

# Multi Layer Ceramic Capacitors

## 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 COG 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  $\pm 15\%$  over the temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The X5R provides intermediate capacitance values which vary  $\pm 15\%$  over the temperature range of  $-55^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ . The Y5V provides the highest capacitance value which vary from 22% to -82% over the temperature range of  $-30^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ . 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 products like Cellular Phone, Pager, Codeless phone
- Multimedia products like DVD, CD-ROM, FDD, HDD, Game machine, Computer, Note book, Digital camera, LCD
- Audio visual products like TV, Camcorder, Minidisk, MP3 Player
- Communication products like Electronic tuner, Duplexer, VCXO, TCXO, Modem
- OA equipment products like Printer, Copy Machine, Fax Machine

# SMD Type

## Shape & Dimensions



Code	Dimensions				
	Length(L)	Width(W)	Thickness(T)	T <sub>1</sub>	g Min.
0603	0.6 ± 0.03	0.30 ± 0.03	0.30 ± 0.03	0.1 to 0.2	0.2
1005	1.0 ± 0.05	0.50 ± 0.05	0.50 ± 0.05	0.15 to 0.3	0.4
1608	1.6 ± 0.1	0.80 ± 0.1	0.80 ± 0.1	0.2 to 0.5	0.5
2012	2.0 ± 0.1	1.25 ± 0.1	0.60 ± 0.1	0.2 to 0.7	0.7
			0.85 ± 0.1		
			1.25 ± 0.1		
3216	3.20 ± 0.25	1.60 ± 0.2	0.85 ± 0.15	0.3 to 0.8	1.5
			1.15 ± 0.15		
			1.60 ± 0.15		
3225	3.20 ± 0.25	2.50 ± 0.2	0.85 ± 0.15	0.3Min.	1.0
			1.15 ± 0.15		
			1.35 ± 0.15		
			1.60 ± 0.20		
			1.80 ± 0.20		
			2.00 ± 0.20		
4520	4.5 ± 0.3	2.0 ± 0.2	1.0 +0, -0.3	0.3Min.	2.0
			1.25 +0, -0.3		
			2.0 ± 0.3		
4532	4.5 ± 0.4	3.2 ± 0.3	1.15 ± 0.10	0.3Min.	2.0
			1.35 ± 0.15		
			1.80 ± 0.20		
			2.0 ± 0.20		
			2.5 ± 0.20		
			2.8 ± 0.20		

## How to Order(Product Identification)

**CS 1608 X7R 104 K 160 N R B**



### 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
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**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%	-30 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%	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 16V	DC 25V	DC 50V	DC 100V	DC 200V	DC 250V	DC 630V	DC 3000V

**7 Termination Code**

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

**8 Packing Code**

Ex.) R : Reel Type B : Bulk Type

**9 Carrier Tape Thickness**

( A : 0.75Max. B : 0.95Max. E : over 0.95mm )

Code	A	B	E	H	I	J	K	L
Tolerance	0.75mm and under	0.85mm	1.0~1.30mm	1.35mm	1.60mm	1.80mm	2.00mm	2.50mm

## Typical Performance Characteristics

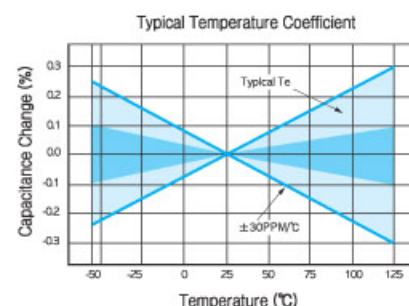
### COG

#### 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	$0 \pm 30 \text{ppm}/^\circ\text{C}$
Operating Temperature	$-55 \sim 125^\circ\text{C}$
Capacitance Tolerance	$> 10 \text{pF}$ : $\pm 5\%$ , $\pm 10\%$ , ( $\pm 1\%$ , $\pm 2\%$ , $\pm 20\%$ ) $\leq 10 \text{pF}$ : $\pm 0.1 \text{pF}$ , $\pm 0.25 \text{pF}$ , $\pm 0.5 \text{pF}$
Dissipation Factor & Q	$\geq 30 \text{pF}$ : $\text{DF} \leq 0.1\%$ , $Q \geq 1000$ $< 30 \text{pF}$ : $Q \geq 400 + 20 \times C$
Insulation Resistance	More than $10,000 \text{M}\Omega$ or $500 \text{Q}\Omega\text{F}$ (Whichever is smaller)
Dielectric Strength	$> 3 \times \text{RVDC}$
Test Voltage	$0.5$ to $5 \text{Vrms}$ ( $\leq 1000 \text{pF}$ ), $1 \pm 0.2 \text{Vrms}$ ( $> 1000 \text{pF}$ )
Test Frequency	$1 \pm 0.1 \text{MHz}$ ( $\leq 1000 \text{pF}$ ), $1 \pm 0.1 \text{kHz}$ ( $> 1000 \text{pF}$ )



