TO. : MINDA　　　　　　　　　　NO. : M201124

APPROVAL SHEET

MULTILAYER CERAMIC CAPACITOR

Commercial Grade

(High Voltage Type (100V~3000V))

(IEC-60384 Qualified)

Approved by customer : (signing or stamping here)

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

2020. 11. 24.

SAMWHA CAPACITOR CO., LTD.

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Home page : www.samwha.com

< SPEC SUMMARY >

SAMWHA Part no.	CS3225X7R225K101NRK		
Type	High voltage		
Item	Specification	Unit	Test methods and Conditions(Capacitance,IR)
Capacitance	2.2	㎌	Testing Frequency : 1 ±0.2kHz Testing Voltage : 1 ±0.2Vrms
Capacitance Tolerance	± 10	%	
Dissipation Factor	Max. 5	%	
Insulation Resistance	More than 45.4	㏁	Applied the rated voltage for 2 minutes of charging.
Chip Size	3.20 ±0.40	L (㎜)	*Capacitance Tolerance Code --- page 1/9 *Chip size -------------------- page 2/9 *Characteristics & Test Method ---- page 3/9~6/9
	2.50 ±0.25	W (㎜)	
	2.00 ±0.25	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 9)

2. General Code

(1) Type Designation

CS	3225	X7R	225	K	101	N	R	K
(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 ㎊ 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	Code	Tolerance
B	± 0.1 ㎊	M	± 20 %
C	± 0.25 ㎊	P	+ 100, −0%
D	± 0.5 ㎊	Z	+ 80, −20%
F	± 1.0 %	H	+ 0.25/-0 ㎊
G	± 2.0 %	I	+ 0/-0.25 ㎊
J	± 5 %	U	+ 5/-0 %
K	± 10 %	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

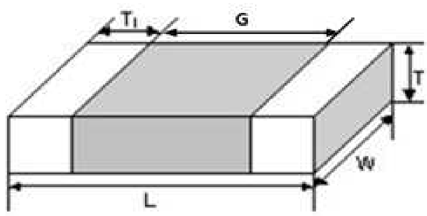
Thickness(mm)		Code	Thickness(mm)		Code
t	Tol(±)		t	Tol(±)	
0.30	0.03	Blank	1.30	0.20	E
0.50	0.05	Blank	1.35	0.20	H
0.60	0.10	A	1.60	0.20	I
0.80	0.10	B	1.80	0.20	J
0.85	0.15	B	2.00	0.25	K
1.00	0.15	E	2.50	0.25	L
1.10	0.15	E	2.80	0.30	M
1.15	0.15	E	3.20	0.30	N
1.25	0.15	E	5.00	0.40	O

3. Temperature Characteristics

See Page 3/9 (No.7)

4. Constructions and Dimensions

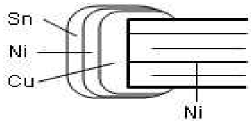
(I) Dimensions



(Unit : mm)

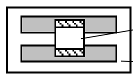
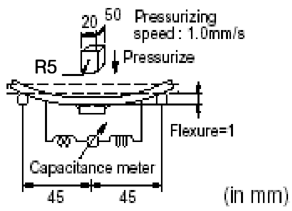
Code	Dimension					
	Length		Width		T1(min)	G(min)
	L	Tol(±)	W	Tol(±)		
0603	0.60	0.03	0.30	0.03	0.05	0.15
1005	1.00	0.05	0.50	0.05	0.05	0.30
1608	1.60	0.15	0.80	0.10	0.10	0.50
2012	2.00	0.20	1.25	0.15	0.10	0.65
3216	3.20	0.30	1.60	0.20	0.15	1.00
3225	3.20	0.40	2.50	0.25	0.15	1.05
4520	4.50	0.40	2.00	0.25	0.20	1.50
4532	4.50	0.40	3.20	0.30	0.20	1.50
5750	5.70	0.50	5.00	0.40	0.30	1.85

