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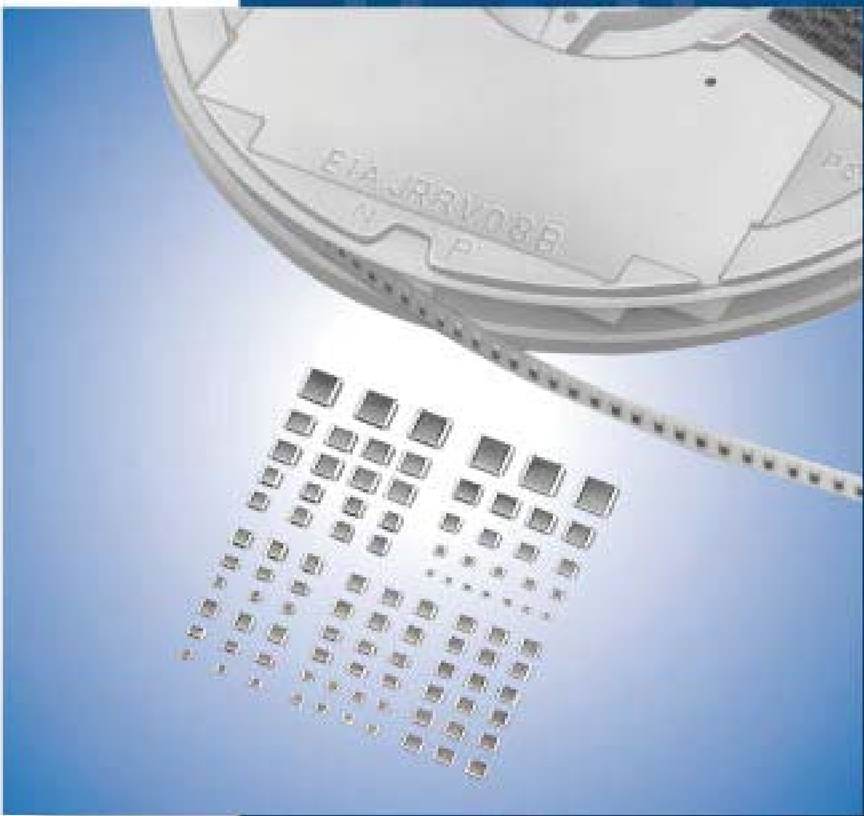
Chip Monolithic Ceramic Capacitors for Automotive



Innovator in Electronics

Murata Manufacturing Co., Ltd.

Cat.No.C03E-5

EU RoHS Compliant

- All the products in this catalog comply with EU RoHS.
- EU RoHS is "the European Directive 2002/95/EC on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment."
- For more details, please refer to our website 'Murata's Approach for EU RoHS' (http://www.murata.com/info/rohs.html).

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● Part Numbering

Chip Monolithic Ceramic Capacitors

(Part Number) GC M 18 8 R7 1H 102 K A37 D
❶ ❷ ❸ ❹ ❺ ❻ ❼ ❽ ❾ ❿

❶Product ID

❷Series

Product ID	Code	Series
GC	J	Soft Termination Type Power-train, Safety Equipment
	M	Power-train, Safety Equipment

❸Dimension (L×W)

Code	Dimension (L×W)	EIA
03	0.6×0.3mm	0201
15	1.0×0.5mm	0402
18	1.6×0.8mm	0603
21	2.0×1.25mm	0805
31	3.2×1.6mm	1206
32	3.2×2.5mm	1210
43	4.5×3.2mm	1812
55	5.7×5.0mm	2220

❹Dimension (T)

Code	Dimension (T)
3	0.3mm
5	0.5mm
6	0.6mm
8	0.8mm
9	0.85mm
A	1.0mm
B	1.25mm
C	1.6mm
D	2.0mm
E	2.5mm
M	1.15mm
N	1.35mm
Q	1.5mm
R	1.8mm
X	Depends on individual standards.

