	± 0.025	0.18~0.22	0.24~0.28	0.25~0.29	0.66	0.78
0603	± 0.03	0.22~0.28	0.31~0.37	0.30~0.36	0.84	1.02
	± 0.05	0.23~0.29	0.32~0.38	0.32~0.38	0.87	1.05
	± 0.07	0.24~0.30	0.32~0.38	0.35~0.40	0.88	1.06
	± 0.09	0.25~0.31	0.33~0.39	0.36~0.42	0.91	1.09
1005	± 0.05	0.36~0.44	0.49~0.57	0.51~0.59	1.34	1.58
	± 0.07	0.37~0.45	0.49~0.57	0.53~0.61	1.35	1.59
	± 0.10	0.38~0.46	0.50~0.58	0.56~0.64	1.38	1.62
	± 0.15	0.40~0.48	0.52~0.60	0.61~0.69	1.44	1.68
	± 0.20	0.42~0.50	0.53~0.61	0.66~0.74	1.48	1.72
	± 0.25	0.44~0.52	0.55~0.63	0.71~0.79	1.54	1.78
	± 0.30	0.45~0.53	0.56~0.64	0.76~0.84	1.57	1.81
	± 0.40	0.49~0.57	0.59~0.67	0.86~0.94	1.67	1.91
1608	± 0.10	0.63~0.73	0.71~0.81	0.80~0.90	2.05	2.35
	± 0.15	0.65~0.75	0.73~0.83	0.90~1.00	2.11	2.41
	± 0.20	0.67~0.77	0.74~0.84	0.95~1.05	2.15	2.45
	± 0.25	0.69~0.79	0.76~0.86	1.00~1.10	2.21	2.51
	± 0.30	0.71~0.81	0.77~0.87	1.05~1.15	2.25	2.55
2012	±0.10	0.79~0.89	0.88~0.98	1.25~1.35	2.55	2.85
	±0.15	0.81~0.91	0.90~1.00	1.30~1.40	2.61	2.91
	±0.20	0.83~0.93	0.91~1.01	1.35~1.45	2.65	2.95
	±0.25	0.85~0.95	0.93~1.03	1.40~1.50	2.71	3.01
	±0.30	0.89~0.97	0.94~1.04	1.45~1.55	2.75	3.05
3216	±0.20	1.64~1.76	1.19~1.31	1.74~1.86	4.02	4.38
	±0.30	1.69~1.81	1.22~1.34	1.84~1.96	4.13	4.49
3225	±0.20	1.64~1.76	1.29~1.41	2.64~2.76	4.22	4.58
	±0.30	1.69~1.81	1.32~1.44	2.74~2.86	4.33	4.69
4532	±0.40	2.17~2.33	1.75~1.91	3.42~3.58	5.67	6.15
5750	±0.40	2.75~2.95	2.03~2.23	5.30~5.50	6.81	7.41

Caution/Notice

Flow Footprint

Chip Size (mm)	Chip Tol. (mm)	a (mm)	b (mm)	c (mm)	(a+2b) min	(a+2b) max	Wmin	Wmax
1005	± 0.05	0.55~0.65	0.70~0.80	0.55~0.65	1.95	2.25	0.55	0.65
	± 0.07	0.55~0.65	0.70~0.80	0.55~0.65	1.95	2.25	0.55	0.65
	± 0.10	0.55~0.65	0.70~0.80	0.60~0.70	1.95	2.25	0.60	0.70
	± 0.15	0.55~0.65	0.70~0.80	0.60~0.70	1.95	2.25	0.60	0.70
	± 0.20	0.60~0.70	0.70~0.80	0.65~0.75	2.00	2.30	0.65	0.75
	± 0.25	0.60~0.70	0.70~0.80	0.65~0.75	2.00	2.30	0.65	0.75
1608	± 0.10	0.90~1.00	0.80~0.90	0.90~1.00	2.50	2.80	0.90	1.00
	± 0.15	0.90~1.00	0.85~0.95	0.90~1.00	2.60	2.90	0.90	1.00
	± 0.20	0.90~1.00	0.85~0.95	0.95~1.05	2.60	2.90	0.95	1.05
	± 0.25	0.95~1.05	0.85~0.95	0.95~1.05	2.65	2.95	0.95	1.05
	± 0.30	0.95~1.05	0.85~0.95	1.00~1.10	2.65	2.95	1.00	1.10
2012	± 0.10	1.00~1.10	1.05~1.15	1.30~1.40	3.10	3.40	1.30	1.40
	± 0.15	1.05~1.15	1.05~1.15	1.30~1.40	3.15	3.45	1.30	1.40
	± 0.20	1.05~1.15	1.05~1.15	1.35~1.45	3.15	3.45	1.35	1.45
	± 0.25	1.05~1.15	1.10~1.20	1.35~1.45	3.25	3.55	1.35	1.45
	± 0.30	1.05~1.15	1.10~1.20	1.40~1.50	3.25	3.55	1.40	1.50
	± 0.35	1.05~1.15	1.10~1.20	1.40~1.50	3.25	3.55	1.40	1.50
3216	± 0.15	2.00~2.10	1.40~1.50	1.70~1.80	4.80	5.10	1.70	1.80
	± 0.20	2.00~2.10	1.40~1.50	1.75~1.85	4.80	5.10	1.75	1.85
	± 0.30	2.05~2.15	1.40~1.50	1.80~1.90	4.85	5.15	1.80	1.90
3225	± 0.30	1.90~2.00	1.55~1.65	2.70~2.80	5.00	5.30	2.70	2.80
	± 0.40	1.95~2.05	1.55~1.65	2.75~2.85	5.05	5.35	2.75	2.85

