TO. : ____________________ NO. : ______________

APPROVAL SHEET

MULTILAYER CERAMIC CAPACITOR
Commercial Grade
(Thin Layer Large-Capacitance Type)

Approved by customer : (signing or stamping here)

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

2020. 04. 21.

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< SPEC SUMMARY >

SAMWHA Part no.	CS2012X5R106K250NRE		
Type	Thin Layer Large-Capacitance		
Item	Specification	Unit	Test methods and Conditions(Capacitance,IR)
Capacitance	10	㎌	Testing Frequency : 1 ±0.1kHz Testing Voltage : 1 ±0.2Vrms
Capacitance Tolerance	± 10	%	
Dissipation Factor	Max. 12.5	%	
Insulation Resistance	More than 5	㏁	Applied the rated voltage for 2 minutes of charging.
Chip Size	2.00 ±0.20	L (㎜)	*Capacitance Tolerance Code --- page 1/8 *Chip size -------------------- page 2/8 *Characteristics & Test Method------ page 3/8~5/8
	1.25 ±0.20	W (㎜)	
	1.25 ±0.20	T (㎜)	

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 8)

2. General Code

(1) Type Designation

CS	2012	X5R	106	K	250	N	R	E
(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%
	X7S	-55 to +125℃	±22%
	X7T	-55 to +125℃	+22% ~ -33%
	Y5V	-30 to +85℃	+22% ~ -82%

4) Capacitance Code(Pico farads) :
The nominal Capacitance Value in ㎊ 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 ㎊
R denotes decimal
8R2 = 8.2 ㎊

5) Capacitance Tolerance Code

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

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

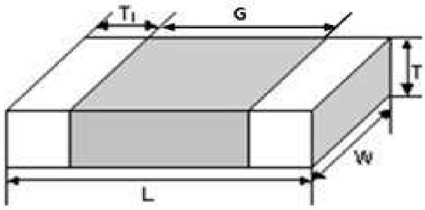
Thickness(mm)		Code
t	Tol(±)	
1.25	0.20	E

3. Temperature Characteristics

See Page 5/8 (No.13)

4. Constructions and Dimensions

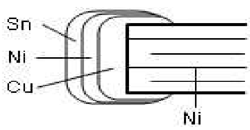
(I) Dimensions



(Unit : mm)

Code	Dimension							
	Length		Width		Thickness		T1(min)	G(min)
	L	Tol(±)	W	Tol(±)	T	Tol(±)		
2012	2.00	0.20	1.25	0.20	1.25	0.20	0.10	0.65

