

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.	CQ2012X7R474K500NRE		
Type	MLCC for Automotive Application		
Items	Specification	Unit	Test Conditions
Capacitance	470.0	nF	Testing Frequency : $1.0 \pm 0.1\text{KHz}$ Testing Voltage : $1.0 \pm 0.2\text{Vrms}$ Should be measured at 25°C.
Capacitance Tolerance	± 10	%	
Dissipation Factor	Max. 12.5	%	
Insulation Resistance	More than 106.38	MΩ	Should be measured with a DC voltage not exceeding rated voltage at 25°C for 2 minutes of charging.
Chip Size	2.00 ± 0.20	L (mm)	Capacitance Tolerance Code ----- page 4/15
	1.25 ± 0.15	W (mm)	Chip size ----- page 5/15
	1.25 ± 0.15	T (mm)	Characteristics & Test Method ----- page 6/15~9/15

※ Thin Layer Large-Capacitance Type

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

<u>CQ</u>	<u>2012</u>	<u>X7R</u>	<u>474</u>	<u>K</u>	<u>500</u>	<u>N</u>	<u>R</u>	<u>E</u>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

1) Multilayer Ceramic Capacitor (Automotive 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 / °C
Class II	X7R	-55 to +125℃	± 15 %
	X7S	-55 to +125℃	± 22 %
	X7T	-55 to +125℃	+ 22 ~ - 33 %
	X6S	-55 to +105℃	± 22 %
	X5R	-55 to +85℃	± 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	Code	Code
B	± 0.1 pF	G	± 2.0 %
C	± 0.25 pF	J	± 5 %
D	± 0.5 pF	K	± 10 %
F	± 1.0 %	M	± 20 %

6) Voltage Code

Code	6R3	100	160	250	350	500	101	201	251	501	631	102	202	302
Rate	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC
Voltage	6.3V	10V	16V	25V	35V	50V	100V	200V	250V	500V	630V	1KV	2KV	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	Thickness (mm)		Code
t	Tolerance (±)		t	Tolerance (±)	
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
1.30	0.20	E			

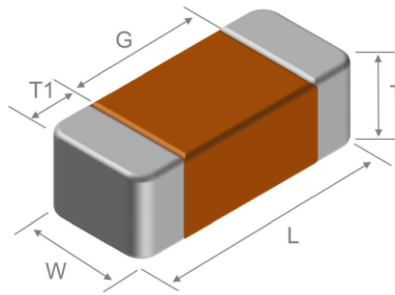
*3216 Size $\geq 2.2\mu\text{F}$ 100V $\Rightarrow$ T : Tol $\pm$ 0.30

2. Temperature Characteristics

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

3. Constructions and Dimensions

1) Dimensions



(Unit : mm)

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
1608	0603	1.60	0.15	0.80	0.10	0.20	0.50
2012	0805	2.00	0.20	1.25	0.15	0.20	0.70
3216	1206	3.20	0.30	1.60	0.20	0.30	1.20
3225	1210	3.20	0.40	2.50	0.25	0.30	1.00
4520	1808	4.50	0.40	2.00	0.25	0.30	1.00
4532	1812	4.50	0.40	3.20	0.30	0.30	2.20
5750	2220	5.70	0.50	5.00	0.40	0.30	3.20

