TO. : Reference Sheet

NO. : A250201

APPROVAL SHEET

MULTILAYER CERAMIC CAPACITOR

Automotive Grade

(AEC-Q200 Qualified)

SAMWHA CAPACITOR .CO., LTD.

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*** Notice**
This sheet is for reference only and is subject to change or be discontinued without notice.
Please contact our sales representatives for detailed information.

< SPECIFICATION SUMMARY >			
SAMWHA Part no.	**CQ1005X7R682K500NR**		
Type	**MLCC for Automotive Application**		
Items	**Specification**	**Unit**	**Test Conditions**
Capacitance	6.8	nF	Testing Frequency : 1.0 ± 0.1KHz Testing Voltage : 1.0 ± 0.2Vrms Should be measured at 25°C.
Capacitance Tolerance	± 10	%	
Dissipation Factor	Max. 2.5	%	
Insulation Resistance	More than 10,000	MΩ	Should be measured with a DC voltage not exceeding rated voltage at 25℃ for 2 minutes of charging.
Chip Size	1.00 ± 0.05	L (㎜)	Capacitance Tolerance Code ---------- page 4/15 Chip size ---------- page 5/15 Characteristics & Test Method ---------- page 6/15~9/15
	0.50 ± 0.05	W (㎜)	
	0.50 ± 0.05	T (㎜)	

Record of Revision

PART NO.		SAMWHA SPEC.	CQ1005X7R682K500NR

NO	REASON	CONTENTS	DATE OF APPROVAL	CHECKED	REMARKS
1	Initial written	full document	96. 03. 27		
2	Re-revision of approval document	full document	25. 02 .01		

General Description

1. General Code

※Caution : ECU/ Power Train/ Safety module/ Etc.
Please contact sales representatives or product engineers before using these Automotive products

(1) Type Designation

CQ	1005	X7R	682	K	500	N	R
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

1) Multilayer Ceramic Capacitor (Automovie 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) Temperautre Coefficient Code

Classification	Code	Temperature Range	Capacitance Tolerance
Class Ⅱ	X7R	-55 to +125℃	± 15 %

4) Capacitance Tolerance Code

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 %

Code	Code
G	± 2.0 %
J	± 5 %
K	± 10 %
M	± 20 %

6) Voltage Code

Code	2R5	040	6R3	100	160	250	350	500	101	201	251	501	631	102	202	302
Rate Voltage	DC 2.5V	DC 4V	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

N : Nickel-Tin Plate

A : Nickel-Tin Plate → Soft Termination Type

8) Packing Code

R : 7“ Reel Type, L : 13“ Reel Type, B : Bulk Type

General Description

9) Thickness option

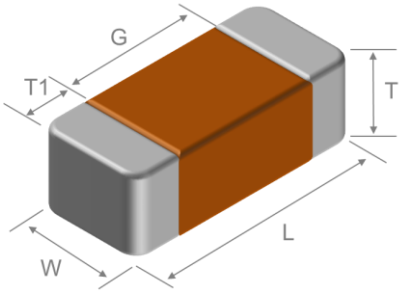
Thickness (mm)		Code
t	Tolerance (±)	
0.50	0.05	Blank

2. Temperature Characteristics

See Page 9 (Specifications and Test Methods : No.21)

3. Constructions and Dimensions

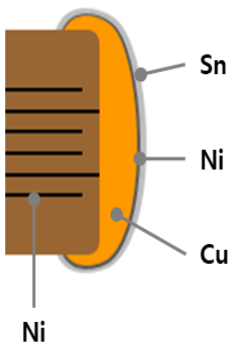
1) Dimensions



(Unit : ㎜)

Size Code	EIA Code	Dimension					
		Length		Width		T1(min.)	G(min.)
		L	Tol(±)	W	Tol(±)		
1005	0402	1.00	0.05	0.50	0.05	0.15	0.30

