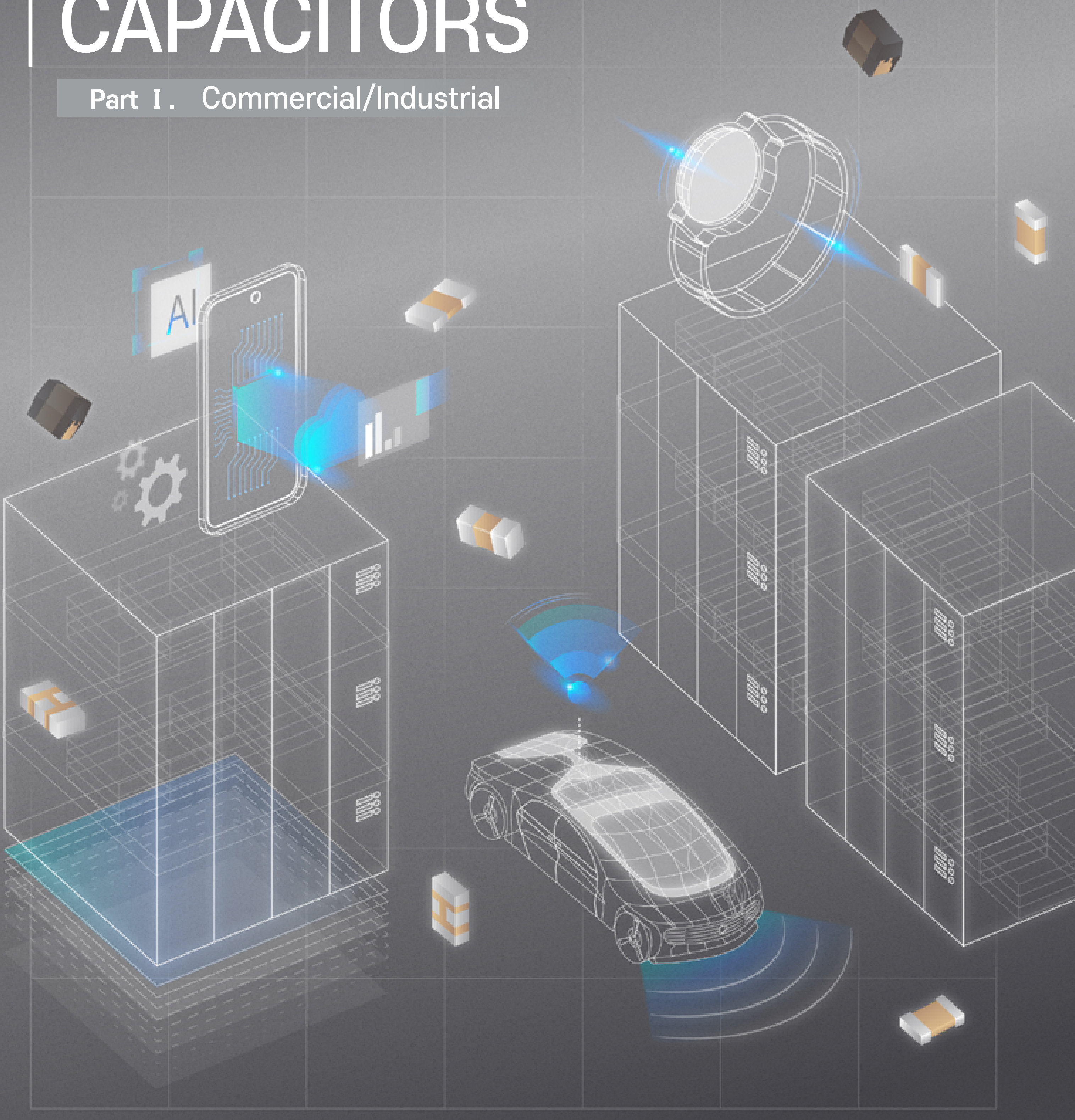
SAMSUNG
ELECTRO-MECHANICS

December 2025

MULTILAYER CERAMIC CAPACITORS

Part Ⅰ. Commercial/Industrial



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.

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Molded Frame Capacitors

Solution for mechanical and thermal stress

MFC

Land Side Capacitors

Lower thickness and space saving

LSC

Explanation of Ceramic Capacitors

High Bending Strength Capacitors

More Resistant to stress caused by board bending

High-bending Strength

Low Acoustic Noise Capacitors

A solution that effectively reduces audible noise

Low Acoustic Noise

Low ESL Capacitors

Space Saving & High Speed Energy Transfer

Low ESL

Part Numbering

CL	10	A	106	M	Q	8	N	N	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
R1	008004/0201
02	01005/0402
03	0201/0603
05	0402/1005

Code	inch/mm
10	0603/1608
21	0805/2012
31	1206/3216
32	1210/3225

Code	inch/mm
42	1808/4520
43	1812/4532
55	2220/5750
L5	0204/0510

Code	inch/mm
L6	0304/0610
01	0306/0816
19	0503/1209

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 (ΔC %)
A	X5R	-55 ~ +85	±15
X	X6S	-55 ~ +105	±22
W	X6T	-55 ~ +105	-33 ~ +22
B	X7R	-55 ~ +125	±15
K	*X7R(S)	-55 ~ +125	±15
Y	X7S	-55 ~ +125	±22
Z	X7T	-55 ~ +125	-33 ~ +22
F	Y5V	-30 ~ +85	-82 ~ +22
M	X8M	-55 ~ +150	-50 ~ +50
E	X8L	-55 ~ +150	-40 ~ +15
J	JIS-B	-25 ~ +85	±10

* X7R(S) = X7R (DC Bias 0.5Vr TCC)

4 CAPACITANCE CODE

Capacitance expressed in ㎊. 2 significant digits plus number of zeros.
example) 106=10×10^6=10,000,000㎊

For Values ＜10㎊, Letter R denotes decimal point
example) 1R5 =1.5㎊

Part Numbering

5 CAPACITANCE TOLERANCE CODE

Code	Tolerance	Code	Tolerance	Code	Tolerance	Code	Tolerance
N	±0.03pF	H	+0.25pF	F	±1%	V	- 5%
A	±0.05pF	L	- 0.25pF	G	±2%	K	±10%
B	±0.1pF	D	±0.5pF	J	±5%	M	±20%
C	±0.25pF	F*	±1pF	U	+5%	Z	-20, +80%

* For Values < 10pF, F=±1pF / Values≥10pF, F=±1%

Series	Nominal Capcitance											
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

Code	Voltage	Code	Voltage	Code	Voltage	Code	Voltage
S	2.5Vdc	O	16Vdc	C	100Vdc	G	500Vdc
R	4.0Vdc	A	25Vdc	D	200Vdc	H	630Vdc
Q	6.3Vdc	L	35Vdc	E	250Vdc	I	1kVdc
P	10Vdc	B	50Vdc	F	350Vdc	J	2kVdc
						K	3kVdc

7 THICKNESS CODE

Size Code (inch/mm)	Code	Thickness	Tolerance
01005/0402	2	0.20	±0.02
0201/0603	3	0.30	±0.03
0402/1005	3	0.30	±0.03*
	5	0.50	±0.05
0603/1608	5	0.50	+0.0/-0.1*
	8	0.80	±0.10
0805/2012	A	0.65	±0.10
	C	0.85	±0.10*
	C	0.85	±0.10
	M	1.15	±0.10
	F	1.25	±0.10
	Q	1.25	±0.15
	Y	1.25	±0.20
1206/3216	C	0.85	±0.15
	C	0.85	±0.10*
	E	1.10	±0.15
	E	1.10	±0.10*
	P	1.15	±0.10*
	M	1.15	±0.15
	F	1.25	±0.15
	H	1.6	±0.20

Size Code (inch/mm)	Code	Thickness	Tolerance
1210/3225	C	0.85	±0.10*
	9	0.90	±0.10*
	F	1.25	±0.20
	S	1.35	±0.15*
	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
1808/4520	F	1.25	±0.20
	G	1.40	±0.20
	I	2.00	±0.20
1812/4532	F	1.25	±0.20
	H	1.60	±0.20
	I	2.00	±0.20
	J	2.50	±0.20
	L	3.20	±0.30
2220/5750	H	1.60	±0.20
	I	2.00	±0.20
	J	2.50	±0.20
	L	3.20	±0.30

* Mark is only applicable to "L","Y","F", 12th code in part number.

Part Numbering

8 DESIGN CODE

Code	Inner electrode	Termination	Plating material	Features
N	Ni	Cu	Ni / Sn	Normal
G	Cu	Cu	Ni / Sn	Normal
S	Ni	Metal Epoxy	Ni / Sn	Normal
C	Ni	Control code	Ni / Sn	Normal
L	Ni	Cu	Ni / Sn	Low profile
Y	Ni	Metal Epoxy	Ni / Sn	Low profile
Z	Ni	Metal Epoxy	Ni / Sn	Normal
Q	Ni	Metal Epoxy	Ni / Sn	Normal
F	Ni	Metal Epoxy	Ni / Sn	Low profile
J	Ni	Metal Epoxy	Ni / Sn	Low Profile
M				Molded Frame Capacitor
U				Acoustic Noise Suppressed Capacitor

9 PRODUCT CODE OR SIZE CONTROL CODE

N = Normal
4 = Industrial (High Level Ⅱ)
L = LICC (Low Inductance Ceramic Capacitor)
J = SLIC (Super Low Inductance Capacitor)

(Unit : inch/mm)

Code \ Size	01005/0402	0201/0603	0402/1005	0603/1608	0805/2012	1206/3216
S	±0.03	±0.05	±0.07	±0.07		±0.30
Q	±0.05	±0.07	±0.10	±0.15	±0.15	
R	±0.07	±0.09	±0.15	±0.20	±0.20	
U	±0.09		±0.20	±0.25	±0.25	
Z			±0.40	±0.30	±0.30	
9			±0.30			

10 CONTROL CODE

N = Standard
W = Industrial (High Level Ⅰ)

11 PACKAGING CODE

Cardboard Tape (paper)

Code	Taping Type
8/C/H	Normal, 7"reel (Quantity option)
J	1mm Pitch, 7"reel
Z	Chip aligned for horizontal, 7"reel
Y	Chip aligned for vertical, 7"reel
O	Normal, 10"reel
3/D/L	Normal, 13"reel (Quantity option)
2	1mm Pitch, 13"reel
7	Chip aligned for vertical, 13"reel

Embossed Tape (plastic)

Code	Taping Type
E/G	Normal, 7"reel (Quantity option)
R	Chip aligned for horizontal, 7"reel
W	Chip aligned for vertical, 7"reel
S	Normal, 10"reel
F	Normal, 13"reel (Quantity option)

Reliability Level Description

Reliability Level (Application guide)	Standard Smart phone, TV, PC, Consumer power etc. Medical Class I, II *5 For Consumer device	High Level Ⅰ Server, Network, Industrial power etc. Medical Class III (Non-Critical)	High Level Ⅱ Server, Network, Industrial power etc. Medical Class III (Non-Critical)	AEC-Q200 Automotive (IATF16949) Car-infotainment (ISO9001)
Part Numbering ⑨, ⑩	NN, etc.	NW, etc.	4N, etc.	PN, PJ, etc.
Humidity Test	40℃, 95%RH, 1Vr, 500h	65℃, 90%RH, 1Vr, 500h	85℃, 85%RH, 1Vr, 1000h	85℃, 85%RH, 1Vr and 1.3~1.5V, 1000h
High Temp Load Test	Max. Temp, *1 1.0~1.5Vr, 1000h	Max. Temp, *1 1.0~1.5Vr, 1000h	Max. Temp, *1 1.0~1.5Vr, 1000h	Max. Temp, *3 2Vr, 1000h
Board Flex	1mm	*2 1mm	2mm	*4 2mm
Temp. Cycling	5cycle	5cycle	1000cycle	1000cycle

* 1. The part marked 'derating' is less than 150% of rated voltage in the durability and operational life test.
* 2. perform 2mm bending outgoing test.
* 3. Some of the parts are applicable in rated voltage x 150% or x 120% or x 100%. Please refer to individual specifications.
* 4. Some of parts are 3mm or 1mm bending guaranteed. Please refer to individual specifications.
* 5. MLCC marked "For Consumer device"can be used in electronic devices for consumer except medical and healthcare

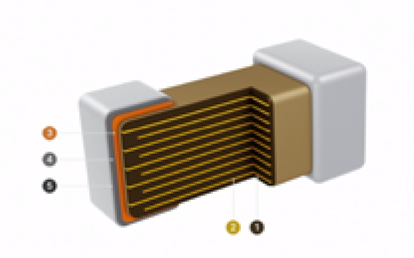
Normal Capacitors_Standard

Features

MLCC for Wide Range Implementation

A general MLCC temporarily charges and removes noise in electronic circuits and is the most widely available chip-type capacitor. The product line allows for realization of various sizes and a wide range of capacitance. It also has the structural capacity to mount chips on a PCB at a high speed.