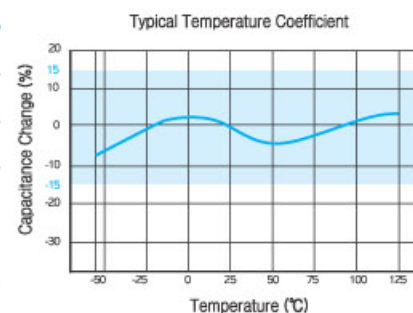
### X7R

#### 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	$\pm 15\%$
Operating Temperature	$-55 \sim 125^\circ\text{C}$
Capacitance Tolerance	$\pm 10\%$ , $\pm 20\%$ , ( $\pm 5\%$ , $+80 \sim -20\%$ )
Dissipation Factor & Q	$50 \text{V Min.} : 2.5\% \text{ Max.}$ $25 \text{V Min.} : 3.0\% \text{ Max.}$ $16 \text{V Min.} : 3.5\% \text{ Max.}$ $10 \text{V Min.} : 5.0\% \text{ Max.}$ $6.3 \text{V Min.} : 5.0\% \text{ Max.}$ ( $< 3.3 \mu\text{F}$ ), $10\% \text{ Max.}$ ( $\geq 3.3 \mu\text{F}$ ) Thin layer large capacitors type 10% Max.
Insulation Resistance	More than $10,000 \text{M}\Omega$ or $500 \text{Q}\Omega\text{F}$ (Whichever is smaller) Thin layer large capacitors type $50 \text{Q}\Omega\text{F Min.}$
Dielectric Strength	$> 2.5 \times \text{RVDC}$
Test Voltage	$1 \pm 0.2 \text{Vrms}$ ( $\leq 10 \mu\text{F}$ , $10 \text{V Min.}$ ) $0.5 \pm 0.1 \text{Vrms}$ ( $\leq 10 \mu\text{F}$ , $6.3 \text{V Max.}$ ) $0.5 \pm 0.1 \text{Vrms}$ ( $> 10 \mu\text{F}$ )
Test Frequency	$1 \pm 0.1 \text{kHz}$ ( $\leq 10 \mu\text{F}$ , $10 \text{V Min.}$ ) $1 \pm 0.1 \text{kHz}$ ( $\leq 10 \mu\text{F}$ , $6.3 \text{V Max.}$ ) $120 \pm 24 \text{Hz}$ ( $> 10 \mu\text{F}$ )



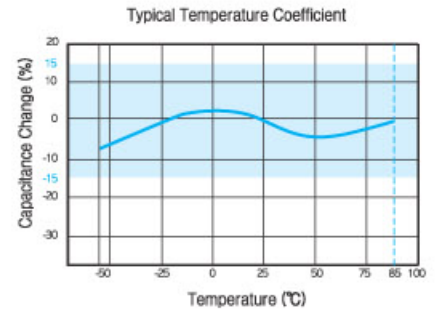
# X5R

## 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	$\pm 15\%$
Operating Temperature	$-55\sim 85^{\circ}\text{C}$
Capacitance Tolerance	$\pm 10\%$ , $\pm 20\%$ , ( $\pm 5\%$ , $+80\sim -20\%$ )
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. ( $<3.3\mu\text{F}$ ), 10% Max. ( $\geq 3.3\mu\text{F}$ ) Thin layer large capacitors type 10% Max.
Insulation Resistance	More than $10,000\text{M}\Omega$ or $500\text{QF}$ (Whichever is smaller) Thin layer large capacitors type $50\text{QF}$ Min.
Dielectric Strength	$>2.5 \times \text{RVDC}$
Test Voltage	$1 \pm 0.2\text{Vrms}$ ( $\leq 10\mu\text{F}$ , 10V Min.) $0.5 \pm 0.1\text{Vrms}$ ( $\leq 10\mu\text{F}$ , 6.3V Max.) $0.5 \pm 0.1\text{Vrms}$ ( $>10\mu\text{F}$ )
Test Frequency	$1 \pm 0.1\text{kHz}$ ( $\leq 10\mu\text{F}$ , 10V Min.) $1 \pm 0.1\text{kHz}$ ( $\leq 10\mu\text{F}$ , 6.3V Max.), $120 \pm 24\text{Hz}$ ( $>10\mu\text{F}$ )



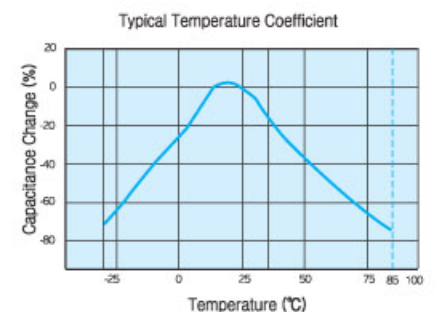
# Y5V

## 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	$+22\% \sim -82\%$
Operating Temperature	$-30\sim 85^{\circ}\text{C}$
Capacitance Tolerance	$-20\sim +80\%$ ( $\pm 20\%$ )
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 $10,000\text{M}\Omega$ or $500\text{QF}$ (Whichever is smaller) Thin layer large capacitors type $50\text{QF}$ Min.
Dielectric Strength	$>2.5 \times \text{RVDC}$
Test Voltage	$1 \pm 0.2\text{Vrms}$ ( $\leq 10\mu\text{F}$ , 10V Min.) $0.5 \pm 0.1\text{Vrms}$ ( $\leq 10\mu\text{F}$ , 6.3V Max.) $0.5 \pm 0.1\text{Vrms}$ ( $>10\mu\text{F}$ )
Test Frequency	$1 \pm 0.1\text{kHz}$ ( $\leq 10\mu\text{F}$ , 10V Min.) $1 \pm 0.1\text{kHz}$ ( $\leq 10\mu\text{F}$ , 6.3V Max.), $120 \pm 24\text{Hz}$ ( $>10\mu\text{F}$ )