❺Temperature Characteristics

Temperature Characteristic Codes			Temperature Characteristics			Operating Temperature Range
Code	Public STD Code		Reference Temperature	Temperature Range	Capacitance Change or Temperature Coefficient	
5C	C0G	EIA	25°C	25 to 125°C	0±30ppm/°C	–55 to 125°C
7U	U2J	EIA	25°C	25 to 125°C	–750±120ppm/°C	–55 to 125°C
C7	X7S	EIA	25°C	–55 to 125°C	±22%	–55 to 125°C
R7	X7R	EIA	25°C	–55 to 125°C	±15%	–55 to 125°C

●Capacitance Change from each temperature

Murata Code	Capacitance Change from 25°C (%)					
	–55°C		–30°C		–10°C	
	Max.	Min.	Max.	Min.	Max.	Min.
5C	0.58	–0.24	0.40	–0.17	0.25	–0.11
7U	8.78	5.04	6.04	3.47	3.84	2.21

❻Rated Voltage

Code	Rated Voltage
0J	DC6.3V
1A	DC10V
1C	DC16V
1E	DC25V
YA	DC35V
1H	DC50V
2A	DC100V
2E	DC250V
2J	DC630V
3A	DC1kV

❼Capacitance

Expressed by three-digit alphanumerics. The unit is pico-farad (pF). The first and second figures are significant digits, and the third figure expresses the number of zeros that follow the two numbers.
If there is a decimal point, it is expressed by the capital letter "**R**." In this case, all figures are significant digits.

Ex.)

Code	Capacitance
R50	0.5pF
1R0	1.0pF
100	10pF
103	10000pF

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Continued from the preceding page.

❽Capacitance Tolerance

Code	Capacitance Tolerance	TC	Series	Capacitance Step	
C	±0.25pF	C0G	**GCM**	≦5.0pF	E12, 1pF Step *
D	±0.5pF	C0G	**GCM**	6.0 to 9.0pF	E12, 1pF Step *
J	±5%	C0G	**GCM**	≧10pF	E12 Step
		U2J	**GCM**	E12 Step	
K	±10%	X7S, X7T, X7R	**GCJ/GCM**	E6 Step	
M	±20%	X7S, X7R	**GCM**	E6 Step	

***** E24 series is also available.

❾Individual Specification Code

Expressed by three figures.

❿Package

Code	Package
L	ø180mm Embossed Taping
D	ø180mm Paper Taping
K	ø330mm Embossed Taping
J	ø330mm Paper Taping
B	Bulk
C	Bulk Case

Selection Guide for Chip Monolithic Ceramic Capacitors

Applications?