- **Wide Selection of Size & Wide Capacitance Range**
  Product that can be Implemented in a Variety of Sizes and Over a Wide Range of Capacitance
- **Excellent DC Bias Characteristics**
  Capacitor with Excellent DC Bias Characteristics
- **High Speed Automatic Chip Placement on PCBs**
  Product that Enables High-Speed Mounting of Chips on PCBs



❶ Ceramic Body
❷ Electrode(Ni/Cu*)
❸ Termination(Cu or Cu+Metal Epoxy)
❹ Plating(Ni)
❺ Plating(Sn)

* Cu internal electrodes are only applicable to select products.

Application

- Computer, Solid State Drive, Display, Mobile Phone, Tablet, Network, Server, Game Console, DC-DC Converter

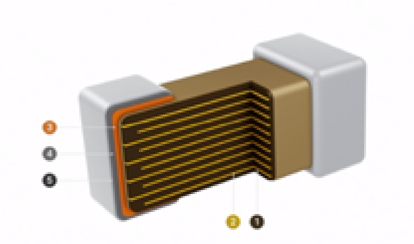
※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

Linup Search | Product Search

Normal Capacitors_High Level Ⅰ

Features

- A High Level Ⅰ MLCC is a chip-type capacitor suitable for industrial applicatons, with greater reliability than a general MLCC
- It has improved the moisture resistance characteristics.
- In the outgoing inspection, proceed with the bending strength evaluation strengthen.



High Level Ⅰ	Improved Reliability (65℃, 90%RH, 1Vr, 500H)
High Level Ⅱ	Reinforced Reliability (85℃, 85%RH, 1Vr, 1000H)

* Cu internal electrodes are only applicable to select products.

Application

- Server, Network, Base station, Solar Inverter, DC-DC Converter

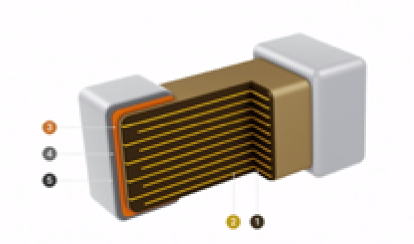
※ For more detailed information about our product lineup, please visit Samsung Electro-Mechanics website by clicking the link below.

Linup Search | Product Search

Normal Capacitors_High Level Ⅱ

Features

- A High Level Ⅱ MLCC is a chip-type capacitor designed to be suitable for outdoor industrial applications.
- Reliability for moisture resistance and temperature change has been strengthened, and the bending strength characteristic is excellent.



High Level Ⅰ	Improved Reliability (65℃, 90%RH, 1Vr, 500H)
High Level Ⅱ	Reinforced Reliability (85℃, 85%RH, 1Vr, 1000H)

* Cu internal electrodes are only applicable to select products.

Application

- Base station, Solar Inverter, DC-DC Converter

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

Linup Search | Product Search

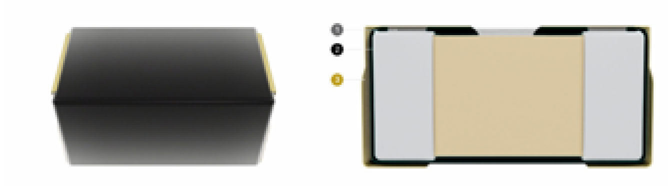
Molded Frame Capacitors (MFC)

Features

MLCC with a High Tolerance to Cracking

A capacitor with a molded frame structure that reduces audible noise, reduces the mounting area for the same capacitance when using a stacked structure, and is more resistant to cracking caused by PCB bending.

- **Reducing Audible Noise**
  A Solution to Reduce the Noise of Mechanical Vibrations Caused by Piezoelectric Properties
- **High Performance & Space Saving**
  High Performance Product with Stacked Structure to Reduce Mounting Space
- **Bending Crack Prevention**
  Absorbs Deformation Stress to Prevent Bending Cracks from Occurring due to PCB Deformation



❶ Metal Epoxy
❷ Epoxy Molding Compound
❸ Frame

Application

- Power, DC-DC Converter where bending stress is high and high reliability is necessary.

Specifications

Samsung P/N	Dimension (mm)			
	L	W	T	E
CL32B225KCDMNW	3.80±0.10	2.80±0.10	3.35±0.10	0.80±0.15
CL32Y475KCDMNW	3.80±0.10	2.80±0.10	3.35±0.10	0.80±0.15

Land Dimension

(Unit : mm)

Chip Size	Chip Tol.	a	b	c	(a+2b)min	(a+2b)max	Wmin	Wmax
1210 (EIA code) MFC	±0.10	2.0~2.2	1.1~1.3	2.30~2.50	4.20	4.80	2.70	2.90

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

Linup Search   Product Search

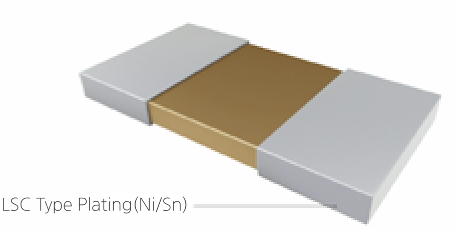
Land Side Capacitors (LSC)

Features

MLCC for Thin Devices and Modules

To accommodate thin devices or modules, this can be mounted between the solder balls to reduce module thickness or secure the mounting area. It can supply current quickly in a stable manner to high-speed APs of mobile devicesand is less susceptible to external environmental stress thanks to high-frequency noise removal.

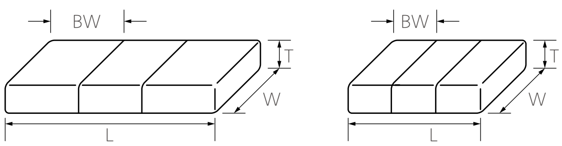
- **Thin in terms of Thickness**
  Thin enough to Support Thin Devices and Modules
- **Removing High Frequency Noise**



Application

- Mobile Phone, Wearable, IC Package, Module Products

Structure and Dimensions



Size Code	Dimension (mm)					EIA (inch)
	L	W	T	Thkckness Code	BW	
02	0.40±0.02	0.20±0.02	0.095±0.015	L	0.10±0.03	01005
05	1.00±0.05	0.50±0.05	0.0975±0.0125	L	0.250±0.075	0402
	1.00±0.05	0.50±0.05	0.20±0.02	2	0.25±0.10	0402
L3	0.30±0.03	0.60±0.03	0.18±0.02	W	0.10±0.03	0102
L5	0.52±0.05	1.00±0.05	0.085±0.015	J	0.145±0.050	0204

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

Linup Search   Product Search

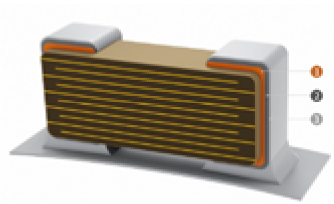
High Bending Strength Capacitors

Features

MLCC with a High Tolerance to Mechanical Stress

Thermal and mechanical stress on the chip can be reduced by the ductile properties of soft termination, which is resistant to stresses caused by board bending.

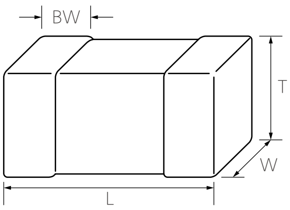
- **Relax The Applied External Stress**
  Products that can Reduce Thermal and Mechanical Stress on the Chip
- **Excellent Bending Strength**



Application

- Mobile Phone, Computer, Solid State Drive, Tablet, Display, SMPS, DC-DC Converter

Structure and Dimensions



Size Code	Dimension (mm)					EIA (inch)
	L	W	T	Thkckness Code	BW	
03	0.60±0.03	0.30±0.03	0.30±0.03	3	0.15±0.05	0201
05	1.00±0.05	0.50±0.05	0.50±0.05	5	0.25±0.10	0402
10	1.60±0.10	0.80±0.10	0.80±0.10	8	0.30±0.20	0603
21	2.00±0.10	1.25±0.10	0.85±0.10	C	0.50+0.2/-0.3	0805
	2.00±0.10	1.25±0.10	1.25±0.10	F		
	2.00±0.15	1.25±0.15	1.25±0.15	Q		
31	3.20±0.15	1.60±0.15	1.25±0.15	F	0.50±0.30	1206
	3.20±0.20	1.60±0.20	1.60±0.20	H		
32	3.20±0.30	2.50±0.20	1.60±0.10	T	0.60±0.30	1210
	3.20±0.30	2.50±0.20	2.50±0.20	J		
	3.20±0.40	2.50±0.30	2.50±0.30	V		

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

Linup Search
General (High Level Ⅰ)
Linup Search
General (High Level Ⅱ)
Product Search
General (High Level Ⅰ)
Product Search
General (High Level Ⅱ)

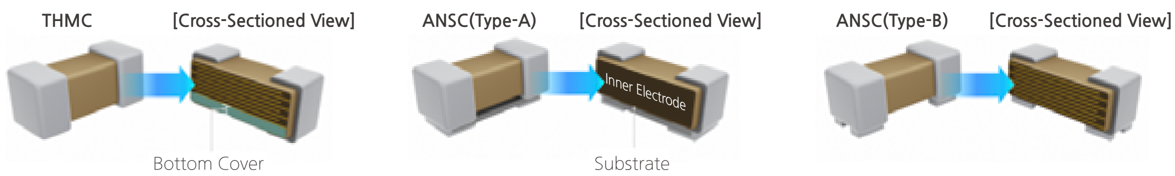
Low Acoustic Noise Capacitors

Features

Noise-Reducing MLCC

MLCC tremors can occur due to piezoelectric phenomena in electronic devices. These tremors are transmitted to the substrate, causing the substrate to tremble, producing audible noise (20Hz~20kHz). Low Acoustic Noise products are a solution that can effectively reduce this noise.

- **Reducing Audible Noise**
  A Solution to Reduce the Noise of Mechanical Vibrations Caused by Piezoelectric Properties
- **Pin to Pin Solution**
  A Solution that can Immediately Replace Existing Products to Reduce Noise

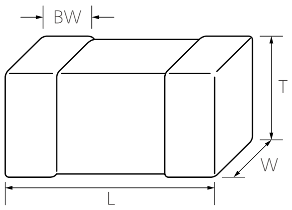


Application

- PAM(GSM / TD-SCDMA / TDD-LTE), PMIC, DC-DC Converter

Structure and Dimensions

Low Acoustic Noise Capacitor_THMC



Size Code	Dimension (mm)					EIA (inch)
	L	W	T	Thkckness Code	BW	
05	1.00±0.25	0.50±0.25	0.60±0.25	6	0.25±0.10	0402
	1.00±0.15	0.50±0.15	0.70±0.10	7		
	1.00±0.20	0.50±0.20	0.80±0.10	8		
	1.00±0.20	0.50±0.20	0.90±0.10	9		
10	1.60±0.30	0.80±0.30	0.90±0.10	9	0.30±0.20	0603
	1.60±0.25	0.80±0.25	0.85±0.10	C	0.30±0.20	
	1.60±0.20	0.80±0.20	1.10±0.10	E		
	1.60±0.25	0.80±0.25	1.15±0.10	M		
	1.60±0.10	0.80±0.10	0.95±0.10	N		
21	2.00±0.20	1.25±0.20	1.10±0.10	E	0.50+0.20/-0.30	0805

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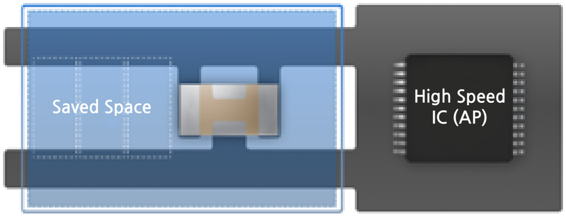
Low ESL Capacitors

Features

MLCC with Low Equivalent Series Inductance

MLCC with low equivalent series inductance (ESL) can be used in circuits with limited mounting area, as a small quantity of MLCCs can sufficiently replace high-speed IC MLCCs.