## X7R Type(0603~3216)

Type		X7R																					
Size		0603		1005			1608					2012					3216						
Volt Cap(pF)	T	6.3	16	10	16	25	50	10	16	25	50	100	10	16	25	50	100	10	16	25	50	100	
		100	0.3	0.3	0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8										
150	0.3	0.3	0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8												
220	0.3	0.3	0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8												
330	0.3	0.3	0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8												
470	0.3	0.3	0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.6	0.6	0.85							
1,000	0.3	0.3	0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.6	0.6	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
1,500	0.3		0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.6	0.6	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
2,200	0.3		0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.6	0.6	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
3,300	0.3		0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.6	0.6	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
4,700	0.3		0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8		0.6	0.6	0.6	0.6	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
6,800	0.3		0.5	0.5	0.5		0.8	0.8	0.8	0.8		0.6	0.6	0.6	0.6	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
10,000	0.3		0.5	0.5	0.5		0.8	0.8	0.8	0.8		0.6	0.6	0.6	0.6	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
15,000			0.5	0.5			0.8	0.8	0.8	0.8		0.6	0.6	0.6	0.6	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
18,000			0.5	0.5			0.8	0.8	0.8	0.8		0.6	0.6	0.6	0.6	1.25	0.85	0.85	0.85	0.85	0.85	0.85	
22,000			0.5	0.5			0.8	0.8	0.8	0.8		0.6	0.6	0.6	0.6	1.25	0.85	0.85	0.85	0.85	0.85	0.85	
33,000			0.5	0.5			0.8	0.8	0.8	0.8		0.6	0.6	0.6	0.6	1.25	0.85	0.85	0.85	0.85	0.85	0.85	
47,000			0.5	0.5			0.8	0.8	0.8	0.8		0.85	0.85	0.85	0.85	1.25	0.85	0.85	0.85	0.85	0.85	1.15	
68,000			0.5	0.5			0.8	0.8	0.8	0.8		0.85	0.85	0.85	0.85		0.85	0.85	0.85	0.85	0.85	1.15	
100,000			0.5	0.5			0.8	0.8	0.8	0.8		0.85	0.85	0.85	0.85		0.85	0.85	0.85	0.85			
150,000							0.8	0.8	0.8			0.85	0.85	0.85	1.25		0.85	0.85	0.85	0.85			
220,000							0.8	0.8	0.8			0.85	0.85	0.85	1.25		0.85	0.85	0.85	0.85			
330,000												0.85	0.85	1.25	1.25		0.85	0.85	0.85	0.85			
470,000												0.85	0.85	1.25	1.25		0.85	0.85	0.85	1.15			
680,000												0.85	0.85	1.25			0.85	0.85	0.85	1.15			
1,000,000												1.25	1.25	1.25			0.85	0.85	1.15	1.15			
1,500,000												1.25					0.85	1.15	1.15	1.6			
2,200,000												1.25					1.15	1.15	1.15	1.6			
3,300,000																	1.15	1.6	1.6				
4,700,000																	1.6	1.6	1.6				
10,000,000																	1.6						





**Large Size Capacitors(3225~4532)**

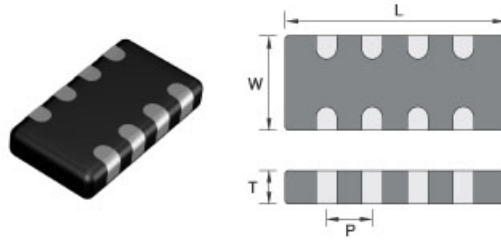
Type		COG		X7R				X5R		Y5V						
Size		3225	4532	3225				4532		3225	3225					
Volt		200	200	16	25	50	100	50	100	10	6.3	10	16	25	50	100
Cap(pF)	T															
560		1.35														
680		1.35														
820		1.35														
1,000		1.35														
1,200			1.8													
1,500			1.8													
1,800			1.8													
2,200			1.8													
2,700			1.8													
3,300																
3,900																
4,700																
5,600																

68,000							1.35									
100,000							1.35									1.35
150,000								1.8								
220,000							2.0	1.8								
470,000								2.0								
680,000						1.35										
1,000,000					1.8	2.5									1.8	
2,200,000			1.15	1.8			2.5	2.5								
3,300,000			1.35													
4,700,000			1.8											0.85	1.8	
10,000,000									2.5			1.35	1.35	2.0		
22,000,000											1.6					
47,000,000											1.6					



## Chip Capacitors Arrays

### Shape & Dimensions



Length (L)	3.20±0.15
Width (W)	1.6±0.15
Thickness (T)	0.8±0.1
P	0.8±0.1

### Capacitance Range

Type		C0G		X7R				Y5V	
Size		3216		3216				3216	
Cap(pF)	T	50	100	16	25	50	100	16	50
10		0.8	0.8						
15		0.8	0.8						
22		0.8	0.8						
47		0.8	0.8						
68		0.8	0.8						
100		0.8	0.8						
150		0.8	0.8						
220		0.8							
330		0.8							
470									
560									
820				0.8	0.8	0.8	0.8		
1,000				0.8	0.8	0.8	0.8		
2,200				0.8	0.8	0.8	0.8		
3,300				0.8	0.8	0.8	0.8		
4,700				0.8	0.8	0.8	0.8		
5,600				0.8	0.8	0.8			
8,200				0.8	0.8	0.8			
10,000				0.8	0.8	0.8			
15,000				0.8	0.8	0.8			
18,000				0.8	0.8				
22,000				0.8				0.8	0.8
33,000				0.8				0.8	0.8
47,000								0.8	0.8
68,000								0.8	
100,000								0.8	
150,000								0.8	

# SMD Type-High Voltage

## Product Offering

SAMWHA high voltage MLCC products with COG(NPO) and X7R temperature characteristic are designed for commercial and industrial applications.

The products are power supply and voltage multiplier circuits applications in various sizes with working voltages up to DC 3.0 KV .

These high voltage capacitors feature a special internal electrode design which reduces voltage concentrations by distributing voltage gradients throughout the entire capacitor.

This unique design also affords that capacitance value is increased in a given case size and voltage rating.

## Features

- High reliability
- High voltage ratings
- Wide voltage level : from 100V to 3000V
- Surface mount suited for Wave and Reflow Soldering
- Tape & reel surface mount assembly
- Suitable for Back-Lighting Inverter, DC-DC Converters, Ballast, Modems & Power Supply, LAN/WLAN interface... etc.

