

TO. : _____

NO. : _____



APPROVAL SHEET

MULTILAYER CERAMIC CAPACITOR
Commercial Grade, Soft Termination Type
(IEC-60384 Qualified)

Approved by customer : (signing or stamping here)

SAMWHA CAPACITOR CO., LTD.		
Written by	Checked by	Approved by
		

2023. 02. 10.



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Contents

Parts Numbering -----

I . General Type ----- Page 3/16 ~ 6/16

II . Thin Layer Large-Capacitance Type ----- Page 7/16 ~ 9/16

III . High Voltage Type ----- Page 10/16 ~ 13/16

Enactment : March 27,1996	STANDARD	NO	SW - M - 04B
	MULTILAYER CERAMIC CAPACITOR Commercial Grade, Soft Termination Type	Page	1 / 16

1. General Article

Application Range

These specifications refer to the "Multilayer Ceramic Capacitors" mainly used to the computer equipment, communication equipment.

***Caution : Industrial equipment / For the high reliability equipment / LED equipment / Etc.**

Please contact sales representatives or product engineers before using the products.

(For details, please refer Page 16)

Reflow soldering only

2. General Code

(1) Type Designation

<u>CS</u>	<u>1608</u>	<u>X7R</u>	<u>104</u>	<u>K</u>	<u>500</u>	<u>A</u>	<u>R</u>	<u>B</u>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

1) Multilayer Ceramic Capacitor (Commercial Grade)

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	Capacitance Tolerance
Class I	C0G	-55 to +125℃	±30 ppm/℃
Class II	X5R	-55 to +85℃	±15%
	X7R	-55 to +125℃	±15%
	Y5V	-30 to +85℃	+22% ~ -82%

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 = 100000 pF

R denotes decimal

8R2 = 8.2 pF

5) Capacitance Tolerance Code

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

Code	Tolerance
M	± 20 %
P	+ 100, - 0%
Z	+ 80, - 20%
H	+ 0.25/-0 pF
I	+ 0/-0.25 pF
U	+ 5/-0 %
V	+ 0/-5 %

6) Voltage Code

code	6R3	100	160	250	350	500	101	201	251	501	631	102	202	302
Vol.	DC 6.3V	DC 10V	DC 16V	DC 25V	DC 35V	DC 50V	DC 100V	DC 200V	DC 250V	DC 500V	DC 630V	DC 1KV	DC 2KV	DC 3KV

7) Termination Code

ex) N : Ni-Sn (Nickel-Tin Plate)

A : Ag/Ni-Sn (Ag Epoxy/Nickel-Tin Plate) -> **Soft Termination Type**

8) Packing Code

ex) R : 7" Reel Type

L : 13" Reel Type

B : Bulk Type

9) Thickness option

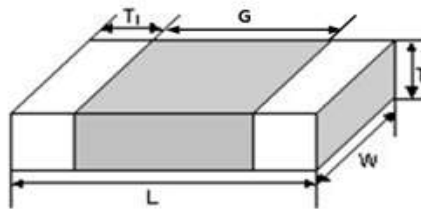
Thickness(mm)		Code	Thickness(mm)		Code
t	Tol(±)		t	Tol(±)	
0.50	0.10	Blank	1.35	0.20	H
0.60	0.10	A	1.60	0.30	I
0.80	0.15	B	1.80	0.30	J
0.85	0.15	B	2.00	0.30	K
1.00	0.15	E	2.50	0.30	L
1.10	0.15	E	2.80	0.30	M
1.15	0.20	E	3.20	0.40	N
1.25	0.20	E	5.00	0.50	O
1.30	0.20	E			

3. Temperature Characteristics

See Page 6/16 (No.14)

4. Constructions and Dimensions

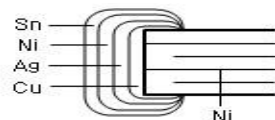
(I) Dimensions



(Unit : mm)

Code	Dimension						
	Length			Width		T1(min)	G(min)
	L	Tol(-)	Tol(+)	W	Tol(±)		
1005	1.00	0.05	0.10	0.50	0.10	0.15	0.30
1608	1.60	0.15	0.20	0.80	0.15	0.20	0.50
2012	2.00	0.20	0.30	1.25	0.20	0.20	0.70
3216	3.20	0.50	0.50	1.60	0.30	0.30	1.20
3225	3.20	0.50	0.50	2.50	0.30	0.30	1.00
4520	4.50	0.50	0.50	2.00	0.30	0.30	1.00
4532	4.50	0.50	0.50	3.20	0.40	0.30	2.20
5750	5.70	0.30	0.70	5.00	0.50	0.30	3.20

(2) Construction of Termination

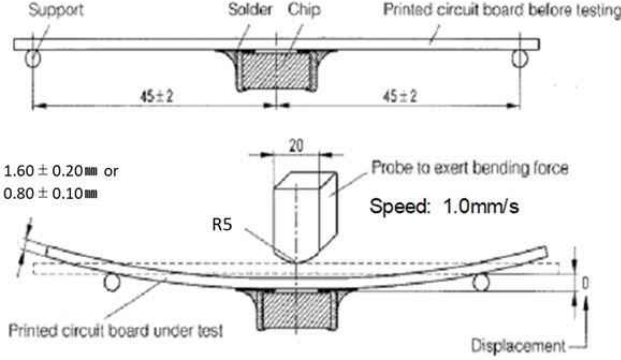


I . General Type

Specifications and Test Methods (General)