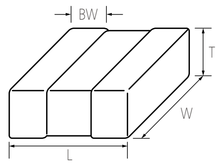
- **Faster Energy Transfer**
  Faster Energy Transfer with Stable Performance
- **Saving Space by One Chip**
  Save Space by Substituting with Less Quantity



Application

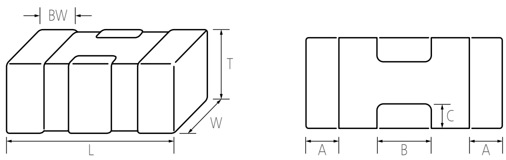
- Mobile Phone, Wearable, Computer, IC Package

Structure and Dimensions



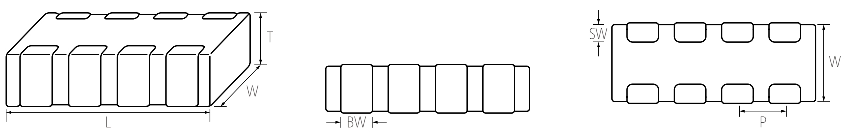
Low ESL Capacitor_Reverse

Size Code	Dimension (mm)					EIA (inch)
	L	W	T	Thkckness Code	BW	
L5	0.52±0.05	1.00±0.05	0.20±0.02	2	0.18±0.06	0204
	0.52±0.05	1.00±0.05	0.30±0.05	3	0.18±0.06	
01	0.80±0.15	1.60±0.20	0.50+0.05/-0.10	5	0.25±0.15	0306



Low ESL Capacitor_3T

Size Code	Dimension (mm)							EIA (inch)
	L	W	T	Thkckness Code	BW			
					A	B	C	
05	1.05±0.05	0.65±0.05	0.45±0.05	5	0.17±0.10	0.35±0.10	0.15±0.10	0402
	1.10±0.15	0.60±0.05	0.60±0.05	6	0.20±0.10	0.35±0.10	0.15±0.10	
	1.00±0.15	0.50±0.15	0.30±0.09	B	0.20±0.10	0.35±0.10	0.15±0.10	
19	1.20±0.05	0.90±0.05	0.75±0.05	7	0.15±0.10	0.50±0.10	0.20±0.10	0503
	1.20±0.05	0.90±0.05	0.60±0.05	A	0.15±0.10	0.50±0.10	0.20±0.10	



Low ESL Capacitor_8T

Size Code	Dimension (mm)							EIA (inch)
	L	W	T	Thkckness Code	BW	SW	P	
10	1.60±0.10	0.80±0.10	0.5+0.05/- 0.1	5	0.25±0.10	0.15±0.10	0.40±0.10	0603

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

Linup Search General (Standard) | Linup Search General (High Level Ⅰ) | Product Search General (Standard) | Product Search General (High Level Ⅰ)

New Product Introduction

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

Commercial MLCC

Application	Type	Part Number	Specifications					Data sheet
			Size Code (inch/mm)	Capacitance	TCC	Rated Voltage (Vdc)	Tolerance (%)	
Smart phone,TV,PC, Consumer power etc, Medical class Ⅰ, Ⅱ For Consumer device	Normal	CL02A105MQ2NQN#	01005/0402	1.0μF	X5R	6.3	±20	→
		CL02X105MR2NQN#	01005/0402	1.0μF	X6S	4.0	±20	→
		CL03B152MB3NNN#	0201/0603	1.5nF	X7R	50	±20	
		CL05A334KM5NQN#	0402/1005	330nF	X5R	63	±10	→
		CL10A106MA5FZN#	0603/1608	220nF	X5R	25	±20	→
Smart phone,TV,PC, Consumer power etc, Medical class Ⅰ, Ⅱ	Normal	CL10C223JC5NQN#	0603/1608	22nF	C0G	100	±5	→
Smart phone,TV,PC, Consumer power etc, Medical class Ⅰ, Ⅱ For Consumer device	Land Side Capacitor	CL05W224MSLHEC#	0402/1005	220nF	X6T	2.5	±20	→
	Low Accoustic Noise ANSC-B	CL10A476MQEURN#	0603/1608	47.0μF	X5R	6.3	±20	→

Industrial MLCC

Application	Type	Part Number	Specifications					Data sheet	Related Article
			Size Code (inch/mm)	Capacitance	TCC	Rated Voltage (Vdc)	Tolerance (%)		
AI Server > Power System	High Level Ⅰ	CL32C223JIVNNW#	1210/3225	22nF	C0G	1000	±5	→	→
	High Level Ⅱ	CL31Y475KCK64N#	1206/3216	4.7μF	X7S	100	±10	→	→
	High Level Ⅰ / MFC	CL32B225KCDMNW#	1210/3225	2.2μF	X7R	100	±10	→	→
AI Server > Computing System	High Level Ⅰ	CL03X475MS3CNW#	0201/0603	4.7μF	X6S	2.5	±20	→	→
		CL05X476MS6N9W#	0402/1005	47μF	X6S	2.5	±20		→
		CL10X107MS8NZW#	0603/1608	100μF	X6S	2.5	±20	→	→
		CL21X226MAYNNW#	0805/2012	22μF	X6S	25	±20	→	→
		CL31X226KAK6NW#	1206/3216	22μF	X6S	25	±10	→	→
AI Server > Network System	High Level Ⅰ	CL31X227MRKNNW#	1206/3216	220μF	X6S	4.0	±20	→	→
		CL31A227MQKNNW#	1206/3216	220μF	X5R	6.3	±20	→	→
	High Level Ⅱ	CL31Z107MRKN4N#	1206/3216	100μF	X7T	4.0	±20	→	→
		CL32X337MSVN4S#	1210/3225	330μF	X6S	2.5	±20	→	→
		CL32Z227MSVN4S#	1210/3225	220μF	X7T	2.5	±20	→	→
		CL32X337MSVN4S#	1210/3225	330μF	X6S	2.5	±20	→	→

Reliability Test Conditions

No.	Item		Performance	Test condition
1	Appearance		No abnormal exterior appearance	Visual Inspection through Microscope (x10)
2	Insulation resistance		10,000MΩ min. or 500MΩ·μF min. (or 100MΩ·μF) product whichever is smaller (Rated voltage ≤16V :10,000MΩ min. or 100MΩ·μF min. product whichever is smaller)	Apply the rated voltage for 60 ~ 120sec. Ratedvoltage > 500V: Insulation Resistance shall be measured with 500±50Vdc
3	Withstanding voltage		No dielectric breakdown ormechanical breakdown	Apply the specified voltage* for 1~5 sec. Charge / Discharge current limit: 50mA max. * CLASS Ⅰ (Rated Voltage < 100V) : 300% of the rated Voltage CLASS Ⅱ (Rated Voltage < 100V) : 250% of the rated Voltage In the case of Vr ≥100V products, following condition shouldbe applied. 100V≤Rated Voltage < 500V : 250% of the rated Voltage 500V≤Rated Voltage < 1000V :150% of the rated Voltage Rated Voltage≥1000V :120% of the rated Voltage
4	Capaci-tance	Class Ⅰ	Within the specified tolerance	
		Class Ⅱ	Within the specified tolerance	
5	Q	Class Ⅰ	Capacitance ≥30pF : Q ≥ 1,000 < 30pF : Q ≥ 400+20×C (C : Capacitance)	
	Tanδ	Class Ⅱ		

Tanδ Class Ⅱ performance:

1. Characteristic : A (X5R)

Rated Voltage	Spec
50V /35V	0.025 max / 0.05 max*
25V	0.025 max / 0.05 max* / 0.10 max*
16V	0.035 max / 0.10 max*
≤10	0.035 max / 0.10 max*

2. Characteristic :B (X7R), X (X6S), Y (X7S)

Rated Voltage	Spec
50V≥/ 35V / 25V	0.025 max / 0.05 max* / 0.10 max*
16V	0.035 max / 0.10 max*
≤10V	0.05 max / 0.10 max*

3.Characteristic : F (Y5V)

Rated Voltage	Spec
50V / 35V / 25V	0.05 max / 0.07 max* / 0.09 max*
16V	0.07 max / 0.09 max* / 0.125 max*
10V	0.125 max / 0.16 max*
≤6.3V	0.16 max

※ The conditions of measurement may be altered upon request.

Test condition (items 4, 5):

Class Ⅰ

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

Class Ⅱ

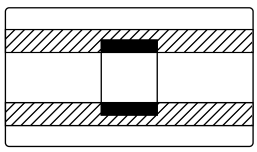
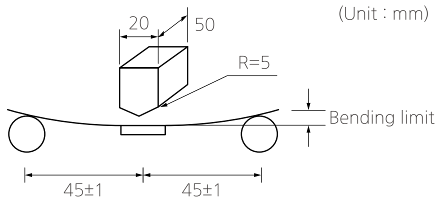
Capacitance	Frequency	Voltage
≤10μF	1㎑±10%	1.0±0.2Vrms
>10μF	120㎐±20%	0.5±0.1Vrms

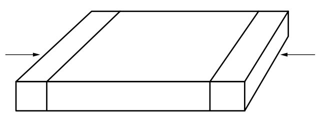
Exception

Capacitance	Frequency	Voltage
0201 (0603)size 0.22μF≤C≤10μF Less than 10V 0402 (1005) size, 2.2μF≤C≤10μF Less than 25V 0603 (1608) size, 10μF Less than 25V 05J105KP5N3* 05J105KQ5N3* 03A105MO3NR* 10B225KP8* 21A475KQQ* 21A106KQQ* 21A625KPQ* 21X106MRC* 21X106KQQ* 21B106KOQ*	1㎑±10%	0.5±0.1Vrms

You can check the specification at the web site or contact sales people for each product with mark*

Reliability Test Conditions

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Performance</th><th>Test condition</th></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Temperature characteristics of capacitance</td><td>Class Ⅰ</td><td>
<table><tr><th>Characteristic</th><th>Temp. coefficien(PPM/℃)</th></tr><tr><td>C</td><td>0 ±30</td></tr></table>
</td><td rowspan="2">
apacitance shall be measured by the steps shown in the following table.
<table><tr><th>Step</th><th>Temperature(℃)</th></tr>
<tr><td>1</td><td>25 ± 2</td></tr>
<tr><td>2</td><td>Min. operating temp ± 2</td></tr>
<tr><td>3</td><td>25 ± 2</td></tr>
<tr><td>4</td><td>Max. operating temp ± 2</td></tr>
<tr><td>5</td><td>25 ± 2</td></tr></table>
(1) Class Ⅰ
Temperature Coefficient shall be calculated from the formula as below
$\text{Temp. Coefficient} = \frac{C2-C1}{C1\times\Delta T} \times 10^6 [\text{ppm/°C}]$
C1 : Capacitance at 3
C2 : Capacitance at 125℃
ΔT : 125℃-25℃=100℃
(1) Class Ⅱ
Capacitance change shall be calculated from the formula as below
$\Delta C = \frac{C2-C1}{C1} \times 100(\%)$
C1 : Capacitance at step 3
C2 : Capacitance at step 2 & step 4
</td></tr>
<tr><td>Class Ⅱ</td><td>
<table><tr><th>Capacitance change</th><th>Capacitance change</th></tr>
<tr><td>Characteristic</td><td>Capacitance change(%) without no bias</td></tr>
<tr><td>A(X5R) / B(X7R)</td><td>±15%</td></tr>
<tr><td>X(X6S), Y(X7S)</td><td>±22%</td></tr>
<tr><td>Z(X7T)</td><td>+22% ~ -33%</td></tr>
<tr><td>F(Y5V)</td><td>+22% ~ -82%</td></tr></table>
</td></tr>
<tr><td>7</td><td colspan="2">Adhesive strength of termination</td><td>No indication of peeling shall occur on the terminal electrode.</td><td>
Apply 1N~10N pressure for 10+/-1 sec.
per respective chip size

0201,0402(mm)1N
0603(mm)2N
1005,1608(mm)5N
2012,3216,3225(mm)10N
</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Bending strength</td><td>Appearance</td><td>No mechanical damage shall occur.</td><td rowspan="2">
Bending Limit: 1mm
Test Speed: 1.0mm/sec.
Keep the test board at the limit point in 5 sec.
Then Measure Capacitance