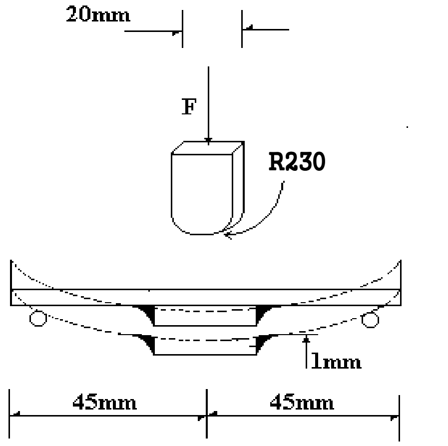
(2) Construction of Termination



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

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Methods and Conditions</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>X7R, X7S, X7T : -55 to +125℃
X5R : -55 to +85℃
Y5V : -30 to +85℃</td><td></td></tr>
<tr><td>2</td><td colspan="2">Insulation Resistance</td><td>50Ω·F min</td><td>·Applied the rated voltage for 2 minutes of charging,
The charge/discharge current is less than 50mA.</td></tr>
<tr><td>3</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>X7R, X7S, X7T, X5R, Y5V : The rated voltage × 250%
- Applied between the terminations for 1 to 5 seconds.
- The charge/discharge current is less than 50mA.</td></tr>
<tr><td>4</td><td colspan="2">Capacitance</td><td>within the specified tolerance</td><td rowspan="2">The capacitance/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.
<table>
<tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr>
<tr><td>C≦10㎌</td><td>1 ± 0.1kHz</td><td>0.5~1.0Vrms</td></tr>
<tr><td>C>10㎌</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</td></tr>
<tr><td>5</td><td colspan="2">Dissipation Factor</td><td>X7R, X7S, X7T, X5R : 12.5%max
*3216 Size 100㎌ : 15%max
Y5V : 20%max</td></tr>
<tr><td>6</td><td colspan="2">Solderability of Termination</td><td>-Termination should be covered with more than 75% of new solder</td><td>*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</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td>No defects which may affect performance</td><td rowspan="4">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.</td></tr>
<tr><td>Capacitance change</td><td>X7R, X7S, X7T, X5R : Within±7.5%
Y5V : Within±20%</td></tr>
<tr><td>Dissipation Factor</td><td>X7R, X7S, X7T, X5R : 12.5%max
*3216 Size 100㎌ : 15%max
Y5V : 20%max</td></tr>
<tr><td>I.R.</td><td>50Ω·F min</td></tr>
<tr><td rowspan="4">8</td><td rowspan="4">Temperature Cycle</td><td>Appearance</td><td>No defects which may affect performance</td><td rowspan="4">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</td></tr>
<tr><td>Capacitance Change</td><td>X7R, X7S, X7T, X5R : Within ±7.5%
Y5V : Within ±20%</td></tr>
<tr><td>Dissipation Factor</td><td>X7R, X7S, X7T, X5R : 12.5%max
*3216 Size 100㎌ : 15%max
Y5V : 20%max</td></tr>
<tr><td>I.R</td><td>50Ω·F min</td></tr>
</table>

No.	Item		Specification	Test Methods and Conditions
9	High Temperature Load	Appearance	No defects which may affect performance	Apply 100% of the rated voltage for 1000+48/-0 hrs at the maximum operating temperature ±3℃. 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	X7R, X7S, X7T, X5R : Within ±12.5% Y5V : Within ±30%	
		Dissipation Factor	X7R, X7S, X7T, X5R : 20%max *3216 Size 100㎌ : 30%max Y5V : 40%max	
		I.R	12.5Ω·F min	
10	Bending strength		 No cracking or marking defects shall occur	·Substrate material : Glass EPOXY Board. ·Thickness : 1.6㎜ 0.8㎜(0603/1005size) *. Test condition - Bending limit : 1mm - Pressurizing speed : 1mm/sec - Holding time : 5±1sec
		Capacitance Change	X7R, X7S, X7T, X5R: Within ±12.5% Y5V : Within ±30% Within +30/-40% (cap≥10㎌)	
11	Vibration Resistance	Appearance	No defects or abnormalities	*Shown in Fig. 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 3mutually perpendicular directions(total is 6hours).
		Capacitance	Whin the specified tolerance	
		Dissipation Factor	X7R, X7S, X7T, X5R : 12.5%max *3216 Size 100㎌ : 15%max Y5V : 20%max	
12	Humidity Load	Appearance	No defects which may affect performance	Apply the rated voltage at 40±2℃ 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	X7R, X7S, X7T, X5R: Within ±12.5% Y5V : Within ±30%	
		Dissipation Factor	X7R, X7S, X7T, X5R : 20%max *3216 Size 100㎌ : 30%max Y5V : 40%max	
		I.R.	12.5Ω·F min	

<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Methods and Conditions</th></tr>
<tr><td>13</td><td>Capacitance Temperature Characteristics</td><td>
<table>
<tr><th>Char.</th><th>Temp. Range</th><th>Reference Temp.</th><th>Cap. Change</th></tr>
<tr><td>X5R</td><td>−55 to +85℃</td><td>25℃</td><td>Within ±15%</td></tr>
<tr><td>X7R</td><td>−55 to +125℃</td><td>25℃</td><td>Within ±15%</td></tr>
<tr><td>X7S</td><td>−55 to +125℃</td><td>25℃</td><td>Within ±22%</td></tr>
<tr><td>X7T</td><td>−55 to +125℃</td><td>25℃</td><td>Within +22/−33%</td></tr>
<tr><td>Y5V</td><td>−30 to +85℃</td><td>25℃</td><td>Within +22/−82%</td></tr>
</table>
</td><td>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.</td></tr>
</table>

*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.

