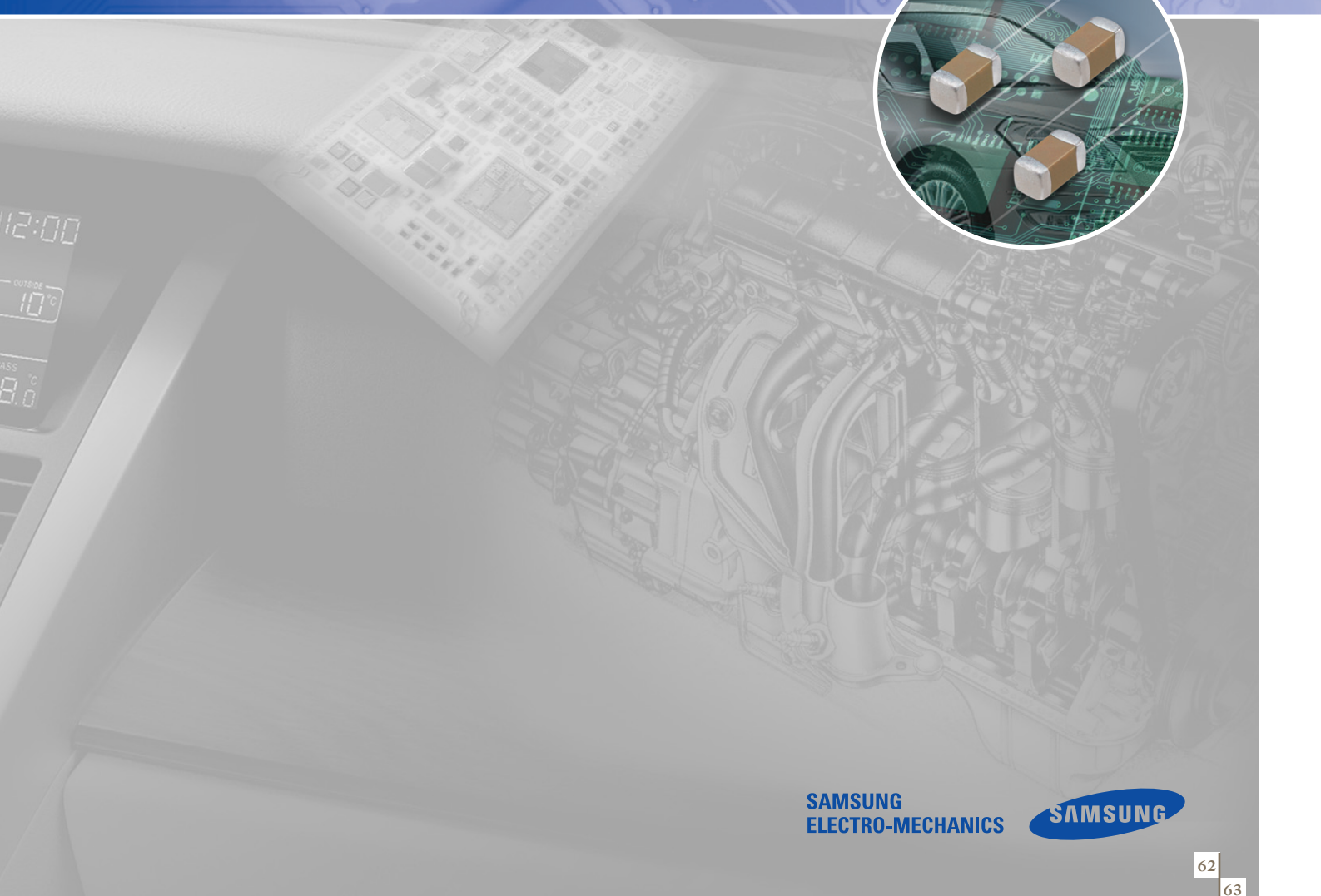
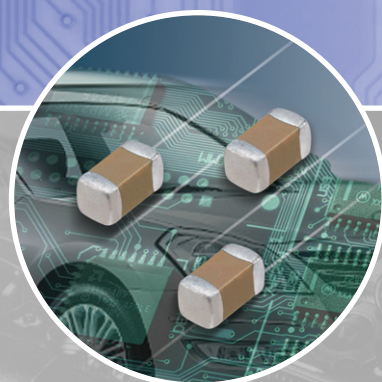


Premium Capacitors for Automotive Applications



**SAMSUNG
ELECTRO-MECHANICS**



Premium Capacitors for Automotive Applications

Part Numbering System (Automotive Capacitors)

	CL	10	B	104	K	B	8	5	P	N	C
	1	2	3	4	5	6	7	8	9	10	11
1. SERIES CODE _____ CL=Multi layer Ceramic Capacitors											
2. SIZE CODE — inch (mm) _____ 05=1005(0402) 10=1608(0603) 21=2012(0805) 31=3216(1206) 32=3225(1210)											
* 3. DIELECTRIC CODE _____ C=C0G (Class I) B=X7R (Class II)											
4. CAPACITANCE CODE _____ Capacitance expressed in pF. 2 significant digits plus number of zeros. example) 106=10 × 10 ⁶ =10000000pF For Values < 10pF, Letter R denotes decimal point example) 1R5=1.5pF											
** 5. TOLERANCE CODE _____ C=±0.25pF D=±0.5pF F=±1pF, ±1%* G=±2% J=±5% K=±10% M=±20% *For Values ≤10pF, F=±1pF, Values>10pF, F=±1% ※This code has only typical specifications. Please refer to individual specifications.											
6. RATED VOLTAGE CODE _____ P=10V O=16V A=25V B=50V C=100V											
*** 7. THICKNESS CODE _____ 5 = 0.50mm 6= 0.60mm 8 = 0.80mm C = 0.85mm P = 1.15mm F = 1.25mm H = 1.60mm J = 2.50mm ※This code has only typical specifications. Please refer to individual specifications.											
8. DESIGN CODE _____ 1=Ni/Cu/Ni Barrier/Sn 100%/Standard 4=Ni/Cu+Soft termination/Ni Barrier/Sn 100%/Standard 5=Ni/Cu+Soft termination/Ni Barrier/Sn 100%/Open Mode ※This code has only typical specifications. Please refer to individual specifications.											
9. PRODUCT CODE _____ P=Automotive product meet AEC-Q-200. ※If orders are placed without returned specification, please allow us to judge that specification is accepted by your side.											
10. GRADE CODE _____ N=Standard											
11. PACKAGING CODE _____ B = Bulk O = Cardboard Tape, 10" Reel E = Embossed Type, 7" Reel P = Bulk Case D = Cardboard Tape, 13" Reel(10,000ea) F = Embossed Type, 13" Reel C = Cardboard Tape, 7" Reel L = Cardboard Tape, 13" Reel(15,000ea) S = Embossed Type, 10" Reel											

This catalog has only typical specifications because there is no space for detailed specifications.
Please approve our product specifications or transact the approval sheet for product specifications before ordering.