No.	Item		Specification						Test Methods and Conditions																
			Class I		Class II																				
1	Operating Temperature Range		C0G : -55 to +125℃		X7R : -55 to +125℃ X5R : -55 to +85℃ Y5V : -30 to +85℃																				
2	Insulation Resistance		More than 10,000 MΩ or 500Ω.F (Whichever is smaller)						·Applied the rated voltage for 2 minutes of charging, The charge/discharge current is less than 50mA.																
3	Voltage proof		No defects or abnormalities						C0G : The rated voltage ×300% X7R, X5R, Y5V : " ×250% - Applied between the terminations for 1 to 5 seconds. - The charge/discharge current is less than 50mA.																
4	Capacitance		within the specified tolerance						The capacitance/Q/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.																
5	Dissipation Factor		30pFmin : Q≥1,000(DF≤0.1%) 30pFmax : Q≥400+20C (DF≤1/ (400+20C))																						
				Char.	50V min	25V	16V	10V	6.3V																
				X7R X5R	≤2.5%/ *≤5%	≤3%/ *≤7%	≤3.5%/ *≤7%	≤5%/ *≤10%	≤5%/ *≤10%																
				Y5V	≤5%/ *≤9%	≤7%/ *≤9%	≤9%/ *≤12.5%	≤12.5%/ *≤15%	≤15%																
<table><tr><th>Cap</th><th>Testing frequency</th><th>Testing Voltage</th></tr><tr><td>C0G (C<1000pF)</td><td>1±0.1MHz</td><td>0.5to5 Vrms</td></tr><tr><td>C0G (C≥1000pF)</td><td>1±0.1kHz</td><td>1±0.2 Vrms</td></tr><tr><td>X7R, X5R,Y5V (C≤10μF)</td><td>1±0.1kHz</td><td>1±0.2 Vrms</td></tr><tr><td>X7R, X5R, Y5V (C>10μF)</td><td>120±24Hz</td><td>0.5±0.1 Vrms</td></tr></table>											Cap	Testing frequency	Testing Voltage	C0G (C<1000pF)	1±0.1MHz	0.5to5 Vrms	C0G (C≥1000pF)	1±0.1kHz	1±0.2 Vrms	X7R, X5R,Y5V (C≤10μF)	1±0.1kHz	1±0.2 Vrms	X7R, X5R, Y5V (C>10μF)	120±24Hz	0.5±0.1 Vrms
Cap	Testing frequency	Testing Voltage																							
C0G (C<1000pF)	1±0.1MHz	0.5to5 Vrms																							
C0G (C≥1000pF)	1±0.1kHz	1±0.2 Vrms																							
X7R, X5R,Y5V (C≤10μF)	1±0.1kHz	1±0.2 Vrms																							
X7R, X5R, Y5V (C>10μF)	120±24Hz	0.5±0.1 Vrms																							
· Initial measurement Perform the initial measurement according to Note1 for Class II · Measurement after test Take it out and set it for 24±2 hours (Class I) or 24±2 hours (Class II) then measure																									
6	Solderability		95% of the terminations is to be soldered evenly and continuously.						*Pb-Free type Solder : 96.5Sn-3Ag-0.5Cu Solder temperature : 245±5℃ Immersion time : 3±0.1sec *Pre-Heating : at 80~120℃ for 10~30sec																
7	Resistance to Soldering Heat	Appearance	No defects which may affect performance						·Preheat the capacitor at 120 to 150℃ for 1 minute. (Preheating for 3225,4520,4532 Step1:100℃ to 120℃, 1min Step2:170℃ to 200℃, 1min) Immerse the capacitor in a eutectic solder solution ·Soldering Temp:260 ±5℃ ·Immersion Time:10 ±0.5 sec ·Initial measurement Perform the initial measurement according to Note1 for Class II ·Measurement after test Take it out and set it for 24±2 hours (Class I) or 24±2 hours (Class II) then measure																
		Capacitance change	within ±2.5% or ±0.25pF (whichever is larger)		X7R, X5R: ≤ ±7.5% Y5V : ≤ ±20%																				
		Dissipation Factor (or Q)	30pFmin : Q≥1,000 (DF≤0.1%) 30pFmax : Q≥400+20C (DF≤1/(400+20C))	Char.	50V min	25V	16V	10V				6.3V													
				X7R X5R	≤2.5%/ *≤5%	≤3%/ *≤7%	≤3.5%/ *≤7%	≤5%/ *≤10%				≤5%/ *≤10%													
				Y5V	≤5%/ *≤9%	≤7%/ *≤9%	≤9%/ *≤12.5%	≤12.5%/ *≤15%				≤15%													
I.R.	More than 10,000MΩ or 500Ω.F (whichever is smaller)																								

No.	Item	Specification							Test Methods and Conditions																
		Class I	Class II																						
8	Rapid change of temperature	Appearance	No defects which may affect performance							Perform the five cycles according to the four heat treatments listed in the following table. <table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><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 to3</td><td>30±3</td><td>2 to3</td></tr></table> Initial measurement Perform the initial measurement according to Note1 for Class II Measurement after test Perform the final measurement according to Note2	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 to3	30±3	2 to3
		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 to3	30±3	2 to3																			
Capacitance Change	Within ±2.5% or ±0.25pF (whichever is larger)	X7R, X5R : Within ±7.5% Y5V : Within ±20%																							
Dissipation Factor (or Q)	30pFmin : Q≥1,000 (DF≤0.1%) 30pFmax : Q≥400+20C (DF≤1/(400+20C))	Char	50V min	25V	16V	10V	6.3V																		
		X7R X5R	≤5%/ *≤7.5%	≤5%/ *≤10%	≤5%/ *≤10%	≤7.5%/ *≤12.5	≤7.5%/ *≤12.5%																		
		Y5V	≤7.5%/ *≤12.5%	≤10%/ *≤12.5%	≤12.5%/ *≤15%	≤15%/ *≤20%	≤20%																		
I.R	More than 10,000MΩ or 500Ω.F (Whichever is smaller)																								
9	Accelerated damp heat, steady state	Appearance	No defects which may affect performance							Temperature : 40±2°C Humidity : 90~95%RH Hour : 500+24/-0 hrs Applied Voltage : Rated Voltage The charge/discharge current is less than 50mA. Initial measurement Perform the initial measurement according to Note1 for Class II Measurement after test Perform the final measurement according to Note2															
		Capacitance Change	Within ±7.5% or ±0.75pF (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)	30pFmin : Q≥200 (DF≤0.5%) 30pFmax : Q≥100+10/3C DF≤1/(100+10/3C)	Char	50V min	25V	16V	10V	6.3V																
				X7R X5R	≤5%/ *≤7.5%	≤5%/ *≤10%	≤5%/ *≤10%	≤7.5%/ *≤12.5	≤7.5%/ *≤12.5%																
Y5V	≤7.5%/ *≤12.5%			≤10%/ *≤12.5%	≤12.5%/ *≤15%	≤15%/ *≤20%	≤20%																		
I.R	More than 500MΩ or 25Ω.F (Whichever is smaller)																								
10	Endurance	Appearance	No defects which may affect performance							Testing time : 1000+48/-0 hrs Applied voltage : Rated voltage < DC250V : ×200% Temperature : C0G, X7R → 125±3°C X5R, Y5V → 85±3°C The charge/discharge current is less than 50mA. Initial measurement Perform the initial measurement according to Note1 for Class II Measurement after test Perform the final measurement according to Note2															
		Capacitance Change	Within ±3% or ±0.3pF (whichever is larger)	X7R, X5R : Within ±12.5% Y5V : Within ±30% (cap<1.0μF) Within +30%, -40% (cap≥1.0μF)																					
		Dissipation Factor (or Q)	30pFmin : Q≥350 (DF≤0.3%) 10pF≤Cp≤30pF : Q≥275+5/2C (DF≤1/(275+5/2C)) 10pFmax : Q≥200+10C (DF≤1/(200+10C))	Char	50V min	25V	16V	10V	6.3V																
				X7R X5R	≤5%/ *≤7.5%	≤5%/ *≤10%	≤5%/ *≤10%	≤7.5%/ *≤12.5	≤7.5%/ *≤12.5%																
Y5V	≤7.5%/ *≤12.5%			≤10%/ *≤12.5%	≤12.5%/ *≤15%	≤15%/ *≤20%	≤20%																		
I.R	More than 1,000MΩ or 50Ω.F (whichever & smaller)																								

