Multi Layer Ceramic Capacitors

General Application

Introduction

SAMWHA's series of multilayer ceramic(MLC) chip capacitors is designed to meet a wide variety of need. Multilayer ceramic chip capacitors are available in both class I and class II formulations. Temperature compensation formulations are class I and temperature stable and general application formulations are classified at class II. The class I multilayer ceramic capacitors are C0G with negligible dependence of electrical properties on temperature, voltage, frequency. The most of commonly used class II dielectric are X7R, X5R and Y5V. The X7R provides intermediate capacitance values which vary +15% over the temperature range of -55°C to 125°C. The X5R provides intermediate capacitance values which vary +15% over the temperature range of -55°C to 85°C. The Y5V provides the highest capacitance value which vary from 22% to -82% over the temperature range of -30°C to 85°C. All class II capacitors vary in capacitance value under the influence of temperature, operating voltage and frequency. We offer a complete line of products for both class I and II.

Features

- SAMWHA's high density ceramic bodies offer superior performance and reliability
- SAMWHA offer various temperature characteristics, rated voltage and packing method
- Material with high dielectric constant and superior manufacturing technology allows very high values in a small size
- Solder coated terminals offer superior solderability

Applications

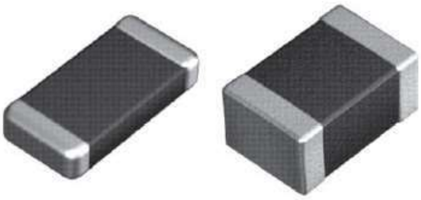
Wide applications throughout commercial and industrial market.

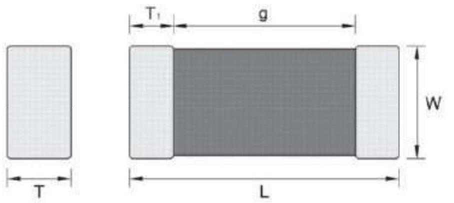
- Communication (Cellular Phone, Pager, Codeless Phone)
- Multimedia (DVD, CD-ROM, FDD, HDD, Game machine, Computer, Notebook, Digital camera, LCD)
- Audio Visual (TV, Camcorder, Minidisk, MP3 Player)
- Communication (Electronic tuner, Duplexer, VCXO, TCXO, Modem)
- OA Equipment (Printer, Copy Machine, Fax Machine)

* special specification like a Automobile, Medical, Military, Aviation should be discuss with our sales representatives

SMD Type

Shape & Dimensions





(Unit: mm)

Code(inch)	Dimensions				
	Length		Width		T1(min)
	L	Tol(±)	W	Tol(±)	
0603(0201)	0.60	0.03	0.30	0.03	0.05
1005(0402)	1.00	0.05	0.50	0.05	0.05
1608(0603)	1.60	0.15	0.80	0.10	0.10
2012(0805)	2.00	0.20	1.25	0.15	0.10
3216(1206)	3.20	0.30	1.60	0.20	0.15
3225(1210)	3.20	0.40	2.50	0.25	0.15
4520(1808)	4.50	0.40	2.00	0.25	0.20
4532(1812)	4.50	0.40	3.20	0.30	0.20
5750(2220)	5.70	0.50	5.00	0.40	0.30

*1608 Size ≥ 10µF = W: 0.8±0.15, T: 0.8±0.15

How to Order (Product Identification)

CS	1608	X7R	104	K	160	N	R	B
1	2	3	4	5	6	7	8	9

1 Type

CS : SMD
SA : ARRAY

2 Size Code

This is expressed in tens of a millimeter. The first two digits are the length, the last two digits are width.

Size(mm)	0603	1005	1608	2012	3216	3225	4520	4532	5750

3 Temperature Coefficient Code

Temperature Characteristic	Temperature Range	Capacitance Change or Temperature Coefficient	Operating Temperature Range
C0G	-55 to 125°C	0±30ppm/°C	-55 to 125°C
X7R	-55 to 125°C	±15%	-55 to 125°C
X5R	-55 to 85°C	±15%	-55 to 85°C
Y5V	-30 to 85°C	+22, -82%	-55 to 85°C

④ Capacitance Code(Pico Farads)

The nominal capacitance value in pF is expressed by three digit numbers.
The first two digits represents significant figures and the last digit denotes the number of zero
Ex.) 104 = 100000pF R denotes decimal 8R2 = 8.2pF

⑤ Capacitance Tolerance Code

Code	Tolerance	Code	Tolerance
B	±0.1pF	M	±20%
C	±0.25pF	P	+100, -0%
D	±0.5pF	Z	+80, -20%
F	±1.0%	H	+0.25/-0pF
G	±2.0%	I	+0/-0.25pF
J	±5.0%	U	+5/ -0%
K	±10%	V	+0/ -5%

⑥ Voltage Code

Code	6R3	100	160	250	500	101	201	251	631	302
Vol.	DC 6.3V	DC 10V	DC 160V	DC 25V	DC 50V	DC 100V	DC 200V	DC 250V	DC 630V	DC 3000V

⑦ Termination Code

Ex.) N : Ni-Sn(Nickel-Tin Plating)

⑧ Packing Code

Ex.) R: Reel Type B: Bulk Type

⑨ Thickness Option

Size(mm)	Thickness(mm)		Code	Size(mm)	Thickness(mm)		Code
	t	Tol(±)			t	Tol(±)	
0603/1005	0.3	0.03	-	3216	1.15	0.15	E
1005	0.5	0.05	-	3216	1.6	0.2	I
2012	0.6	0.1	A	3225	1.8	0.2	J
1608	0.8	0.1	B	3225/4532/5750	2	0.25	K
2012/3216	0.85	0.15	B	3225/4532/5750	2.5	0.25	L
2012	1.25	0.15	E				

Size(mm)	Code	Packaging	Size(mm)	Code	Packaging
0603/1005	-	Paper Taping	3216	E	Embossed Taping
1005	-	Paper Taping	3216	I	Embossed Taping
2012	A	Paper Taping	3225	J	Embossed Taping
1608	B	Paper Taping	3225/4532/5750	K	Embossed Taping
2012/3216	B	Paper Taping	3225/4532/5750	L	Embossed Taping
2012	E	Embossed Taping			

Typical Performance Characteristics

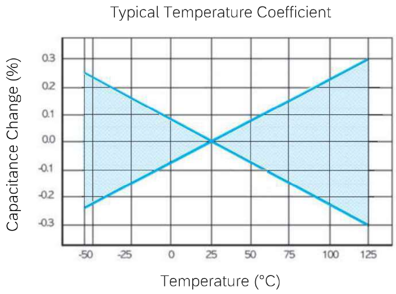
COG

Application

Suited for precision circuits, requiring stable dielectric characteristics,
negligible dependence of capacitance and dissipation factor on time, voltage and frequency.