★
Class I

Symbol	EIA Code	Operation Temperature Range(°C)	Temperature Coefficient Range(ppm/°C)
C	COG	-55 ~ +125	0 ±30

Class II

Symbol	EIA Code	Operation Temperature Range(°C)	Capacitance Change (ΔC %)
B	X7R	-55 ~ +125	0 ±15

★★
Capacitance Tolerance

Code	Capacitance Tolerance	TC	Capacitance Step	Rated Capacitance
C	± 0.25 pF	COG	Under 5 pF	E-12 series ★
D	± 0.5 pF	COG	6.0 to 9.0 pF	E-12 series ★
J	± 5%	COG	Over 10 pF	E-12 series
K	± 10%	X7R	Under 0.01 μF	E-3 series
			Over 0.01 μF	E-6 series
M	± 20%	X7R	Under 0.01 μF	E-3 series
			Over 0.01 μF	E-6 series

★E-24 series is also available

Series	Capacitance Step											
	1.0				2.2				4.7			
E-3	1.0				2.2				4.7			
E-6	1.0		1.5		2.2		3.3		4.7		6.8	
E-12	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2
E-24	1.0	1.1	1.2	1.3	2.2	2.4	2.7	3.0	4.7	5.1	5.6	6.2
	1.5	1.6	1.8	2.0	3.3	3.6	3.9	4.3	6.8	7.5	8.2	9.1

★★★

Size	Code	Thickness(mm)	Spec(mm) ★
0402(1005)	5	0.50	±0.05
0603(1608)	8	0.80	±0.10
0805(2012)	6	0.60	±0.10
	C	0.85	±0.10
	F	1.25	±0.10
1206(3216)	C	0.85	±0.15
	P	1.15	±0.10
	H	1.60	±0.20

★The tolerance will be changed by Customer' standards and our new products. (High Capacitance)
Please check with our sales representatives or product engineers before ordering.

Part Numbering System

General Capacitors

High Capacitance Capacitors

Super Small Size Capacitors

Medium-High Voltage Capacitors

Array Type Capacitors

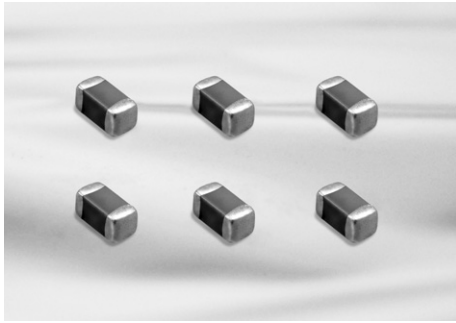
Low ESL Capacitors

Reliability Test Condition

Premium Capacitors for Automotive Applications

Packaging Specification

Application Manual for Surface Mounting



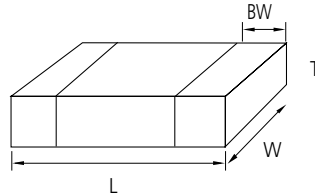
Feature

- Automotive products are manufactured in state of the art facilities recommended for registration to ISO/TS 16949:2002.
- Automotive products meet AEC-Q-200 requirements.
- Automotive products are RoHS compliant.
- Samsung terminations are suitable for all flow and reflow soldering systems. (10/21/31 size type only)
- Automotive products meet JEDEC-020-D requirements.
- COG dielectric components contain BME and copper terminations with a Ni/Sn plated overcoat.
- X7R dielectric components have BME and soft terminations with a Ni/Sn plated overcoat.

Application

- Automotive Electronic Equipment
(Powertrain, Safety, Body & Chassis, Convenience, Infotainment)

Structure and Dimensions



Code	EIA Code	Dimension(mm)			
		L	W	T	BW
05	0402	1.00±0.05	0.50±0.05	0.50(±0.05)	0.25±0.10
10	0603	1.60±0.10	0.80±0.10	0.80(±0.10)	0.3±0.2
21	0805	2.00±0.10	1.25±0.10	0.60(±0.10)	0.5+0.2/-0.3
				0.85(±0.10)	
				1.25(±0.10)	
31	1206	3.20±0.20	1.60±0.20	0.85(±0.15)	0.5±0.3
				1.15(±0.10)	
				1.60(±0.20)	

Automotive Capacitors Table (COG, X7R)

TC	Size(mm)	Thickness (mm)	Vr	Capacitance (pF)			Capacitance (nF)						
				100	220	470	1	2.2	4.7	10	22	47	100
COG	0402(1005)	0.50	50	█	█								
			100	█									
	0603(1608)	0.80	50	█	█	█							
			100	█	█								
	0805(2012)	0.60 0.85 1.25	50	█	█	█	█						
			100	█	█								

TC	Size(mm)	Thickness (mm)	Vr	Capacitance (nF)					Capacitance (μF)					
				10	22	47	100	220	470	1	2.2	4.7	10	
X7R	0402(1005)	0.50	10	█	█	█	█							
			16	█	█	█	█							
			25	█	█									
			50	█	█									
	0603(1608)	0.80	10	█	█	█	█	█						
			16	█	█	█	█	█						
			25	█	█	█	█							
			50	█	█	█								
			100	█										
	0805(2012)	1.25	10	10			█	█	█	█				
				16			█	█						
				25			█	█						
		0.60	25	10			█	█						
				16			█	█						
				25			█	█						
		0.85	50	10			█	█						
				16			█	█						
				25			█	█						
		0.60	100	10			█	█						
				16			█	█						
				25			█	█						
	1206(3216)	1.60	10	10			█	█	█	█				
				16			█	█						
				25			█	█						
0.85		50	10			█	█							
			16			█	█							
			25			█	█							