No.	Item	Specification		Test Methods and Conditions																								
		Class I	Class II																									
11	Substrate bending test	 No cracking or marking defects shall occur		·Substrate material : Glass EPOXY Board. ·Thickness : 1.6mm 0.8mm(0603/1005size) *. Test condition – Bending limit : 2mm – Pressurizing speed : 1mm/sec – Holding time : 5±1sec – Reflow soldering only																								
		Capacitance Change	Within ±5% or ±0.5pF (whichever is larger) X7R, X5R: Within ±10% Y5V: Within ±30%																									
12	Vibration	Appearance	No defects or abnormalities		*After soldering and then let sit for 24±2hr(temperature compensating type), 24±2hr(high dielectric constant type) at room temperature. The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz, shall be traversed(from 10Hz to 55Hz then 10Hz again) in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3mutually perpendicular directions(total is 6hours).																							
		Capacitance	Whin the specified tolerance																									
		Q/DF	30pFmin : $Q \geq 1,000$ ($DF \leq 0.1\%$) 30pFmax : $Q \geq 400+20C$ ($DF \leq 1/(400+20C)$)	<table><tr><td>Char.</td><td>50V min</td><td>25V</td><td>16V</td><td>10V</td><td>6.3V</td></tr><tr><td>X7R X5R</td><td>$\leq 2.5\%$ *$\leq 5\%$</td><td>$\leq 3\%$ *$\leq 7\%$</td><td>$\leq 3.5\%$ *$\leq 7\%$</td><td>$\leq 5\%$ *$\leq 10\%$</td><td>$\leq 5\%$ *$\leq 10\%$</td></tr><tr><td>Y5V</td><td>$\leq 5\%$ *$\leq 9\%$</td><td>$\leq 7\%$ *$\leq 9\%$</td><td>$\leq 9\%$ *$\leq 12.5\%$</td><td>$\leq 12.5\%$ *$\leq 15\%$</td><td>$\leq 15\%$</td></tr></table>						Char.	50V min	25V	16V	10V	6.3V	X7R X5R	$\leq 2.5\%$ * $\leq 5\%$	$\leq 3\%$ * $\leq 7\%$	$\leq 3.5\%$ * $\leq 7\%$	$\leq 5\%$ * $\leq 10\%$	$\leq 5\%$ * $\leq 10\%$	Y5V	$\leq 5\%$ * $\leq 9\%$	$\leq 7\%$ * $\leq 9\%$	$\leq 9\%$ * $\leq 12.5\%$	$\leq 12.5\%$ * $\leq 15\%$	$\leq 15\%$	
				Char.		50V min	25V	16V	10V	6.3V																		
X7R X5R	$\leq 2.5\%$ * $\leq 5\%$	$\leq 3\%$ * $\leq 7\%$	$\leq 3.5\%$ * $\leq 7\%$	$\leq 5\%$ * $\leq 10\%$	$\leq 5\%$ * $\leq 10\%$																							
Y5V	$\leq 5\%$ * $\leq 9\%$	$\leq 7\%$ * $\leq 9\%$	$\leq 9\%$ * $\leq 12.5\%$	$\leq 12.5\%$ * $\leq 15\%$	$\leq 15\%$																							
13	Damp heat, steady state	Appearance	No defects which may affect performance		·Temperature : 40±2℃ ·Humidity : 90~95%RH ·Hour : 500+24/-0 hrs ·Initial measurement Perform the initial measurement according to Note1 for Class II ·Measurement after test Perform the final measurement according to Note2																							
		Capacitance Change	within ±5% or ±0.5pF (Whichever is larger)	X7R, X5R: Within ±12.5% Y5V: Within ±30%																								
		Dissipation (or Q)	30pF min : $Q \geq 350$ ($DF \leq 0.3\%$) 10pF ≤ Cp ≤ 30pF : $Q \geq 275+5/2C$ ($DF \leq 1/(275+5/2C)$) 10pFmax : $Q \geq 200+10C$ ($DF \leq 1/(200+10C)$)	<table><tr><td>Char</td><td>50V min</td><td>25V</td><td>16V</td><td>10V</td><td>6.3V</td></tr><tr><td>X7R X5R</td><td>$\leq 5\%$ *$\leq 7.5\%$</td><td>$\leq 5\%$ *$\leq 10\%$</td><td>$\leq 5\%$ *$\leq 10\%$</td><td>$\leq 7.5\%$ *$\leq 12.5\%$</td><td>$\leq 7.5\%$ *$\leq 12.5\%$</td></tr><tr><td>Y5V</td><td>$\leq 7.5\%$ *$\leq 12.5\%$</td><td>$\leq 10\%$ *$\leq 12.5\%$</td><td>$\leq 12.5\%$ *$\leq 15\%$</td><td>$\leq 15\%$ *$\leq 20\%$</td><td>$\leq 20\%$</td></tr></table>						Char	50V min	25V	16V	10V	6.3V	X7R X5R	$\leq 5\%$ * $\leq 7.5\%$	$\leq 5\%$ * $\leq 10\%$	$\leq 5\%$ * $\leq 10\%$	$\leq 7.5\%$ * $\leq 12.5\%$	$\leq 7.5\%$ * $\leq 12.5\%$	Y5V	$\leq 7.5\%$ * $\leq 12.5\%$	$\leq 10\%$ * $\leq 12.5\%$	$\leq 12.5\%$ * $\leq 15\%$	$\leq 15\%$ * $\leq 20\%$	$\leq 20\%$	
				Char		50V min	25V	16V	10V	6.3V																		
				X7R X5R		$\leq 5\%$ * $\leq 7.5\%$	$\leq 5\%$ * $\leq 10\%$	$\leq 5\%$ * $\leq 10\%$	$\leq 7.5\%$ * $\leq 12.5\%$	$\leq 7.5\%$ * $\leq 12.5\%$																		
Y5V	$\leq 7.5\%$ * $\leq 12.5\%$	$\leq 10\%$ * $\leq 12.5\%$	$\leq 12.5\%$ * $\leq 15\%$	$\leq 15\%$ * $\leq 20\%$	$\leq 20\%$																							
		I.R.	More than 1,000MΩ or 50Ω.F (Whichever is smaller)																									