*3216 Size $\geq 2.2\mu\text{F}$ 100V $\Rightarrow$ L, W : Tol $\pm$ 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	Max. operating temperature $\pm 3^{\circ}\text{C}$ 1000+48/-0 hrs															
		Capacitance Change	Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ (Whichever is larger)	Within $\pm 10.0\%$ (*Within $\pm 12.5\%$)	Measurement after test	Let sit for 24 ± 2 hours at room temperature, then measure															
		Q/D.F.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 16V min.: 0.05 max. 10V: 0.075 max. *0.2 max.																	
		I.R.	More than 10,000M Ω or 500 Ω . F (*50 Ω . 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 $\pm 2.5\%$ or $\pm 0.25\text{pF}$ (Whichever is larger)	Within $\pm 10.0\%$																	
		Q/D.F.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 16V min.: 0.05 max. 10V: 0.075 max. *0.2 max.	<table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Temp.($^{\circ}\text{C}$)</td><td>-55+0/-3</td><td>25± 2</td><td>125+3/-0</td><td>25± 2</td></tr><tr><td>Time(min)</td><td>15± 3</td><td>1</td><td>15± 3</td><td>1</td></tr></table>		Step	1	2	3	4	Temp.($^{\circ}\text{C}$)	-55+0/-3	25 ± 2	125+3/-0	25 ± 2	Time(min)	15 ± 3	1	15 ± 3	1
		Step	1	2			3	4													
Temp.($^{\circ}\text{C}$)	-55+0/-3	25 ± 2	125+3/-0	25 ± 2																	
Time(min)	15 ± 3	1	15 ± 3	1																	
I.R.	More than 10,000M Ω or 500 Ω . F (*50 Ω . F) (Whichever is smaller)		Initial measurement	Perform the initial measurement according to Note 1 for Class II																	
					Measurement after test	Let sit for 24 ± 2 hours at room temperature, then measure															
4	Destructive Physical Analysis		No defects or abnormalities		Per EIA-469																
5	Moisture Resistance	Appearance	No defects which may affect performance		Temperature	25~65 $^{\circ}\text{C}$															
		Capacitance Change	Within $\pm 3.0\%$ or $\pm 0.30\text{pF}$ (Whichever is larger)	Within $\pm 12.5\%$	Humidity	80~98%															
		Q/D.F.	30pF min.: $Q \geq 350$ 10pF min. and 30pF max.: $Q \geq 275+5/2 \times C$ 10pF max.: $Q \geq 200+10 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 16V min.: 0.05 max. 10V: 0.075 max. *0.2 max.	Cycle Time	24 hrs/cycle, 10 cycles															
		I.R.	More than 10,000M Ω or 500 Ω . F (*50 Ω . F) (Whichever is smaller)		Measurement after test	Let sit for 24 ± 2 hours at room temperature, then measure															
6	Humidity Bias	Appearance	No defects which may affect performance		Temperature	85 $\pm 3^{\circ}\text{C}$															
		Capacitance Change	Within $\pm 3.0\%$ or $\pm 0.30\text{pF}$ (Whichever is larger)	Within $\pm 12.5\%$	Humidity	80~85%															
		Q/D.F.	30pF min.: $Q \geq 200$ 30pF max.: $Q \geq 100+10/3 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 16V min.: 0.05 max. 10V: 0.075 max. *0.2 max.	Applied Voltage	Rated Voltage and 1.3+0.2/-0V															
		I.R.	More than 1,000M Ω or 50 Ω . F (*5 Ω . F) (Whichever is smaller)		Applied Time	1000+48/-0 hrs															
					Charge/Discharge Current	50mA max.															
					Measurement after test	Let sit for 24 ± 2 hours at room temperature, then measure															
7	High Temperature Operating Life	Appearance	No defects which may affect performance		Temperature	Max. operating temp. $\pm 3^{\circ}\text{C}$															
		Capacitance Change	Within $\pm 3.0\%$ or $\pm 0.30\text{pF}$ (Whichever is larger)	Within $\pm 12.5\%$	Applied Voltage	Rated Voltage x200% (*150%)															
		Q/D.F.	30pF min.: $Q \geq 350$ 10pF min. and 30pF max.: $Q \geq 275+5/2 \times C$ 10pF max.: $Q \geq 200+10 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 16V min.: 0.05 max. 10V: 0.075 max. *0.2 max.	Applied Time	1000+48/-0 hrs															
		I.R.	More than 1,000M Ω or 50 Ω . F (*5 Ω . F) (Whichever is smaller)		Charge/Discharge Current	50mA max.															
					Measurement after test	Let sit for 24 ± 2 hours at room temperature, then measure															
					Initial Measurement for Class II	Applied 200% of the rated voltage for one hour at 125 $\pm 3^{\circ}\text{C}$ Remove and let sit for 24 ± 2 hours at room temperature, then measure															