Dielectric Characteristics

Temperature Characteristic	0±30ppm/℃
Operating Temperature	-55~125℃
Capacitance Tolerance	> 10pF : ±5%, ±10%,(±1%, ±2%, ±20%) ≤10pF: ±0.1pF, ±0.25pF, ±0.5pF
Dissipation Factor & Q	≥30pF : DF≤0.1%, Q≥1000 <30pF : DF≤1/(400+20×C), Q≥100 + 20×C
Insulation Resistance	More than 10,000MΩ or 500ΩF (Whichever is smaller)
Dielectric Strength	> 3×RVDC
Test Voltage	0.5 to 5Vrms(< 1000pF),1±0.2Vrms(≥1000pF)
Test Frequency	1±0.1㎒(< 1000pF), 1±0.1㎑(≥1000pF)



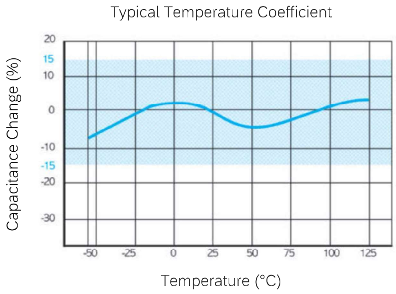
X7R

Application

Stable class || dielectric properties, suited for by-pass and coupling purposes, filtering, frequency discrimination, DC blockage, and as voltage transient suppression elements

Dielectric Characteristics

Temperature Characteristic	±15%
Operating Temperature	-55~125℃
Capacitance Tolerance	±10%, ±20%(±5%, +80~-20%)
Dissipation Factor & Q	50V Min. : 2.5% Max. 25V Min. : 3.0% Max. 16V Min. : 3.5% Max. 10V Min. : 5.0% Max. 6.3V Min. : 5.0% Max. Thin layer large capacitors type 12.5% Max.
Insulation Resistance	More than 10,000MΩ or 500ΩF (Whichever is smaller) Thin layer large capacitors type 50ΩF Min.
Dielectric Strength	> 2.5×RVDC
Test Voltage	1±0.2Vrms(≤10μF) 0.5±0.1Vrms(> 10μF)
Test Frequency	1±0.1V㎑ (≤10μF) 120±24㎐(> 10μF)



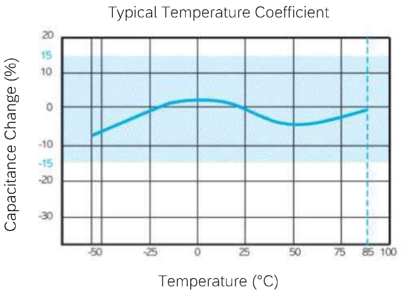
X5R

Application

Stable class II dielectric properties, suited for by-pass and coupling purposes, filtering, frequency discrimination, DC blockage, and as voltage transient suppression elements.

Dielectric Characteristics

Temperature Characteristic	±15%
Operating Temperature	-55~85℃
Capacitance Tolerance	±10%, ±20%, (±5%, +80~-20%)
Dissipation Factor & Q	50V Min. : 2.5% Max. 25V Min. : 3.0% Max. 16V Min. : 3.5% Max. 10V Min. : 5.0% Max. 6.3V Min. : 5.0% Max. Thin layer large capacitors type 12.5% Max.
Insulation Resistance	More than 10,000MΩ or 500ΩF (Whichever is smaller) Thin layer large capacitors type 50ΩF Min.
Dielectric Strength	> 2.5×RVDC
Test Voltage	1±0.2Vrms(≤10μF) 0.5±0.1Vrms(> 10μF)
Test Frequency	1±0.1V㎑ (≤10μF) 120±24㎐(> 10μF)



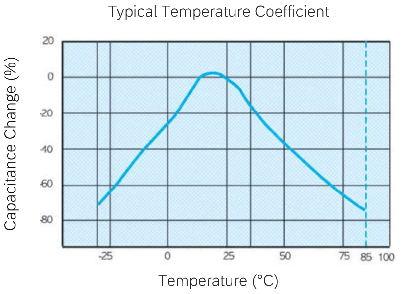
Y5V

Application

The Hi-K(Y5V) dielectrics deliver high capacitance density and are ideally suited for applications where space is at a premium, or as replacement for tantalum capacitors. Typically applications include use as by-pass or decoupling elements. Best performance is obtained at or near room temperature, with low DC bias.

Dielectric Characteristics

Temperature Characteristic	+22%~-82%
Operating Temperature	-30~85℃
Capacitance Tolerance	-20~+80%(±20%)
Dissipation Factor & Q	50V Min. : 5% Max. 25V Min. : 7% Max. 16V Min. : 9% Max. 10V Min. : 12.5% Max. 6.3V Min. : 15% Max. Thin layer large capacitors type 20% Max.
Insulation Resistance	More than 10,000MΩor 500ΩF (Whichever is smaller) Thin layer large capacitors type 50ΩF Min.
Dielectric Strength	> 2.5×RVDC
Test Voltage	1±0.2Vrms(≤10μF) 0.5±0.1Vrms(> 10μF)
Test Frequency	1±0.1V㎑ (≤10μF) 120±24 ㎐(> 10μF)



Appendix I

C0G-Temperature Compensating Type(0603~3216)