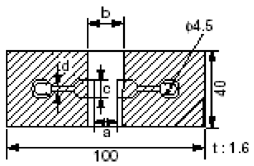
(2) Construction of Termination



Specifications and Test Methods (High voltage type)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class Ⅰ</th><th>Class Ⅱ</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>C0G :-55 to+125℃</td><td>X7R : -55 to +125℃</td><td></td></tr>
<tr><td>2</td><td>Dimensions</td><td colspan="2">Within the specified dimension</td><td>Using calipers</td></tr>
<tr><td>3</td><td>Voltage proof</td><td colspan="2">No defects or abnormalities</td><td>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><th>Cap.</th><th>Rated voltage</th><th>Test voltage</th><th>Time</th></tr>
<tr><td rowspan="2">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 rowspan="4">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></td></tr>
<tr><td>4</td><td>Insulation Resistance</td><td>More than
10,000 MΩ</td><td>-DC100V~1KV
:C≥0.01㎌:More than 100MΩ·㎌
:C<0.01㎌:More than 10,000MΩ
-DC2~3KV:More than6,000 MΩ</td><td>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.</td></tr>
<tr><td>5</td><td>Capacitance</td><td colspan="2">within the specified tolerance</td><td rowspan="2">
<table>
<tr><th>Cap</th><th>Testing frequency</th><th>Testing Voltage</th><th>Measure temperature</th></tr>
<tr><td>C0G</td><td>1±0.2㎒(C<1000㎊)
1±0.1㎑(C≥1000㎊)</td><td rowspan="2">AC 1±0.2Vrms</td><td rowspan="2">25℃</td></tr>
<tr><td>X7R</td><td>1±0.2㎑</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 Ⅰ) or 24±2 hours (Class Ⅱ) then measure</td></tr>
<tr><td>6</td><td>Dissipation Factor</td><td>C0G Char. :
30㎊min
: Q≧1,000(DF≦0.1%)
30㎊max
: Q≧400+20C
(DF≦1/ (400+20C))</td><td>5% max</td></tr>
<tr><td>7</td><td>Temperature characteristic of capacitance</td><td>Temp. Coefficient
C0G char. :
0±30ppm/℃
(Temp. Range :
-55to+125℃)</td><td>Cap. Change within ±15%
(Temp. Range : -55 to +125℃)</td><td>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><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>
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</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class Ⅰ</th><th>Class Ⅱ</th></tr>
<tr><td>8</td><td colspan="2">Adhesive Strength of Termination</td><td colspan="2">No removal of the terminations or other defect should occur</td><td>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.

</td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Vibration</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td rowspan="3">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.)</td></tr>
<tr><td>Capacitance</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Dissipation Factor(or Q)</td><td>C0G Char. :
30pFmin
: Q≧1,000(DF≦0.1%)
30pFmax
: Q≧400+20C
(DF≦1/ (400+20C))</td><td>5% max</td></tr>
<tr><td rowspan="2">10</td><td colspan="2" rowspan="2">Substrate bending test</td><td colspan="2">No cracking defects should occur.</td><td rowspan="2">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.


*. Test condition
- Bending limit : 1mm
- Pressurizing speed : 1mm/sec
- Holding time : 5±1sec</td></tr>
<tr><td colspan="2">

<table>
<tr><th>L×X (mm)</th><th colspan="4">Dimension(mm)</th></tr>
<tr><th></th><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></td></tr>
<tr><td>11</td><td colspan="2">Solderability</td><td colspan="2">95% of the terminations is to be soldered evenly and continuously.</td><td>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</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Methods and Conditions</th></tr>
<tr><th>Class Ⅰ</th><th>Class Ⅱ</th></tr>
<tr><td rowspan="4">12</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">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><th>Step</th><th>Temperature</th><th>Time</th></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></td></tr>
<tr><td>Capacitance change</td><td>within ±2.5%or ±0.25pF (whichever is larger)</td><td>within ±10%</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>C0G Char. :
30pFmin
: Q≧1,000(DF≦0.1%)
30pFmax
: Q≧400+20C
(DF≦1/ (400+20C))</td><td>5% max</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ</td><td>-DC100V~1KV
:C≥0.01㎌:More than 100MΩ·㎌
:C<0.01㎌:More than 10,000MΩ
-DC2~3KV:More than1,000 MΩ</td></tr>
<tr><td rowspan="4">13</td><td rowspan="4">Rapid change of temperature</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Perform the 5 cycles according to the 4 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. ±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>·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>Within ±2.5%or ±0.25pF (whichever is larger)</td><td>within ±15%</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>C0G Char. :
30pFmin
: Q≧1,000(DF≦0.1%)
30pFmax
: Q≧400+20C
(DF≦1/ (400+20C))</td><td>5% max</td></tr>
<tr><td>I.R</td><td>More than 10,000MΩ</td><td>-DC100V~1KV
:C≥0.01㎌:More than 100MΩ·㎌
:C<0.01㎌:More than 10,000MΩ
-DC2~3KV:More than 3,000MΩ</td></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Damp heat, steady state</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">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</td></tr>
<tr><td>Capacitance Change</td><td>within ±5% or ±0.5pF (Whichever is larger)</td><td>Within ±15%</td></tr>
<tr><td>Dissipation Factor (or Q)</td><td>C0G Char. :
C≧30pF : Q≧350
C<30pF : $Q \geq 275+\frac{5}{2}C$</td><td>7.5% max</td></tr>
<tr><td>I.R</td><td>More than 1,000MΩ</td><td>-DC100V~1KV
:C≥0.01㎌:More than 10MΩ·㎌
:C<0.01㎌:More than 1,000MΩ
-DC2~3KV:More than 1,000MΩ</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">Endurance</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">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><th>Operating temperature range</th><th>Rated voltage</th><th>Test voltage</th></tr><tr><td rowspan="2">C0G</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>·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>within ±3% or ±0.3pF (Whichever is larger)</td><td>DC100V,630V:Within ±15%
DC1KV:Within ±20%
DC2~3KV:Within ±20%</td></tr>
<tr><td>Dissipation (or Q)</td><td>C0G Char. :
C≧30pF : Q≧350
C<30pF : $Q \geq 275+\frac{5}{2}C$</td><td>7.5% max</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td><td>-DC100V~1KV
:C≥0.01㎌:More than 10MΩ·㎌
:C<0.01㎌:More than 1,000MΩ
-DC2~3KV:More than 2,000MΩ</td></tr>
</table>