Function	Type	Series
Decoupling, Smoothing	High Capacitance	**GRM (X5R, X7R, Y5V etc.)** 68pF–100μF
	Array (2 or 4 Elements)	**GNM** 10pF–2.2μF
Frequency Control/Tuning, Impedance Matching	Class 1 TC's	**GRM (C0G)** 0.1pF–0.1μF
		GRM (U2J etc.)
High Speed Decoupling	Low Inductance (Reverse Geometry)	**LLL** 2200pF–10μF
	Low Inductance (Controlled ESR)	**LLR** 1.0μF
	Low Inductance (Multi-Termination)	**LLA/LLM (From 1GHz)** 0.01μF–4.7μF
High Frequency	Low ESR, Ultra Small	**GJM (500MHz to 10GHz)** 0.1pF–33pF
	Lowest ESR	**GQM (500MHz to 10GHz)** 0.1pF–100pF
Optical Communications	Wire-Die-Bonding	**GMA** 100pF–0.47μF **GMD** 100pF–1μF
Medium Voltage High-Frequency Snubber	250V/630V/1kV/2kV/3.15kV Low Dissipation	**GRM (C0G, U2J)** 10pF–47000pF
Medium Voltage LCD Backlight Inverter	3.15kV Low Dissipation	**GRM (C0G)** 5pF–47pF
Medium Voltage Decoupling, Smoothing	250V/630V/1kV High Capacitance	**GRM (X7R)** 220pF–1μF
	250V/630V/1kV Soft Termination	**GRJ (X7R)** 470pF–1μF
	250V/450V/630V Large Capacitance and High Allowable Ripple Current	**GR3 (X7T)** 10000pF–1μF
Medium Voltage For Camera Flash Circuit only	350V High Capacitance	**GR7** 10000pF–47000pF
Medium Voltage For Information Devices only	2kV High Capacitance	**GR4** 100pF–10000pF
	Safety Standard Certified	**Type GD** 10pF–4700pF **Type GF** 10pF–4700pF
AC Lines Noise Removal	Safety Standard Certified	**Type GC** 100pF–330pF **Type GF** 470pF–4700pF **Type GB** 10000pF–56000pF
	AC250V which meets Japanese Law	**GA2** 470pF–0.1μF
Automotive (Powertrain, Safety Equipment)	High Capacitance	**GCM (X7R etc.)** 100pF–47μF
	Class 1 TC's	**GCM (C0G etc.)** 1.0pF–56000pF
Medium Voltage for Automotive (Powertrain, Safety Equipment)	250V/630V/1kV Low Dissipation	**GCM (U2J)** 10pF–47000pF
	250V/630V Soft Termination	**GCJ (X7R)** 1000pF–0.47μF

Chip Monolithic Ceramic Capacitors

Chip Monolithic Ceramic Capacitors for Automotive

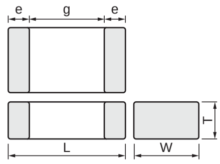
For Automotive GCM Series

■ Features

1. The GCM series meet AEC-Q200 requirements.
2. Higher resistance of solder-leaching due to the Ni-barriered termination, applicable for reflow-soldering, and flow-soldering (GCM18/21/31 type only).
3. The operating temperature range of R7/C7/5C series: -55 to 125°C.
4. A wide selection of sizes is available, from miniature LxWxT:0.6x0.3x0.3mm to LxWxT: 3.2x2.5x2.5mm.
5. The GCM series is available in paper or embossed tape and reel packaging for automatic placement.
6. The GCM series is a lead free product.

■ Applications

Automotive electronic equipment (power-train, safety equipment)



Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GCM033	0.6 ±0.03	0.3 ±0.03	0.3 ±0.03	0.1 to 0.2	0.2
GCM155	1.0 ±0.05	0.5 ±0.05	0.5 ±0.05	0.15 to 0.35	0.3
GCM188*	1.6 ±0.1	0.8 ±0.1	0.8 ±0.1	0.2 to 0.5	0.5
GCM216			0.6 ±0.1		
GCM219	2.0 ±0.15	1.25 ±0.15	0.85 ±0.1	0.2 to 0.7	0.7
GCM21B			1.25 ±0.15		
GCM319	3.2 ±0.15	1.6 ±0.15	0.85 ±0.1		
GCM31M			1.15 ±0.1	0.3 to 0.8	1.5
GCM31C	3.2 ±0.2	1.6 ±0.2	1.6 ±0.2		
GCM32N			1.35 ±0.15		
GCM32R	3.2 ±0.3	2.5 ±0.2	1.8 ±0.2	0.3 min.	1.0
GCM32D			2.0 ±0.2		
GCM32E			2.5 ±0.2		

* Bulk Case: 1.6 ±0.07(L)×0.8 ±0.07(W)×0.8 ±0.07(T)
The figure indicates typical specification.