(2) Construction of Termination



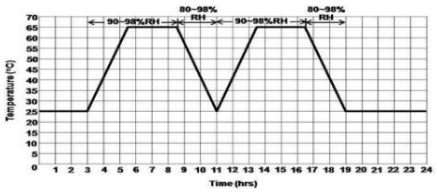
Specifications and Test Methods (For Automotive Applications)

No.	AEC-Q200 Test Item		Specification		Test Methods and Conditions	
			Class I	Class II		
1	Pre-and Post-Stress Electrical Test		-			
2	High Temperature Exposure (Storage)	Appearance	No defects which may affect performance		Temperature Applied Time Measurement after test	Max. operating temperature ±3°C 1000+48/-0 hrs Let sit for 24±2 hours at room temperature, then measure
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10.0%		
		Q/D.F.	Q≧1000 (DF≦0.1%)	5% max.		
		I.R.	More than 10,000MΩ or 500Ω.F (Whichever is smaller)			
3	Temperature Cycle	Appearance	No defects which may affect performance		Perform the 1000 cycles according to the four heat treatments listed in the following table	
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10.0%		
		Q/D.F.	Q≧1000 (DF≦0.1%)	5% max.	Initial measurement Measurement after test	Perform the initial measurement according to Note 1 for Class II Let sit for 24±2 hours at room temperature, then measure
		I.R.	More than 10,000MΩ or 500Ω.F (Whichever is smaller)			
4	Destructive Physical Analysis		No defects or abnormalities		Per EIA-469	
5	Moisture Resistance	Appearance	No defects which may affect performance		Temperature Humidity Cycle Time Measurement after test	25~65°C 80~98% 24 hrs/cycle, 10 cycles Let sit for 24±2 hours at room temperature, then measure
		Capacitance Change	Within ±3.0% or±0.30pF (Whichever is larger)	Within ±12.5%		
		Q/D.F.	Q≧350 (DF≦0.3%)	5% max.		
		I.R	More than 10,000MΩ or 500Ω.F (Whichever is smaller)			
6	Humidity Bias	Appearance	No defects which may affect performance		Temperature Humidity Applied Voltage Applied Time Charge/Discharge Current Measurement after test	85±3°C 80~85% Rated Voltage and 1.3+0.2/-0V 1000+48/-0 hrs 50mA max. Let sit for 24±2 hours at room temperature, then measure
		Capacitance Change	Within ±3.0% or ±0.30pF (Whichever is larger)	Within ±12.5%		
		Q/D.F.	Q≧200 (DF≦0.5%)	5% max.		
		I.R.	More than 1,000MΩ or 50Ω.F (Whichever is smaller)			
7	High Temperature Operating Life	Appearance	No defects which may affect performance		Temperature Applied Voltage Applied Time Charge/Discharge Current Measurement after test Initial Measurement for Class II	Max. operating temp. ±3°C Rated Voltage x200% (*150%) 1000+48/-0 hrs 50mA max. Let sit for 24±2 hours at room temperature, then measure Applied 200% of the rated voltage for one hour at 125±3°C Remove and let sit for 24±2 hours at room temperature, then measure
		Capacitance Change	Within ±3.0% or ±0.30pF (Whichever is larger)	Within ±12.5%		
		Q/D.F.	Q≧350 (DF≦0.3%)	5% max.		
		I.R.	More than 1,000MΩ or 50Ω.F (Whichever is smaller)			

Step 1 2 3 4

Temp.(℃) -55+0/-3 25±2 125+3/-0 25±2

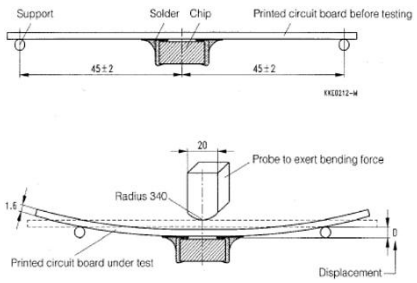
Time(min) 15±3 1 15±3 1



Specifications and Test Methods (For Automotive Applications)