Type	C0G									
Size(inch)	0603(0201)		1005(0402)		1608(0603)		2012(0805)		3216(1206)	
Volt(V) / Cap.	25	50	25	50	25	50	25	50	25	50
0.5pF(0R5)										
1pF(010)										
2pF(020)										
3pF(030)										
4pF(040)										
5pF(050)										
6pF(060)										
7pF(070)										
8pF(080)										
9pF(090)										
10pF(100)										
12pF(120)										
15pF(150)										
18pF(180)										
22pF(220)										
27pF(270)										
33pF(330)										
39pF(390)										
47pF(470)										
56pF(560)										
68pF(680)										
82pF(820)										
100pF(101)										
120pF(121)										
150pF(151)										
180pF(181)										
220pF(221)		0.3								
270pF(271)										
330pF(331)										
390pF(391)										
470pF(471)										
560pF(561)										
680pF(681)										
820pF(821)										
1000pF(102)	0.3									
1200pF(122)										
1500pF(152)									1.15	1.15
1800pF(182)										
2200pF(222)							0.6	0.6		
2700pF(272)										
3300pF(332)										
3900pF(392)										
4700pF(472)										
5600pF(562)										
6800pF(682)				0.5						
10000pF(103)			0.5		0.8	0.8				
12000pF(123)										
15000pF(153)										
18000pF(183)										
22000pF(223)										
27000pF(273)										
33000pF(333)							1.25	1.25		
47000pF(473)										
56000pF(563)										
68000pF(683)										
82000pF(823)										
0.1µF(104)									1.60	1.60

Temperature Compensating Type : Dissipation Factor Page 20 (No.5)

Appendix II

X7R-High Dielectric Constant Type(0603~3225) & Thin Layer Large-Capacitance Type

Type	X7R																												
Size(inch)	0603(0201)				1005(0402)					1608(0603)					2012(0805)					3216(1206)					3225(1210)				
Cap. \ Volt(V)	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
100pF(101)																													
470pF(471)																													
1000pF(102)																													
2200pF(222)																													
4700pF(472)																													
10000pF(103)	0.3	0.3	0.3	0.3																									
15000pF(153)																													
22000pF(223)																													
33000pF(333)															0.6	0.6	0.6	0.6	0.6										
47000pF(473)																													
68000pF(683)																													
0.1µF(104)								0.5	0.5						0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85					
0.15µF(154)																													
0.22µF(224)							0.5							0.8															
0.33µF(334)																													
0.47µF(474)						0.5														1.15	1.15	1.15	1.15	1.15					
0.68µF(684)																													
1.0µF(105)					0.5							0.8	0.8						1.25						2.0	2.0	2.0	2.0	2.0
2.2µF(225)										0.8	0.8																		
4.7µF(475)																	1.25	1.25						1.6					2.5
10µF(106)															1.25	1.25						1.6	1.6						
22µF(226)																				1.6	1.6						2.5	2.5	
47µF(476)																									2.5	2.5			
100µF(107)																													

General Type : Dissipation Factor Page 20 (No.5)

*General Type : Dissipation Factor Page 20 (No.5)

Thin Layer Large-Capacitance Type: Dissipation Factor Page 20 (No.5)

X5R-High Dielectric Constant Type(0603~3225) & Thin Layer Large-Capacitance Type

Type	X5R																												
Size(inch)	0603(0201)				1005(0402)					1608(0603)					2012(0805)					3216(1206)					3225(1210)				
Cap. \ Volt(V)	6.3	10	16	25	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
100pF(101)																													
470pF(471)																													
1000pF(102)																													
2200pF(222)																													
4700pF(472)																													
10000pF(103)																													
15000pF(153)																													
22000pF(223)																													
33000pF(333)																													
47000pF(473)																													
68000pF(683)																													
0.1µF(104)				0.3					0.5										0.85	0.8	0.8	0.8	0.8	0.8					
0.15µF(154)																0.85	0.85	0.85											
0.22µF(224)			0.3																										
0.33µF(334)															0.85														1.8
0.47µF(474)																													
0.68µF(684)																													
1.0µF(105)		0.3																						1.15					
2.2µF(225)	0.3						0.5	0.5						0.8									1.15						
4.7µF(475)												0.8	0.8						1.25	1.15	1.15	1.15			1.8	1.8	1.8	1.8	
10µF(106)					0.5	0.5					0.8												1.6	1.6					2.5
22µF(226)																1.25	1.25	1.25				1.6			2.0	2.0	2.0	2.5	
47µF(476)										0.8					1.25						1.6						2.5		
100µF(107)																				1.6					2.5	2.5			

General Type : Dissipation Factor Page 20 (No.5)

*General Type : Dissipation Factor Page 20 (No.5)

Thin Layer Large-Capacitance Type: Dissipation Factor Page 20 (No.5)

Y5V-High Dielectric Constant Type(0603-3225) & Thin Layer Large-Capacitance Type

Type	Y5V																								
Size(inch)	1005(0402)					1608(0603)					2012(0805)					3216(1206)					3225(1210)				
Volt(V) / Cap.	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50	6.3	10	16	25	50
1000pF(102)																									
2200pF(222)																									
4700pF(472)																									
10000pF(103)																									
15000pF(153)																									
22000pF(223)					0.5																				
33000pF(333)																									
47000pF(473)																									
68000pF(683)																									
0.1µF(104)				0.5																					
0.15µF(154)																									
0.22µF(224)										0.8															
0.33µF(334)																									
0.47µF(474)			0.5						0.8																
0.68µF(684)																									
1.0µF(105)	0.5	0.5													1.25				1.15	1.15					
2.2µF(225)								0.8								1.15	1.15	1.15							
3.3µF(335)							0.8															1.8	1.8	1.8	1.8
4.7µF(475)						0.8							1.25	1.25											2.0
10µF(106)											1.25	1.25									1.8			2.0	2.5
22µF(226)																							2.0		
47µF(476)																					2.0	2.0			
100µF(107)																1.6	1.6	1.6	1.6	1.6	2.5	2.5			

General Type : Dissipation Factor Page 20 (No.5)

*General Type : Dissipation Factor Page 20 (No.5)

Thin Layer Large-Capacitance Type: Dissipation Factor Page 20 (No.5)

Automotive Application

Features

- SAMWHA Series meet AEC-Q200 requirements
- SAMWHA Series Certify IATF 16949(ISO/TS 16949), ISO 9001, ISO 14001
  SAMWHA Series are RoHS Compliant

Applications

- Automotive Electronic Equipment

How to Order (Product Identification)

CQ	1608	X7R	104	K	500	N	R	B
1	2	3	4	5	6	7	8	9

1 Monolithic Multilayer Ceramic Capacitor Leadless Type for Automotive Application

2 **Size Code**
This is expressed in tens of a millimeter.
The first two digits are the length, The last two digits are width.