- Part Numbering System
- General Capacitors
- High Capacitance Capacitors
- Super Small Size Capacitors
- Medium-High Voltage Capacitors
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- Reliability Test Condition
- Premium Capacitors for Automotive Applications
- Packaging Specification
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Product Lineup (Automotive Capacitors_COG)

	Part Number	Size L×W (mm)	Capacitance	Rated Voltage (Vdc)	Capacitance Tolerance	Thickness Max. (mm)
1	CL05C010CB51PN □	1.00×0.50	1.0pF	50	±0.25pF	0.55
2	CL05C010CC51PN □		1.0pF	100	±0.25pF	0.55
3	CL05C1R5CB51PN □		1.5pF	50	±0.25pF	0.55
4	CL05C1R5CC51PN □		1.5pF	100	±0.25pF	0.55
5	CL05C2R2CB51PN □		2.2pF	50	±0.25pF	0.55
6	CL05C2R2CC51PN □		2.2pF	100	±0.25pF	0.55
7	CL05C3R3CB51PN □		3.3pF	50	±0.25pF	0.55
8	CL05C3R3CC51PN □		3.3pF	100	±0.25pF	0.55
9	CL05C4R7CB51PN □		4.7pF	50	±0.25pF	0.55
10	CL05C4R7CC51PN □		4.7pF	100	±0.25pF	0.55
11	CL05C6R8DB51PN □		6.8pF	50	±0.5pF	0.55
12	CL05C6R8DC51PN □		6.8pF	100	±0.5pF	0.55
13	CL05C100JB51PN □		10pF	50	±5%	0.55
14	CL05C100JC51PN □		10pF	100	±5%	0.55
15	CL05C120JB51PN □		12pF	50	±5%	0.55
16	CL05C120JC51PN □		12pF	100	±5%	0.55
17	CL05C150JB51PN □		15pF	50	±5%	0.55
18	CL05C150JC51PN □		15pF	100	±5%	0.55
19	CL05C180JB51PN □		18pF	50	±5%	0.55
20	CL05C180JC51PN □		18pF	100	±5%	0.55
21	CL05C220JB51PN □		22pF	50	±5%	0.55
22	CL05C220JC51PN □		22pF	100	±5%	0.55
23	CL05C270JB51PN □		27pF	50	±5%	0.55
24	CL05C270JC51PN □		27pF	100	±5%	0.55
25	CL05C330JB51PN □		33pF	50	±5%	0.55
26	CL05C330JC51PN □		33pF	100	±5%	0.55
27	CL05C390JB51PN □		39pF	50	±5%	0.55
28	CL05C390JC51PN □		39pF	100	±5%	0.55
29	CL05C470JB51PN □		47pF	50	±5%	0.55
30	CL05C470JC51PN □		47pF	100	±5%	0.55
31	CL05C560JB51PN □		56pF	50	±5%	0.55
32	CL05C560JC51PN □		56pF	100	±5%	0.55
33	CL05C680JB51PN □		68pF	50	±5%	0.55
34	CL05C680JC51PN □		68pF	100	±5%	0.55
35	CL05C820JB51PN □		82pF	50	±5%	0.55
36	CL05C820JC51PN □		82pF	100	±5%	0.55
37	CL05C101JB51PN □		100pF	50	±5%	0.55
38	CL05C101JC51PN □		100pF	100	±5%	0.55
39	CL05C121JB51PN □		120pF	50	±5%	0.55
40	CL05C151JB51PN □		150pF	50	±5%	0.55
41	CL05C221JB51PN □		220pF	50	±5%	0.55
1	CL10C010CB81PN □	1.60×0.80	1.0pF	50	±0.25pF	0.9
2	CL10C010CC81PN □		1.0pF	100	±0.25pF	0.9
3	CL10C1R5CB81PN □		1.5pF	50	±0.25pF	0.9
4	CL10C1R5CC81PN □		1.5pF	100	±0.25pF	0.9

※ □ mark means packaging code. If you want to learn the code or quantity in detail, please see p80.

Product Lineup (Automotive Capacitors_COG)

	Part Number	Size L×W (mm)	Capacitance	Rated Voltage (Vdc)	Capacitance Tolerance	Thickness Max. (mm)
5	CL10C2R2CB81PN □	1.60×0.80	2.2pF	50	±0.25pF	0.9
6	CL10C2R2CC81PN □		2.2pF	100	±0.25pF	0.9
7	CL10C3R3CB81PN □		3.3pF	50	±0.25pF	0.9
8	CL10C3R3CC81PN □		3.3pF	100	±0.25pF	0.9
9	CL10C4R7CB81PN □		4.7pF	50	±0.25pF	0.9
10	CL10C4R7CC81PN □		4.7pF	100	±0.25pF	0.9
11	CL10C6R8DB81PN □		6.8pF	50	±0.5pF	0.9
12	CL10C6R8DC81PN □		6.8pF	100	±0.5pF	0.9
13	CL10C100JB81PN □		10pF	50	±5%	0.9
14	CL10C100JC81PN □		10pF	100	±5%	0.9
15	CL10C120JB81PN □		12pF	50	±5%	0.9
16	CL10C120JC81PN □		12pF	100	±5%	0.9
17	CL10C150JB81PN □		15pF	50	±5%	0.9
18	CL10C150JC81PN □		15pF	100	±5%	0.9
19	CL10C180JB81PN □		18pF	50	±5%	0.9
20	CL10C180JC81PN □		18pF	100	±5%	0.9
21	CL10C220JB81PN □		22pF	50	±5%	0.9
22	CL10C220JC81PN □		22pF	100	±5%	0.9
23	CL10C270JB81PN □		27pF	50	±5%	0.9
24	CL10C270JC81PN □		27pF	100	±5%	0.9
25	CL10C330JB81PN □		33pF	50	±5%	0.9
26	CL10C330JC81PN □		33pF	100	±5%	0.9
27	CL10C390JB81PN □		39pF	50	±5%	0.9
28	CL10C390JC81PN □		39pF	100	±5%	0.9
29	CL10C470JB81PN □		47pF	50	±5%	0.9
30	CL10C470JC81PN □		47pF	100	±5%	0.9
31	CL10C560JB81PN □		56pF	50	±5%	0.9
32	CL10C560JC81PN □		56pF	100	±5%	0.9
33	CL10C680JB81PN □		68pF	50	±5%	0.9
34	CL10C680JC81PN □		68pF	100	±5%	0.9
35	CL10C820JB81PN □		82pF	50	±5%	0.9
36	CL10C820JC81PN □		82pF	100	±5%	0.9
37	CL10C101JB81PN □		100pF	50	±5%	0.9
38	CL10C101JC81PN □		100pF	100	±5%	0.9
39	CL10C121JB81PN □		120pF	50	±5%	0.9
40	CL10C151JB81PN □		150pF	50	±5%	0.9
41	CL10C221JB81PN □		220pF	50	±5%	0.9
42	CL10C271JB81PN □		270pF	50	±5%	0.9
43	CL10C331JB81PN □		330pF	50	±5%	0.9
44	CL10C391JB81PN □		390pF	50	±5%	0.9
45	CL10C471JB81PN □		470pF	50	±5%	0.9
46	CL10C561JB81PN □		560pF	50	±5%	0.9
47	CL10C681JB81PN □		680pF	50	±5%	0.9
48	CL10C821JB81PN □		820pF	50	±5%	0.9
49	CL10C102JB81PN □		1nF	50	±5%	0.9