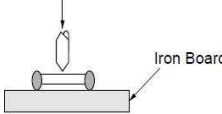
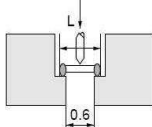
2. Specifications and Test Methods (For Automotive Applications)

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.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 50V: 0.025 max. 25V: 0.03 max. 16V: 0.035 max. 10V: 0.05 max. *0.125 max.							
		I.R.	More than 10,000MΩ or 500Ω. F (*50Ω. 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.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 50V: 0.025 max. 25V: 0.03 max. 16V: 0.035 max. 10V: 0.05 max. *0.125 max.							
		I.R.	More than 10,000MΩ or 500Ω. F (*50Ω. F) (Whichever is smaller)								
12	Vibration	Appearance	No defects which may affect performance			Type of Vibration Vibration Time Total Amplitude Vibration directions and time From 10Hz to 2000Hz then 10Hz 20min. 1.5mm 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.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 50V: 0.025 max. 25V: 0.03 max. 16V: 0.035 max. 10V: 0.05 max. *0.125 max.							
		I.R.	More than 10,000MΩ or 500Ω. F (*50Ω. 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.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 50V: 0.025 max. 25V: 0.03 max. 16V: 0.035 max. 10V: 0.05 max. *0.125 max.							
		I.R.	More than 10,000MΩ or 500Ω. F (*50Ω. 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.					
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±15%							
		Q/D.F.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 50V: 0.025 max. 25V: 0.03 max. 16V: 0.035 max. 10V: 0.05 max. *0.125 max.		Transfer Time 20sec. max. Measurement after test Let sit for 24±2 hours at room temperature, then measure, Perform the initial measurement according to Note 1 for Class II Initial measurement					
		I.R.	More than 10,000MΩ or 500Ω. F (*50Ω. F) (Whichever is smaller)								
		Step			1				2		
		Temp.(°C)			-55+0/-3				125+3/-0		
Time(min.)			15±3		15±3						

2. Specifications and Test Methods (For Automotive Applications)

No.	AEC-Q200 Test Item		Specification		Test Methods and Conditions																		
			Class I	Class II																			
15	ESD	Appearance	No defects which may affect performance		Per AEC-Q200-002																		
		Capacitance Change	Within the specified tolerance																				
		Q/D.F.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 50V: 0.025 max. 25V: 0.03 max. 16V: 0.035 max. 10V: 0.05 max. *0.125 max.																			
		I.R.	More than 10,000MΩ or 500Ω. F (*50Ω. F) (Whichever is smaller)																				
16	Solderability		95% of the terminations is to be soldered evenly and continuously.		(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℃.																		
17	Electrical Characterization	Appearance	No defects which may affect performance		The capacitance/Q/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.																		
		Capacitance Change	Within the specified tolerance																				
		Q/D.F.	30pF min.: $Q \geq 1000$ 30pF max.: $Q \geq 400+20 \times C$ C: Nominal Capacitance (pF)	Rated Voltage 50V: 0.025 max. 25V: 0.03 max. 16V: 0.035 max. 10V: 0.05 max. *0.125 max.	<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>	Class	Capacitance (C)	Frequency	Voltage	Class I	C<1000pF	1±0.1MHz	0.5~5Vrms	C ≥ 1000pF	1±0.1kHz	1±0.2Vrms	Class II	C ≤ 10μF	1±0.1kHz	0.5~1.0Vrms	C>10μF	120±24Hz	0.5±0.1Vrms
		Class	Capacitance (C)	Frequency	Voltage																		
		Class I	C<1000pF	1±0.1MHz	0.5~5Vrms																		
			C ≥ 1000pF	1±0.1kHz	1±0.2Vrms																		
Class II	C ≤ 10μF	1±0.1kHz	0.5~1.0Vrms																				
	C>10μF	120±24Hz	0.5±0.1Vrms																				
I.R. at 25℃	More than 100,000MΩ or 1,000Ω. F (Whichever is smaller)	More than 10,000MΩ or 500Ω. F (*50Ω. F) (Whichever is smaller)	Measurement after test Initial measurement																				
I.R. at 125℃	More than 10,000MΩ or 100Ω. F (Whichever is smaller)	More than 1,000MΩ or 10Ω. F (*1Ω. F) (Whichever is smaller)	Applied Voltage Charging Time Charge/Discharge Current																				
Voltage proof	No dielectric breakdown or mechanical breakdown		Rated voltage 2min. 50mA max.																				
18	Board Flex	Appearance	No defects which may affect performance		Apply a force in the direction shown in the following figure for 60±5 seconds.																		
		Capacitance Change	Within ±5.0% or ±0.5pF (Whichever is larger)	Within the specified tolerance	Flexure for Class I: 3mm max. or Class II: 2mm max.																		
19	Terminal Strength	Appearance	No defects which may affect performance		Applied Force 18N [*] Holding Time 60±1 seconds. *10N for 1608 size (EIA:0603) 2N for 1005 size (EIA:0402)																		
		Capacitance Change	Within ±5.0% or ±0.5pF (Whichever is larger)	Within the specified tolerance																			