3 **Temperature Coefficient Code**

Classification	Code	Temperature Range	Temperature Coefficient
Class I	C0G	-55 to +125°C	±30 ppm/°C
Class II	X7R	-55 to +125°C	+15%
Class II	X8R	-55 to +150°C	+15%

4 **Capacitance Code(Pico Farads)**
The nominal capacitance value in pF is expressed by three digit numbers.
The first two digits represents significant figures and the last digit denotes the number of zero
Ex.) 104 = 100000pF
R denotes decimal
8R2 = 8.2pF

5 Capacitance Tolerance Code

Code	Tolerance	Code	Tolerance
B	±0.1pF	G	±2.0%
C	±0.25pF	J	±5%
D	±0.5pF	K	±10%
F	±1.0%	M	±20%

6 Voltage Code

Code	6R3	100	160	250	500	101	201	251	501	631	102	202	302
Rated Voltage	DC 6.3V	DC 10V	DC 16V	DC 25V	DC 50V	DC 100V	DC 200V	DC 250V	DC 500V	DC 630V	DC 1KV	DC 2KV	DC 3KV

7 Termination & Design Code

N : Nickel-Tin plating, A : Ag epoxy/Nickel-Tin plating, O : Open Mode, F : Floating mode
S : Ag Epoxy/Nickel-Tin plating + Open mode type

Normal Type | Ag Type (Soft termination) | Open Mode Type | Floating Mode Type | Soft term + Open Mode Type

8 Packing Code

R: Reel Type, B: Bulk Type

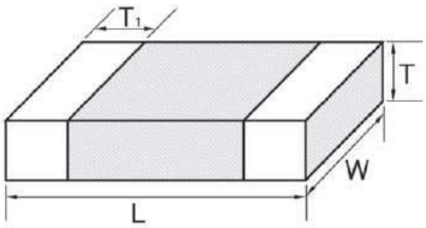
9 Thickness Option

Size(mm)	Thickness(mm)		Code	Size(mm)	Thickness(mm)		Code
	t	Tol(±)			t	Tol(±)	
0603/1005	0.3	0.03	-	3216	1.15	0.15	E
1005	0.5	0.05	-	3216	1.6	0.2	I
2012	0.6	0.1	A	3225	1.8	0.2	J
1608	0.8	0.1	B	3225/4532/5750	2	0.25	K
2012/3216	0.85	0.15	B	3225/4532/5750	2.5	0.25	L
2012	1.25	0.15	E				

Size(mm)	Code	Packaging	Size(mm)	Code	Packaging
0603/1005	-	Paper Taping	3216	E	Embossed Taping
1005	-	Paper Taping	3216	I	Embossed Taping
2012	A	Paper Taping	3225	J	Embossed Taping
1608	B	Paper Taping	3225/4532/5750	K	Embossed Taping
2012/3216	B	Paper Taping	3225/4532/5750	L	Embossed Taping
2012	E	Embossed Taping			

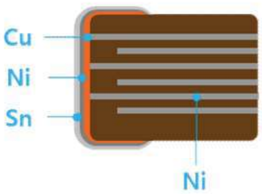
Temperature Characteristic See Page 24 (No.22)

Dimensions

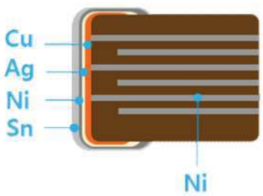


Code(inch)	Dimensions				
	Length		Width		T1(min)
	L	Tol(±)	W	Tol(±)	
1005(0402)	1.00	0.05	0.50	0.05	0.05
1608(0603)	1.60	0.15	0.80	0.10	0.10
2012(0805)	2.00	0.20	1.25	0.15	0.10
3216(1206)	3.20	0.30	1.60	0.20	0.15
3225(1210)	3.20	0.40	2.50	0.25	0.15

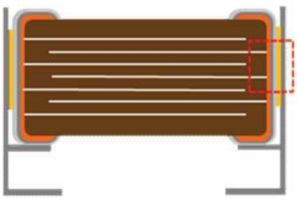
Construction of Termination



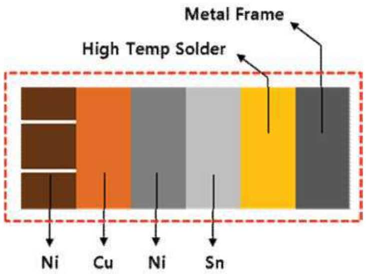
a. Ni Type I



b. Ni Type II
(Soft Termination)



c. Metal Frame Type



Termination Details

Capacitance Table.