※ □ mark means packaging code. If you want to learn the code or quantity in detail, please see p80.

- Part Numbering System
- General Capacitors
- High Capacitance Capacitors
- Super Small Size Capacitors
- Medium-High Voltage Capacitors
- Array Type Capacitors
- Low ESL Capacitors
- Reliability Test Condition
- Premium Capacitors for Automotive Applications
- Packaging Specification
- Application Manual for Surface Mounting



Product Lineup (Automotive Capacitors_COG)

	Part Number	Size L×W (mm)	Capacitance	Rated Voltage (Vdc)	Capacitance Tolerance	Thickness Max. (mm)
1	CL21C100JB61PN □	2.00×1.25	10pF	50	±5%	0.7
2	CL21C100JC61PN □		10pF	100	±5%	0.7
3	CL21C120JB61PN □		12pF	50	±5%	0.7
4	CL21C120JC61PN □		12pF	100	±5%	0.7
5	CL21C150JB61PN □		15pF	50	±5%	0.7
6	CL21C150JC61PN □		15pF	100	±5%	0.7
7	CL21C180JB61PN □		18pF	50	±5%	0.7
8	CL21C180JC61PN □		18pF	100	±5%	0.7
9	CL21C220JB61PN □		22pF	50	±5%	0.7
10	CL21C220JC61PN □		22pF	100	±5%	0.7
11	CL21C270JC61PN □		27pF	100	±5%	0.7
12	CL21C330JB61PN □		33pF	50	±5%	0.7
13	CL21C330JC61PN □		33pF	100	±5%	0.7
14	CL21C390JB61PN □		39pF	50	±5%	0.7
15	CL21C390JC61PN □		39pF	100	±5%	0.7
16	CL21C470JB61PN □		47pF	50	±5%	0.7
17	CL21C470JC61PN □		47pF	100	±5%	0.7
18	CL21C560JB61PN □		56pF	50	±5%	0.7
19	CL21C560JC61PN □		56pF	100	±5%	0.7
20	CL21C680JB61PN □		68pF	50	±5%	0.7
21	CL21C680JC61PN □		68pF	100	±5%	0.7
22	CL21C820JB61PN □		82pF	50	±5%	0.7
23	CL21C820JC61PN □		82pF	100	±5%	0.7
24	CL21C101JB61PN □		100pF	50	±5%	0.7
25	CL21C101JC61PN □		100pF	100	±5%	0.7
26	CL21C121JB61PN □		120pF	50	±5%	0.7
27	CL21C121JC61PN □		120pF	100	±5%	0.7
28	CL21C151JB61PN □		150pF	50	±5%	0.7
29	CL21C151JC61PN □		150pF	100	±5%	0.7
30	CL21C221JB61PN □		220pF	50	±5%	0.7
31	CL21C221JC61PN □		220pF	100	±5%	0.7
32	CL21C271JB61PN □		270pF	50	±5%	0.7
33	CL21C271JC61PN □		270pF	100	±5%	0.7
34	CL21C331JB61PN □		330pF	50	±5%	0.7

※ □ mark means packaging code. If you want to learn the code or quantity in detail, please see p80.

Product Lineup (Automotive Capacitors_COG)

	Part Number	Size L×W (mm)	Capacitance	Rated Voltage (Vdc)	Capacitance Tolerance	Thickness Max. (mm)
35	CL21C331JC61PN □	2.00×1.25	330pF	100	±5%	0.7
36	CL21C471JBC1PN □		470pF	50	±5%	0.95
37	CL21C471JCC1PN □		470pF	100	±5%	0.95
38	CL21C561JBC1PN □		560pF	50	±5%	0.95
39	CL21C561JCC1PN □		560pF	100	±5%	0.95
40	CL21C681JBC1PN □		680pF	50	±5%	0.95
41	CL21C681JCC1PN □		680pF	100	±5%	0.95
42	CL21C821JBC1PN □		820pF	50	±5%	0.95
43	CL21C821JCC1PN □		820pF	100	±5%	0.95
44	CL21C102JBC1PN □		1nF	50	±5%	0.95
45	CL21C102JCC1PN □		1nF	100	±5%	0.95
46	CL21C102JCF1PN □		1nF	100	±5%	1.35
47	CL21C122JBC1PN □		1.2nF	50	±5%	0.95
48	CL21C152JBC1PN □		1.5nF	50	±5%	0.95
49	CL21C182JBC1PN □		1.8nF	50	±5%	0.95
50	CL21C222JBC1PN □		2.2nF	50	±5%	0.95
51	CL21C272JBC1PN □		2.7nF	50	±5%	0.95
52	CL21C332JBC1PN □		3.3nF	50	±5%	0.95
53	CL21C392JBC1PN □		3.9nF	50	±5%	0.95
54	CL21C472JBC1PN □		4.7nF	50	±5%	0.95
55	CL21C562JBC1PN □		5.6nF	50	±5%	0.95
56	CL21C102JBF1PN □		1nF	50	±5%	1.35
57	CL21C122JBF1PN □		1.2nF	50	±5%	1.35
58	CL21C152JBF1PN □		1.5nF	50	±5%	1.35
59	CL21C182JBF1PN □		1.8nF	50	±5%	1.35
60	CL21C222JBF1PN □		2.2nF	50	±5%	1.35
61	CL21C272JBF1PN □		2.7nF	50	±5%	1.35
62	CL21C332JBF1PN □		3.3nF	50	±5%	1.35
63	CL21C392JBF1PN □		3.9nF	50	±5%	1.35
64	CL21C472JBF1PN □		4.7nF	50	±5%	1.35
65	CL21C562JBF1PN □		5.6nF	50	±5%	1.35
66	CL21C682JBF1PN □		6.8nF	50	±5%	1.35
67	CL21C822JBF1PN □	8.2nF	50	±5%	1.35	
68	CL21C103JBF1PN □	10nF	50	±5%	1.35	

※ □ mark means packaging code. If you want to learn the code or quantity in detail, please see p80.