No.	Item		Specification				Test Methods and Conditions																											
			Class I	Class II																														
14	Temperature characteristic of capacitance	Capacitance Change		<table><tr><th>Char.</th><th>Temp Range</th><th>Reference Temp.</th><th>Cap Change</th></tr><tr><td>X7R</td><td>-55 to +125℃</td><td rowspan="3">25℃</td><td>Within ±15%</td></tr><tr><td>X5R</td><td>-55 to +85℃</td><td>Within ±15%</td></tr><tr><td>Y5V</td><td>-30 to +85℃</td><td>Within +22% -82%</td></tr></table>				Char.	Temp Range	Reference Temp.	Cap Change	X7R	-55 to +125℃	25℃	Within ±15%	X5R	-55 to +85℃	Within ±15%	Y5V	-30 to +85℃	Within +22% -82%	(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℃) the capacitance shall be with in 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 <table><tr><th>Step</th><th>Temperature(℃)</th></tr><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></table> (2) High Dielectric Constant Type The ranges of capacitance change compared with the 25℃ value over the temperature range shown in the table shall be in the specified range.	Step	Temperature(℃)	1	25±2	2	-55±3	3	25±2	4	125±3(for C0G)	5	25±2
		Char.	Temp Range	Reference Temp.	Cap Change																													
X7R	-55 to +125℃	25℃	Within ±15%																															
X5R	-55 to +85℃		Within ±15%																															
Y5V	-30 to +85℃		Within +22% -82%																															
Step	Temperature(℃)																																	
1	25±2																																	
2	-55±3																																	
3	25±2																																	
4	125±3(for C0G)																																	
5	25±2																																	
		Temperature Coefficient	<table><tr><th>Char.</th><th>Temp Range</th><th>Temperature Coefficient</th></tr><tr><td>C0G</td><td>-55 to +125℃</td><td>±30 ppm/℃</td></tr></table>	Char.	Temp Range	Temperature Coefficient	C0G	-55 to +125℃	±30 ppm/℃																									
Char.	Temp Range	Temperature Coefficient																																
C0G	-55 to +125℃	±30 ppm/℃																																

*Note1. Initial Measurement for Class II

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

*Note2. Measurement after test

1. Class I

Let sit for 24±2 hours at room temperature, then measurement

2. Class II

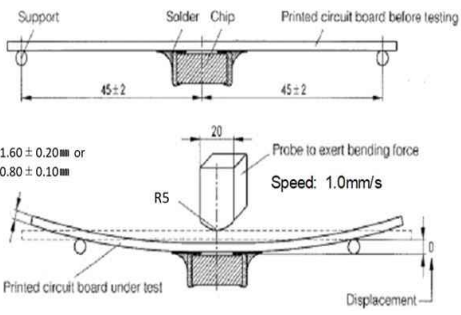
Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature, then measure.

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

II . Thin Layer Large–Capacitance Type

Specifications and Test Methods (Thin Layer Large-Capacitance Type)

No.	Item		Specification	Test Methods and Conditions															
1	Operating Temperature Range		X7R : -55 to +125℃ X5R : -55 to +85℃ Y5V : -30 to +85℃																
2	Insulation Resistance		50Ω·F min	·Applied the rated voltage for 2 minutes of charging, The charge/discharge current is less than 50mA.															
3	Voltage proof		No defects or abnormalities	X7R, X5R, Y5V : The rated voltage × 250% – Applied between the terminations for 1 to 5 seconds. – The charge/discharge current is less than 50mA.															
4	Capacitance		within the specified tolerance	The capacitance/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.															
5	Dissipation Factor		X7R, X5R : 12.5%max *3216 Size 100μF : 15%max Y5V : 20%max	<table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>C≤10μF</td><td>1 ± 0.1kHz</td><td>0.5~1.0Vrms</td></tr><tr><td>C>10μF</td><td>120 ± 24Hz</td><td>0.5±0.1Vrms</td></tr></table> · Initial measurement Perform the initial measurement according to Note1 for Class II · Measurement after test Take it out and set it for 24±2 hours (Class II) then measure	Capacitance	Frequency	Voltage	C≤10μF	1 ± 0.1kHz	0.5~1.0Vrms	C>10μF	120 ± 24Hz	0.5±0.1Vrms						
Capacitance	Frequency	Voltage																	
C≤10μF	1 ± 0.1kHz	0.5~1.0Vrms																	
C>10μF	120 ± 24Hz	0.5±0.1Vrms																	
6	Solderability		95% of the terminations is to be soldered evenly and continuously.	*Pb-Free type Solder : 96.5Sn-3Ag-0.5Cu Solder temperature : 245±5℃ Immersion time : 3±0.1sec *Pre-Heating : at 80~120℃ for 10~30sec															
7	Resistance to Soldering Heat	Appearance	No defects which may affect performance	Preheat the capacitor at 120 to 150℃ for 1 minute. (Preheating for 3225,4520,4532 Step1:100℃ to 120℃, 1min Step2:170℃ to 200℃, 1min) Immerse the capacitor in a eutectic solder solution at 260±5℃ for 10±0.5 seconds. ·Initial measurement Perform the initial measurement according to Note1 for Class II ·Measurement after test Let sit at room temperature for 24±2 hours,then measure.															
Capacitance change		X7R, X5R : Within±7.5% Y5V : Within±20%																	
Dissipation Factor		X7R, X5R : 12.5%max *3216 Size 100μF : 15%max Y5V : 20%max																	
I.R.		50Ω·F min																	
8	Rapid change of temperature	Appearance	No defects which may affect performance	Perform the five cycles according to the four heat treatments listed in the following table. <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>30±3</td><td>2 to3</td><td>30±3</td><td>2 to3</td></tr></table> ·Initial measurement Perform the initial measurement according to Note1 for Class II ·Measurement after test Perform the final measurement according to Note2	Step	1	2	3	4	Temp (℃)	Min. operating temp. +0/-3	Room Temp	Max. operating temp. +3/-0	Room Temp	Time (min)	30±3	2 to3	30±3	2 to3
Step		1	2		3	4													
Temp (℃)		Min. operating temp. +0/-3	Room Temp		Max. operating temp. +3/-0	Room Temp													
Time (min)		30±3	2 to3		30±3	2 to3													
Capacitance Change	X7R, X5R : Within ±7.5% Y5V : Within ±20%																		
Dissipation Factor	X7R, X5R : 12.5%max *3216 Size 100μF : 15%max Y5V : 20%max																		
I.R		50Ω·F min																	