## How to Order(Product Identification)

**CS 4520 COG 150 J 302 N R E**

1 2 3 4 5 6 7 8 9

### 1 Type

CS : SMD

### 2 Size Code

Size(mm)	1608	2012	3216	3225	4520	4532

### 3 Dielectric (Temp. Coefficient)

COG, X7R

### 4 Capacitance

1st two digits are value, 3rd digit denotes number of zeros;

331 = 330pF, 104 = 100000pF, 8R2C = 8.2pF

**5 Tolerance**

Code	Tolerance	Code	Tolerance
B	$\pm 0.1$ pF	C	$\pm 0.25$ pF
D	$\pm 0.50$ pF	F	$\pm 1\%$
G	$\pm 2\%$	J	$\pm 5\%$
K	$\pm 10\%$	M	$\pm 20\%$
Z	+80~-20%		

**6 Rated Voltage Code**

1st two digits are value, 3rd digit denotes number of zeros; 302 = 3000V, 251 = 250V

**7 Plating**

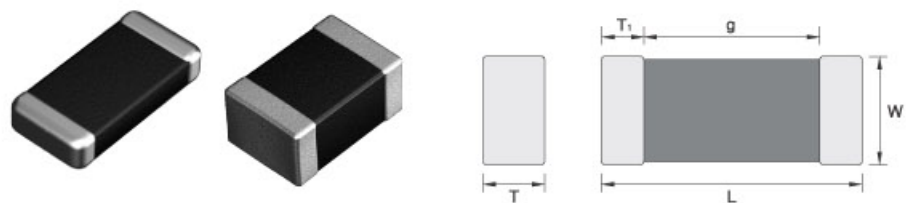
Ni / Sn Plated

**8 Packing**

B : Bulk Pack R : Reel Pack

**9 Thickness Code**

Code	Tolerance	Code	Tolerance
B	0.85mm	E	1.0~1.30mm
H	1.35mm	I	1.60mm
J	1.80mm	K	2.00mm
L	2.50mm	M	2.80mm

**Shape & Dimensions**

(Unit : mm)

Code	Dimensions				
	Length(L)	Width(W)	Thickness(T)	T <sub>1</sub>	g Min.
1608(0603)	$1.6 \pm 0.1$	$0.80 \pm 0.1$	$0.80 \pm 0.1$	0.2 To 0.5	0.5
2012(0805)	$2.0 \pm 0.15$	$1.25 \pm 0.15$	$0.60 \pm 0.1$	0.2 To 0.7	0.7
			$0.85 \pm 0.1$		
			$1.25 \pm 0.15$		
3216(1206)	$3.20 \pm 0.25$	$1.60 \pm 0.2$	$0.85 \pm 0.15$	0.3 To 0.8	1.5
			$1.15 \pm 0.15$		
			$1.30 \pm 0.15$		
			$1.60 \pm 0.2$		

(Unit : mm)

Code	Dimensions				
	Length(L)	Width(W)	Thickness(T)	T <sub>1</sub>	g Min.
3225(1210)	3.20±0.30	2.50±0.2	0.85±0.15	0.3 Min	1
			1.15±0.15		
			1.35±0.15		
			1.60±0.20		
			1.80±0.20		
			2.00±0.20		
			2.50±0.20		
4520(1808)	4.5±0.3	2.0±0.2	1.00 +0, -0.3	0.3 Min	2
			1.15±0.2		
			1.25±0.2		
			1.60±0.25		
			2.0±0.3		
4532(1812)	4.5±0.4	3.2±0.3	1.15±0.10	0.3 Min	2
			1.35±0.15		
			1.6±0.25		
			1.80±0.25		
			2.0±0.20		
			2.5±0.20		
			2.8±0.20		

## Typical Performance Characteristics

Dielectric Characteristics	COG(NPO)	X7R
Dielectric Classification	Ultra Stable	Stable
Rated temperature range	-55°C to +125°C	-55°C to +125°C
TCC(Temperature Characteristics Coefficient)	0±30ppm	±15%
Dissipation Factor(tan δ)	C≥30pF : Q≥1,000 (DF:≤ 0.1%) C<30pF : Q≥400+20C(DF: ≤1/(400+20C))	2.5% Max.
IR(Insulation Resistance)	500V Below : Rated voltage 60sec 500V Above : 500V 60sec More than 10,000 MΩ	500V Below:Rated voltage 60sec 500V Above:500V 60sec -DC250V~1KV :C≥0.01μF:More than 100MΩ μF :C<0.01μF:More than 10,000MΩ -DC2~3KV:More than6,000 MΩ
Capacitance Tolerance	<10pF : ±0.25pF, ±0.5pF ≥10pF : ±5%, ±0%	±10%, ±20%
Dielectric strength	630V:150% Rated Voltage 1kV~3kV:120% Rated Voltage 3.15kV:DC 4095V	250V:150% Rated Voltage 630V:150% Rated Voltage 1kV~2kV: 120% Rated Voltage
Aging characteristics	0%	2.5% per decade hr, typical

## Capacitance Range

COG (Temperature compensation type)