Class I (C0G)

Size Code (EIA Code)	1005(0402)				1608(0603)				2012(0805)				3216(1206)				3225(1210)			
Cap. \ Rated Volt(V)	16	25	50	100	16	25	50	100	16	25	50	100	16	25	50	100	16	25	50	100
0.5pF(0R5)																				
1pF(010)																				
2.2pF(2R2)																				
3pF(030)																				
4pF(040)																				
4.7pF(4R7)																				
5pF(050)																				
6.8pF(6R8)																				
8pF(080)																				
9pF(090)																				
10pF(100)																				
12pF(120)																				
15pF(150)																				
18pF(180)																				
22pF(220)																				
27pF(270)																				
33pF(330)																				
39pF(390)																				
47pF(470)																				
56pF(560)																				
68pF(680)																				
82pF(820)																				
100pF(101)																				
120pF(121)																				
150pF(151)																				
180pF(181)																				
220pF(221)																				
270pF(271)																				
330pF(331)																				
390pF(391)																				
470pF(471)																				
560pF(561)																				
680pF(681)																				
820pF(821)																				
1000pF(102)																				
1200pF(122)																				
1500pF(152)																				
1800pF(182)																				
2200pF(222)																				
2700pF(272)																				
3300pF(332)																				
4700pF(472)																				

Class II (X7R)

Size Code (EIA Code)	1005(0402)				1608(0603)				2012(0805)				3216(1206)				3225(1210)			
Cap. \ Rated Volt(V)	16	25	50	100	16	25	50	100	16	25	50	100	16	25	50	100	16	25	50	100
1000pF(102)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
1500pF(152)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
2200pF(222)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
3300pF(332)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
4700pF(472)	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
6800pF(682)	G	G	G		G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
10000pF(103)	G	G	G		G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
15000pF(153)	G	G	G		G	G	G		G	G	G	G	G	G	G		G	G	G	G
22000pF(223)	G	G	G		G	G	G		G	G	G	G	G	G	G		G	G	G	G
33000pF(333)	G	G	T		G	G	G		G	G	G	G	G	G	G		G	G	G	G
47000pF(473)	G	G			G	G	G		G	G	G	G	G	G	G		G	G	G	G
68000pF(683)	G	G			G	G	G		G	G	G	G	G	G	G		G	G	G	G
0.1uF(104)	T	T			G	G	G		G	G	G	G	G	G	G		G	G	G	G
0.15uF(154)					G	G	T		G	G	T	T	G	G	G		G	G	G	G
0.22uF(224)					T	T	T		G	T	T	T	G	G	G		G	G	G	G
0.33uF(334)					T	T			T	T	T		G	G	G		G	G	G	G
0.47uF(474)					T	T			T	T	T		G	G	G		G	G	G	G
0.68uF(684)					T	T			T	T	T		G	G	T		G	G	G	
1.0uF(105)					T	T			T	T			G	G	T		G	G	G	
2.2uF(225)									T	T			T	T	T		G	G	T	
4.7uF(475)									T				T	T			T	T	T	
10uF(106)													T	T			T	T		
22uF(226)																	T			

G: General Type for Automotive Application

T: Thin Layer Large-Capacitance Type for Automotive Application

Typical Performance Characteristics

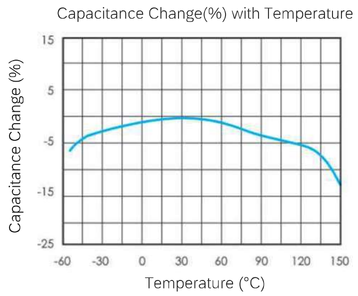
X8R

Application

The X8R series could be applicable to devices that operating in high-temperature environments Temperature Characteristics (x8r, -55 to 150°C, Capacitance Change +15%) Excellent DC-bias, Temperature and Aging properties

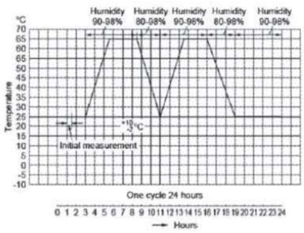
Dielectric Characteristics

Temperature Characteristic	±15%
Operating Temperature	-55~150℃
Capacitance Tolerance	±10%, ±20%
Dissipation Factor & Q	50V : 2.5% max. 25V : 3.0% max. 16V : 3.5% max. 10V : 5.0% max
Insulation Resistance	More than 10,000MΩ or 500ΩF (Whichever is smaller)
Dielectric Strength	> 2.5×RVDC
Test Voltage	0.5~1.0Vrms
Test Frequency	1±0.1㎑



Size Code (EIA Code)	1608(0603)				2012(0805)				3216(1206)			
Cap. \ Rated Volt(V)	16	25	50	100	16	25	50	100	16	25	50	100
1000pF(102)												
4700pF(472)												
6800pF(682)												
10000pF(103)												
22000pF(223)												
470000pF(473)												
680000pF(683)												
0.1uF(104)												
0.15uF(154)												
0.22uF(224)												
0.47uF(474)												
0.68uF(684)												
1.0uF(105)												
2.2uF(225)												
4.7uF(475)												
10uF(106)												
22uF(226)												
47uF(476)												
100uF(107)												

Specifications and Test Methods(For Automotive Applications)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200</th><th colspan="2">Specification</th><th rowspan="2">Test Methods
And Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td>1</td><td colspan="2">Pre-and Post-Stress
Electrical Test</td><td colspan="2">No defects which may affect performance</td><td></td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">High
Temperature
Exposure</td><td>Appearance</td><td>No marking defects</td><td></td><td rowspan="4">Temperature : Max. operating temperature±3°C
Maintenance Time : 1000+48/-0 hrs
Let sit for 24±2 hours at room Temperature, then measure.</td></tr>
<tr><td>Capacitance
Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
16V Min : 0.05 Max.
10V : 0.075 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Temperature
Cycle</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Perform the 1000 cycles according to the four heat treatments listed in the following table. Let sit for 24+2 hours at room temperature, then measure.<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp(℃)</td><td>Min. operating temp.+0/-3</td><td>Room temp.</td><td>Max. operating temp.+3/-0</td><td>Room temp.</td></tr><tr><td>Time(min)</td><td>15±3</td><td>1</td><td>15±3</td><td>1</td></tr></table>Initial measurement Perform the initial measurement according to Note1 for Class II.</td></tr>
<tr><td>Capacitance
Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
16V Min : 0.05 Max.
10V : 0.075 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
<tr><td>4</td><td colspan="2">Destructive Physical Analysis</td><td colspan="2">No defects or abnormalities</td><td>Per EIA-469</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">Moisture
Resistance</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Temperature : 25-65°C,
Humidity: 80-98%
Cycle Time: 24 hrs/cycle, 10 cycles
Let sit for 24±2 hours at room temperature, then measure.
</td></tr>
<tr><td>Capacitance
Change</td><td>Within ±3.0% or ±0.30pF
(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td>Q/D.F</td><td>30pF Min. : Q≥350
10pF Min. and 30pF
Max. : Q≥275+5/2xC
10pF Max. : Q≥200+10xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
16V Min : 0.05 Max.
10V : 0.075 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Humidity
Bias</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Temperature : 85±3°C
Humidity: 80~85%
Applied Voltage: Rated Voltage and 1.3+0.2/-OV
Maintenance Time: 1000+48/-0 hrs
Let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance
Change</td><td>Within ±3.0% or ±0.30pF
(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td>Q/D.F</td><td>30pF Min. : Q≥200
30pF Max. : Q≥100+10/3xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
16V Min : 0.05 Max.
10V : 0.075 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω.F(Whichever is smaller)</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">High
Temperature
Operational
Life</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Temperature : Max. operating temperature±3°C
Applied Voltage: Rated Voltage X 200%
Maintenance Time: 1000+48/-0 hrs
Let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.