No.	Item	Specification	Test Methods and Conditions
9	Endurance	Appearance	No defects which may affect performance Apply 150% of the rated voltage for 1000+48/-0 hrs at the maximum operating temperature $\pm 3^{\circ}\text{C}$. The charge/discharge current is less than 50mA. -Initial measurement Perform the initial measurement according to Note1 for Class II -Measurement after test Perform the final measurement according to Note2
		Capacitance Change	
		Dissipation Factor	
		I.R	
10	Substrate bending test	 No cracking or marking defects shall occur	Substrate material : Glass EPOXY Board. Thickness : 1.6mm 0.8mm(0603/1005size) *. Test condition - Bending limit : 2mm - Pressurizing speed : 1mm/sec - Holding time : 5±1sec - Reflow soldering only
		Capacitance Change	
11	Vibration	Appearance	No defects or abnormalities After soldering and then let sit for 24±2hr at room temperature. The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz, shall be traversed(from 10Hz to 55Hz then 10Hz again) in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions(total is 6hours).
		Capacitance	
		Dissipation Factor	
12	Accelerated damp heat, steady state	Appearance	Apply the rated voltage at 40±2°C and 90 to 95%RH for 500+24/-0 hrs. The charge/discharge current is less than 50mA. -Initial measurement Perform the initial measurement according to Note1 for Class II -Measurement after test Perform the final measurement according to Note2
		Capacitance Change	
		Dissipation Factor	
		I.R.	

No.	Item	Specification				Test Methods and Conditions
13	Temperature characteristic of capacitance	Char.	Temp. Range	Reference Temp.	Cap. Change	The capacitance change should be measured after 5 min. at each specified temperature stage. The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table should be within the specified ranges.
		X5R	-55 to +85℃	25℃	Within ±15%	
		X7R	-55 to +125℃	25℃	Within ±15%	
		Y5V	-30 to +85℃	25℃	Within +22/-82%	

*Note1. Initial Measurement for Class II

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

*Note2. Measurement after test

Class II

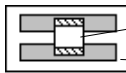
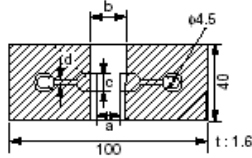
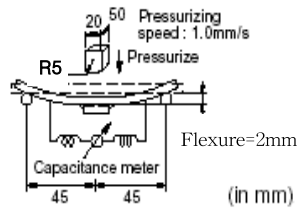
Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature, then measure.

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

III . High Voltage Type

Specifications and Test Methods (High voltage type)

No.	Item	Specification		Test Methods and Conditions																	
		Class I	Class II																		
1	Operating Temperature Range	C0G :-55 to+125℃	X7R : -55 to +125℃																		
2	Dimensions	Within the specified dimension		Using calipers																	
3	Voltage proof	No defects or abnormalities		No failure should be observed when voltage in table is applied between the terminations, provided the charge/discharge current is less than 50mA. <table><tr><td>Cap.</td><td>Rated voltage</td><td>Test voltage</td><td>Time</td></tr><tr><td rowspan="3">C0G</td><td>DC100V~630V</td><td>150% of the rated voltage</td><td rowspan="6">1to5 sec.</td></tr><tr><td>DC1kV, DC2kV DC3kV, DC3.15kV</td><td>120% of the rated voltage</td></tr><tr><td>X7R</td><td>DC100V~630V</td><td>150% of the rated voltage</td></tr><tr><td>DC1kV</td><td rowspan="3">120% of the rated voltage</td></tr><tr><td>DC2kV</td></tr><tr><td>DC3kV</td></tr></table>	Cap.	Rated voltage	Test voltage	Time	C0G	DC100V~630V	150% of the rated voltage	1to5 sec.	DC1kV, DC2kV DC3kV, DC3.15kV	120% of the rated voltage	X7R	DC100V~630V	150% of the rated voltage	DC1kV	120% of the rated voltage	DC2kV	DC3kV
Cap.	Rated voltage	Test voltage	Time																		
C0G	DC100V~630V	150% of the rated voltage	1to5 sec.																		
	DC1kV, DC2kV DC3kV, DC3.15kV	120% of the rated voltage																			
	X7R	DC100V~630V		150% of the rated voltage																	
DC1kV	120% of the rated voltage																				
DC2kV																					
DC3kV																					
4	Insulation Resistance	More than 10,000 MΩ	-DC100V~1KV :C≥0.01μF:More than 100MΩ·μF :C<0.01μF:More than 10,000MΩ -DC2~3KV:More than6,000 MΩ	Rated voltage <DC500V : Applied the rated voltage for 2 minutes of charging. Rated voltage ≥DC500V : The insulation resistance should be measured with DC500±50V and within 2 minutes of charging.																	
5	Capacitance	within the specified tolerance		<table><tr><td>Cap</td><td>Testing frequency</td><td>Testing Voltage</td><td>Measure temperature</td></tr><tr><td rowspan="2">C0G</td><td>1±0.2MHz(C<1000pF) 1±0.1kHz(C≥1000pF)</td><td rowspan="3">AC 1±0.2Vrms</td><td rowspan="3">25℃</td></tr><tr><td>X7R</td><td>1±0.2kHz</td></tr></table>	Cap	Testing frequency	Testing Voltage	Measure temperature	C0G	1±0.2MHz(C<1000pF) 1±0.1kHz(C≥1000pF)	AC 1±0.2Vrms	25℃	X7R	1±0.2kHz							
Cap	Testing frequency	Testing Voltage	Measure temperature																		
C0G	1±0.2MHz(C<1000pF) 1±0.1kHz(C≥1000pF)	AC 1±0.2Vrms	25℃																		
	X7R			1±0.2kHz																	
6	Dissipation Factor			C0G Char. : 30pFmin : Q≥1,000(DF≤0.1%) 30pFmax : Q≥400+20C (DF≤1/ (400+20C))	2.5% max	Initial measurement Perform the initial measurement according to Note1 for Class II Measurement after test Take it out and set it for 24±2 hours (Class I) or 24±2 hours (Class II) then measure															
7	Temperature characteristic of capacitance	Temp. Coefficient C0G char. : 0±30ppm/℃ (Temp. Range : -55to+125℃)	Cap. Change within ±15% (Temp. Range : -55 to +125℃)	C0G : 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. <table><tr><td>Step</td><td>Temperature(℃)</td></tr><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></table> X7R : The range of capacitance change compared with the 25℃value should be within the specified range. -Pretreatment Perform a heat treatment at 150 -10, +0℃ for 60±5min. and then let sit for 24±2hrs.(Class I), 24±2hrs.(Class II) at room Temperature	Step	Temperature(℃)	1	25±2	2	-55±3	3	25±2	4	125±3 (for C0G)	5	25±2					
Step	Temperature(℃)																				
1	25±2																				
2	-55±3																				
3	25±2																				
4	125±3 (for C0G)																				
5	25±2																				