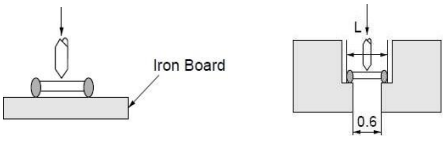
No.	AEC-Q200 Test Item		Specification		Test Methods and Conditions
			Class Ⅰ	Class Ⅱ	
8	External Visual		No defects or abnormalities		Visual inspection
9	Physical Dimension		Within the specified dimensions		Using calipers
10	Resistance to Solvent	Appearance	No defects which may affect performance		Per MIL-STD-202 Method 215
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	Q≧1000 (DF≦0.1%)	2.5% max.	
		I.R.	More than 10,000MΩ or 500Ω.F(Whichever is smaller)		
11	Mechanical Shock	Appearance	No defects which may affect performance		Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks) Wave form: Half-sine Duration: 0.5ms Peak value: 1,500G Velocity change: 4.7m/s
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	Q≧1000 (DF≦0.1%)	2.5% max.	
		I.R.	More than 10,000MΩ or 500Ω.F(Whichever is smaller)		
12	Vibration	Appearance	No defects which may affect performance		Type of Vibration: From 10Hz to 2000Hz then 10Hz Vibration Time: 20min. Total Amplitude: 1.5mm Vibration directions and time: This cycle should be performed 12 times in each of three mutually perpendicular directions (total of 36 times)
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	Q≧1000 (DF≦0.1%)	2.5% max.	
		I.R.	More than 10,000MΩ or 500Ω.F(Whichever is smaller)		
13	Resistance to Solder Heat	Appearance	No defects which may affect performance		Temperature: 260±5°C Dipping Time: 10±1sec. Measurement after test: Let sit for 24±2 hours at room temperature, then measure Initial measurement: Perform the initial measurement according to Note 1 for Class II
		Capacitance Change	Within the specified tolerance	Within the specified tolerance	
		Q/D.F.	Q≧1000 (DF≦0.1%)	2.5% max.	
		I.R.	More than 10,000MΩ or 500Ω.F(Whichever is smaller)		
14	Thermal Shock	Appearance	No defects which may affect performance		Perform the 300 cycles according to the two heat treatments listed in the following table. Step: 1 / 2 Temp.(℃): -55+0/-3 / 125+3/-0 Time(min.): 15±3 / 15±3 Transfer Time: 20sec. max. Measurement after test: Let sit for 24±2 hours at room temperature, then measure. Initial measurement: Perform the initial measurement according to Note 1 for Class II
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±15%	
		Q/D.F.	Q≧1000 (DF≦0.1%)	2.5% max.	
		I.R.	More than 50Ω.F		