Initial Measurement for Class II
Applied 200% of the rated voltage for one hour at Max. operating temperature±3°C Remove and let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance
Change</td><td>Within ±3.0% or ±0.30pF
(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td>Q/D.F</td><td>30pF Min. : Q≥350
10pF Min. and 30pF
Max. : Q≥275+5/2xC
10pF Max. : Q≥200+10xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
16V Min : 0.05 Max.
10V : 0.075 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω.F(Whichever is smaller)</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200</th><th colspan="2">Specification</th><th rowspan="2">Test Methods
And Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td>8</td><td colspan="2">External Visual</td><td colspan="2">No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>9</td><td colspan="2">Physical Dimension</td><td colspan="2">Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td rowspan="4">10</td><td rowspan="4">Resistance to Solvents</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Per MIL-STD-202 Method 215</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
50V : 0.025 Max.
25V : 0.03 Max.
16V : 0.035 Max.
10V : 0.05 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
<tr><td rowspan="4">11</td><td rowspan="4">Mechanical Shock</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks)

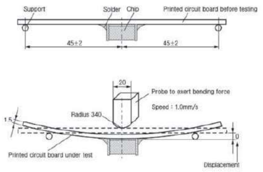
Test Pulse
Wave form: Half-sine
Duration : 0.5ms
Peak value: 1,500G
Velocity change : 4.7m/s</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
50V : 0.025 Max.
25V : 0.03 Max.
16V : 0.035 Max.
10V : 0.05 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
<tr><td rowspan="4">12</td><td rowspan="4">Vibration</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td rowspan="4">The specimens should be subjected to a simple harmonic motion having a total amplitude of 1.5mm. The entire frequency range of 10 to 2,000 Hz and return to 10 Hz should be traversed in 20 minutes. This cycle should be performed 12 times in each of three mutually perpendicular directions (total of 36 times).</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
50V : 0.025 Max.
25V : 0.03 Max.
16V : 0.035 Max.
10V : 0.05 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
<tr><td rowspan="4">13</td><td rowspan="4">Resistance to Solder Heat</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Temperature(Eutectic solder solution): 260±5°C
Dipping Time : 10±1s
Let sit for 24±2 hours at room temperature, then measure.
Initial measurement
Perform the initial measurement according to Note1 for Class II.</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
50V : 0.025 Max.
25V : 0.03 Max.
16V : 0.035 Max.
10V : 0.05 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200</th><th colspan="2">Specification</th><th rowspan="2">Test Methods
And Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Thermal
Shock</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="3">Perform the 300 cycles according to the two heat treatments listed in the following table. Transfer Time: 20s Max.
Let sit for 24±2 hours at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th></tr><tr><td>Temp(℃)</td><td>Min. operating temp.+0/-3</td><td>Max. operating temp+3/-0</td></tr><tr><td>Time(min)</td><td>15±3</td><td>15±3</td></tr></table></td></tr>
<tr><td>Capacitance
Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td><td>Within ±15%</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
50V : 0.025 Max.
25V : 0.03 Max.
16V : 0.035 Max.
10V : 0.05 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td><td>Initial measurement Perform the initial measurement according to Note1 for Class II.</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">ESD</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Per AEC-Q200-002</td></tr>
<tr><td>Capacitance
Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
50V : 0.025 Max.
25V : 0.03 Max.
16V : 0.035 Max.
10V : 0.05 Max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
<tr><td>16</td><td>Solderability</td><td></td><td colspan="2">95% of the terminations is to be soldered evenly
And continuously.</td><td>(a) Preheat at 155°C for 4 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.

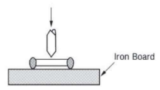
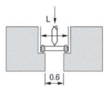
(b) Steam aging for 8 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.

(c) Steam aging for 8 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 120±5 seconds at 260±5°C.</td></tr>
<tr><td rowspan="5">17</td><td rowspan="5">Electrical
Characteriza-
tion</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td rowspan="5">The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table
<table><tr><th>Class</th><th>Capacitance (C)</th><th>Frequency</th><th>Voltage</th></tr><tr><td>Class I</td><td>C≤1000pF
C > 1000pF</td><td>1±0.1MHz
1±0.1kHz</td><td>0.5~5Vrms
1±0.2Vrms</td></tr><tr><td>Class II</td><td>C≤110μF
C > 10μF</td><td>1±0.1kHz
120±24kHz</td><td>1±0.2Vrms
0.5±0.1Vrms</td></tr></table>Initial measurement
Perform the initial measurement according to Note1 for Class II

Should be measured with a DC voltage at 25°C and Max. operating temperature for 2 minutes of charging.</td></tr>
<tr><td>Capacitance
Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F</td><td>30pF Min : Q≥1000
30pF Max : Q≥400+20xC
C : Nominal Capacitance(pF)</td><td>Rated Voltage
50V : 0.025 Max.
25V : 0.03 Max.
16V : 0.035 Max.
10V : 0.05 Max.</td></tr>
<tr><td>I.R. at 25°C</td><td>More than 10,000MΩ or 500Ω.F
(Whichever is smaller)</td><td>More than 10,000MΩ or 500Ω.F
(Whichever is smaller)</td></tr>
<tr><td>I.R. at Max operating Temp.</td><td>100Ω.F
(Whichever is smaller)</td><td>More than 1,000MΩ or 10Ω.F
(Whichever is smaller)</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200</th><th colspan="2">Specification</th><th rowspan="2">Test Methods
And Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td>18</td><td colspan="2">Voltage proof</td><td colspan="2">No dielectric breakdown or mechanical breakdown</td><td>Applied 250% of the rated voltage for 1~5 seconds
The charge/discharge current is less than 50mA.</td></tr>
<tr><td rowspan="2">19</td><td rowspan="2">Board Flex</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="2">Apply a force in the direction shown in the following figure for 60±5 seconds.