No.	Item	Specification		Test Methods and Conditions																																			
		Class I	Class II																																				
8	Adhesive Strength of Termination	No removal of the terminations or other defect should occur		Solder the capacitor to the testing jig(glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply 10N force in the direction of the arrow. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.  10N(5N:Size 1.6×0.8mm only), 10±1s Speed : 1.0mm/s Glass Epoxy Board																																			
9	Vibration	Appearance	No defects or abnormalities		The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 min. This motion should be applied for a period of 2hrs. in each 3mutually perpendicular directions(total of 6hrs.)																																		
		Capacitance	Within the specified tolerance																																				
		Dissipation Factor(or Q)	C0G Char. : 30pFmin : $Q \geq 1,000(DF \leq 0.1\%)$ 30pFmax : $Q \geq 400+20C$ ($DF \leq 1 / (400+20C)$)	2.5% max																																			
10	Substrate bending test		No cracking defects should occur.		Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock. <table><tr><th rowspan="2">L×X (mm)</th><th colspan="4">Dimension(mm)</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>1.6×0.8</td><td>1.0</td><td>3.0</td><td>1.2</td><td rowspan="6">1.0</td></tr><tr><td>2.0×1.25</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>3.2×1.6</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>3.2×2.5</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr></table> *. Test condition - Bending limit : 2mm - Pressurizing speed : 1mm/sec - Holding time : 5±1sec - Reflow soldering only	L×X (mm)	Dimension(mm)				a	b	c	d	1.6×0.8	1.0	3.0	1.2	1.0	2.0×1.25	1.2	4.0	1.65	3.2×1.6	2.2	5.0	2.0	3.2×2.5	2.2	5.0	2.9	4.5×2.0	3.5	7.0	2.4	4.5×3.2	3.5	7.0	3.7
		L×X (mm)	Dimension(mm)																																				
			a	b		c	d																																
1.6×0.8	1.0	3.0	1.2	1.0																																			
2.0×1.25	1.2	4.0	1.65																																				
3.2×1.6	2.2	5.0	2.0																																				
3.2×2.5	2.2	5.0	2.9																																				
4.5×2.0	3.5	7.0	2.4																																				
4.5×3.2	3.5	7.0	3.7																																				
Capacitance Change	Within ±5% or ±0.5pF (whichever is larger)	Within ±10%																																					
11	Solderability	95% of the terminations is to be soldered evenly and continuously.		Immerse the capacitor in a solution of ethanol and rosin(25% rosin in weight proportion). Immerse in eutectic solder solution for 2±0.5 sec. at 245±5℃. Immersing speed : 25±2.5mm/s																																			

No.	Item	Specification		Test Methods and Conditions															
		Class I	Class II																
12	Resistance to Soldering Heat	Appearance	No defects which may affect performance																
		Capacitance change	within ±2.5%or ±0.25pF (whichever is larger)	within ±10%															
		Dissipation Factor (or Q)	COG Char. : 30pFmin : Q≥1,000(DF≤0.1%) 30pFmax : Q≥400+20C (DF≤1/ (400+20C))	2.5% max															
		I.R.	More than 10,000MΩ	-DC100V~1KV :C≥0.01μF:More than 100MΩ·μF :C<0.01μF:More than 10,000MΩ -DC2~3KV:More than1,000 MΩ															
				Preheat the capacitor at 120 to 150℃* for 1 min. Immerse the capacitor in eutectic solder solution at 260±5℃ for 10±1 sec. -Immersing speed : 25±2.5mm/s -Initial measurement Perform the initial measurement according to Note1 for Class II -Measurement after test Let sit at room Temperature for 24±2hrs.(Class I), 24±2hrs.(Class II) then measure. *Preheating for more than 3.2×2.5mm															
				<table><tr><td>Step</td><td>Temperature</td><td>Time</td></tr><tr><td>1</td><td>100℃ to 120℃</td><td>1 min</td></tr><tr><td>2</td><td>170℃ to 200℃</td><td>1 min</td></tr></table>	Step	Temperature	Time	1	100℃ to 120℃	1 min	2	170℃ to 200℃	1 min						
Step	Temperature	Time																	
1	100℃ to 120℃	1 min																	
2	170℃ to 200℃	1 min																	
13	Rapid change of temperature	Appearance	No defects which may affect performance																
		Capacitance Change	Within ±2.5%or ±0.25pF (whichever is larger)	within ±15%															
		Dissipation Factor (or Q)	COG Char. : 30pFmin : Q≥1,000(DF≤0.1%) 30pFmax : Q≥400+20C (DF≤1/ (400+20C))	DC100V~1KV: 2.5% max DC2~3KV : 5%max															
		I.R	More than 10,000MΩ	-DC100V~1KV :C≥0.01μF:More than 100MΩ·μF :C<0.01μF:More than 10,000MΩ -DC2~3KV:More than 3,000MΩ															
				Perform the 5 cycles according to the 4 heat treatments listed in the following table.															
				<table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Temp (℃)</td><td>Min. operating temp. ±3</td><td>Room Temp</td><td>Max. operating temp. ±2</td><td>Room Temp</td></tr><tr><td>Time (min)</td><td>30±3</td><td>2 to3</td><td>30±3</td><td>2 to3</td></tr></table>	Step	1	2	3	4	Temp (℃)	Min. operating temp. ±3	Room Temp	Max. operating temp. ±2	Room Temp	Time (min)	30±3	2 to3	30±3	2 to3
Step	1	2	3	4															
Temp (℃)	Min. operating temp. ±3	Room Temp	Max. operating temp. ±2	Room Temp															
Time (min)	30±3	2 to3	30±3	2 to3															
				-Initial measurement Perform the initial measurement according to Note1 for Class II -Measurement after test Perform the final measurement according to Note2															
14	Damp heat, steady state	Appearance	No defects which may affect performance																
		Capacitance Change	within ±5% or ±0.5pF (Whichever is larger)	Within ±15%															
		Dissipation Factor (or Q)	COG Char. : C≥30pF : Q≥350 C<30pF : Q≥275+ $\frac{5}{2}$ C	5% max															
		I.R	More than 1,000MΩ	-DC100V~1KV :C≥0.01μF:More than 10MΩ·μF :C<0.01μF:More than 1,000MΩ -DC2~3KV:More than 1,000MΩ															
				Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500+24/-0 hrs. -Initial measurement Perform the initial measurement according to Note1 for Class II -Measurement after test Perform the final measurement according to Note2															
15	Endurance	Appearance	No defects which may affect performance																
		Capacitance Change	within ±3% or ±0.3pF (Whichever is larger)	DC100V,630V:Within ±15% DC1KV:Within ±20% DC2~3KV:Within ±20%															
		Dissipation (or Q)	COG Char. : C≥30pF : Q≥350 C<30pF : Q≥275+ $\frac{5}{2}$ C	5% max															
		I.R.	More than 1,000MΩ	-DC100V~1KV :C≥0.01μF:More than 10MΩ·μF :C<0.01μF:More than 1,000MΩ -DC2~3KV:More than 2,000MΩ															
				Apply the voltage in following table for 1,000+48/-0hrs. at maximum operating temperature ±3℃. The charge/discharge current is less than 50mA.															
				<table><tr><td>Operating temperature range</td><td>Rated voltage</td><td>Test voltage</td></tr><tr><td rowspan="2">COG</td><td>Rated voltage ≥DC1KV</td><td>Rated voltage</td></tr><tr><td>Rated voltage <DC1KV</td><td>120% of the rated voltage</td></tr><tr><td rowspan="3">X7R</td><td>DC100V~250V</td><td>150% of the rated voltage</td></tr><tr><td>DC500V~630V</td><td>120% of the rated voltage</td></tr><tr><td>DC1KV~DC3KV</td><td>110% of the rated voltage</td></tr></table>	Operating temperature range	Rated voltage	Test voltage	COG	Rated voltage ≥DC1KV	Rated voltage	Rated voltage <DC1KV	120% of the rated voltage	X7R	DC100V~250V	150% of the rated voltage	DC500V~630V	120% of the rated voltage	DC1KV~DC3KV	110% of the rated voltage
Operating temperature range	Rated voltage	Test voltage																	
COG	Rated voltage ≥DC1KV	Rated voltage																	
	Rated voltage <DC1KV	120% of the rated voltage																	
X7R	DC100V~250V	150% of the rated voltage																	
	DC500V~630V	120% of the rated voltage																	
	DC1KV~DC3KV	110% of the rated voltage																	
				-Initial measurement Perform the initial measurement according to Note1 for Class II -Measurement after test Perform the final measurement according to Note2															