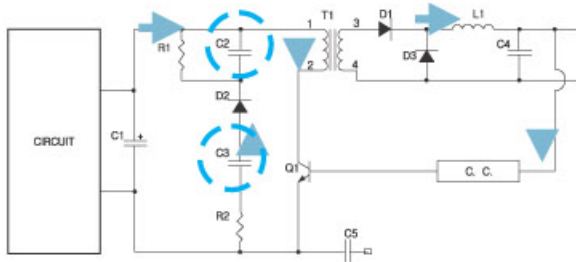
Dielectric Size Code	1608 (0603)		2012 (0805)		3216 (1206)		3225 (1210)		4520 (1808)				4532 (1812)			
	200	200	200	500/630	250	500	250	500/630	1000	2000	3000	200/250	500	1000	2000	3000
Rated Voltage(V)																
Capacitance																
0.5pF																
1pF																
4pF																
5pF																
8pF																
10pF																
15pF																
18pF																
22pF																
33pF																
47pF																
68pF																
100pF																
120pF																
150pF																
180pF																
220pF																
270pF																
330pF																
470pF																
560pF																
680pF																
820pF																
1000pF																
1500pF																
2200pF																
3300pF																
5600pF																





## Application(Typical circuit)

### DC-DC Converter

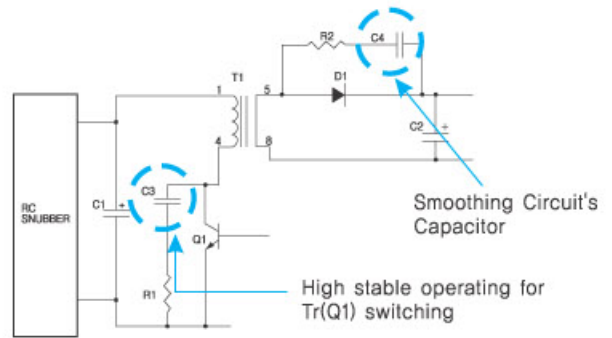


High stable operating for Tr(Q1) switching

C2 : X7R ; 250V 10nF~47nF

C3 : COG ; 630V 47pF~100pF

### Switching Power Supply



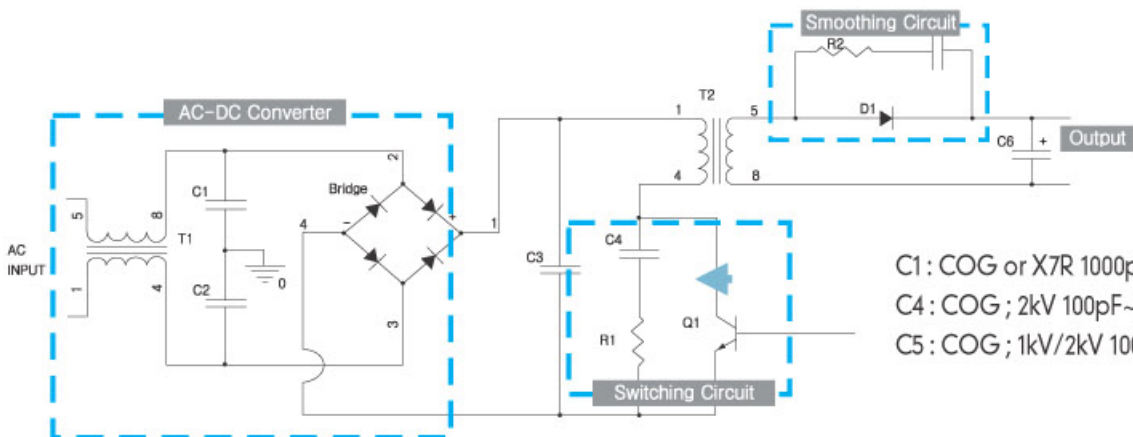
Smoothing Circuit's Capacitor

High stable operating for Tr(Q1) switching

C3 : COG, X7R ; 2kV 100pF~1000pF

C4 : COG, X7R ; 2kV 100pF~1000pF

### Primary circuit and Snubber switching power supply

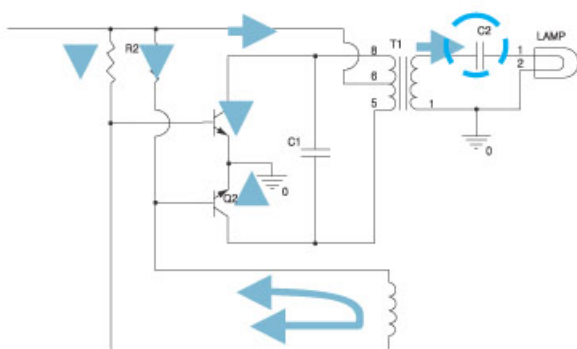


C1 : COG or X7R 1000pF~4700pF

C4 : COG ; 2kV 100pF~330pF

C5 : COG ; 1kV/2kV 100pF~470pF

### LCD back light Inverter



C2 : COG ; 3kV 10 ~100pF

SAMWHA CAPACITOR CO., LTD offers a line of MLCC(Multilayer Ceramic Capacitor). These parts are rated at 3kV dc and safety approved and certified to UL (Underwriters Laboratories Inc. ® )



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**SAMWHA CAPACITOR CO LTD**

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NAMSA-MYEUN

YONGIN-SHI, KYONGGI-DO 449-880 REPUBLIC OF KOREA

**Component Recognition, Model(s)** CS45XXYYTTA302NRE.



Marking: Company name, model designation and Recognized Component Mark for Canada,

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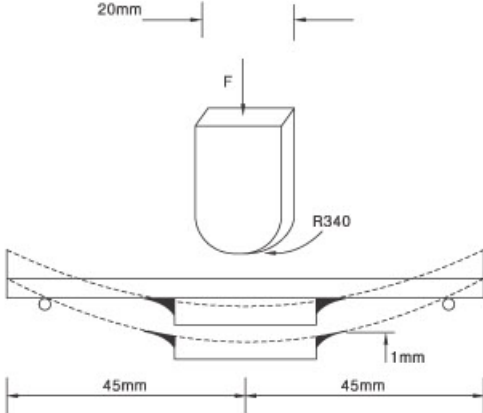
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## Reliability and Test Conditions(General Type)