Part Numbering System

General Capacitors

High Capacitance Capacitors

Super Small Size Capacitors

Medium-High Voltage Capacitors

Array Type Capacitors

Low ESL Capacitors

Reliability Test Condition

Premium Capacitors for Automotive Applications

Packaging Specification

Application Manual for Surface Mounting



Product Lineup (Automotive Capacitors_X7R)

	Part Number	Size L×W (mm)	Capacitance	Rated Voltage (Vdc)	Capacitance Tolerance	Thickness Max. (mm)
1	CL05B223KB54PN □	1.00×0.50	22nF	50	±10%	0.55
2	CL05B104KO54PN □		100nF	16	±10%	0.55
1	CL10B221KC85PN □	1.60×0.80	220pF	100	±10%	0.90
2	CL10B471KC85PN □		470pF	100	±10%	0.90
3	CL10B102KB85PN □		1.0nF	50	±10%	0.90
4	CL10B102KC85PN □		1.0nF	100	±10%	0.90
5	CL10B222KB85PN □		2.2nF	50	±10%	0.90
6	CL10B222KC85PN □		2.2nF	100	±10%	0.90
7	CL10B472KB85PN □		4.7nF	50	±10%	0.90
8	CL10B472KC85PN □		4.7nF	100	±10%	0.90
9	CL10B103KA85PN □		10nF	25	±10%	0.90
10	CL10B103KB85PN □		10nF	50	±10%	0.90
11	CL10B103KC85PN □		10nF	100	±10%	0.90
12	CL10B153KA85PN □		15nF	25	±10%	0.90
13	CL10B153KB85PN □		15nF	50	±10%	0.90
14	CL10B223KA85PN □		22nF	25	±10%	0.90
15	CL10B223KB85PN □		22nF	50	±10%	0.90
16	CL10B333KA85PN □		33nF	25	±10%	0.90
17	CL10B333KB85PN □		33nF	50	±10%	0.90
18	CL10B473KO85PN □		47nF	16	±10%	0.90
19	CL10B473KA85PN □		47nF	25	±10%	0.90
20	CL10B473KB85PN □		47nF	50	±10%	0.90
21	CL10B683KO85PN □		68nF	16	±10%	0.90
22	CL10B683KA85PN □		68nF	25	±10%	0.90
23	CL10B683KB85PN □		68nF	50	±10%	0.90
24	CL10B104KO85PN □		100nF	16	±10%	0.90
25	CL10B104KA85PN □		100nF	25	±10%	0.90
26	CL10B104KB85PN □		100nF	50	±10%	0.90
27	CL10B154KO84PN □		150nF	16	±10%	0.90
28	CL10B154KA84PN □		150nF	25	±10%	0.90
29	CL10B224KO84PN □		220nF	16	±10%	0.90
30	CL10B224KA84PN □		220nF	25	±10%	0.90
31	CL10B334KO84PN □		330nF	16	±10%	0.90
32	CL10B334KA84PN □		330nF	25	±10%	0.90
33	CL10B474KO84PN □		470nF	16	±10%	0.90
34	CL10B474KA84PN □		470nF	25	±10%	0.90
35	CL10B105KO84PN □		1μF	16	±10%	0.90
1	CL21B102KB65PN □	2.00×1.25	1.0nF	50	±10%	0.70
2	CL21B102KC65PN □		1.0nF	100	±10%	0.70
3	CL21B222KB65PN □		2.2nF	50	±10%	0.70
4	CL21B222KC65PN □		2.2nF	100	±10%	0.70
5	CL21B472KB65PN □		4.7nF	50	±10%	0.70
6	CL21B472KC65PN □		4.7nF	100	±10%	0.70
7	CL21B103KB65PN □		10nF	50	±10%	0.70
8	CL21B103KC65PN □		10nF	100	±10%	0.70
9	CL21B153KB65PN □		15nF	50	±10%	0.70
10	CL21B153KC65PN □		15nF	100	±10%	0.70
11	CL21B223KB65PN □		22nF	50	±10%	0.70
12	CL21B223KC65PN □		22nF	100	±10%	0.70

※ □ mark means packaging code. If you want to learn the code or quantity in detail, please see p80.

Product Lineup (Automotive Capacitors_X7R)