</td></tr>
<tr><td>Capacitance</td><td>
<table><tr><th colspan="2">Capacitance change</th><th>Capacitance change</th></tr>
<tr><td colspan="2">Class Ⅰ</td><td>Within ±5% or ±0.5pF whichever is larger</td></tr>
<tr><td>Class Ⅱ</td><td>A(X5R)
B(X7R)
X(X6S)
Y(X7S)
Z(X7T)</td><td>Within ±10%</td></tr></table>
</td></tr>
<tr><td>9</td><td colspan="2">Solderability</td><td>More than 95% of the terminal surface is to be soldered newly, so metal part does not come out or dissolve
</td><td>
<table><tr><th>Solder</th><td>Sn_Ag3_0.5Cu</td></tr>
<tr><th>Solder temp.</th><td>245±5℃</td></tr>
<tr><th>Flux</th><td>RMA Type</td></tr>
<tr><th>Dip time</th><td>3±0.3sec</td></tr>
<tr><th>Pre-heating</th><td>at 80~120℃ for 10~30sec.</td></tr></table>
</td></tr>
</table>

Reliability Test Conditions

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Performance</th><th>Test condition</th></tr>
<tr><td rowspan="6">10</td><td rowspan="6">Resis-tance to soldering heat</td><td>Appearance</td><td>No mechanical damage shall occur</td><td rowspan="6">Solder temperature: 270±5℃DIP TIME:10±1 sec.
Each termination shall be fully immersed and preheated as below:
<table><tr><th>Step</th><th>Temp.(℃)</th><th>Time(sec.)</th></tr><tr><td>1</td><td>80~100</td><td>60</td></tr><tr><td>2</td><td>150~180</td><td>60</td></tr></table>Leave the capacitor in ambient condition for specified time* before measurement.
* 24±2 Hours (Class Ⅰ)
24±2 Hours (Class Ⅱ)</td></tr>
<tr><td>Capacitance</td><td><table><tr><th colspan="2">Capacitance change</th><th>Capacitance change</th></tr><tr><td colspan="2">Class Ⅰ</td><td>±2.5% or ±0.25㎊ whichever is larger</td></tr><tr><td rowspan="2">Class Ⅱ</td><td>A(X5R)
B(X7R)
X(X6S)
Y(X7S)
Z(X7T)</td><td>Within ±7.5%</td></tr><tr><td>F(Y5V)</td><td>Within ±20%</td></tr></table></td></tr>
<tr><td>Q (Class Ⅰ)</td><td>Within the specified initial value</td></tr>
<tr><td>Tanδ (Class Ⅱ)</td><td>Within the specified initial value</td></tr>
<tr><td>Insulation resistance</td><td>Within the specified initial value</td></tr>
<tr><td>Withstand-ing voltage</td><td>No breakdown of dielectric</td></tr>
<tr><td rowspan="5">11</td><td rowspan="5">Vibration test</td><td>Appearance</td><td>No mechanical damage shall occur.</td><td rowspan="5">The capacitor shall be subjected to a harmonic motion having a total amplitude of 1.5mm changing frequency from 10Hz to 55Hz and back to 10Hz in about 1 min.

Repeat this for 2hours each in 3mutually perpendicular directions.</td></tr>
<tr><td>Capacitance</td><td><table><tr><th colspan="2">Capacitance change</th><th>Capacitance change</th></tr><tr><td colspan="2">Class Ⅰ</td><td>±2.5% or ±0.25㎊ whichever is larger</td></tr><tr><td rowspan="3">Class Ⅱ</td><td>A(X5R)
B(X7R)</td><td>Within ±5%</td></tr><tr><td>X(X6S)
Y(X7S)
Z(X7T)</td><td>Within ±10%</td></tr><tr><td>F(Y5V)</td><td>Within ±20%</td></tr></table></td></tr>
<tr><td>Q (Class Ⅰ)</td><td>Within the specified initial value</td></tr>
<tr><td>Tanδ (Class Ⅱ)</td><td>Within the specified initial value</td></tr>
<tr><td>Insulation resistance</td><td>Within the specified initial value</td></tr>
</table>

Reliability Test Conditions

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Performance</th><th>Test condition</th></tr>
<tr><td rowspan="5">12</td><td rowspan="5">Moisture resis-tance</td><td>Appearance</td><td>No mechanical damage shall occur</td><td rowspan="5">Applied voltage : Rated voltage

Temperature : 40±2℃
Humidity : 90~95%RH
Duration time : 500+12/-0Hr.
Charge/Discharge current : 50㎃ max.

Perform the initial measurement according to Note1.
Perform the final measurement according to Note2.

This test is only applied to Vr≤500V products.
You can check the specification at the web site or contact sales people for each product with mark*</td></tr>
<tr><td>Capacitance</td><td><table><tr><th colspan="2">Capacitance change</th><th>Capacitance change</th></tr><tr><td colspan="2">Class Ⅰ</td><td>±7.5% or ±0.75㎊ whichever is larger</td></tr><tr><td rowspan="2">Class Ⅱ</td><td>A(X5R)
B(X7R)
X(X6S)
Y(X7S)
Z(X7T)</td><td>Within ±12.5%</td></tr><tr><td>F(Y5V)</td><td>±30%</td></tr></table></td></tr>
<tr><td>Q (Class Ⅰ)</td><td>Capacitance ≥30㎊: Q≥200
< 30㎊: Q≥100+10/3×C
(C: Capacitance)</td></tr>
<tr><td>Tanδ (Class Ⅱ)</td><td>1. Capacitance : A (X5R)
0.05 max / 0.075 max* (35V / 50V)
0.05 max / 0.075 max* / 0.125 max*(16V / 25V)
0.075 max / 0.125 max* (≤10V)

2. Capacitance : B (X7R), X (X6S)
0.05 max / 0.125 max* (16V / 25V / 35V / 50V≥)
0.075 max / 0.125 max* (≤10V)

3. Capacitance : F (Y5V)
0.09 max (50V)
0.09 max / 0.125 max* (25V / 35V)
0.09 max / 0.125 max* / 0.16 max* (16V)
0.16 max / 0.195 max* (10V)
0.195 max (4V / 6.3V)</td></tr>
<tr><td>Insulation resistance</td><td>500㏁ min. or 25㏁·μF min. product whichever is smaller / 12.5㏁·μF or over*</td></tr>
</table>

Reliability Test Conditions

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Performance</th><th>Test condition</th></tr>
<tr><td rowspan="5">13</td><td rowspan="5">High temperature resistance</td><td>Appearance</td><td>No mechanical damage shall occur</td><td rowspan="5">Temperature : max. operating temperature

Duration Time: 1000+48/-0 Hr.
Charge/Discharge Current: 50mAmax.

Apply Voltage : 100% of Rated Voltage
It depends on each item (120%/150%/200% Rated Voltage)

Perform the initial measurement according to Note1 for classⅡ
Perform the final measurement according to Note2.

You can check the specification at the web site or contact sales people for each product with mark*</td></tr>
<tr><td>Capacitance</td><td><table>
<tr><th colspan="2">Capacitance change</th><th>Capacitance change</th></tr>
<tr><td colspan="2">Class Ⅰ</td><td>±3% or ±0.3pF whichever is larger</td></tr>
<tr><td rowspan="2">Class Ⅱ</td><td>A(X5R)
B(X7R)
X(X6S)
Y(X7S)
Z(X7T)</td><td>Within ±12.5%</td></tr>
<tr><td>F(Y5V)</td><td>±30%</td></tr>
</table></td></tr>
<tr><td>Q (Class Ⅰ)</td><td>Capacitance≥30pF : Q≥350
10pF≤Capacitance<30pF : Q≥275+2.5×C
Capacitance < 10pF: Q≥200+10×C
(C: Capacitance)</td></tr>
<tr><td>Tanδ (Class Ⅱ)</td><td>1. Capacitance :A (X5R)
0.05 max / 0.075 max* (35V / 50V)
0.05 max / 0.075 max* / 0.125 max*(16V / 25V)
0.075 max / 0.125 max* (≤10V)

2. Capacitance : B (X7R), X (X6S)
0.05 max / 0.125 max* (16V / 25V / 35V / 50V≥)
0.075 max / 0.125 max* (≤10V)

3. Capacitance : F (Y5V)
0.09 max (50V)
0.09 max / 0.125 max* (25V / 35V)
0.09 max / 0.125 max* / 0.16 max* (16V)
0.16 max / 0.195 max* (10V)
0.195 max (4V / 6.3V)</td></tr>
<tr><td>Insulation resistance</td><td>1,000MΩmin. or 50MΩ·μFmin. product whichever is smaller / 25MΩ·μFor over*</td></tr>
</table>

Reliability Test Conditions

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Performance</th><th>Test condition</th></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Tempera-ture cycle</td><td>Appearance</td><td>No mechanical damage shall occur</td><td rowspan="5">Capacitor shall be subjected to 5 cycles.
Condition for 1 cycle :
<table><tr><th>Step</th><th>Temp.(℃)</th><th>Time(min.)</th></tr><tr><td>1</td><td>Min.rated temp.+0/-3</td><td>30</td></tr><tr><td>2</td><td>25</td><td>2~3</td></tr><tr><td>3</td><td>Max.rated temp.+3/-0</td><td>30</td></tr><tr><td>4</td><td>25</td><td>2~3</td></tr></table>
Leave the capacitor in ambient condition for specified time before measurement.
* 24±2 Hours (Class Ⅰ)
24±2 Hours (Class Ⅱ)</td></tr>
<tr><td>Capacitance</td><td><table><tr><th colspan="2">Capacitance change</th><th>Capacitance change</th></tr><tr><td colspan="2">Class Ⅰ</td><td>±2.5% or ±0.25pF whichever is larger</td></tr><tr><td rowspan="4">Class Ⅱ</td><td>A(X5R)</td><td>Within ±7.5%/±10%/±15%*</td></tr><tr><td>B(X7R)</td><td>Within ±7.5%</td></tr><tr><td>X(X6S)
Y(X7S)
Z(X7T)</td><td>Within ±15%</td></tr><tr><td>F(Y5V)</td><td>Within ±20%</td></tr></table></td></tr>
<tr><td>Q (Class Ⅰ)</td><td>Within the specified initial value</td></tr>
<tr><td>Tanδ (Class Ⅱ)</td><td>Within the specified initial value</td></tr>
<tr><td>Insulation resistance</td><td>Within the specified initial value</td></tr>
</table>

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

Note 2. Latter Measurement

1. CLASS Ⅰ
   Leave the capacitor in ambient condition for 24±2 hours before measurement. Then perform the measurement.
2. CLASS Ⅱ
   Perform the heat treatment at 150℃ +0/-10℃ for 1 hour. Then Leave the capacitor in ambient condition for 24±2 hours before measurement.
   Then perform the measurement.

Note 3. All Size in Reliability Test Condition Section is “inch”

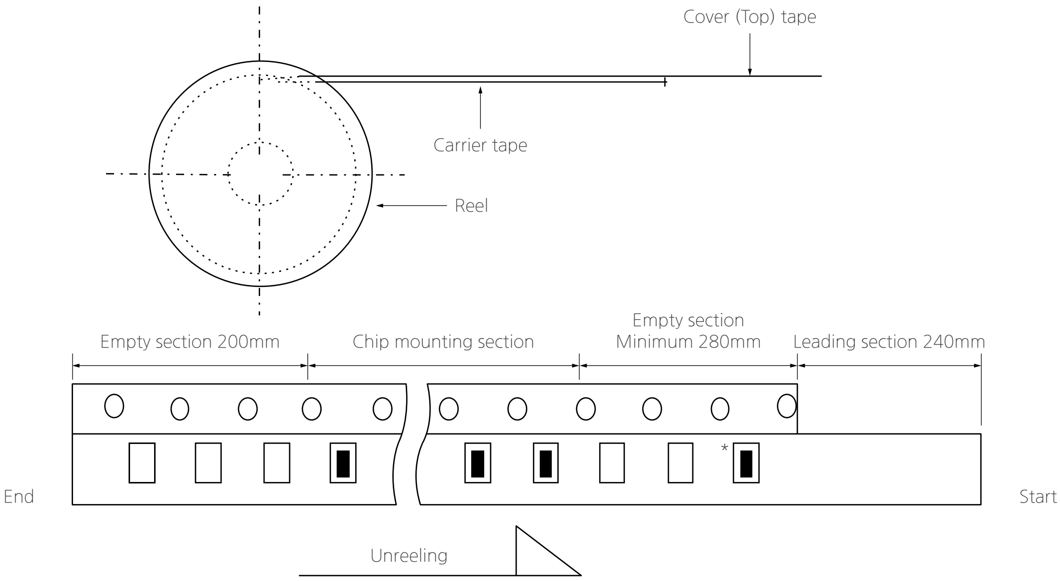
Note 4. Camera Strobe Circuit Capacitors Should be Following a Special Reliability Test Condition.
Please check with our sales representatives or product engineers.