Capacitance Table

Temperature Compensating Type C0G(5C)

6 ex.6: T Dimension Part Number Code

LxW [mm] / Rated Voltage [Vdc] / Capacitance	0.6x0.3 (03) <0201>	1.0x0.5 (15) <0402>	1.6x0.8 (18) <0603>		2.0x1.25 (21) <0805>		3.2x1.6 (31) <1206>	
	25 (1E)	50 (1H)	100 (2A)	50 (1H)	100 (2A)	50 (1H)	100 (2A)	50 (1H)
1.0pF(**1R0**)	3	5	8	8				
2.0pF(**2R0**)	3	5	8	8				
3.0pF(**3R0**)	3	5	8	8				
4.0pF(**4R0**)	3	5	8	8				
5.0pF(**5R0**)	3	5	8	8				
6.0pF(**6R0**)	3	5	8	8				
7.0pF(**7R0**)	3	5	8	8				
8.0pF(**8R0**)	3	5	8	8				
9.0pF(**9R0**)	3	5	8	8				
10pF(**100**)	3	5	8	8				
12pF(**120**)	3	5	8	8				
15pF(**150**)	3	5	8	8				
18pF(**180**)	3	5	8	8				
22pF(**220**)	3	5	8	8				
27pF(**270**)	3	5	8	8				
33pF(**330**)	3	5	8	8				
39pF(**390**)	3	5	8	8				
47pF(**470**)	3	5	8	8				
56pF(**560**)	3	5	8	8				
68pF(**680**)	3	5	8	8				
82pF(**820**)	3	5	8	8				
100pF(**101**)	3	5	8	8	6			
120pF(**121**)		5	8	8	6			
150pF(**151**)		5	8	8	6			
180pF(**181**)		5	8	8	6			
220pF(**221**)		5	8	8	6			
270pF(**271**)		5	8	8	6			
330pF(**331**)		5	8	8	6			
390pF(**391**)		5	8	8	6			
470pF(**471**)		5	8	8	6			
560pF(**561**)			8	8	6	6		
680pF(**681**)			8	8	6	6		
820pF(**821**)			8	8	6	6		
1000pF(**102**)			8	8	6	6		
1200pF(**122**)			8	8	6	6		
1500pF(**152**)			8	8	6	6		
1800pF(**182**)				8	6	6	9	
2200pF(**222**)				8	6	6	9	
2700pF(**272**)				8	6	6	9	
3300pF(**332**)				8	6	6	9	
3900pF(**392**)				8		6	9	
4700pF(**472**)						6	9	9
5600pF(**562**)						9	9	9
6800pF(**682**)						9	9	9
8200pF(**822**)						9	9	9
10000pF(**103**)						9	9	9
12000pF(**123**)						9		9
15000pF(**153**)						9		9
18000pF(**183**)						B		9
22000pF(**223**)						B		9
27000pF(**273**)								9
33000pF(**333**)								9
39000pF(**393**)								9
47000pF(**473**)								M
56000pF(**563**)								M

The part numbering code is shown in ( ) and Unit is shown in [ ]. < >: EIA [inch] Code

Capacitance Table

High Dielectric Constant Type X7R(R7)/X7S(C7)