No.	Item		Specification		Test Methods and Conditions
			Class I	Class II	
16	Humidity Load (Application : DC250V item)	Appearance		No defects which may affect performance	Apply the rated voltage at $40\pm 2^{\circ}\text{C}$ and relative humidity of 90 to 95 for $500+24/-0$ hrs. Initial measurement Perform the initial measurement according to Note1 for Class II Measurement after test Perform the final measurement according to Note2
		Capacitance Change		Within $\pm 15\%$	
		Dissipation (or Q)		5% max.	
		I.R.		$C \geq 0.01\mu\text{F}$: More than $10\text{M}\Omega$, μF $C < 0.01\mu\text{F}$: More than $1,000\text{M}\Omega$	

*Note1. Initial Measurement for Class II

Perform a heat treatment at $150+0,-10^{\circ}\text{C}$ for one hour and then let sit for 24 ± 2 hours at room temperature, then measure

*Note2. Measurement after test

1. Class I

Let sit for 24 ± 2 hours at room temperature, then measurement

2. Class II

Perform a heat treatment at $150+0,-10^{\circ}\text{C}$ 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."

5. Packing

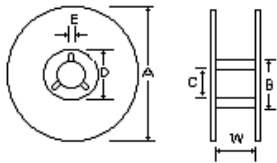
(1) Bulk packing

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

(2) Reel Packing

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

(3) Reel Dimensions



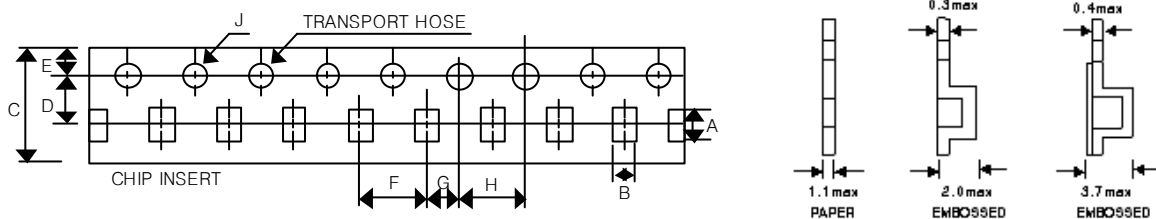
(Unit : mm)

MARK	SIZE	A	B	C	D	E	W
7 " REEL	0603~3225	$\Phi 178 \pm 2$	$\Phi 50 \text{Min}$	$\Phi 13 \pm 0.5$	$\Phi 21 \pm 0.8$	2 ± 0.5	10 ± 1.5
	4520~4532	$\Phi 180 +0, -3$	$\Phi 60 -0, +1$	$\Phi 13 \pm 0.2$	$\Phi 57 -0 +1$	3 ± 0.2	13 ± 0.5
13 " REEL	1005~3225	$\Phi 330 \pm 2$	$\Phi 70 \text{Min}$	$\Phi 13 \pm 0.5$	$\Phi 21 \pm 0.8$	2 ± 0.5	10 ± 1.5

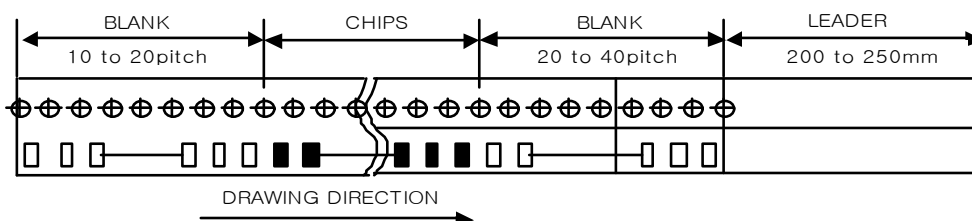
(4) Number of Package

TYPE	EIA CODE	7"	13"
		Qt/REEL	Qt/REEL
CS0603	CC0201	15,000	
CS1005	CC0402	10,000	50,000
CS1608	CC0603	4,000	15,000
CS2012	CC0805	3,000 ~ 4,000	8,000 ~ 15,000
CS3216	CC1206	2,000 ~ 4,000	6,000 ~ 10,000
CS3225	CC1210	1,000 ~ 3,000	4,000 ~ 10,000
CS4520	CC1808	1,500 ~ 3,000	-
CS4532	CC1812	500 ~ 1,000	1,500 ~ 5,000

(5) Tape Dimensions



TYPE	EIA CODE	A	B	C	D	E	F	G	H	J
CS0603	CC0201	0.67 ± 0.05	0.37 ± 0.05	8.0 ± 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
CS1005	CC0402	1.15 ± 0.1	0.65 ± 0.1	8.0 ± 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
CS1608	CC0603	1.9 ± 0.2	1.10 ± 0.2	8.0 ± 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
CS2012	CC0805	2.4 ± 0.2	1.65 ± 0.2	8.0 ± 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
CS3216	CC1206	3.6 ± 0.2	2.00 ± 0.2	8.0 ± 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
CS3225	CC1210	3.6 ± 0.2	2.80 ± 0.2	8.0 ± 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
CS4520	CC1808	4.8 ± 0.2	2.3 ± 0.2	12.0 ± 0.3	5.5 ± 0.1	1.75 ± 0.1	4.0 ± 0.1 8.0 ± 0.1	2.0 ± 0.1	4.0 ± 0.1	1.5 ± 0.1
CS4532	CC1812	4.9 ± 0.2	3.6 ± 0.2	12.0 ± 0.3	5.5 ± 0.1	1.75 ± 0.1	8.0 ± 0.1	2.0 ± 0.1	4.0 ± 0.1	1.5 ± 0.1



6. Caution

► 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(ΔT) within the range recommended in Table 1.