No.	Item	Characteristic		Test Methods and Conditions																																				
		Temperature Compensating Type	High Dielectric Constant Type																																					
1	Operating Temperature Range	C0G : -55 to +125°C	X7R : -55 to +125°C X5R : -55 to +85°C Y5V : -30 to +85°C																																					
2	Insulation Resistance	More than 10,000MΩ or 500ΩF(Whichever is smaller)		Applied the rated voltage for 2minutes of charging																																				
3	Dielectric Strength	No defects or abnormalities		- C0G : Rated Voltage × 300% - X7R, X5R, Y5V : " × 250% - High Voltage Type : DC 1kV, 2kV, 3kV ; The Rated Voltage × 120%																																				
4	Capacitance	Within the specified tolerance																																						
5	Dissipation Factor	30pF Min. : Q ≥ 1,000 (DF ≤ 0.1%)  30pF Max. : Q ≥ 400+20C (DF ≤ 1/(400+20C))	<table border="1"> <thead> <tr> <th>Char.</th> <th>50V Min.</th> <th>25V</th> <th>16V</th> <th>10V</th> <th>6.3V</th> </tr> </thead> <tbody> <tr> <td>X7R X5R</td> <td>≤ 2.5%</td> <td>≤ 3%</td> <td>≤ 3.5%</td> <td>≤ 5.0%</td> <td>≤ 5.0% ( &lt; 3.3μF ) ≤ 10% ( ≥ 3.3μF )</td> </tr> <tr> <td>Y5V</td> <td>≤ 5% ( &lt; 220nF ) ≤ 7% ( ≥ 220nF )</td> <td>≤ 7%</td> <td>≤ 9% ( &lt; 220nF ) ≤ 12.5% ( ≥ 220nF )</td> <td>≤ 12.5%</td> <td>≤ 15%</td> </tr> </tbody> </table>	Char.	50V Min.	25V	16V	10V	6.3V	X7R X5R	≤ 2.5%	≤ 3%	≤ 3.5%	≤ 5.0%	≤ 5.0% ( < 3.3μF ) ≤ 10% ( ≥ 3.3μF )	Y5V	≤ 5% ( < 220nF ) ≤ 7% ( ≥ 220nF )	≤ 7%	≤ 9% ( < 220nF ) ≤ 12.5% ( ≥ 220nF )	≤ 12.5%	≤ 15%	<table border="1"> <thead> <tr> <th>Cap.</th> <th>Testing Frequency</th> <th>Testing Voltage</th> </tr> </thead> <tbody> <tr> <td>C0G (C ≤ 1000pF)</td> <td>1 ± 0.1MHz</td> <td>0.5 to 5V rms</td> </tr> <tr> <td>C0G (C &gt; 1000pF)</td> <td>1 ± 0.1kHz</td> <td>1 ± 0.2V rms</td> </tr> <tr> <td>X7R, X5R, Y5V (C ≤ 10μF 10V Min.)</td> <td>1 ± 0.1kHz</td> <td>1 ± 0.2V rms</td> </tr> <tr> <td>X7R, X5R, Y5V (C ≤ 10μF 6.3V Max.)</td> <td>1 ± 0.1kHz</td> <td>0.5 ± 0.1V rms</td> </tr> <tr> <td>X7R, X5R, Y5V (C &gt; 10μF)</td> <td>120 ± 24Hz</td> <td>0.5 ± 0.1V rms</td> </tr> </tbody> </table>	Cap.	Testing Frequency	Testing Voltage	C0G (C ≤ 1000pF)	1 ± 0.1MHz	0.5 to 5V rms	C0G (C > 1000pF)	1 ± 0.1kHz	1 ± 0.2V rms	X7R, X5R, Y5V (C ≤ 10μF 10V Min.)	1 ± 0.1kHz	1 ± 0.2V rms	X7R, X5R, Y5V (C ≤ 10μF 6.3V Max.)	1 ± 0.1kHz	0.5 ± 0.1V rms	X7R, X5R, Y5V (C > 10μF)	120 ± 24Hz	0.5 ± 0.1V rms
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6	Solderability of Termination	Termination should be covered with more than 75% of new solder		- Pb-Free Type Solder : 96.5Sn-3Ag-0.5Cu Solder Temperature : 260 ± 5°C Immersion Time : 3 ± 0.1sec  - Pre-Heating at 80~120°C for 10~30sec																																				
7	Resistance to Soldering Heat	Appearance	No marked defect		- Soldering Temp : 260 +5°C/-0°C - Immersion Time : 10 ± 0.5 sec - Take it out and set it for 24 ± 2 hours (temperature compensating type) or 48 ± 4hours(high dielectric constant type)then measure																																			
		Capacitance	Within ± 2.5% or ± 0.25pF (whichever is larger)	X7R, X5R : ≤ ± 7.5% Y5V : ≤ ± 20%																																				
	Dissipation Factor (or Q)	30pF Min. : Q ≥ 1,000 (DF ≤ 0.1%)  30pF Max. : Q ≥ 400+20C (DF ≤ 1/(400+20C))	<table border="1"> <thead> <tr> <th>Char.</th> <th>50V Min.</th> <th>25V</th> <th>16V</th> <th>10V</th> <th>6.3V</th> </tr> </thead> <tbody> <tr> <td>X7R X5R</td> <td>≤ 2.5%</td> <td>≤ 3%</td> <td>≤ 3.5%</td> <td>≤ 5.0%</td> <td>≤ 5.0% ( &lt; 3.3μF ) ≤ 10% ( ≥ 3.3μF )</td> </tr> <tr> <td>Y5V</td> <td>≤ 5% ( &lt; 220nF ) ≤ 7% ( ≥ 220nF )</td> <td>≤ 7%</td> <td>≤ 9% ( &lt; 220nF ) ≤ 12.5% ( ≥ 220nF )</td> <td>≤ 12.5%</td> <td>≤ 15%</td> </tr> </tbody> </table>	Char.		50V Min.	25V	16V	10V	6.3V	X7R X5R	≤ 2.5%	≤ 3%	≤ 3.5%	≤ 5.0%	≤ 5.0% ( < 3.3μF ) ≤ 10% ( ≥ 3.3μF )	Y5V	≤ 5% ( < 220nF ) ≤ 7% ( ≥ 220nF )	≤ 7%	≤ 9% ( < 220nF ) ≤ 12.5% ( ≥ 220nF )	≤ 12.5%	≤ 15%																		
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No.	Item	Characteristic					Test Methods and Conditions																				
		Temperature Compensating Type	High Dielectric Constant Type																								
8	Temperature Cycle	Appearance	No marking defects					<table border="1"> <thead> <tr> <th>Step</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>Temp. (°C)</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>30±3</td> <td>2 to 3</td> <td>30±3</td> <td>2 to 3</td> </tr> </tbody> </table> <p>Take it out and set it for 24±2 hours (temperature compensating) or 48±4 hours (high dielectric constant type) at room temperature, then measure.</p>	Step	1	2	3	4	Temp. (°C)	Min. Operating Temp. +0, -3	Room Temp.	Max. Operating Temp. +3, -0	Room Temp.	Time (Min.)	30±3	2 to 3	30±3	2 to 3				
		Step	1	2	3	4																					
		Temp. (°C)	Min. Operating Temp. +0, -3	Room Temp.	Max. Operating Temp. +3, -0	Room Temp.																					
		Time (Min.)	30±3	2 to 3	30±3	2 to 3																					
Capacitance Change	Within ±2.5% or ±0.25µF (whichever is larger)	X7R, X5R : Within ±7.5% Y5V : Within ±20%																									
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I.R.	More than 10,000MΩ or 500Ω.F (Whichever is smaller)																										