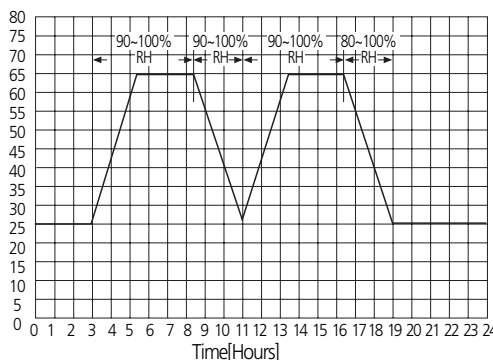
	Part Number	Size L×W (mm)	Capacitance	Rated Voltage (Vdc)	Capacitance Tolerance	Thickness Max. (mm)	
13	CL21B333KBC5PN □	2.00×1.25	33nF	50	±10%	0.95	
14	CL21B333KCC5PN □		33nF	100	±10%	0.95	
15	CL21B473KAC5PN □		47nF	25	±10%	0.95	
16	CL21B473KBC5PN □		47nF	50	±10%	0.95	
17	CL21B473KCC5PN □		47nF	100	±10%	0.95	
18	CL21B683KAC5PN □		68nF	25	±10%	0.95	
19	CL21B683KBC5PN □		68nF	50	±10%	0.95	
20	CL21B683KCC5PN □		68nF	100	±10%	0.95	
21	CL21B104KOC5PN □		100nF	16	±10%	0.95	
22	CL21B104KAC5PN □		100nF	25	±10%	0.95	
23	CL21B104KBC5PN □		100nF	50	±10%	0.95	
24	CL21B104KBF5PN □		100nF	50	±10%	1.35	
25	CL21B104KCC5PN □		100nF	100	±10%	0.95	
26	CL21B104KCF5PN □		100nF	100	±10%	1.35	
27	CL21B154KOF4PN □		150nF	16	±10%	1.35	
28	CL21B154KAF4PN □		150nF	25	±10%	1.35	
29	CL21B154KBF4PN □		150nF	50	±10%	1.35	
30	CL21B224KOF4PN □		220nF	16	±10%	1.35	
31	CL21B224KAF4PN □		220nF	25	±10%	1.35	
32	CL21B224KBF4PN □		220nF	50	±10%	1.35	
33	CL21B334KOF4PN □		330nF	16	±10%	1.35	
34	CL21B334KAF4PN □		330nF	25	±10%	1.35	
35	CL21B334KBF4PN □		330nF	50	±10%	1.35	
36	CL21B474KOF4PN □		470nF	16	±10%	1.35	
37	CL21B474KAF4PN □		470nF	25	±10%	1.35	
38	CL21B474KBF4PN □		470nF	50	±10%	1.35	
39	CL21B684KOF4PN □		680nF	16	±10%	1.35	
40	CL21B684KAF4PN □		680nF	25	±10%	1.35	
41	CL21B105KOF4PN □		1μF	16	±10%	1.35	
42	CL21B105KAF4PN □		1μF	25	±10%	1.35	
43	CL21B225KOF4PN □		2.2μF	16	±10%	1.35	
1	CL31B104KBC5PN □		3.20×1.60	100nF	50	±10%	1.00
2	CL31B154KBP5PN □			150nF	50	±10%	1.25
3	CL31B224KAC5PN □	220nF		25	±10%	1.00	
4	CL31B224KBP5PN □	220nF		50	±10%	1.25	
5	CL31B334KAC5PN □	330nF		25	±10%	1.00	
6	CL31B334KBH5PN □	330nF		50	±10%	1.80	
7	CL31B474KAC5PN □	470nF		25	±10%	1.00	
8	CL31B474KBH5PN □	470nF		50	±10%	1.80	
9	CL31B684KAP5PN □	680nF		25	±10%	1.25	
10	CL31B684KBH5PN □	680nF		50	±10%	1.80	
11	CL31B105KOP5PN □	1μF		16	±10%	1.25	
12	CL31B105KAP5PN □	1μF		25	±10%	1.25	
13	CL31B105KBH5PN □	1μF		50	±10%	1.80	
14	CL31B155KOH4PN □	1.5μF		16	±10%	1.80	
15	CL31B155KAH4PN □	1.5μF		25	±10%	1.80	
16	CL31B155KBH4PN □	1.5μF		50	±10%	1.80	
17	CL31B225KOH4PN □	2.2μF		16	±10%	1.80	
18	CL31B225KAH4PN □	2.2μF		25	±10%	1.80	
19	CL31B225KBH4PN □	2.2μF		50	±10%	1.80	

※ □ mark means packaging code. If you want to learn the code or quantity in detail, please see p80.

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Reliability Test Condition (Automotive Capacitors)

No	Item	Performance	Test Condition															
1	Pre-and Post-Stress Electrical Test	-																
2	High Temperature Exposure	Appearance	No abnormal exterior appearance															
		Capacitance Change	CLASS I	Within $\pm 2.5\%$ or $0.25\mu\text{F}$, (Whichever is larger)														
			CLASS II	Within $\pm 10\%$														
		Q	CLASS I	Capacitance $\geq 30\mu\text{F}$: $Q \geq 1,000$ $< 30\mu\text{F}$: $Q \geq 400 + 20 \times C$ (C : Capacitance)														
		Tan δ	CLASS II	Rated Voltage $\geq 25\text{V}$: 0.03 max $\geq 16\text{V}$: 0.05 max $\geq 10\text{V}$: 0.075 max														
IR		More than $10,000 \text{M}\Omega$ or $500 \text{M}\Omega \times \mu\text{F}$ (Whichever is smaller)																
3	Temperature Cycling	Appearance	No abnormal exterior appearance															
		Capacitance Change	CLASS I	Within $\pm 2.5\%$ or $0.25\mu\text{F}$, (Whichever is larger)														
			CLASS II	Within $\pm 10\%$														
		Q	CLASS I	Capacitance $\geq 30\mu\text{F}$: $Q \geq 1,000$ $< 30\mu\text{F}$: $Q \geq 400 + 20 \times C$ (C : Capacitance)														
		Tan δ	CLASS II	Rated Voltage $\geq 25\text{V}$: 0.03 max $\geq 16\text{V}$: 0.05 max $\geq 10\text{V}$: 0.075 max														
IR		More than $10,000 \text{M}\Omega$ or $500 \text{M}\Omega \times \mu\text{F}$ (Whichever is smaller)																
4	Destructive Physical Analysis	No defects or abnormalities	Per EIA 469															
5	Moisture Resistance	Appearance	No abnormal exterior appearance															
		Capacitance Change	CLASS I	Within $\pm 2.5\%$ or $0.25\mu\text{F}$, (Whichever is larger)														
			CLASS II	Within $\pm 12.5\%$														
		Q	CLASS I	Capacitance $\geq 30\mu\text{F}$: $Q \geq 350$ $10 \leq \text{Capacitance} < 30\mu\text{F}$: $Q \geq 275 + (5/2) \times C$ Capacitance $< 10\mu\text{F}$: $Q \geq 200 + 10 \times C$ (C : Capacitance)														
		Tan δ	CLASS II	Rated Voltage $\geq 25\text{V}$: 0.03 max $\geq 16\text{V}$: 0.05 max $\geq 10\text{V}$: 0.075 max														
IR		More than $10,000 \text{M}\Omega$ or $500 \text{M}\Omega \times \mu\text{F}$ (Whichever is smaller)																
			1000Cycles Measurement at 24 ± 2 hrs after test conclusion <table border="1" style="margin-top: 10px; width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> <th>Time(min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating Temp. ± 2</td> <td>15 ± 3</td> </tr> <tr> <td>2</td> <td>25 ± 2</td> <td>1</td> </tr> <tr> <td>3</td> <td>Max. operating Temp. ± 2</td> <td>15 ± 3</td> </tr> <tr> <td>4</td> <td>25 ± 2</td> <td>1</td> </tr> </tbody> </table>	Step	Temperature(°C)	Time(min.)	1	Min. operating Temp. ± 2	15 ± 3	2	25 ± 2	1	3	Max. operating Temp. ± 2	15 ± 3	4	25 ± 2	1
Step	Temperature(°C)	Time(min.)																
1	Min. operating Temp. ± 2	15 ± 3																
2	25 ± 2	1																
3	Max. operating Temp. ± 2	15 ± 3																
4	25 ± 2	1																
			10Cycles, $t=24$ hrs/cycle Heat ($25\sim 65^\circ\text{C}$) and humidity ($80\sim 98\%$), Unpowered measurement at 24 ± 2 hrs after test conclusion 															