Flexure for Class l: 3mm
for Class II: 2mm</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td><td>Within the specified tolerance</td></tr>
<tr><td rowspan="2">20</td><td rowspan="2">Terminal Strength</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="2">Apply *18N force in parallel with the test jig for 60±1 seconds.

*10N for 1608(EIA:0603) size
2N for 1005(EIA:0402) size</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td><td>Within the specified tolerance</td></tr>
<tr><td>21</td><td colspan="2">Beam Load</td><td colspan="2">The chip endure following force.
<table><tr><th>Chip Length</th><th>Thickness (T)</th><th>Force</th></tr><tr><td>2.5mm Max.</td><td>T≤0.5mm
T > 0.5mm</td><td>8N
20N</td></tr><tr><td>32.Mm Min.</td><td>T < 1.25mm
T≥1.25mm</td><td>15N
54.5N</td></tr></table></td><td>Apply a force as shown in the following figure.

(i) Chip Length: 2.5mm Max.
Beam Speed: 0.5mm/s

(ii) Chip Length: 3.2mm Min.
Beam Speed: 2.5mm/s
</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200</th><th colspan="2">Specification</th><th rowspan="2">Test Methods
And Conditions</th></tr>
<tr><th>Class I</th><th>Class II</th></tr>
<tr><td rowspan="3">22</td><td rowspan="3">Capacitance Temperature Characteristics</td><td>Capacitance Change</td><td></td><td>X7R : Within ±15%
X7S : Within ±22%
X6S : Within ±22%
X7T : Within +22% ~ -33%</td><td rowspan="3">(i) Class I
The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step 1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient.

The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps
1,3 and 5 by the capacitance value in step 3.

<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr><tr><td>Temp(℃)</td><td>25±2</td><td>Min. operating temp. ±3</td><td>25±2</td><td>Max. operating temp. ±3</td><td>25±2</td></tr></table>
(ii) Class II
The ranges of capacitance change compared with the 25°C value over the temperature range from -55°C to 125°C

Initial measurement
Perform the initial measurement according to Note 1 for Class II.</td></tr>
<tr><td>Temperature Coefficient</td><td>0±30 ppm/°C</td><td></td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF
(Whichever is larger)</td><td></td></tr>
</table>

- In case of thin layer type Capacitor, it can be different from normal specification. So Please ask to our sales person.

*Note 1. Initial Measurement for Class II

Perform a heat treatment at 150+0/-10°C for one hour, and then let sit for 24+2 hours at room temperature, then measure.

"Following the International standards, the title of each test item is subject to change."

Packing

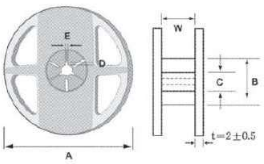
Bulk packing

① 1000 pcs per Polybag
② 5 Polybags per Inner box 3
③ 10 Inner boxes per Out box

Reel Packing

① 8-10 Reels per Inner box
② 10 Inner boxes per Out box

Reel Dimensions

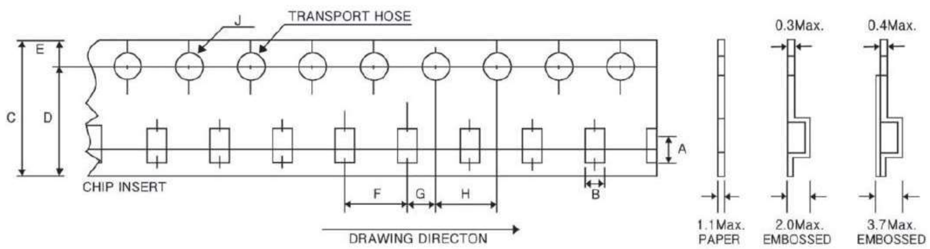


Mark	Size Code	EIA Code	A	B	C	D	E	W
7" REEL	1005~3225	0402~1210	Ø178±2	Ø50Min.	Ø13±0.5	Ø21±0.8	2±0.5	10±1.5
13" REEL	1005~3225	0402~1210	Ø178±2	Ø50Min.	Ø13±0.5	Ø21±0.8	2±0.5	10±1.5

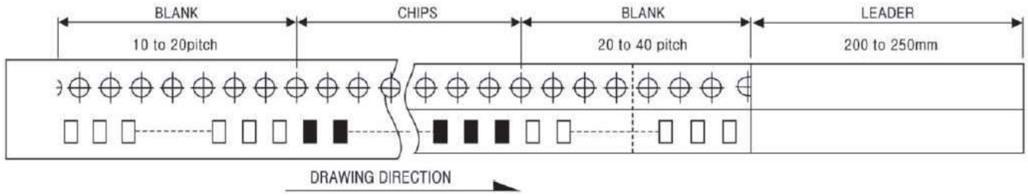
Number of Packages

Type	EIA CODE	7" Quantity(EA)/Reel	13" Quantity(EA)/Reel
1005	0402	10,000	50,000
1608	0603	4,000	16,000
2012	0805	3,000 ~ 4,000	10,000
3216	1206	2,000 ~ 4,000	6,000 ~ 10,000
3225	1210	1,000 ~ 3,000	4,000 ~ 10,000