9	Humidity Load	Appearance	No marking defects					<ul style="list-style-type: none"> <li>- Temperature : 40±2°C</li> <li>- Humidity : 90~95%</li> <li>- Hour : 500±12hrs</li> <li>- Test Voltage : The rated voltage</li> <li>- Take it out and set it for 24±2 hours (temperature compensating) or 48±4 hours (high dielectric constant type) at room temperature, then measure.</li> <li>The charge/discharge current is less than 50mA</li> </ul>																			
		Capacitance Change	Within ±7.5% or ±0.75µF (whichever is larger)	X7R, X5R : Within ±12.5% Y5V : Within +30%, -40% (Y5V/1.0µF, 2.2µF, 4.7µF/10V) Within ±30% (others)																							
		Dissipation Factor (or Q)	30µF Min. : Q ≥ 200 (DF ≤ 0.5%)  30µF Max. : Q ≥ 100 +10/3C (DF ≤ 1/(100+10/3C))	<table border="1"> <thead> <tr> <th>Char.</th> <th>50V Min.</th> <th>25V</th> <th>16V</th> <th>10V</th> <th>6.3V</th> </tr> </thead> <tbody> <tr> <td>X7R X5R</td> <td>≤5%</td> <td>≤5%</td> <td>≤5%</td> <td>≤5%</td> <td>≤7.5% (&lt;3.3µF) ≤12.5% (≥3.3µF)</td> </tr> <tr> <td>Y5V</td> <td>≤7.5%</td> <td>≤10% (&lt;1µF) ≤12.5% (≥1µF)</td> <td>≤12.5%</td> <td>≤15%</td> <td>≤20%</td> </tr> </tbody> </table>					Char.	50V Min.	25V	16V	10V	6.3V	X7R X5R	≤5%	≤5%	≤5%	≤5%	≤7.5% (<3.3µF) ≤12.5% (≥3.3µF)	Y5V	≤7.5%	≤10% (<1µF) ≤12.5% (≥1µF)	≤12.5%	≤15%	≤20%	
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I.R.	More than 500MΩ or 25Ω.F (Whichever is smaller)																										
10	High Temperature Load	Appearance	No marking defects					<ul style="list-style-type: none"> <li>- Testing time : 1000±12hrs</li> <li>- Applied Voltage : Rated Voltage × 200%</li> <li>- Temperature : C0G, X7R → 125±3°C X5R, Y5V → 85±3°C</li> <li>- Take it out and set it for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.</li> <li>The charge/discharge current is less than 50mA</li> </ul>																			
		Capacitance Change	Within ±3% or ±0.3µF (whichever is larger)	X7R, X5R : Within ±12.5% Y5V : Within ±30% (Cap. < 1.0µF) Within +30%, -40% (Cap. ≥ 1.0µF)																							
		Dissipation Factor (or Q)	30µF Min. : Q ≥ 350 (DF ≤ 0.3%)  10µF ≤ Cp ≤ 30µF : Q ≥ 275 +5/2C (DF ≤ 1/(275+5/2C))  10µF Max. : Q ≥ 200+10C (DF ≤ 1/(200+10C))	<table border="1"> <thead> <tr> <th>Char.</th> <th>50V Min.</th> <th>25V</th> <th>16V</th> <th>10V</th> <th>6.3V</th> </tr> </thead> <tbody> <tr> <td>X7R X5R</td> <td>≤5%</td> <td>≤5%</td> <td>≤5%</td> <td>≤5%</td> <td>≤7.5% (&lt;3.3µF) ≤12.5% (≥3.3µF)</td> </tr> <tr> <td>Y5V</td> <td>≤7.5%</td> <td>≤10% (&lt;1µF) ≤12.5% (≥1µF)</td> <td>≤12.5%</td> <td>≤15%</td> <td>≤20%</td> </tr> </tbody> </table>					Char.	50V Min.	25V	16V	10V	6.3V	X7R X5R	≤5%	≤5%	≤5%	≤5%	≤7.5% (<3.3µF) ≤12.5% (≥3.3µF)	Y5V	≤7.5%	≤10% (<1µF) ≤12.5% (≥1µF)	≤12.5%	≤15%	≤20%	
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No.	Item	Characteristic		Test Methods and Conditions																			
		Temperature Compensating Type	High Dielectric Constant Type																				
11	Bending Strength	 <p style="text-align: center;">No cracking or marking defects shall occur</p>		<ul style="list-style-type: none"> <li>- Substrate Material : Glass EPOXY Board</li> <li>- Board Thickness : 1.6mm 0.8mm(0603/1005size)</li> <li>※ Test Condition</li> <li>- Bending Limit : 1mm</li> <li>- Pressurizing Speed : 1mm/sec</li> </ul>																			
		Capacitance Change	Within $\pm 5\%$ or $\pm 0.5\mu\text{F}$ (whichever is larger)		X7R, X5R : Within $\pm 12.5\%$ Y5V : Within $\pm 30\%$																		
12	Humidity Steady State	Appearance	No marking defects		<ul style="list-style-type: none"> <li>- Temperature : <math>40 \pm 2^\circ\text{C}</math></li> <li>- Humidity : 90-95%</li> <li>- Hour : <math>500 \pm 12</math> hours</li> <li>- Take it out and set it for <math>24 \pm 2</math> hours (temperature compensating type) or <math>48 \pm 4</math> hours (high dielectric constant type) at room temperature, then measure.</li> </ul>																		
		Capacitance Change	Within $\pm 5\%$ or $\pm 0.5\mu\text{F}$ (whichever is larger)	X7R, X5R : Within $\pm 12.5\%$ Y5V : Within $\pm 30\%$																			
		Dissipation Factor(or Q)	30pF Min. : $Q \geq 350$ ( $DF \leq 0.3\%$ )  $10\mu\text{F} \leq C_p \leq 30\mu\text{F}$ : $Q \geq 275 + 5/2C$ $(DF \leq 1/(275 + 5/2C))$  10pF Max. : $Q \geq 200 + 10C$ $(DF \leq 1/(200 + 10C))$	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Char.</th> <th>50V Min.</th> <th>25V</th> <th>16V</th> <th>10V</th> <th>6.3V</th> </tr> </thead> <tbody> <tr> <td>X7R X5R</td> <td><math>\leq 5\%</math></td> <td><math>\leq 5\%</math></td> <td><math>\leq 5\%</math></td> <td><math>\leq 5\%</math></td> <td><math>\leq 5.0\%</math> (<math>&lt; 3.3\mu\text{F}</math>) <math>\leq 10\%</math> (<math>\geq 3.3\mu\text{F}</math>)</td> </tr> <tr> <td>Y5V</td> <td><math>\leq 7.5\%</math></td> <td><math>\leq 10\%</math> (<math>&lt; 1\mu\text{F}</math>) <math>\leq 12.5\%</math> (<math>\geq 1\mu\text{F}</math>)</td> <td><math>\leq 12.5\%</math></td> <td><math>\leq 15\%</math></td> <td><math>\leq 20\%</math></td> </tr> </tbody> </table>		Char.	50V Min.	25V	16V	10V	6.3V	X7R X5R	$\leq 5\%$	$\leq 5\%$	$\leq 5\%$	$\leq 5\%$	$\leq 5.0\%$ ( $< 3.3\mu\text{F}$ ) $\leq 10\%$ ( $\geq 3.3\mu\text{F}$ )	Y5V	$\leq 7.5\%$	$\leq 10\%$ ( $< 1\mu\text{F}$ ) $\leq 12.5\%$ ( $\geq 1\mu\text{F}$ )	$\leq 12.5\%$	$\leq 15\%$	$\leq 20\%$
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I.R.	More than $1000\text{M}\Omega$ or $50\Omega$ , F (whichever is smaller)																						