2. Specifications and Test Methods (For Automotive Applications)

No.	AEC-Q200 Test Item		Specification		Test Methods and Conditions													
			Class I	Class II														
20	Beam Load Test		The chip endure following force. <table><tr><td>Chip Length</td><td>Thickness (T)</td><td>Force</td></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>		Chip Length	Thickness (T)	Force	2.5mm max.	T≤0.5mm	8N	T>0.5mm	20N	3.2mm min.	T<1.25mm	15N	T≥1.25	54.5N	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  
Chip Length	Thickness (T)	Force																
2.5mm max.	T≤0.5mm	8N																
	T>0.5mm	20N																
3.2mm min.	T<1.25mm	15N																
	T≥1.25	54.5N																
21	Capacitance Temperature Characteristics	Capacitance Change		X5R, X7R : Within ±15% X7S : Within ±22% X7T : Within +22% ~ -33% X6S : Within ±22%	(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.(°C)</td><td>25±2</td><td>-55±3</td><td>25±2</td><td>125±3</td><td>25±2</td></tr></table>	Step	1	2	3	4	5	Temp.(°C)	25±2	-55±3	25±2	125±3	25±2	
		Step	1	2		3	4	5										
		Temp.(°C)	25±2	-55±3		25±2	125±3	25±2										
Temperature Coefficient	0±30 ppm/°C																	
Capacitance Drift	Within ±0.2% or ±0.05pF (Whichever is larger)		(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.															

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 $\pm$ 0/-10°C for one hour, and then let sit for 24 $\pm$ 2 hours at room temperature, then measure.

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

3. Packing

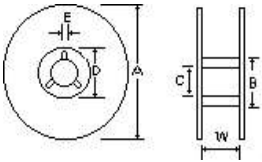
(1) Bulk Packing

- 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)

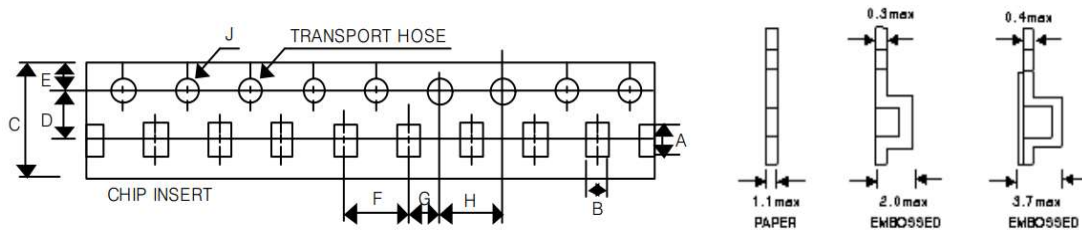
Mark	Size Code	EIA Code	A	B	C	D	E	W
7 " Reel	1005~3225	0402~1210	$\Phi 178 \pm 2$	$\Phi 50 \text{Min}$	$\Phi 13 \pm 0.5$	$\Phi 21 \pm 0.8$	2 ± 0.5	10 ± 1.5
	4520~4532	1808~1812	$\Phi 180 +0, -3$	$\Phi 60 -0, +1$	$\Phi 13 \pm 0.2$	$\Phi 57 -0 +1$	3 ± 0.2	13 ± 0.5
13 " Reel	1005~3225	0402~1210	$\Phi 330 \pm 2$	$\Phi 70 \text{Min}$	$\Phi 13 \pm 0.5$	$\Phi 21 \pm 0.8$	2 ± 0.5	10 ± 1.5