Specifications and Test Methods (For Automotive Applications)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200
Test 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">15</td><td rowspan="4">ESD</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="4">Per AEC-Q200-002</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>Q≧1000 (DF≦0.1%)</td><td>2.5% max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω.F(Whichever is smaller)</td></tr>
<tr><td>16</td><td colspan="2">Solderability</td><td colspan="2">95% of the terminations is to be soldered evenly and continuously.</td><td>(a) Preheat at 155℃ for 4 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5℃.
(b) Steam aging for 8 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5℃.
(c) Steam aging for 8 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 120±5 seconds at 260±5℃.</td></tr>
<tr><td rowspan="6">17</td><td rowspan="6">Electrical Characterization</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="3">The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table.
<table><tr><th>Class</th><th>Capacitance (C)</th><th>Frequency</th><th>Voltage</th></tr><tr><td rowspan="2">Class I</td><td>C<1000pF</td><td>1±0.1MHz</td><td>0.5~5Vrms</td></tr><tr><td>C≥1000pF</td><td>1±0.1kHz</td><td>1±0.2Vrms</td></tr><tr><td rowspan="2">Class II</td><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>Measurement after test: Take it out and set it for 24±2 hours (Class II) then measure
Initial measurement: Perform the initial measurement according to Note1 for Class II</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>Q≧1000 (DF≦0.1%)</td><td>2.5% max.</td></tr>
<tr><td>I.R. at 25℃</td><td>More than 100,000MΩ or 1,000Ω.F (Whichever is smaller)</td><td>More than 10,000MΩ or 500Ω.F (Whichever is smaller)</td><td>Applied Voltage: Rated voltage
Charging Time: 2min.
Charge/Discharge Current: 50mA max.</td></tr>
<tr><td>I.R. at 125℃</td><td>More than 10,000MΩ or 100Ω.F (Whichever is smaller)</td><td>More than 1,000MΩ or 10Ω.F (Whichever is smaller)</td></tr>
<tr><td>Voltage proof</td><td colspan="2">No dielectric breakdown or mechanical breakdown</td><td>Applied Voltage: 250% of the rated voltage
Applied Time: 1 to 5sec.
Charge/Discharge Current: 50mA max.</td></tr>
<tr><td rowspan="3">18</td><td rowspan="3">Board Flex</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="3">Apply a force in the direction shown in the following figure for 60±5 seconds.
 

Flexure for Class I: 3mm max. or Class II: 2mm max.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF (Whichever is larger)</td><td>Within the specified tolerance</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="3">19</td><td rowspan="3">Terminal Strength</td><td>Appearance</td><td colspan="2">No defects which may affect performance</td><td rowspan="3">Applied Force: 18N*
Holding Time: 60±1 seconds.
*10N for 1608 size (EIA:0603)
2N for 1005 size (EIA:0402)</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF (Whichever is larger)</td><td>Within the specified tolerance</td></tr>
<tr><td colspan="3"></td></tr>
</table>

Specifications and Test Methods (For Automotive Applications)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200
Test 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>20</td><td colspan="2">Beam Load Test</td><td>The chip endure following force.
<table><tr><th>Chip Length</th><th>Thickness (T)</th><th>Force</th></tr><tr><td rowspan="2">2.5mm max.</td><td>T≤0.5mm</td><td>8N</td></tr><tr><td>T>0.5mm</td><td>20N</td></tr><tr><td rowspan="2">3.2mm min.</td><td>T<1.25mm</td><td>15N</td></tr><tr><td>T≥1.25</td><td>54.5N</td></tr></table></td><td colspan="2"></td><td>Apply a force as shown in the following figure
(i) Chip Length : 2.5mm max . (ii) Chip Length : 3.2mm min.
Beam Speed : 0.5mm/s Beam Speed : 2.5mm/s
 
</td></tr>
<tr><td rowspan="3">21</td><td rowspan="3">Capacitance Temperature Characteris-tics</td><td>Capacitance Change</td><td></td><td>X7R, X7S, X7T : -55 to +125℃
X6S : -55 to +105℃
X5R : -55 to +85℃
Y5V : -30 to +85℃</td><td rowspan="3">(i) Class Ⅰ
The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step 1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient.
The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.
<table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>Temp.(℃</td><td>25±2</td><td>-55±3</td><td>25±2</td><td>125±3</td><td>25±2</td></tr></table>
(ii) Class Ⅱ
The ranges of capacitance change compared with the 25°C value over the temperature range from -55°C to 125°C.
Initial measurement Perform the initial measurement according to Note 1 for Class Ⅱ.</td></tr>
<tr><td>Temperature Coefficient</td><td>0±30 ppm/℃</td><td></td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF
(Whichever is larger)</td><td></td></tr>
</table>

In the case of "*" is specifications for "Thin Layer Large Capacitance Type"

Note 1. Initial Measurement for Class II
Perform a heat treatment at 150+0/-10oC for one hour, and then let sit for 24±2 hours at room temperature, then measure.