No	Item	Performance	Test Condition		
6	Biased Humidity	Appearance	1000hrs 85 °C/85%RH, Rated Voltate and 1.3~1.5V, (add 100kohm resistor) Measurement at 24±2hrs after test conclusion The charge/discharge current is less than 50mA.		
		Capacitance Change		CLASS I	Within ±2.5% or 0.25pF, (Whichever is larger)
				CLASS II	Within ±12.5%
		Q		CLASS I	Capacitance ≥ 30pF : Q ≥ 200 < 30pF : Q ≥ 100 +(10/3) × C (C : Capacitance)
		Tanδ		CLASS II	Rated Voltage ≥ 25V : 0.035 max ≥ 16V : 0.05 max ≥ 10V : 0.075max
IR		More than 500 μΩ or 25 μΩ × μF (Whichever is Smaller)			
7	High Temperature Operating Life	Appearance	1000hrs @ TA=125 °C, 200% Rated Voltage, Measurement at 24±2hrs after test conclusion The charge/discharge current is less than 50mA.		
		Capacitance Change		CLASS I	Within ±3.0% or 0.3pF, (Whichever is larger)
				CLASS II	Within ±12.5%
		Q		CLASS I	Capacitance ≥ 30pF : Q ≥ 350 ≥ 10pF : Q ≥ 275+(5/2) × C < 10pF : Q ≥ 200+10 × C (C : Capacitance)
		Tanδ		CLASS II	Rated Voltage ≥ 25V : 0.035 max ≥ 16V : 0.05 max ≥ 10V : 0.075max
IR		More than 1,000 μΩ or 50 μΩ × μF (Whichever is smaller)			
8	External Visual	No abnormal exterior appearance	Microscope (x10)		
9	Physical Dimensions	Within the specified dimensions	Using the calipers		
10	Mechanical Shock	Appearance	Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks)		
		Capacitance Change		CLASS I	Within ±2.5% or 0.25pF, (Whichever is larger)
				CLASS II	Within ±10%
		Q		CLASS I	Capacitance ≥ 30pF : Q ≥ 1,000 < 30pF : Q ≥ 400 +20 × C (C : Capacitance)
		Tanδ		CLASS II	Rated Voltage ≥ 25V : 0.025 max ≥ 16V : 0.035 max ≥ 10V : 0.05max
IR		More than 10,000 μΩ or 500 μΩ × μF (Whichever is smaller)			

Peakvalue	Duration	Wave
1,500G	0.5ms	Half sine

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No	Item	Performance	Test Condition	
11	Appearance	No abnormal exterior appearance	5g's for 20min., 12cycles each of 3 orientations, Use 8" x5" PCB 0.031" Thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10~2000 Hz.	
	Capacitance Change	CLASS I		Within $\pm 2.5\%$ or 0.25pF, (Whichever is larger)
		CLASS II		Within $\pm 10\%$
	Q	CLASS I		Capacitance $\geq 30\text{pF}$: Q $\geq 1,000$ < 30pF : Q $\geq 400+20 \times C$ (C : Capacitance)
	Tan δ	CLASS II		Rated Voltage $\geq 25\text{V}$: 0.025 max $\geq 16\text{V}$: 0.035 max $\geq 10\text{V}$: 0.05max
IR		More than 10,000 M Ω or 500 M $\Omega \times \mu\text{F}$ (Whichever is smaller)		
12	Appearance	No abnormal exterior appearance	Solder pot : 260 \pm 5 $^{\circ}\text{C}$, 10 \pm 1sec.	
	Capacitance Change	CLASS I		Within $\pm 2.5\%$ or 0.25pF, (Whichever is larger)
		CLASS II		Within $\pm 10\%$
	Q	CLASS I		Capacitance $\geq 30\text{pF}$: Q $\geq 1,000$ < 30pF : Q $\geq 400+20 \times C$ (C : Capacitance)
	Tan δ	CLASS II		Rated Voltage $\geq 25\text{V}$: 0.025 max $\geq 16\text{V}$: 0.035 max $\geq 10\text{V}$: 0.05max
IR		More than 10,000 M Ω or 500 M $\Omega \times \mu\text{F}$ (Whichever is smaller)		
13	Appearance	No abnormal exterior appearance	-55 $^{\circ}\text{C}/+125^{\circ}\text{C}$ Note: Number of cycles required - 300, Maximum transfer time-20 sec, Dwell time-15min. Air-Air	
	Capacitance Change	CLASS I		Within $\pm 2.5\%$ or 0.25pF, (Whichever is larger)
		CLASS II		Within $\pm 10\%$
	Q	CLASS I		Capacitance $\geq 30\text{pF}$: Q $\geq 1,000$ < 30pF : Q $\geq 400+20 \times C$ (C : Capacitance)
	Tan δ	CLASS II		Rated Voltage $\geq 25\text{V}$: 0.025 max $\geq 16\text{V}$: 0.035 max $\geq 10\text{V}$: 0.05max
IR		More than 10,000 M Ω or 500 M $\Omega \times \mu\text{F}$ (Whichever is smaller)		
14	Appearance	No abnormal exterior appearance	AEC-Q200-002	
	Capacitance Change	CLASS I		Within $\pm 2.5\%$ or 0.25pF, (Whichever is larger)
		CLASS II		Within $\pm 10\%$
	Q	CLASS I		Capacitance $\geq 30\text{pF}$: Q $\geq 1,000$ < 30pF : Q $\geq 400+20 \times C$ (C : Capacitance)
	Tan δ	CLASS II		Rated Voltage $\geq 25\text{V}$: 0.025 max $\geq 16\text{V}$: 0.035 max $\geq 10\text{V}$: 0.05max
IR		More than 10,000 M Ω or 500 M $\Omega \times \mu\text{F}$ (Whichever is smaller)		