(4) Number of Package

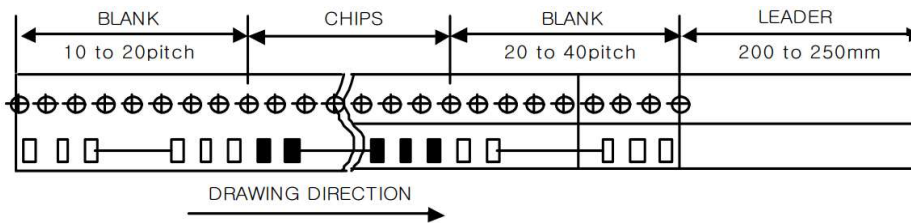
Size Code	EIA Code	7"	13"
		Quantity(pcs)/Reel	Quantity(pcs)/Reel
1005	0402	10,000	50,000
1608	0603	4,000	15,000
2012	0805	3,000 ~ 4,000	8,000 ~ 15,000
3216	1206	2,000 ~ 4,000	6,000 ~ 10,000
3225	1210	1,000 ~ 3,000	4,000 ~ 10,000
4520	1808	1,500 ~ 3,000	-
4532	1812	500 ~ 1,000	1,500 ~ 5,000

Packing

(5) Tape Dimensions



Size Code	EIA Code	사이즈	두께	A	B	C	D	E	F	G	H	J
CS0603	CC0201	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
CS1005	CC0402	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
CS1005	CC0402	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
CS1005	CC0402	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
CS1608	CC0603	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
CS1608	CC0603	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
CS1608	CC0603	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
CS1608	CC0603	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
CS2012	CC0805	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
CS2012	CC0805	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
CS2012	CC0805	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
CS2012	CC0805	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
CS2012	CC0805	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
CS2012	CC0805	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
CS3216	CC1206	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
CS3216	CC1206	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
CS3216	CC1206	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
CS3225	CC1210	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
CS3225	CC1210	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
CS3225	CC1210	3225	L	3.5±0.1	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
CS4532	CC1812	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

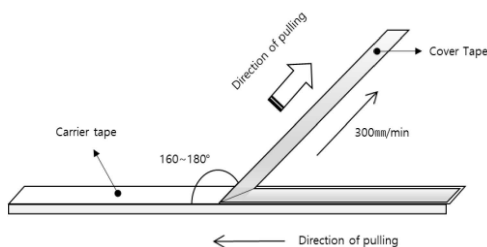


(6) Cover tape peel-off Strength

1. Peeling strength

10 g.f to 70 g.f

2. Measurement Method

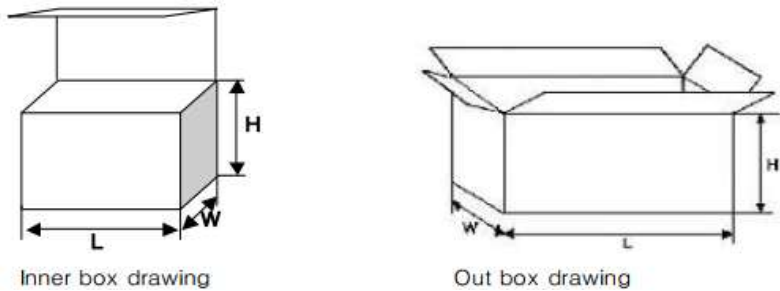


Packing

(7) Packing Label(* Reference image)



(8) Packing Box



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 °C 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(ΔT) within the range recommended in Table 1.