No.	Item		Specification: Class Ⅰ	Specification: Class Ⅱ	Test Methods and Conditions
16	Humidity Load (Application : DC250V item)	Appearance		No defects which may affect performance	Apply the rated voltage 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
		Capacitance Change		Within ±15%	
		Dissipation (or Q)		7.5% max	
		I.R.		C≥0.01㎌:More than 10㏁·㎌ C<0.01㎌:More than 1,000㏁	

*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."

5. Packing

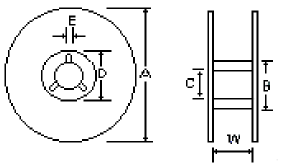
(1) Bulk packing

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



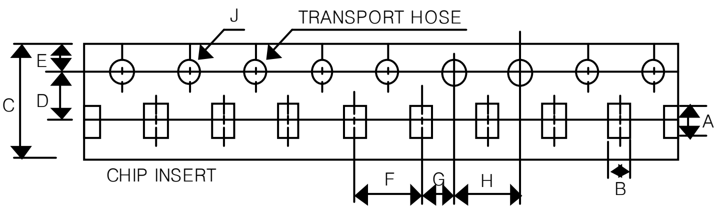
(Unit : mm)

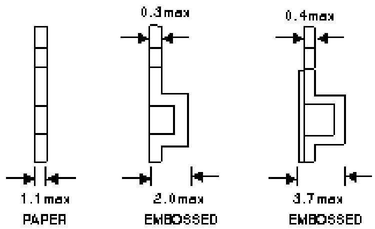
MARK	SIZE	A	B	C	D	E	W
7 " REEL	0603~3225	Φ178±2	Φ50Min	Φ13±0.5	Φ21±0.8	2±0.5	10±1.5
	4520~4532	Φ180+0,-3	Φ60-0,+1	Φ13±0.2	Φ57-0+1	3±0.2	13±0.5
13 " REEL	1005~3225	Φ330±2	Φ70Min	Φ13±0.5	Φ21±0.8	2±0.5	10±1.5

(4)Number of Package

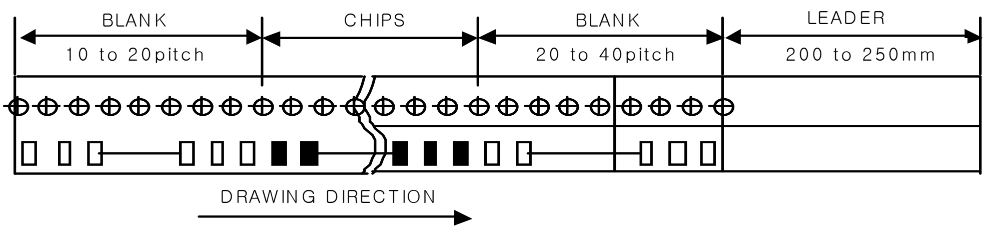
TYPE	EIA CODE	7" Qt/REEL	13" Qt/REEL
CS0603	CC0201	15,000	
CS1005	CC0402	10,000	50,000
CS1608	CC0603	4,000	15,000
CS2012	CC0805	3,000 ~ 4,000	8,000 ~ 15,000
CS3216	CC1206	2,000 ~ 4,000	6,000 ~ 10,000
CS3225	CC1210	1,000 ~ 3,000	4,000 ~ 10,000
CS4520	CC1808	1,500 ~ 3,000	-
CS4532	CC1812	500 ~ 1,000	1,500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