5. Packing

(1) Bulk packing

① 1000 pcs per Polybag

② 5 Polybags per Inner box

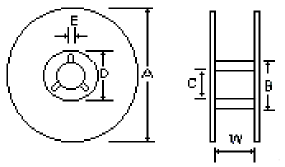
③ 10 Inner boxes per Out box

(2) Reel Packing

① 8~10 Reels per Inner box

② 6 Inner boxes per Out box

(3) Reel Dimensions



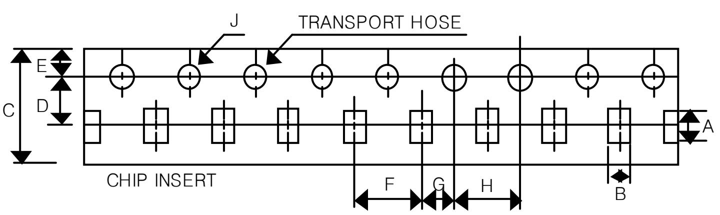
(Unit : mm)

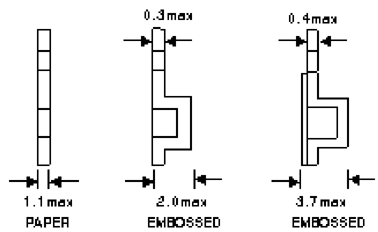
MARK	SIZE	A	B	C	D	E	W
7 " REEL	0603~3225	Φ178±2	Φ50Min	Φ13±0.5	Φ21±0.8	2±0.5	10±1.5
	4520~4532	Φ180+0,-3	Φ60-0,+1	Φ13±0.2	Φ57-0+1	3±0.2	13±0.5
13 " REEL	1005~3225	Φ330±2	Φ70Min	Φ13±0.5	Φ21±0.8	2±0.5	10±1.5

(4)Number of Package

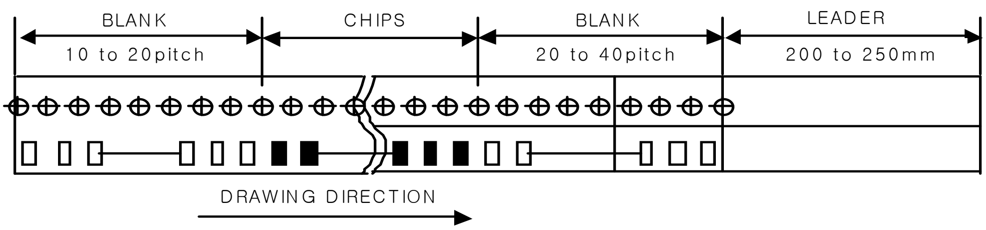
TYPE	EIA CODE	7"	13"
		Qt/REEL	Qt/REEL
CS0603	CC0201	15,000	
CS1005	CC0402	10,000	50,000
CS1608	CC0603	4,000	15,000
CS2012	CC0805	3,000 ~ 4,000	8,000 ~ 15,000
CS3216	CC1206	2,000 ~ 4,000	6,000 ~ 10,000
CS3225	CC1210	1,000 ~ 3,000	4,000 ~ 10,000
CS4520	CC1808	1,500 ~ 3,000	-
CS4532	CC1812	500 ~ 1,000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

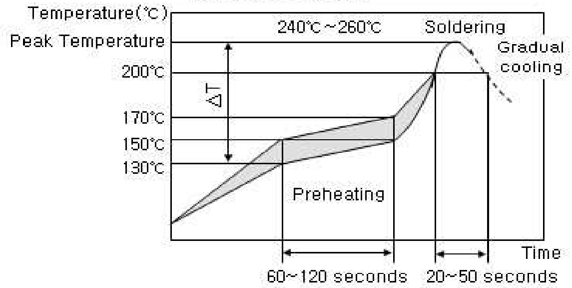
2. Please refer to the recommended soldering profiles as shown in figures, and keep the temperature difference(△T) within the range recommended in Table 1.