Note 2. The spec is certified in VW80808-2
Follow the test process and measurement method according to VW80808-1

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

Packing

(1) Bulk Packing

① 1000 pcs per polybag

② 5 polybags per inner box

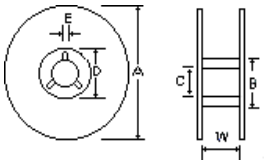
③ 10 inner boxes per out box

(2) Reel Packing

① 8~10 reels per inner box

② 6 inner boxes per out box

(3) Reel Dimensions



(Unit : mm)

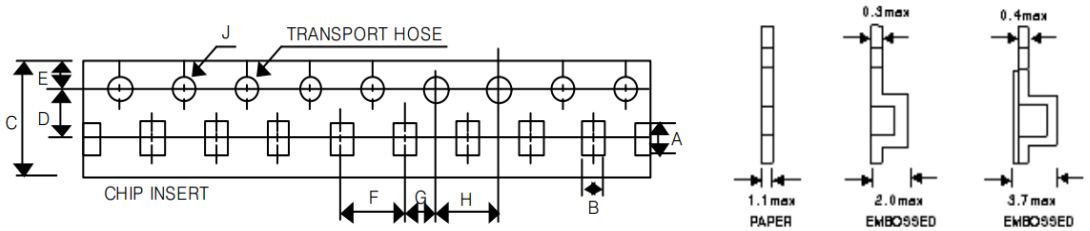
Mark	Size Code	EIA Code	A	B	C	D	E	W
7 ″ Reel	1005~3225	0402~1210	Φ178±2	Φ50Min	Φ13±0.5	Φ21±0.8	2±0.5	10±1.5
	4520~4532	1808~1812	Φ180+0,-3	Φ60-0,+1	Φ13±0.2	Φ57-0+1	3±0.2	13±0.5
13 ″ Reel	1005~3225	0402~1210	Φ330±2	Φ70Min	Φ13±0.5	Φ21±0.8	2±0.5	10±1.5

(4) Number of Package

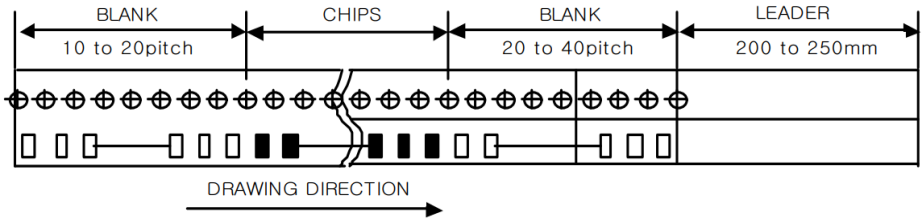
Size Code	EIA Code	7"	13"
		Quantity(pcs)/Reel	Quantity(pcs)/Reel
1005	0402	10,000	50,000
1608	0603	4,000	15,000
2012	0805	3,000 ~ 4,000	8,000 ~ 15,000
3216	1206	2,000 ~ 4,000	6,000 ~ 10,000
3225	1210	1,000 ~ 3,000	4,000 ~ 10,000
4520	1808	1,500 ~ 3,000	-
4532	1812	500 ~ 1,000	1,500 ~ 5,000