Table 1

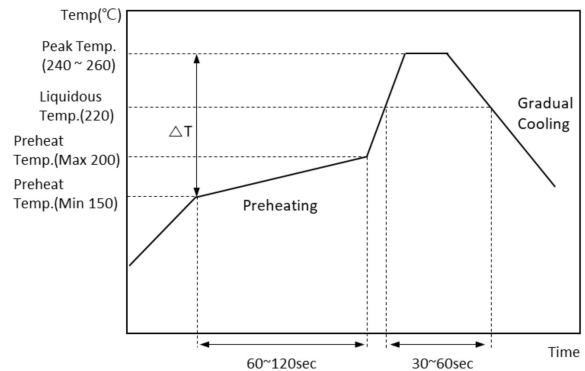
Size code (EIA Code)	Temperature Difference
0603, 1005, 1608, 2012, 3216	$\Delta T \leq 150^\circ\text{C}$
3225 size and over	$\Delta T \leq 130^\circ\text{C}$

Recommended Conditions

Size code (EIA Code)	Lead Free Solder
Peak Temperature	240 - 260°C
Atmosphere	Air or N ₂

* Compliant Standard JESD22

► Standard condition for reflow soldering



► 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(ΔT) within the range recommended in Table 2.

Table 2

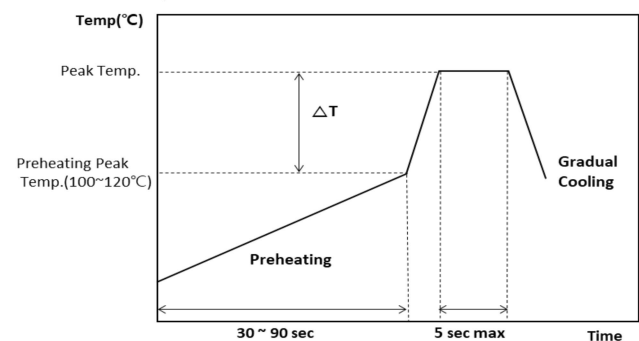
Size code	Temperature Difference
1608, 2012, 3216	$\Delta T \leq 150^\circ\text{C}$

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



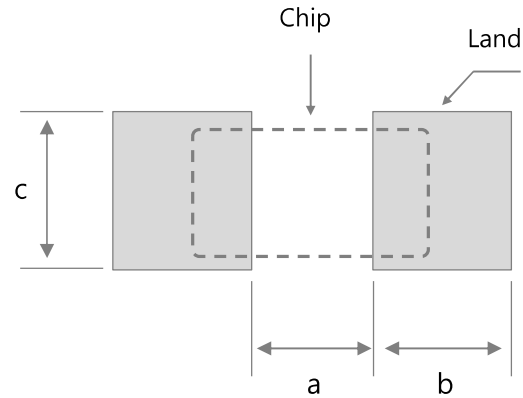
Notice
► Land Dimension


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 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:

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

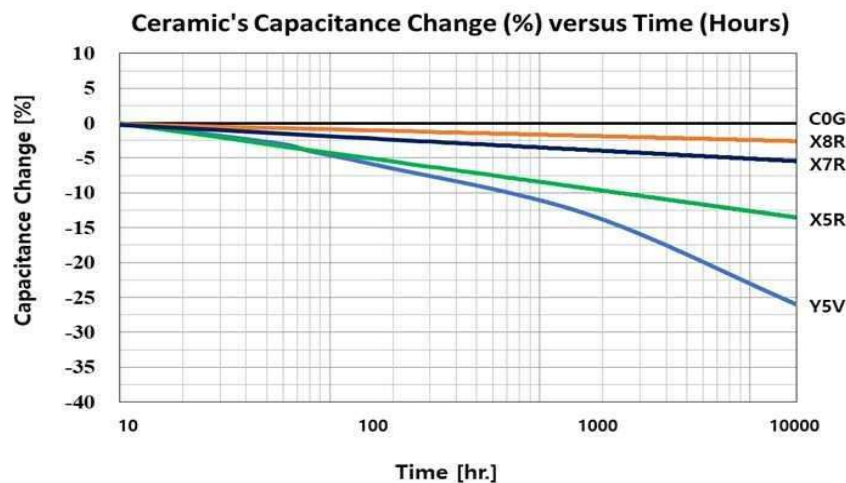
where,

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 (also known as 'de-aged') by exposing the component to elevated temperatures approaching its curie temperature (approximately 120°C). 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°C 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.

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