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

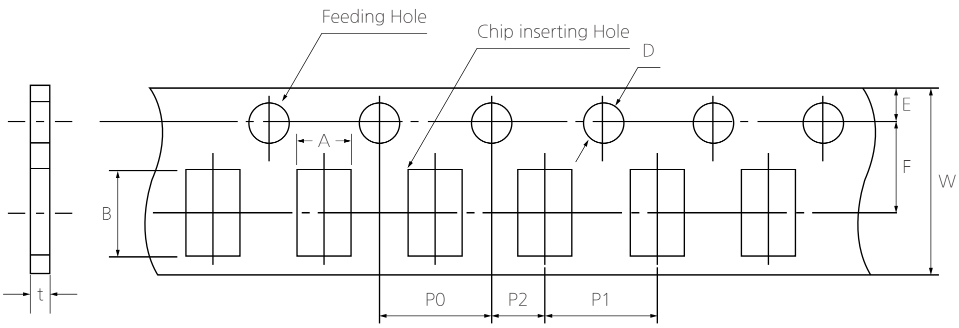
(Unit : pcs)

Type	Size (inch/mm)	Chip Thickness (mm)	Taping Type	Pitch (mm)	Plastic 7 inches reel	Plastic 10 inches reel	Plastic 13 inches reel
MLCC	008004/0201	0.125	EMBOSSED	1	20K/50K	-	-
	01005/0402	0.2	PAPER	2	20k	-	100K
	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
		1.0	EMBOSSED	4	3K	-	-
	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

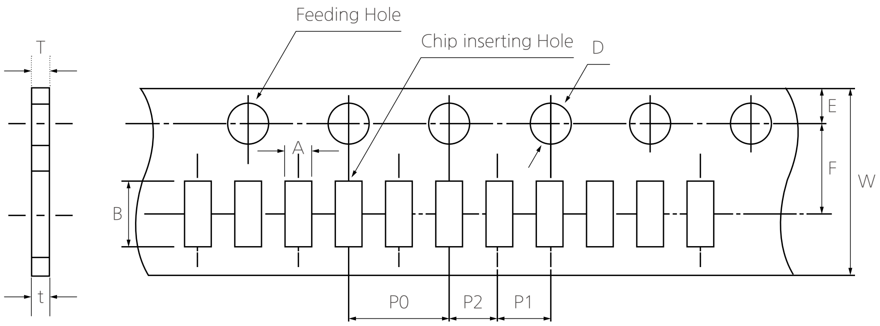


(Unit : mm)

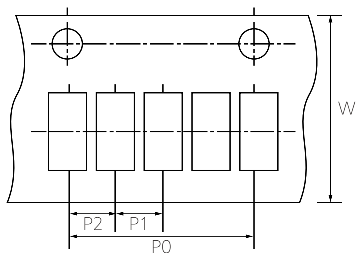
Size (inch/mm)	A	B	W	F	E	P1	P2	P0	D	t
0603/ 1608	1.00 ±0.10	1.90 ±0.10	8.00 ±0.30	3.50 ±0.05	1.75 ±0.10	4.00 ±0.10	2.00 ±0.05	4.00 ±0.10	φ1.50 +0.10/-0	1.1 Below
0805/ 2012	1.55 ±0.10	2.30 ±0.10								
1206/ 3216	2.05 ±0.10	3.60 ±0.10								

※ 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 (P1 : 1mm/2mm pitch)



2mm pitch



1mm pitch

(Unit : mm)

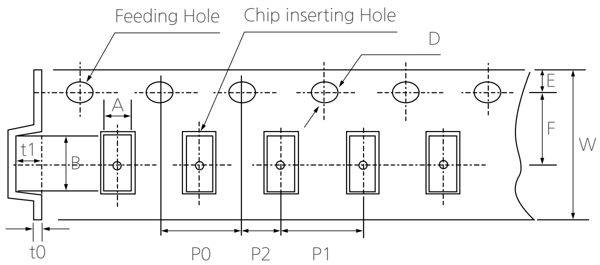
Size (inch/mm)	A	B	W	F	E	P1	P2	P0	D	t
01005/ 0402	0.25 ±0.02	0.46 ±0.02	8.00 ±0.30	3.50 ±0.05	1.75 ±0.10	2mm pitch 2.00±0.05 1mm pitch 1.0±0.05	2mm pitch 2.00±0.05 1mm pitch 1.0±0.05	4.00 ±0.10	φ1.50 +0.1/-0.03	0.25 ±0.02
0201/ 0603	0.38 ±0.03	0.68 ±0.03								0.35 ±0.03
0402/ 1005	0.62 ±0.05	1.12 ±0.05								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.

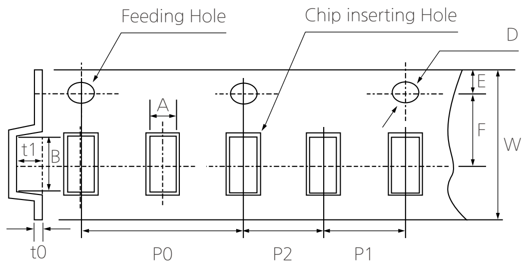
Packaging Specifications

Ⅲ. Embossed (Plastic) tape

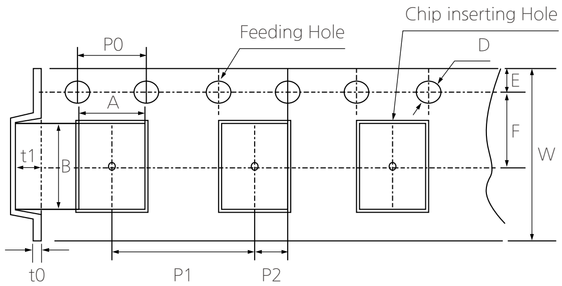
(1) Embossed (Plastic) tape (P1: 4mm pitch)



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



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



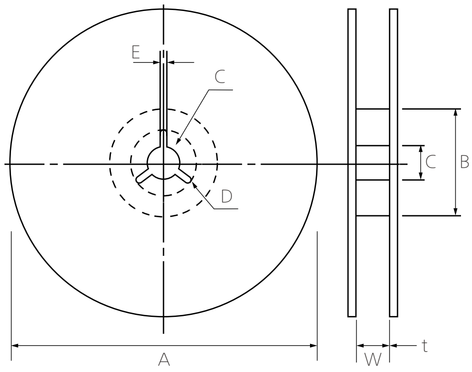
(Unit : mm)

<table>
<tr><th>Size (inch/mm)</th><th>A</th><th>B</th><th>W</th><th>F</th><th>E</th><th>P1</th><th>P2</th><th>P0</th><th>D</th><th>t1</th><th>t0</th></tr>
<tr><td>01005/ 0402</td><td>0.23 ±0.02</td><td>0.45 ±0.02</td><td>4.00 ±0.05</td><td>1.80 ±0.02</td><td>0.90 ±0.05</td><td>1.00 ±0.02</td><td>1.00 ±0.02</td><td>2.00 ±0.03</td><td>φ0.80 ±0.04</td><td rowspan="2">0.35 Below</td><td rowspan="2">0.50 Below</td></tr>
<tr><td>015008/ 05025</td><td>0.32 ±0.03</td><td>0.58 ±0.03</td><td rowspan="5">8.00 ±0.30</td><td rowspan="5">3.50 ±0.05</td><td rowspan="11">1.75 ±0.10</td><td>2.00 ±0.05</td><td rowspan="11">2.00 ±0.05</td><td rowspan="11">4.00 ±0.10</td><td>φ1.50 0.1/-0.03</td></tr>
<tr><td>0603/ 1608</td><td>1.05 ±0.15</td><td>1.90 ±0.15</td><td rowspan="4">4.00 ±0.10</td><td rowspan="10">φ1.50 0.1/-0</td><td rowspan="4">2.92 Below</td><td rowspan="10">0.60 Below</td></tr>
<tr><td>0805/ 2012</td><td>1.45 ±0.20</td><td>2.30 ±0.20</td></tr>
<tr><td>1206/ 3216</td><td>1.90 ±0.20</td><td>3.50 ±0.20</td></tr>
<tr><td>1210/ 3225</td><td>2.80 ±0.20</td><td>3.60 ±0.20</td></tr>
<tr><td>1808/ 4520</td><td>2.30 ±0.20</td><td>4.90 ±0.20</td><td rowspan="3">12.0 ±0.30</td><td rowspan="3">5.60 ±0.05</td><td rowspan="3">8.00 ±0.10</td><td rowspan="3">3.80 Below</td></tr>
<tr><td>1812/ 4532</td><td>3.60 ±0.20</td><td>4.90 ±0.20</td></tr>
<tr><td>2220/ 5750</td><td>5.50 ±0.20</td><td>6.20 ±0.20</td></tr>
<tr><td>0204/ 0510</td><td>0.62 0.05 /-0.10</td><td>1.12 0.05 /-0.10</td><td rowspan="2">8.00 ±0.30</td><td rowspan="2">3.50 ±0.05</td><td rowspan="2">4.00 ±0.10</td><td rowspan="2">2.50 Below</td></tr>
<tr><td>0306/ 0816</td><td>1.10 ±0.20</td><td>1.90 ±0.20</td></tr>
</table>

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

Packaging Specifications

Ⅳ. Reel Size



(Unit : mm)

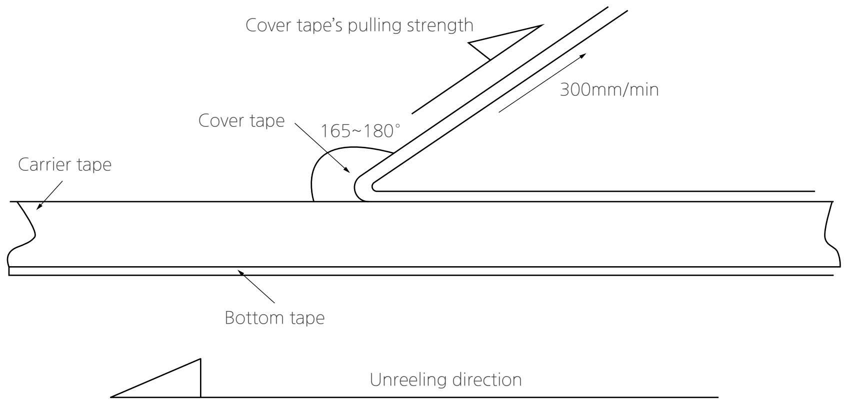
Symbol	Tape Width	A	B	C	D	E	W	t
7"Reel	4mm	φ178±2.0	MINφ50	φ13±0.5	21±0.8	2.0±0.5	5±0.5	1.2±0.2
	8mm	φ178±2.0	MINφ50	φ13±0.5	21±0.8	2.0±0.5	10±1.5	0.9±0.2
	12mm	φ178±2.0	MINφ50	φ13±0.5	21±0.8	2.0±0.5	13±0.5	1.2±0.2
10"Reel	8mm	φ258±2.0	MINφ70	φ13±0.5	21±0.8	2.0±0.5	10±1.5	1.8±0.2
13"Reel	8mm	φ330±2.0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

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)

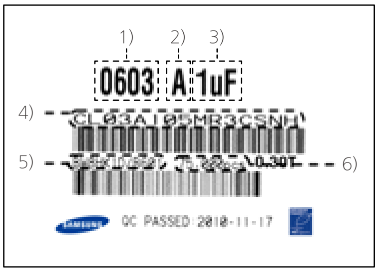
* If the static electricity of SMT process causes any problems, please contact us.

Packaging Specifications

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

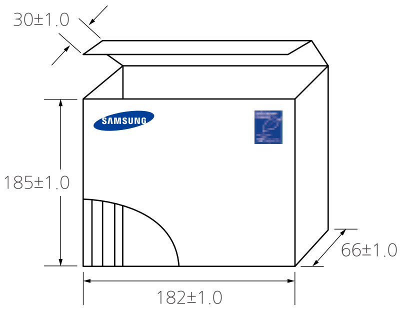
1) Double packaging with the paper type of inner box and outer box.
2) Avoid any damages during transportation by car, airplane and ship.
3) Remark information of contents on inner box and outer box

※ If special packaging is required, please contact us.