Packing

(5) Tape Dimensions



Size Code	EIA Code	Size	Thickness	A	B	C	D	E	F	G	H	J
0603	0201	0603	all	0.7±0.02	0.4±0.02	8±0.1	3.5±0.05	1.75±0.05	2±0.05	2±0.05	4±0.1	1.55±0.03
1005	0402	1005	all	1.12±0.03	0.62±0.03	8±0.1	3.5±0.05	1.75±0.05	2±0.05	2±0.05	4±0.1	1.55±0.03
1005	0402	1005	all	1.12±0.03	0.58±0.03	8±0.1	3.5±0.05	1.75±0.05	2±0.05	2±0.05	4±0.1	1.55±0.03
1005	0402	1005	all	1.16±0.03	0.66±0.03	8±0.05	3.5±0.05	1.75±0.05	2±0.05	2±0.05	4±0.1	1.55±0.03
1005	0402	1005	all	1.29±0.1	0.78±0.1	8±0.3	3.5±0.05	1.75±0.1	2±0.05	2±0.1	4±0.1	1.5±0.1
1608	0603	1608	A, B	1.8±0.05	0.95±0.05	8±0.1	3.5±0.05	1.75±0.05	2±0.05	2±0.05	4±0.1	1.55±0.03
1608	0603	1608	A, B	1.78±0.05	0.92±0.05	8±0.1	3.5±0.05	1.75±0.05	2±0.05	2±0.05	4±0.1	1.55±0.03
1608	0603	1608	B	1.9±0.05	1.1±0.05	8±0.2	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.1	1.5+0.1
1608	0603	1608	B	1.9±0.05	1.1±0.05	8±0.1	3.5±0.05	1.75±0.05	4±0.1	2±0.05	4±0.1	1.55±0.03
2012	0805	2012	E	2.25±0.1	1.35±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.05	1.5±0.1
2012	0805	2012	E	2.4±0.1	1.6±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.05	1.5±0.1
2012	0805	2012	E	2.25±0.1	1.35±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.1	1.5+0.1
2012	0805	2012	E	2.25±0.05	1.53±0.08	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.1	1.5+0.1
2012	0805	2012	A	2.3±0.05	1.55±0.05	8±0.1	3.5±0.05	1.75±0.05	4±0.1	2±0.05	4±0.1	1.55±0.03
2012	0805	2012	B	2.3±0.05	1.55±0.05	8±0.1	3.5±0.05	1.75±0.05	4±0.1	2±0.05	4±0.1	1.55±0.03
3216	1206	3216	E	3.5±0.1	1.88±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.05	1.5±0.1
3216	1206	3216	I	3.45±0.1	1.75±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.05	1.5±0.1
3216	1206	3216	I	3.7±0.1	1.85±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.05	1.5±0.1
3225	1210	3225	L	3.58±0.1	2.75±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.05	1.5±0.1
3225	1210	3225	J	3.58±0.1	2.85±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.05	1.5±0.1
3225	1210	3225	L	3.5±0.2	2.7±0.1	8±0.1	3.5±0.05	1.75±0.1	4±0.1	2±0.05	4±0.05	1.5±0.1
4532	1812	4532	K	5.1±0.2	3.7±0.2	12±0.3	5.5±0.1	1.75±0.1	8±0.1	2±0.1	4±0.1	1.5±0.1
4532	1812	4532	L	4.9±0.4	3.6±0.3	12±0.1	5.5±0.05	1.75±0.1	8±0.1	2±0.05	4±0.05	1.5±0.1
4532	1812	4532	M	4.9±0.1	3.6±0.1	12±0.1	5.5±0.05	1.75±0.1	8±0.1	2±0.05	4±0.05	1.5±0.1

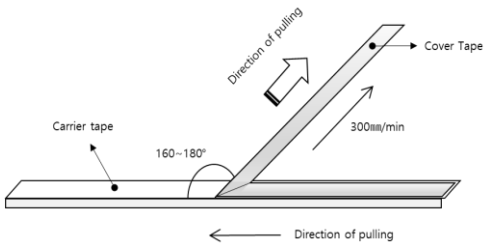


(6) Cover tape peel-off Strength

1. Peeling strength

10 g.f to 70 g.f

2. Measurement Method

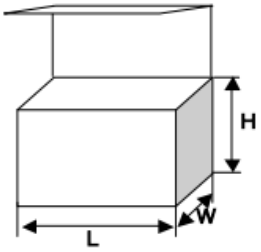


Packing

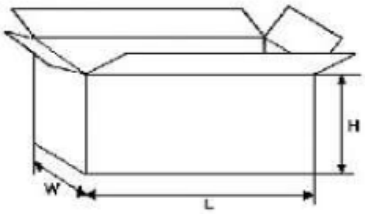
(7) Packing Label(* Reference image)