Table 1

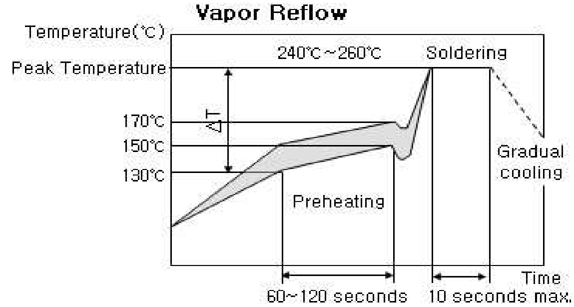
Size code	Temperature Difference
0603, 1005, 1608, 2012, 3216	△T≤190℃
3225size and over	△T≤130℃

[Standard Conditions for Reflow Soldering]

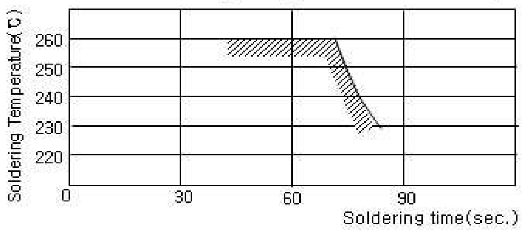
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]



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

▶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(Polybromide biphenyl), PBDE(Polybrominated diphenyl ethers), asbestos.

* Note

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

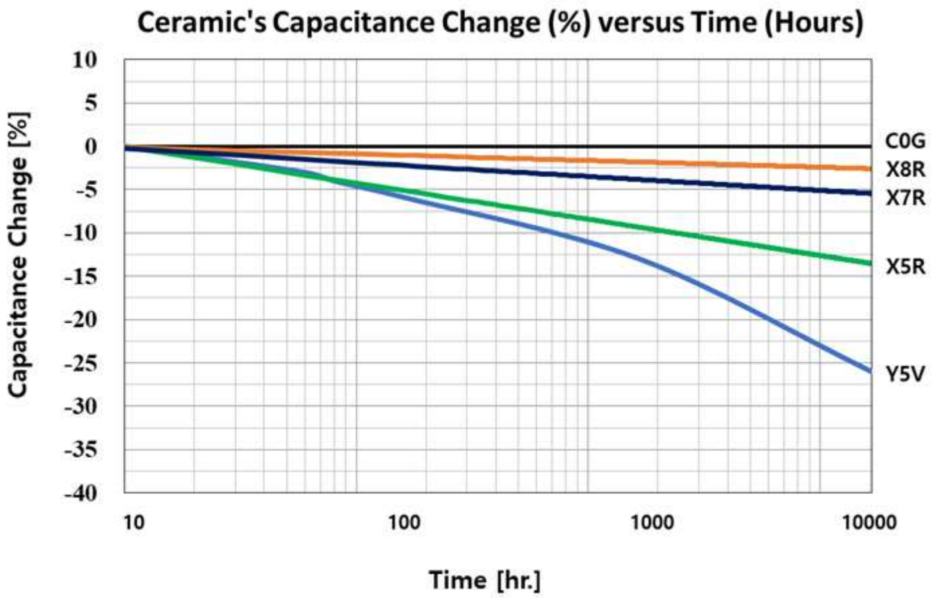
(Typically represented by X7R, Y5V temperature characteristic of which main composition is BaTiO3)

'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:

$C_t = C_{24} (1 - k \log10 \ t)$

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℃). This 'deaging' can occur during the component's solder-assembly onto the PCB, during life or temperature cycle testing., or by ' baking ' at 150℃ 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.

①Aircraft equipment ②Aerospace equipment ③Undersea equipment ④Power plant equipment
⑤Medical equipment ⑥Transportation equipment (vehicles, trains, ships, etc.)
⑦Traffic signal equipment ⑧Disaster prevention / crime prevention equipment
⑨Industrial equipment (Conveyors, Robot equipment, etc) ⑩Led equipment
⓪Application of similar complexity and/or reliability requirements to the applications listed above