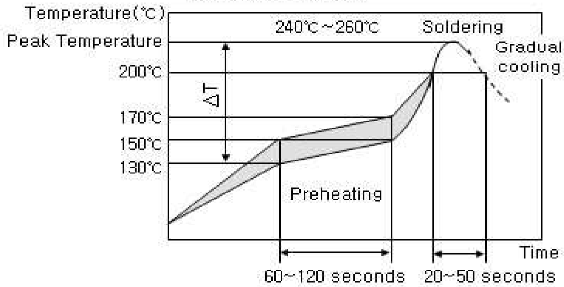
2. Please refer to the recommended soldering profiles as shown in figures, and keep the temperature difference(△T) within the range recommended in Table 1.

Table 1

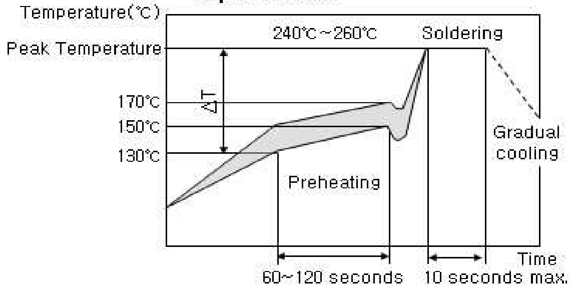
Size code	Temperature Difference
0603, 1005, 1608, 2012, 3216	△T≤190℃
3225size and over	△T≤130℃

[Standard Conditions for Reflow Soldering]

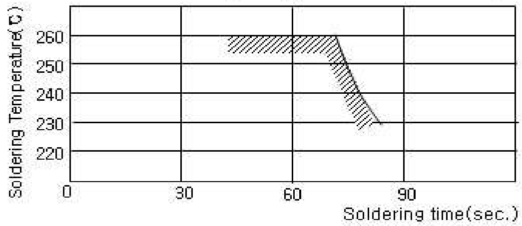
Infrared Reflow



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

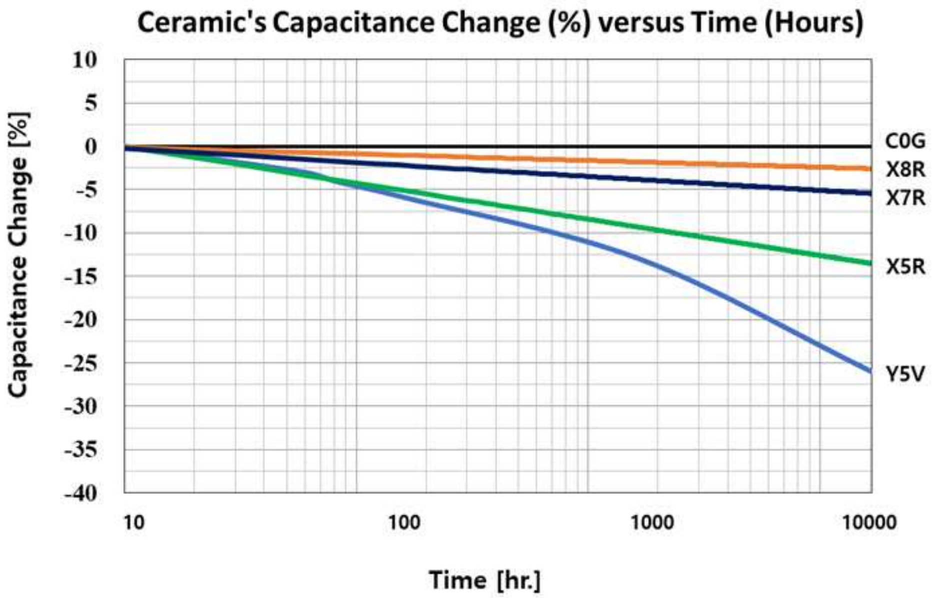
(Typically represented by X7R, Y5V temperature characteristic of which main composition is $BaTiO_3$)

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

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

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