① Customer
② Part No.
③ Lot No
④ Q/ty

(8) Packing Box



Inner box drawing



Out box drawing

Packing Box Dimensions (Unit : mm)

Division		Size		
		L	W	H
Inner Box	7 " Reel Box (in 5 reels)	183	65	185
	7 " Reel Box (in 10 reels)	185	135	185
	13 " Reel Box	330	65	337
Out Box	7 " Reel Box	430	390	210
	13 " Reel Box	350	350	360

Caution

▶ Storage Condition

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

MLCC should be stored at 5~40℃ with a relative humidity of 20~70%.

High humidity can reduce solderability due to oxidation.

Use the product within 6 months of the outgoing delivery date, and check the packaging if more than 6 months have passed.

It's recommended to use within 1 year to avoid solderability issues from long-term storage.

If over 1 year, verify solderability before use.

▶ The Regulation of Environmental Pollution Materials

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

Pb, Cd, Hg, Cr+6, PBB(Polybrominated biphenyl), PBDE(Polybrominated diphenyl ethers), asbestos

▶ 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.

▶ Standard condition for reflow soldering

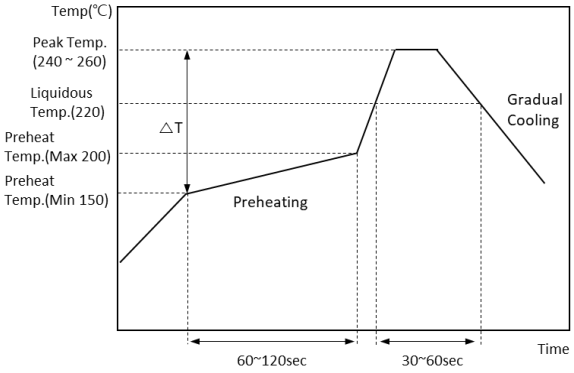


Table 1

Size code (EIA Code)	Temperature Difference
0603, 1005, 1608, 2012, 3216	△T≤150°C
3225 size and over	△T≤130°C

Recommended Conditions

Size code (EIA Code)	Lead Free Solder
Peak Temperature	240 - 260°C
Atmosphere	Air or N_2

* Compliant Standard JESD22

▶ Flow 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 2.

Table 2

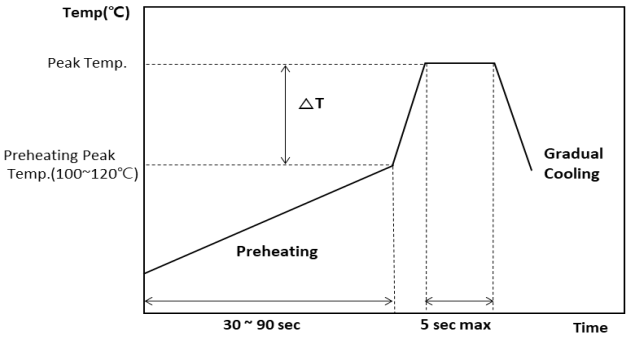
Size code	Temperature Difference
1608, 2012, 3216	△T≤150°C

Recommended Conditions

Conditions	Lead Free Solder
Soldering Peak Temperature	250 - 260°C
Atmosphere	Air or N_2