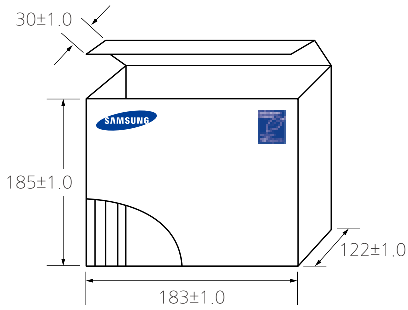
Ⅲ. 7" Box packaging

(Unit : mm)

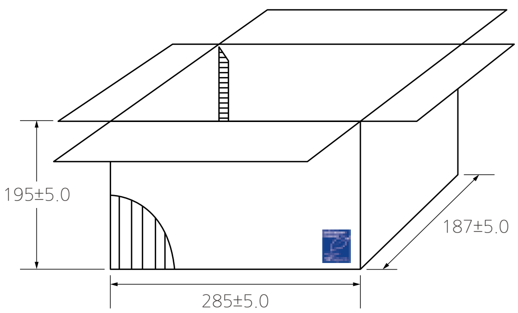
■ Inner Box (7" × 5 REEL)



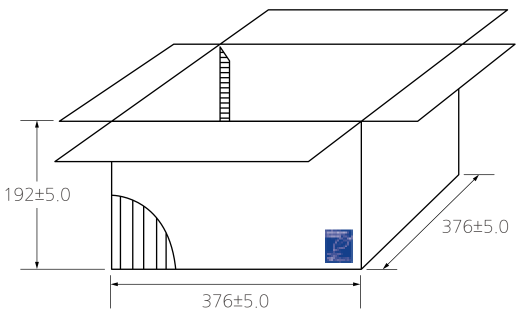
■ Inner Box (7" × 10 REEL)



■ Outer Box (7" × 20 REEL)



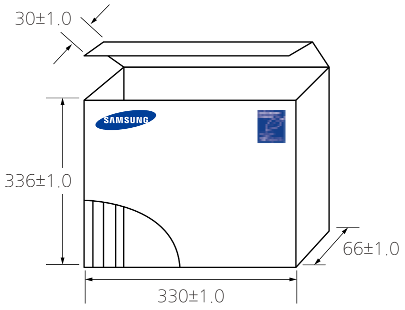
■ Outer Box (7" × 60 REEL)



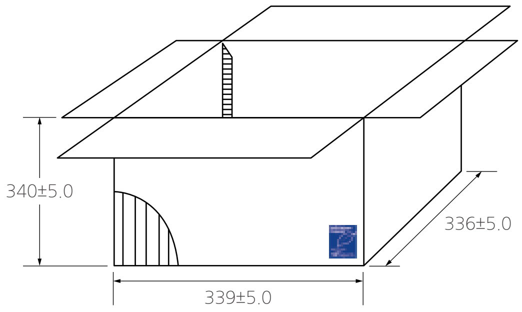
Packaging Specifications

Ⅳ. 13" Box packaging

■ Inner Box (13" × 4 REEL)



■ Outher Box (13" × 20 REEL)



6 Chip Weight

Size (L/W) (inch/mm)	Size (T) (mm)	Temp	Weight (mg/pc)
01005/0402	0.2	C0G	0.08
	0.2	X7R	0.09
	0.2	X5R	0.1
0201/0603	0.3	C0G	0.25
	0.3	X7R	0.28
	0.3	X5R	0.32
0402/1005	0.5	C0G	1.2
	0.5	X7R	1.5
	0.5	X5R	1.6
0603/1608	0.8	C0G	4.6
	0.8	X7R	5.8
	0.8	X5R	6.9
0805/2012	0.65	C0G	7.2
	1.25	X7R	18.4
	1.25	X5R	20.9
1206/3216	1.25	C0G	33.9
	1.6	X7R	56.9
	1.6	X5R	58.9
1210/3225	2.5	C0G	77.3
	2.5	X7R	117.7
	2.5	X5R	132.2

※ The weight of product is typical value per size, for more details, please contact us.

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
≤1,000㎊	1㎒±10%	0.5~5Vrms
>1,000㎊	1㎑±10%	

Class Ⅱ

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

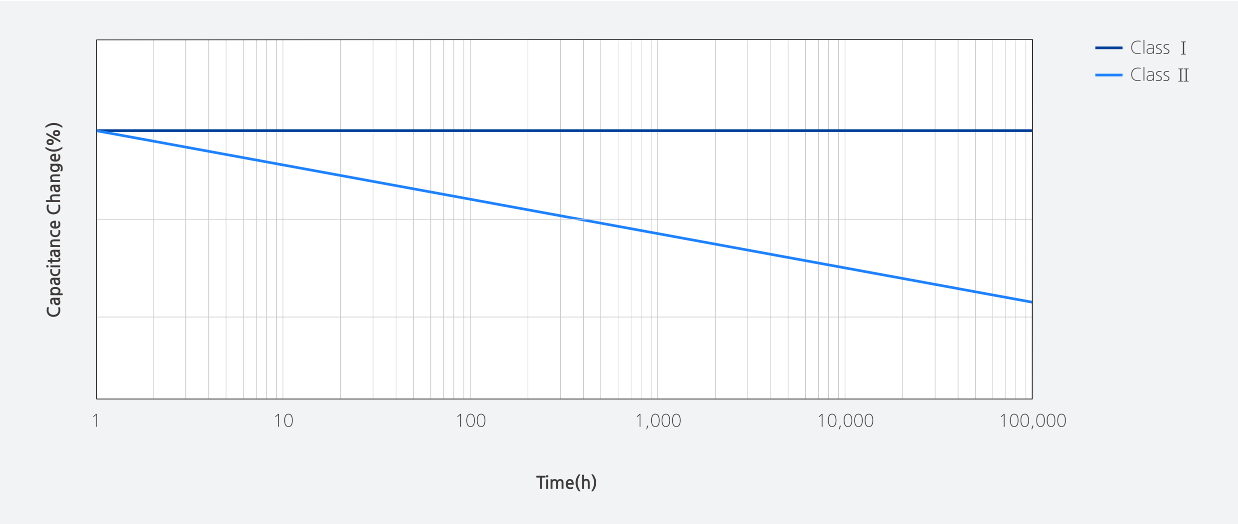
While the charging current decreases, and insulation resistance (IR) in MLCC is saturated by time.
Therefore, insulation resistance shall be measured 1 minute after applying the rated voltage.

4 Capacitance Aging

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



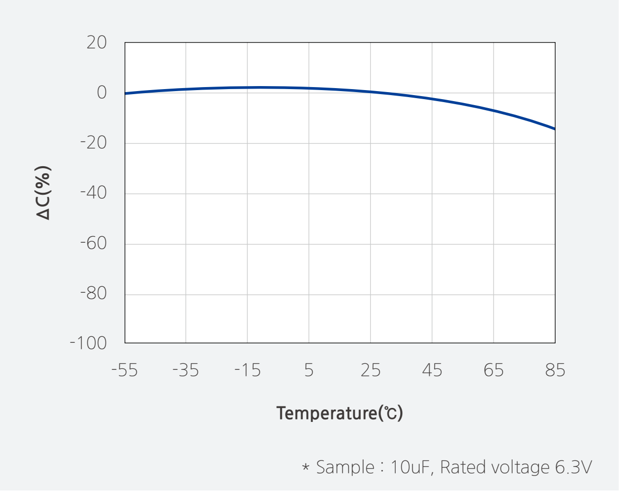
[Example of Capacitance Aging]

Caution/Notice

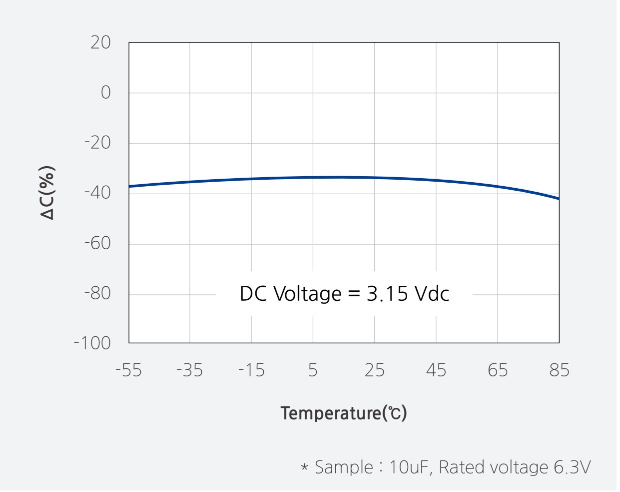
5 Temperature Characteristics of Capacitance (TCC)

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 (X5R)]



[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.

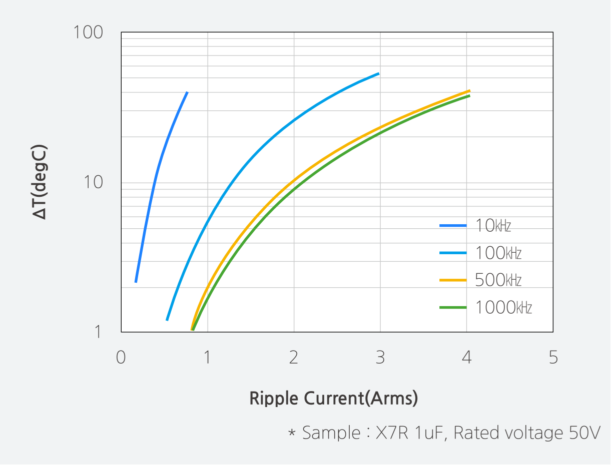
Ⅲ. In addition, Bias TCC of MLCC should be taken into account when DC voltage is applied to MLCC.

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℃



[Example of Ripple current]

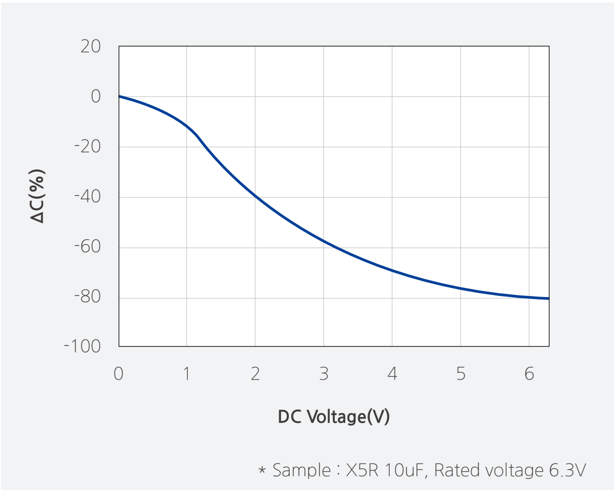
Caution/Notice

7 DC & AC Voltage Characteristics

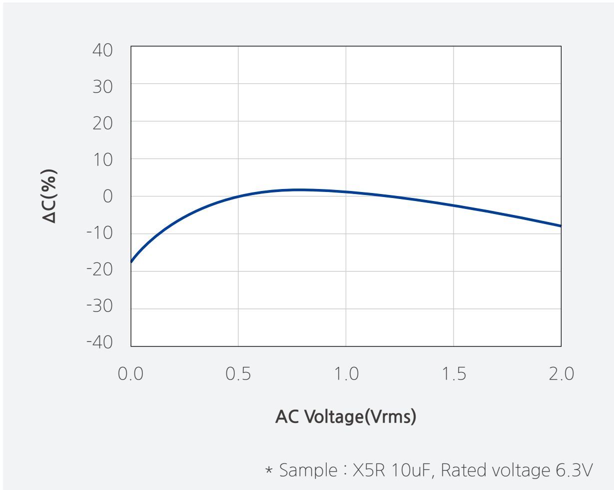
It is required to consider voltage characteristics in the circuit since the capacitance value of high dielectric constant MLCC (ClassⅡ) is changed by applied DC & AC voltage.