※ The initial value of high dielectric constant types shall be measured after the heat temperature of  $150^\circ\text{C} \pm 0/-10^\circ\text{C}$ , 1hr and sitting of  $48\text{hr} \pm 4\text{hr}$  at room temperature & room humidity

No.	Item	Characteristic				Test Methods and Conditions												
		Temperature Compensating Type		High Dielectric Constant Type														
13	Capacitance Temperature Change Characteristics					<p>(1) Temperature Compensating Type: 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, (C0G: +25 to 125°C) the capacitance shall be within the specified tolerance for the temperature coefficient. The capacitance drift is calculated by dividing the difference between the maximum measured values in the step 1, 3 and 5 by the Cap. value in step 3</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>25±2</td> </tr> <tr> <td>2</td> <td>-55±3</td> </tr> <tr> <td>3</td> <td>25±2</td> </tr> <tr> <td>4</td> <td>125±3(for C0G)</td> </tr> <tr> <td>5</td> <td>25±2</td> </tr> </tbody> </table> <p>(2) High Dielectric Constant Type : The ranges of capacitance change compared with the 25°C value over the temperature range shown in the table shall be in the specified range.</p>	Step	Temperature(°C)	1	25±2	2	-55±3	3	25±2	4	125±3(for C0G)	5	25±2
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14	Preservation(keeping)	※ When solderability is considered, capacitors are recommended to be used in 12 months				<p>(1) Temperature : 25°C ±10°C (2) Relative Humidity : Below 70% RH</p>												
15	The regulation of environmental pollution materials.	※ Never use materials mentioned below in MLCC products regulated this document. Pb, Cd, Hg, Cr+6, PBB(polybromide biphenyl), PBDE(polybrominated diphenyl ethers), asbestos.																