*Lead Free Solder : Sn-3.0Ag-0.5Cu

▶ Flow Profile



Notice

▶ Land Dimension

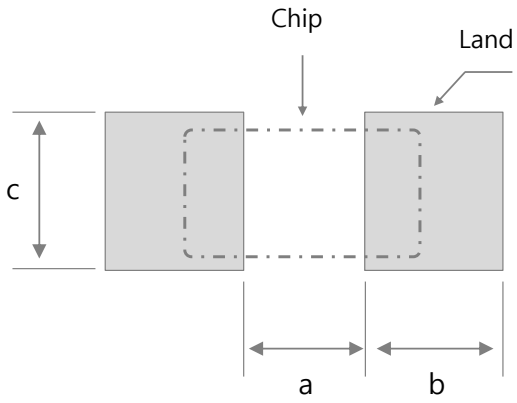


Table . Reflow Soldering Method

Chip size [mm]	Chip tol. [mm]	a [mm]	b [mm]	c [mm]
0603	±0.03	0.2~0.25	0.2~0.3	0.25~0.35
	±0.05/±0.09	0.23~0.3	0.25~0.35	0.3~0.4
1005	±0.1	0.3~0.5	0.35~0.45	0.4~0.6
	±0.2	0.4~0.6	0.4~0.5	0.5~0.7
1608	±0.1	0.6~0.8	0.6~0.7	0.6~0.8
	±0.2	0.7~0.9	0.7~0.8	0.8~1.0
2012	±0.1	0.9~1.3	0.6~0.8	1.2~1.4
	±0.2	1.0~1.4	0.6~0.8	1.2~1.4
3216	±0.2	1.8~2.0	0.9~1.2	1.5~1.7
	±0.3	1.9~2.1	1.0~1.3	1.7~1.9
3225		2.0~2.4	1.0~1.2	1.8~2.3
4532		3.0~3.5	1.2~1.4	2.3~3.0
5750		4.0~4.6	1.4~1.6	3.5~4.8

*Please confirm the suitable land dimensions, which are determined through the evaluation of the actual SET and PCB

Notice

(1) 'Aging'/'De-aging' behavior of high dielectric constant type MLCCs

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

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

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

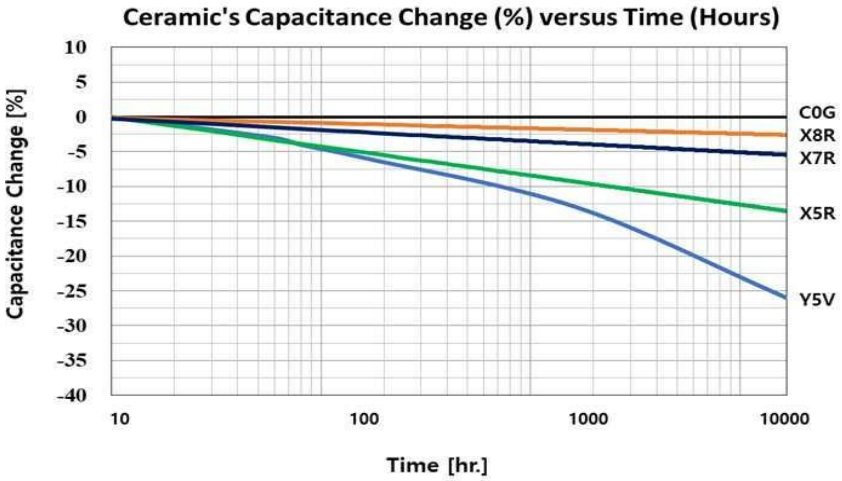
where,

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

(2) Caution of Application

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.

ⓐ Aircraft equipment ⓑ Aerospace equipment ⓒ Undersea equipment ⓓ Power plant equipment
ⓔ Medical equipment ⓕ Transportation equipment (vehicles, trains, ships, etc.)
ⓖ Traffic signal equipment ⓗ Disaster prevention / crime prevention equipment
ⓘ Industrial equipment (Conveyors, Robot equipment, etc) ⓙ Led equipment
ⓚ Application of similar complexity and/or reliability requirements to the applications listed above