No	Item	Performance	Test Condition																		
15	Solderability	95% of the terminations is to be soldered evenly and continuously	a) Preheat at 155 °C for 4 hours, Immerse in solder for 5s at 235 ± 5 °C b) Steam aging for 8 hours, Immerse in solder for 5s at 235 ± 5 °C c) Steam aging for 8 hours, Immerse in solder for 120s at 260 ± 5 °C solder : a solution ethanol and rosin																		
16	Electrical Characterization	Capacitance	Within specified tolerance																		
		Q	CLASS I Capacitance ≥ 30pF : Q ≥ 1,000 < 30pF : Q ≥ 400 + 20 × C (C: Capacitance)																		
		Tanδ	CLASS II Rated Voltage ≥ 25V : 0.025 max ≥ 16V : 0.035 max ≥ 10V : 0.05max																		
		IR@25 °C	CLASS I	More than 100,000 MΩ or 1,000 MΩ × μF (Whichever is smaller)																	
			CLASS II	More than 10,000 MΩ or 500 MΩ × μF (Whichever is smaller)																	
		IR@125 °C	CLASS I	More than 10,000 MΩ or 100 MΩ × μF (Whichever is smaller)																	
CLASS II	More than 1,000 MΩ or 10 MΩ × μF (Whichever is smaller)																				
Dielectric Strength	No dielectric breakdown or mechanical breakdown																				
The Capacitance /D.F. should be measured at 25 °C,																					
<table border="1"> <thead> <tr> <th>Class</th> <th>Capacitance</th> <th>Frequency</th> <th>Vrms</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I</td> <td>1000pF ↓</td> <td>1 kHz ± 10%</td> <td>0.5~5Vrms</td> </tr> <tr> <td>1000pF ↑</td> <td>1 kHz ± 10%</td> <td>1.0 ± 0.2Vrms</td> </tr> <tr> <td rowspan="2">Class II</td> <td>10 μF ↓</td> <td>1 kHz ± 10%</td> <td>1.0 ± 0.2Vrms</td> </tr> <tr> <td>10 μF ↑</td> <td>120 Hz ± 20%</td> <td>0.5 ± 0.1Vrms</td> </tr> </tbody> </table>				Class	Capacitance	Frequency	Vrms	Class I	1000pF ↓	1 kHz ± 10%	0.5~5Vrms	1000pF ↑	1 kHz ± 10%	1.0 ± 0.2Vrms	Class II	10 μF ↓	1 kHz ± 10%	1.0 ± 0.2Vrms	10 μF ↑	120 Hz ± 20%	0.5 ± 0.1Vrms
Class	Capacitance	Frequency	Vrms																		
Class I	1000pF ↓	1 kHz ± 10%	0.5~5Vrms																		
	1000pF ↑	1 kHz ± 10%	1.0 ± 0.2Vrms																		
Class II	10 μF ↓	1 kHz ± 10%	1.0 ± 0.2Vrms																		
	10 μF ↑	120 Hz ± 20%	0.5 ± 0.1Vrms																		
I.R. should be measured with a DC voltage not exceeding Rated Voltage @25 °C, @125 °C for 60~120 sec.																					
Dielectric Strength : 250% of the rated voltage for 1~5 seconds The charge/discharge current is less than 50mA.																					
17	Board Flex	Appearance	No abnormal exterior appearance																		
		Capacitance Change	CLASS I Within ± 5.0% or 0.5pF, (Whichever is larger)																		
			CLASS II Within ± 10%																		
			Bending to the limit for 5 seconds Limit : Class I - 3mm Class II - 2mm																		
18	Terminal Strength(SMD)	Appearance	No abnormal exterior appearance																		
		Capacitance Change	CLASS I Within ± 2.5% or 0.25pF, (Whichever is larger)																		
			CLASS II Within ± 10%																		
			18N, for 60 ± 1 sec. * 0603(1608) -10N, 0402(1005) -2N																		
19	Beam Load	Destruction value should be exceed Chip Length ≤ 2.5mm a) Chip Thickness > 0.5mm : 20N b) Chip Thickness ≤ 0.5mm : 8N Chip Length ≥ 3.2mm a) Chip Thickness ≥ 1.25mm : 54.5N b) Chip Thickness < 1.25mm : 15N	Beam speed Chip Length ≤ 2.5mm, 0.5 ± 0.05 mm/sec Chip Length ≥ 3.2mm, 2.5 ± 0.25 mm/sec																		
20	Capacitance Temperature Characteristics	Capacitance Change	CLASS I 0 ± 30 ppm/°C																		
			CLASS II Within ± 15%																		
		Temperature Coefficient	CLASS I 0 ± 30 ppm/°C																		
			CLASS I Within ± 0.2% or 0.05pF, (Whichever is larger)																		
		Capacitance Drift	CLASS I																		
<table border="1"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> <th>Time(min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>25 ± 2</td> <td>1</td> </tr> <tr> <td>2</td> <td>Min. Operating Temp. ± 2</td> <td>15 ± 3</td> </tr> <tr> <td>3</td> <td>25 ± 2</td> <td>1</td> </tr> <tr> <td>4</td> <td>Max. Operating Temp. ± 2</td> <td>15 ± 3</td> </tr> <tr> <td>5</td> <td>25 ± 2</td> <td>1</td> </tr> </tbody> </table>				Step	Temperature(°C)	Time(min)	1	25 ± 2	1	2	Min. Operating Temp. ± 2	15 ± 3	3	25 ± 2	1	4	Max. Operating Temp. ± 2	15 ± 3	5	25 ± 2	1
Step	Temperature(°C)	Time(min)																			
1	25 ± 2	1																			
2	Min. Operating Temp. ± 2	15 ± 3																			
3	25 ± 2	1																			
4	Max. Operating Temp. ± 2	15 ± 3																			
5	25 ± 2	1																			

* If you want more detailed information, Please Visit Samsung Electro-mechanics website(www.sem1cr.com)

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- General Capacitors
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