Tape Dimensions



Type	EIA CODE	A	B	C	D	E	F	G	H	J
1005	0402	1.15±0.1	0.65±0.1	8.00±0.3	3.5±0.05	1.75±0.1	2.0±0.05	2.0±0.1	4.0±0.1	1.5±0.1
1608	0603	1.9±0.2	1.10±0.2	8.00±0.3	3.5±0.05	1.75±0.1	4.0±0.1	2.0±0.1	4.0±0.1	1.5±0.1
2012	0805	2.4±0.2	1.65±0.2	8.00±0.3	3.5±0.05	1.75±0.1	4.0±0.1	2.0±0.1	4.0±0.1	1.5±0.1
3216	1206	3.6±0.2	2.00±0.2	8.00±0.3	3.5±0.05	1.75±0.1	4.0±0.1	2.0±0.1	4.0±0.1	1.5±0.1
3225	1210	3.6±0.2	2.80±0.2	8.00±0.3	3.5±0.05	1.75±0.1	4.0±0.1	2.0±0.1	4.0±0.1	1.5±0.1



Caution

Storage Condition

When solderability is considered, capacitor are recommended to be used in 12 months.

(1) Temperature : 25℃ ± 10℃

(2) Relative Humidity : Below 70% RH

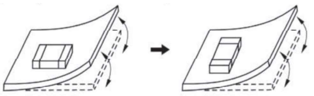
The Regulation of Environmental Pollution Materials

Never use materials mentioned below in MLCC products regulated this document. Pb, Cd, Hg, Cr^{+6}, PBB(Polybrominated biphenyl), PBDE(Polybrominated diphenyl ethers), asbestos

Mounting Position

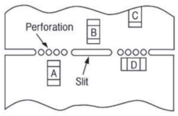
Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

(Component direction)



Locate chip horizontal to the direction in which stress acts

(Chip Mounting Close to Board Separation Point)



Chip arrangement
Worst A-C-(B, D) Best

Reflow Soldering

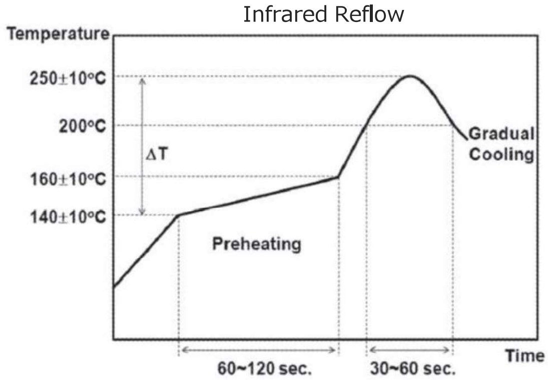
1. The sudden temperature change easily causes mechanical damages to ceramic components. Therefore, the preheating procedures should be required for the soldering of ceramic components.

2. Please refer to the recommended soldering profiles as shown in figures, and keep the temperature difference(AT) within the range recommended in Table 1.

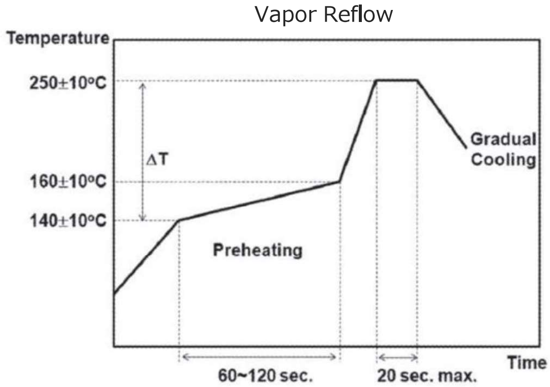
Table 1.

Size code (EIA Code)	Temperature Difference
1005~3216 (0402~1206)	△T≤190℃
3225 (1210)	△T≤130℃

Infrared Reflow



Vapor Reflow



'Aging'/'De-aging' behavior of high dielectric constant type MLCCS

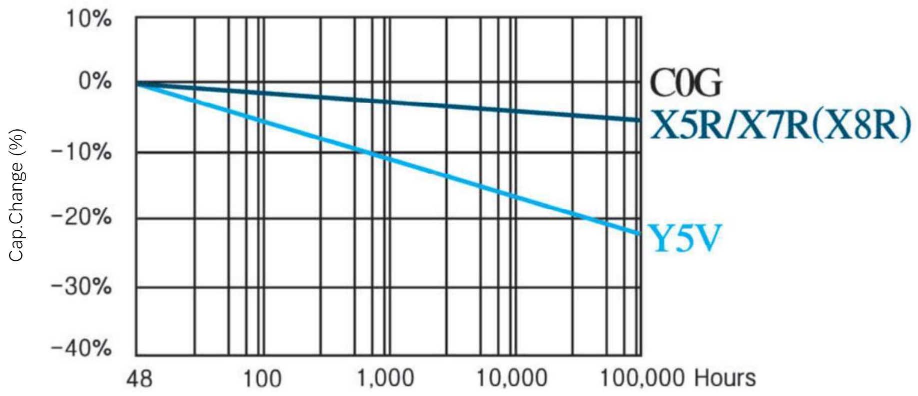
(Typically represented by X7R temperature characteristic of which main composition is $BaTiO_3$)

'Aging' / 'De-aging' Behavior of high dielectric MLCCs Please note that high dielectric type dielectric ceramic capacitors have a "normal" 'aging' behavior / characteristic, that is;
their capacitance value decreases with time from its value when it was first manufactured.
From that date, the capacitance value begins to decrease at a logarithmic rate defined by:

$$C_t = C_{48}(1 - K \log10\, t)$$

C_t : Capacitance value, t hours after the start of 'aging'
C_{48} : Capacitance value, 48 hours after its manufacture
K : Aging constant (capacitance decrease per decade-hour)
t : time, in hours, from the start of 'aging'

Ceramic's Capacitance Change(%) versus Time (hours)



The capacitance value can be restored(also known as 'de-aged') by exposing the component to elevated temperatures approaching its curie temperature(approximately 120°C).
This 'de-aging' can occur during the component's solder-assembly onto the PCB, during life or temperature cycle testing, or by baking at 150°C for about 1 hour.

Dielectric	Maximum percent capacitance loss per decade hour, k
C0G	0
X7R	~3%