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

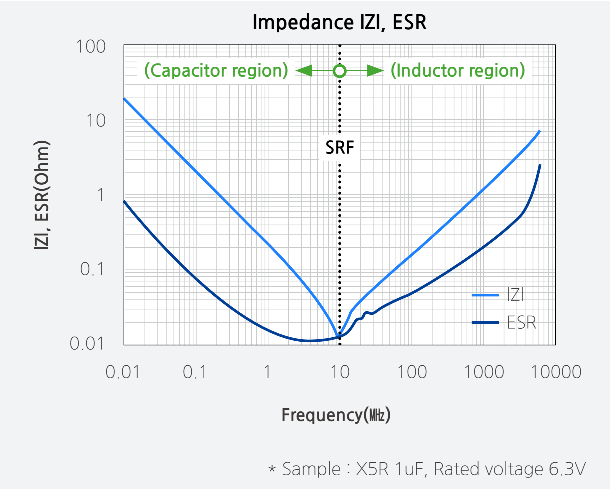
Electrical impedance (Z) of MLCC is the measurement of the opposition that MLCC presents to a current (I) when a voltage (V) is applied. It is defined as the ratio of the voltage to the current (Z=V/I).
Impedance extends the concept of resistance to AC circuits and is a complex number consisting of the 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

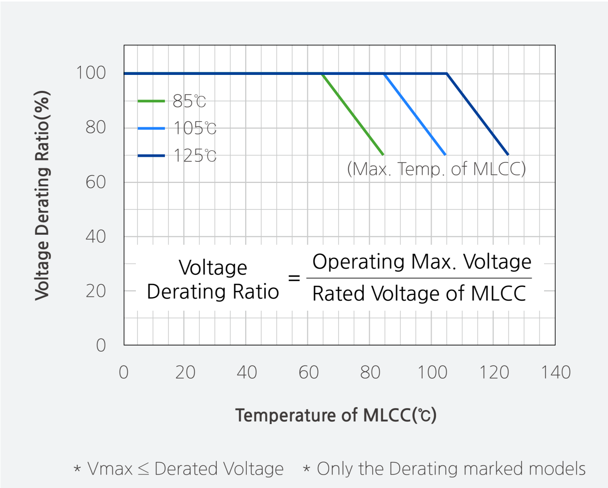
Electrical & Mechanical Caution

1 Derating

MLCC with the test voltage at 100% of the rated voltage in the high temperature resistance test are labeled as “derated MLCC.” For this type of MLCC, the voltage and temperature should be derated as shown in the following graph for the equivalent life time of a normal MLCC with the test voltage at 150% of the rated voltage in the high temperature resistance test.

Ⅰ. The derated MLCC should be applied with the derating voltage and temperature as shown in the following graph.

Ⅱ. The “Temperature of MLCC” in the x-axis of the graph below indicates the surface temperature of MLCC including self-heating effect. The “Voltage Derating Ratio” in the y-axis of the graph below gives the maximum operating voltage of MLCC with reference to the maximum voltage (Vmax) as defined in section “3-2. Applied Voltage.”



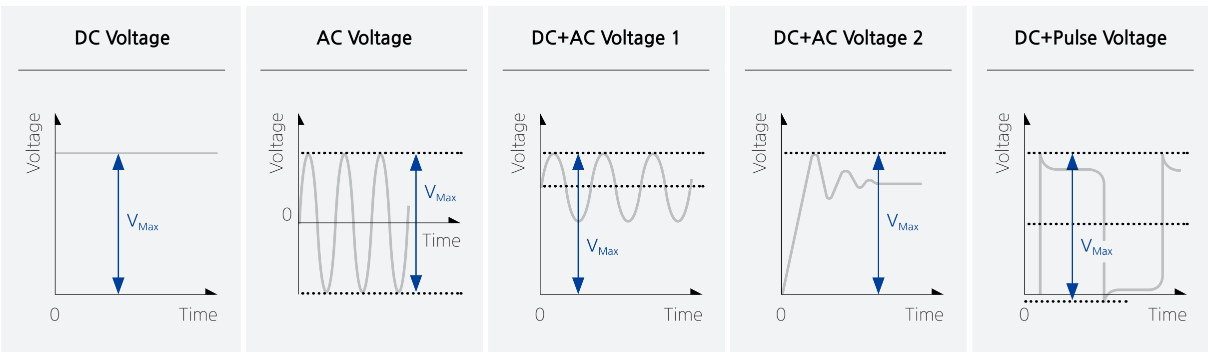
[Example of derating graph for derated MLCC]

2 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]

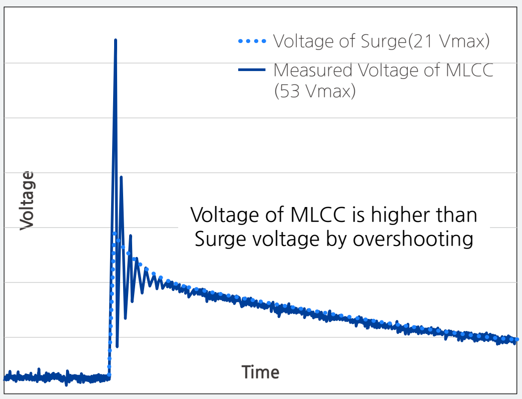
Caution/Notice

Ⅱ. Effect of EOS (Electrical Overstress)

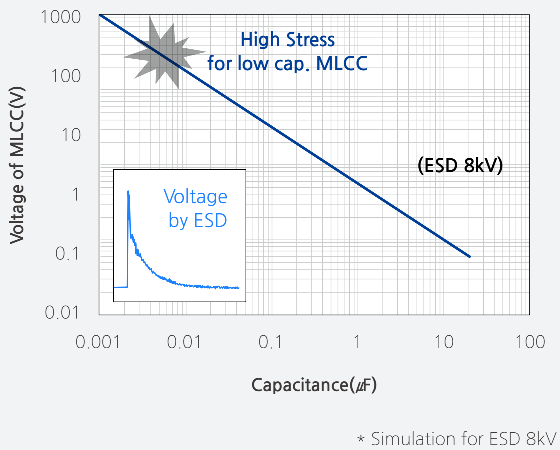
- Electrical Overstress such as a surge voltage or EOS can cause damages to MLCC, resulting in the electrical short failure caused by the dielectric breakdown in MLCC.
- Down time of MLCC is varied with the applied voltage and the room temperature and a dielectric shock caused by EOS can accelerate heating 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.

(1) Surge
When the overcurrent caused by surge is applied to MLCC, the influx of current into MLCC can induce the overshooting phenomenon of voltage as shown in the graph below and result in the electrical short failure in MLCC. Therefore, it is necessary to be careful to prevent the influx of surge current into MLCC.

(2) ESD (Electrostatic Discharge)
Since the voltage of the static electricity is very high but the quantity of electric charge is small compared to the surge, ESD can cause damage to MLCC with low capacitance as shown in the following graph, whereas surge with lots of electric charge quantity can cause damages to even high capacitance MLCC.



[Example of Surge applied to MLCC]



[Example of ESD applied to MLCC]

3 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.

4 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.

5 Piezo-electric Phenomenon

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

Caution/Notice

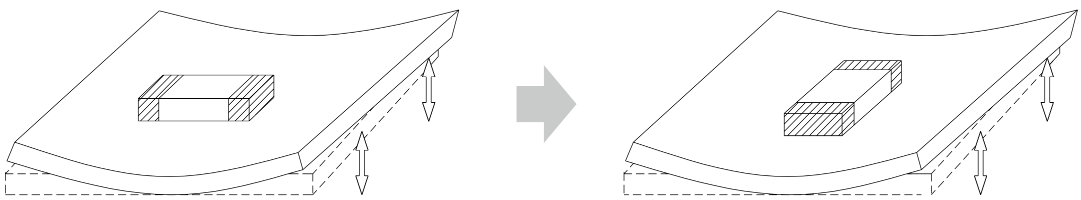
Process of Mounting and Soldering

1 Mounting

MLCC with the test voltage at 100% of the rated voltage in the high temperature resistance test are labeled as "derated MLCC." For this type of MLCC, the voltage and temperature should be derated as shown in the following graph for the equivalent life time of a normal MLCC with the test voltage at 150% of the rated voltage in the high temperature resistance test.

Ⅰ. Mounting position

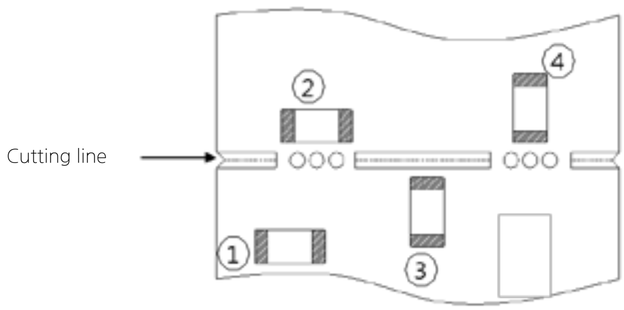
It is recommended to locate the major axis of MLCC in parallel to the direction in which the stress is applied.



Not recommended　　　　Recommended

Ⅱ. Cautions during mounting near the cutout

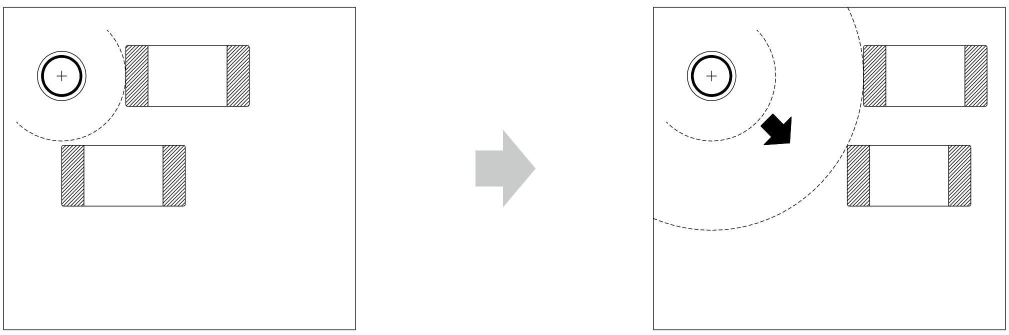
Please take the following measures to effectively reduce the stress generated from the cutting of PCB. Select the mounting location shown below, since the mechanical stress is affected by a location and a direction of MLCC mounted near the cutting line.



※ 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

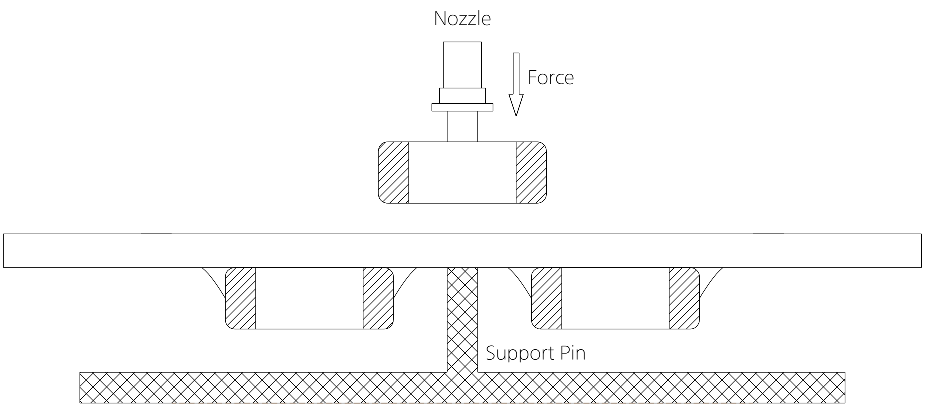
Ⅰ. Mounting Head Pressure

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.

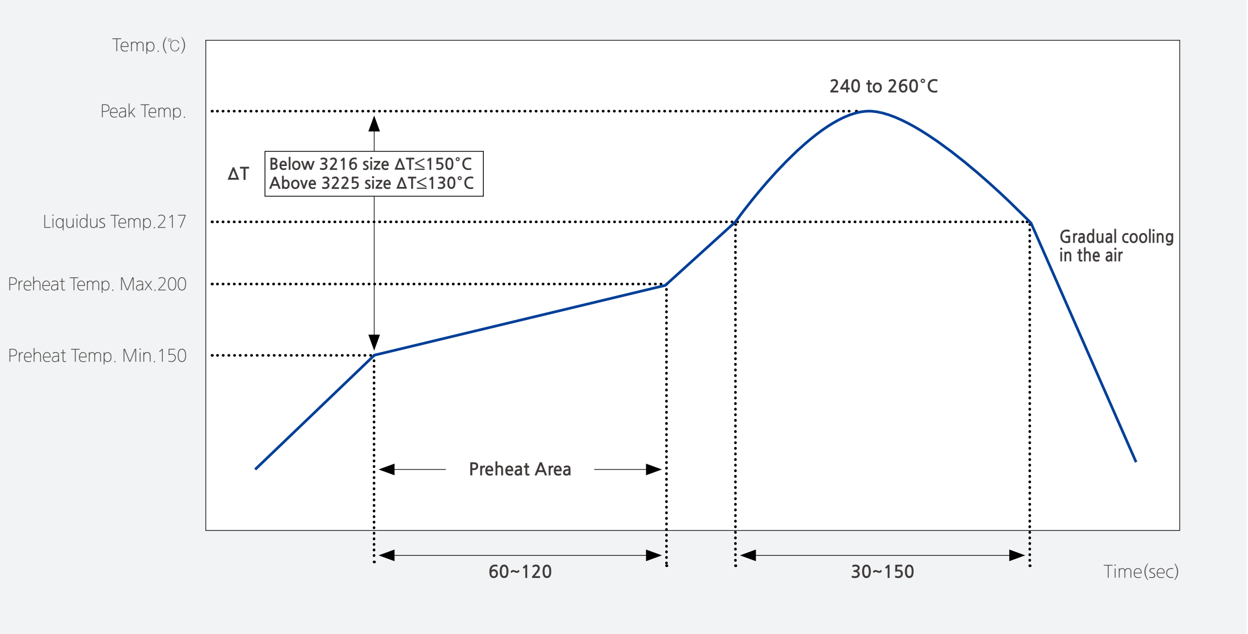
Caution/Notice

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.