Caution/Notice

Others

1 Storage environment

Ⅰ. Recommendation for temperature/humidity

Even taping and packaging materials are designed to endure a long-term storage, they should be stored with a temperature of 0~40°C and an RH of 0~70% otherwise, too high temperatures or humidity may deteriorate the quality of the product rapidly.

As oxidization is accelerated when relative humidity is above 70%RH, the lower the humidity is, the better the solderability is. As the temperature difference may cause dew condensation during the storage of the product, it is a must to maintain a temperature control environment

Ⅱ. Shelf Life

An allowable storage period should be within 6 months from the outgoing date of delivery in consideration of solderability. As for products in storage over 6 months, please check solderability before use.

2 Caution for corrosive environment

As corrosive gases may deteriorate the solderability of MLCC outer termination, it is a must to store MLCC in an environment without gases. MLCC that is exposed to corrosive gases may cause its quality issues due to the corrosion of plating layers and the penetration of moisture.

3 Equipment in operation

Ⅰ. Do not touch MLCC directly with bare hands to prevent an electric shock or damage.

Ⅱ. The termination of MLCC shall not be contacted with a conductive object (short -circuit). Do not expose MLCC to conductive liquid containing acidic or alkaline material.

Ⅲ. Do not use the equipment in the following conditions.

(1) Exposure to water or oil
(2) Exposure to direct sunlight
(3) Exposure to Ozone or ultra-violet radiation.
(4) Exposure to corrosive gas (e.g. hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas)
(5) Exposure to vibration or mechanical shock exceeding specified limit
(6) Exposure to high humidity

Ⅳ. If the equipment starts generating any smoke, fire or smell, immediately switch it off or unplug from the power source. If the equipment is not switched off or unplugged, serious damage may occur due to the continuous power supply. Please be careful with the high temperature in this condition.

4 Waste treatment

In case of scrapping MLCC, it is incinerated or buried by a licensed industrial waste company. When scrapping MLCC, it is recommended to incinerate or bury the scrappage by a licensed industrial waste company.

Caution/Notice

5 Operating temperature

The operating temperature limit is determined by the specification of each models.

Ⅰ. Do not use MLCC over the maximum operating temperature. Pay attention to equipment's temperature distribution and the seasonal fluctuation of ambient temperature.

Ⅱ. The surface temperature of MLCC cannot exceed the maximum operating temperature including self-heating effects.

6 Transportation

The performance of MLCC may be affected by transportation conditions.

Ⅰ. MLCC shall be protected from excessive temperature, humidity and a mechanical force during transportation. During transportation, the cartons shall not be deformed and the inner packaging shall be protected from excessive external forces.

Ⅱ. Do not apply excessive vibrations, shocks or excessive forces to MLCC.

- If excessive mechanical shock or stress are applied, MLCC's ceramic body may crack.
- When the surface of MLCC is hit with the sharp edge of an air driver, a soldering iron, or a tweezer, etc, MLCC may crack or become short-circuited.

Ⅲ. MLCC may crack and become non-functional due to the excessive shocks or dropping during transportation.

7 Notice

Some special products are excluded from this document. Please be advised that this is a standard product specification for a reference only. We may change, modify or discontinue the product specifications without notice at any time. So, you need to approve the product specifications before placing an order. Should you have any question regarding the product specifications, please contact our sales personnel or application engineers.

Caution/Notice

Caution of Application

Disclaimer

All product specifications, statements, information and data (collectively, the “Information”) in this spec sheet or made available on the website are subject to change.

The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed.

All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

ANY USE OF PRODUCT OUTSIDE OF SPECIFICATIONS OR ANY STORAGE OR INSTALLATION INCONSISTENT WITH PRODUCT GUIDANCE VOIDS ANY WARRANTY.

Although Samsung Electro-Mechanics designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur.

Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies)

in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage. Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicted or that other measures may not be required.

Limitation

Please contact us with usage environment information such as voltage, current, temperature, or other special conditions before using our products for the applications listed below. The below application conditions require especially high reliability products to prevent defects that may directly cause damages or loss to third party’s life, body or property.

If you have any questions regarding this ‘Limitation’, you should first contact our sales personnel or application engineers.

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② Military equipment
③ Atomic energy-related equipment
④ Undersea equipment
⑤ Medical equipment
⑥ Disaster prevention/crime prevention equipment
⑦ Power plant control equipment
⑧ Traffic signal equipment
⑨ Data-processing equipment
⑩ Electric heating apparatus, burning equipment
⑪ Safety equipment
⑫ Any other applications with the same as or similar complexity or reliability to the applications

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