Table 1

Size code	Temperature Difference
0603, 1005, 1608, 2012, 3216	$\Delta T \leq 190^\circ\text{C}$
3225size and over	$\Delta T \leq 130^\circ\text{C}$

3. Capacitors designated as for only reflow soldering must not apply to wave soldering.

► Storage Condition

*When Solderability is considered, Capacitor are recommended to be used in 12 months

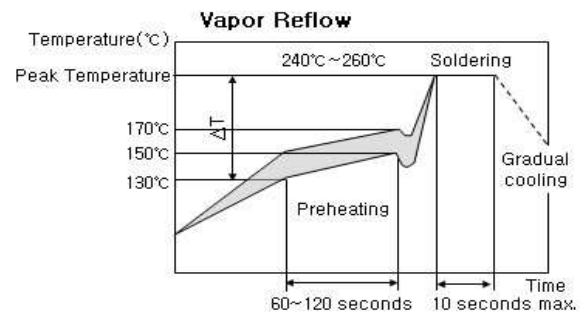
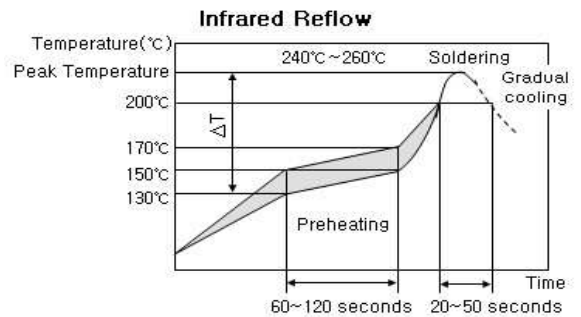
- (1) Temperature: $25^\circ\text{C} \pm 10^\circ\text{C}$
- (2) Relative Humidity: Below 70% RH

► The Regulation of Environmental Pollution Materials.

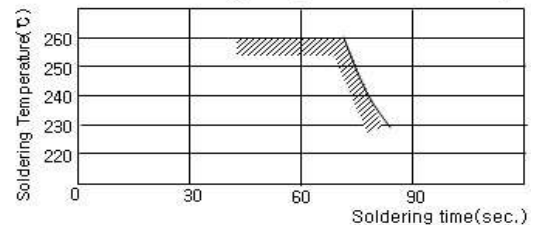
*Never use materials mentioned below in MLCC products regulated this document.

Pb, Cd, Hg, Cr^{+6} , PBB(Polybromide biphenyl), PBDE(Polybrominated diphenyl ethers), asbestos.

[Standard Conditions for Reflow Soldering]



[Allowable Soldering Temperature and Time]



In case of repeated soldering, the accumulated soldering time must be within the range shown above.

* Note

(1) 'Aging'/'De-aging' Behavior of high dielectric MLCCs

(Typically represented by X7R, Y5V temperature characteristic of which main composition is BaTiO₃)

'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:

$$C_t = C_{24} (1 - k \log_{10} t)$$

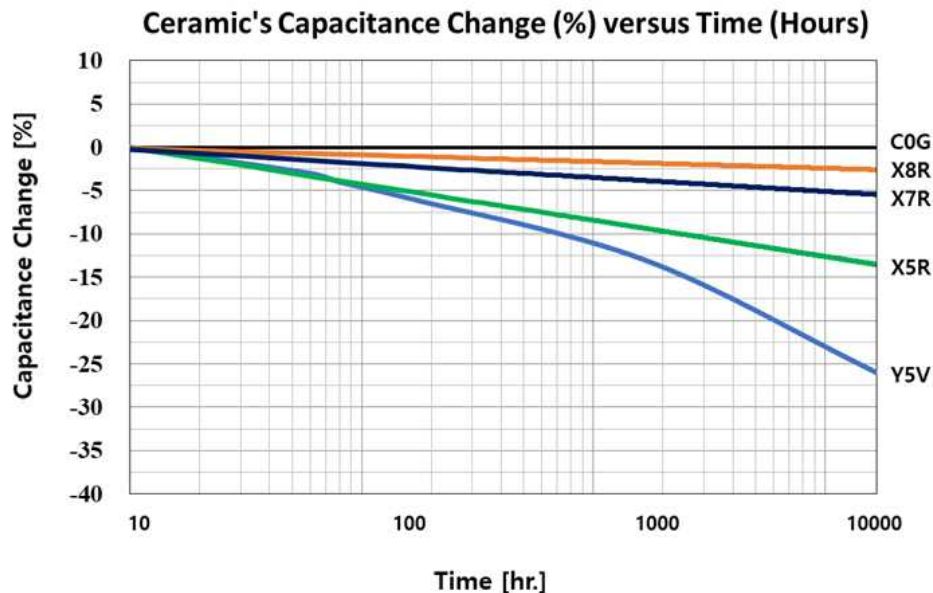
where :

C_t = Capacitance Value, t hours after the start of 'aging'

C_{24} = Capacitance Value, 24 hours after its manufacture

k = aging constant (capacitance decrease per decade-hour)

t = time, in hours, from the start of 'aging'



The capacitance value can be restored (a.k.a. 'de-aged') by exposing the component to elevated temperatures approaching its Curie Temperature (approximately 120°C). This 'deaging' 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.

- (2) Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.
- ① Aircraft equipment ② Aerospace equipment ③ Undersea equipment ④ Power plant equipment
 - ⑤ Medical equipment ⑥ Transportation equipment (vehicles, trains, ships, etc.)
 - ⑦ Traffic signal equipment ⑧ Disaster prevention / crime prevention equipment
 - ⑨ Industrial equipment (Conveyors, Robot equipment, etc) ⑩ Led equipment
 - ⑪ Application of similar complexity and/or reliability requirements to the applications listed above