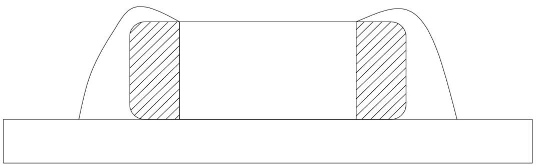
- Drop in solder wettability
- Solder voids
- Potential occurrence of whisker
- Drop in adhesive strength
- Drop in self-alignment properties
- Potential occurrence of tombstones

Ⅲ. Cooling

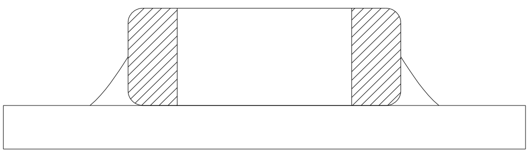
Natural cooling with air is recommended.

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



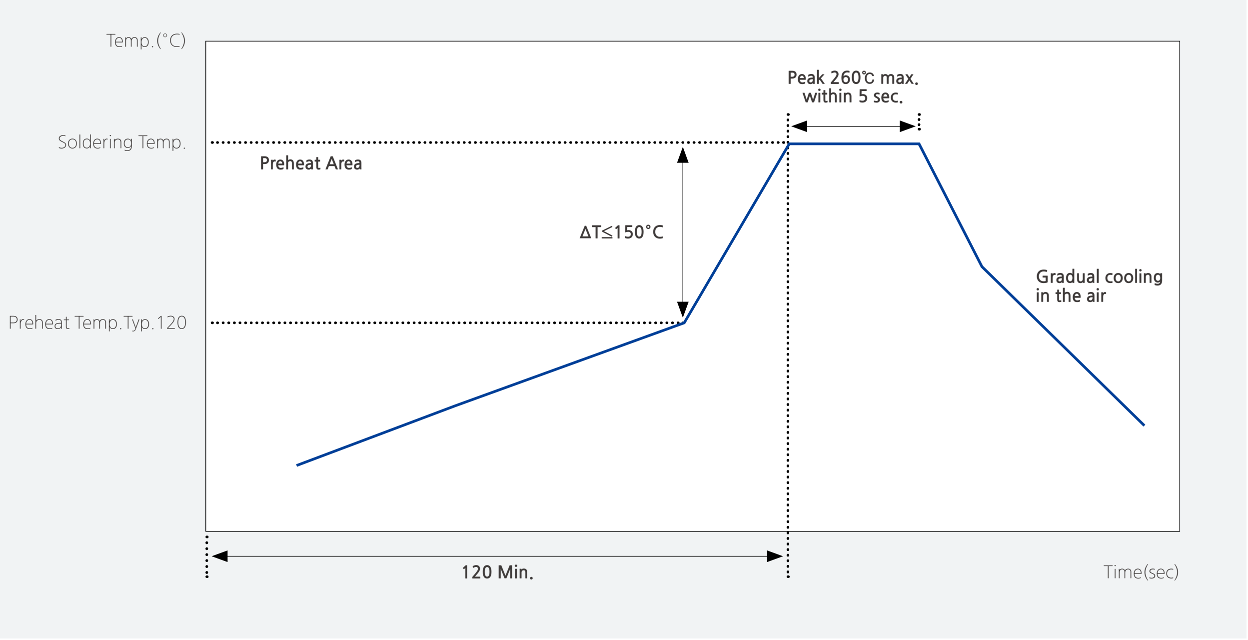
Not enough solder
Weak holding force may cause bad connections or detaching of the capacitor

- 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.
- The design of a suitable solder land is necessary since the more the solder amount is, the larger the force MLCC experiences and the higher the chance MLCC cracks.

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

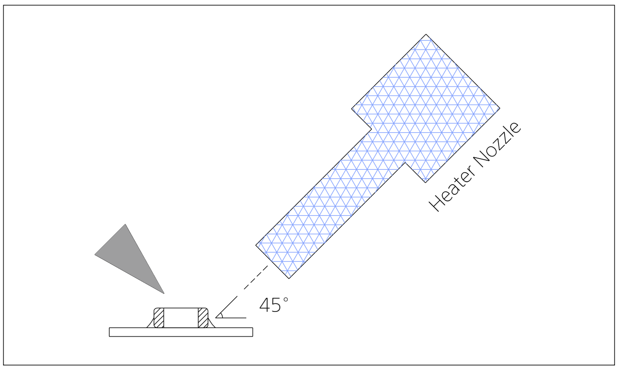
* Caution - Iron tip should not contact with ceramic body directly
Lead-free solder: Sn-3.0Ag-0.5CU

Ⅱ. How to use a spot heater

Compared to local heating using a solder iron, heat by a spot heater heats the overall MLCC and the PCB, which is likely to lessen the thermal shocks.
For a high density PCB, a spot heater can prevent the problem to connect between a solder iron and MLCC directly.

- If the distance from the air nozzle outlet to MLCC is too close, MLCC may be cracked due to the thermal stress. Follow the conditions set in the table below to prevent this problem.
- The spot heater application angle as shown in the figure is recommended to create a suitable solder fillet shape.
- In case that heat of higher than 350℃ is applied to MLCC containing epoxy material, the epoxy material in MLCC may be damaged by heat.

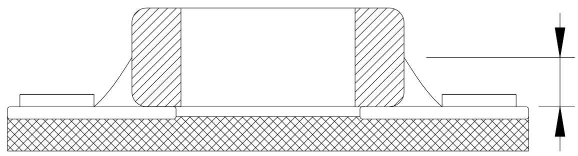
Distance	≥ 5㎜
Hot Air Application angle	45℃
Hot Air Temperature Nozzle Outlet	≤ 400℃
Application Time	≤ 10s



Caution/Notice

Ⅲ. 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

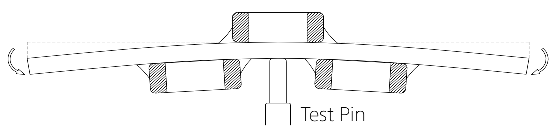
Ⅰ. In general, cleaning is unnecessary if rosin flux is used.
When acidic flux is used strongly, chlorine in the flux may dissolve into some types of cleaning fluids, thereby affecting the performance of MLCC.
This means that the cleansing solution must be carefully selected and should always be new.

Ⅱ. Cautions for cleaning

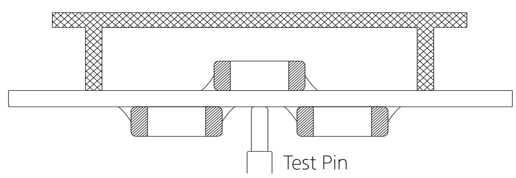
MLCC or solder joint may be cracked with the vibration of PCB, if ultrasonic vibration is too strong during cleaning. When high pressure cleaning equipment is used, test should be done for the cleaning equipment and its process before the cleaning in order to avoid damages on MLCC.

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

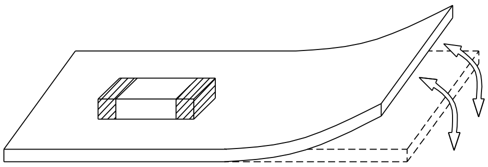


Recommended

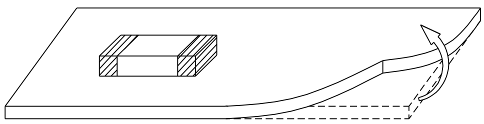
Caution/Notice

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.

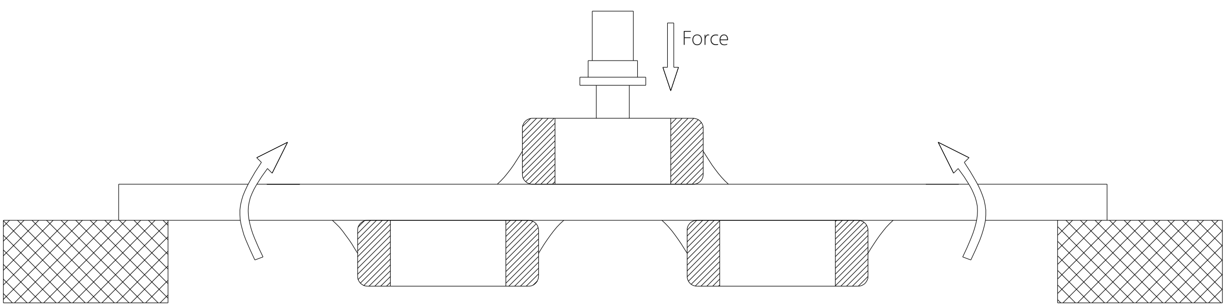
10 Assembly Handling

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.



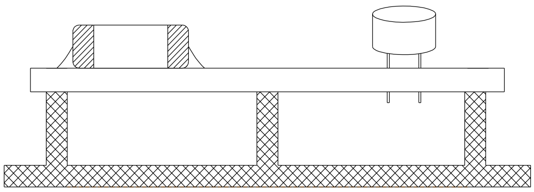
Caution/Notice

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.

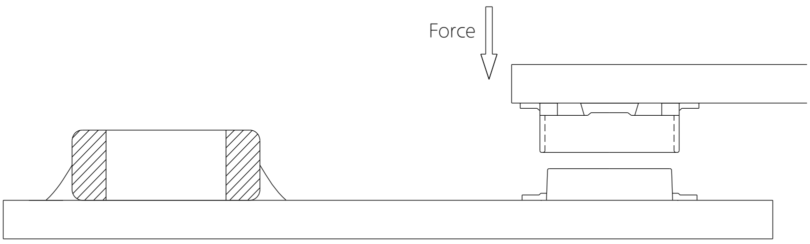
Not recommended



Recommended

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.

Caution/Notice

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.

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.

Caution/Notice

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.

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.

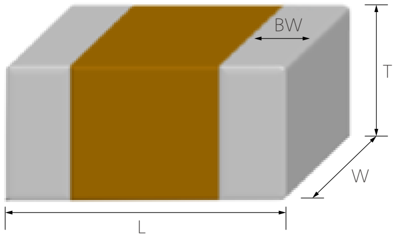
Ⅲ. Surge resistance must be evaluated since the excessive surge caused by the inductance of the actual system may apply to MLCC.

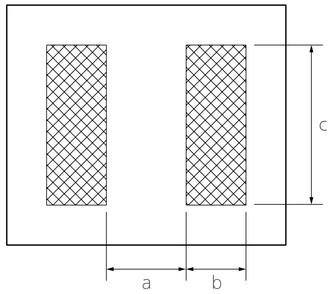
Ⅳ. Note the actual MLCC size and the termination shape.

Caution/Notice

4 Land dimension

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





Reflow Footprint

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

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

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.

Caution/Notice

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.

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.

Disclaimer & Limitation of Use and Applications

1 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.
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.

2 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.

① Aerospace/Aviation equipment
② 1wheeler, 2wheeler and 3wheeler vehicle
③ Automotive of Transportation equipment
④ Military equipment
⑤ Atomic energy-related equipment
⑥ Undersea equipment
⑦ Medical equipment
⑧ Disaster prevention/crime prevention equipment
⑨ Power plant control equipment
⑩ Traffic signal equipment
⑪ Data-processing equipment
⑫ Electric heating apparatus, burning equipment
⑬ Safety equipment
⑭ Any other applications with the same as or similar complexity or reliability to the applications

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