6 ex.6: T Dimension Part Number Code

LxW [mm] / Capacitance	0.6x0.3 (03) <0201>			1.0x0.5 (15) <0402>				1.6x0.8 (18) <0603>					2.0x1.25 (21) <0805>							3.2x1.6 (31) <1206>						3.2x2.5 (32) <1210>					
Rated Voltage [Vdc]	25 (1E)	16 (1C)	10 (1A)	100 (2A)	50 (1H)	25 (1E)	16 (1C)	100 (2A)	50 (1H)	25 (1E)	16 (1C)	6.3 (0J)	100 (2A)	50 (1H)	35 (YA)	25 (1E)	16 (1C)	10 (1A)	6.3 (0J)	100 (2A)	50 (1H)	25 (1E)	16 (1C)	10 (1A)	6.3 (0J)	100 (2A)	50 (1H)	25 (1E)	16 (1C)	10 (1A)	6.3 (0J)
100pF(**101**)	3																														
150pF(**151**)	3																														
220pF(**221**)	3			5	5																										
330pF(**331**)	3			5	5																										
470pF(**471**)	3			5	5																										
680pF(**681**)	3			5	5																										
1000pF(**102**)	3			5	5			8	8																						
1500pF(**152**)	3			5	5			8	8																						
2200pF(**222**)		3		5	5			8	8																						
3300pF(**332**)		3		5	5			8	8																						
4700pF(**472**)			3	5	5			8	8																						
6800pF(**682**)			3		5			8	8				6																		
10000pF(**103**)			3		5	5		8	8				6																		
15000pF(**153**)					5	5		8	8				6																		
22000pF(**223**)					5	5		8	8				6																		
33000pF(**333**)						5	5		8	8			9	9																	
47000pF(**473**)						5	5		8	8			B	B																	
68000pF(**683**)							5		8	8			B	B																	
0.10µF(**104**)							5	8	8	8	8		B	B						9											
0.15µF(**154**)									8	8				B		B				M											
0.22µF(**224**)									8	8				B		B				M											
0.33µF(**334**)											8			9		B					M										
0.47µF(**474**)										8	8			B		9					M										
0.68µF(**684**)															B	B	9				M										
1.0µF(**105**)										8	8				B	B	9				M						E				
2.2µF(**225**)												8				B	B	B			C	M				D					
4.7µF(**475**)																	B	B				C	C				E	D			
10µF(**106**)																			B				C	C				E	D		
22µF(**226**)																									C				E	E	
47µF(**476**)																															E

The part numbering code is shown in ( ) and Unit is shown in [ ]. < >: EIA [inch] Code

Temperature Compensating Type

L x W [mm]		0.6x0.3(**03**)<0201>	1.0x0.5(**15**)<0402>	1.6x0.8(**18**)<0603>	
Rated Volt. [Vdc]		25(**1E**)	50(**1H**)	100(**2A**)	50(**1H**)
TC		C0G(**5C**)			
Capacitance	Tolerance	Part Number			
1.0pF(**1R0**)	±0.25pF(**C**)	**GCM0335C1E1R0CD03D**	**GCM1555C1H1R0CZ13D**	**GCM1885C2A1R0CZ13D**	**GCM1885C1H1R0CZ13D**
2.0pF(**2R0**)	±0.25pF(**C**)	**GCM0335C1E2R0CD03D**	**GCM1555C1H2R0CZ13D**	**GCM1885C2A2R0CZ13D**	**GCM1885C1H2R0CZ13D**
3.0pF(**3R0**)	±0.25pF(**C**)	**GCM0335C1E3R0CD03D**	**GCM1555C1H3R0CZ13D**	**GCM1885C2A3R0CZ13D**	**GCM1885C1H3R0CZ13D**
4.0pF(**4R0**)	±0.25pF(**C**)	**GCM0335C1E4R0CD03D**	**GCM1555C1H4R0CZ13D**	**GCM1885C2A4R0CZ13D**	**GCM1885C1H4R0CZ13D**
5.0pF(**5R0**)	±0.25pF(**C**)	**GCM0335C1E5R0CD03D**	**GCM1555C1H5R0CZ13D**	**GCM1885C2A5R0CZ13D**	**GCM1885C1H5R0CZ13D**
6.0pF(**6R0**)	±0.5pF(**D**)	**GCM0335C1E6R0DD03D**	**GCM1555C1H6R0DZ13D**	**GCM1885C2A6R0DZ13D**	**GCM1885C1H6R0DZ13D**
7.0pF(**7R0**)	±0.5pF(**D**)	**GCM0335C1E7R0DD03D**	**GCM1555C1H7R0DZ13D**	**GCM1885C2A7R0DZ13D**	**GCM1885C1H7R0DZ13D**
8.0pF(**8R0**)	±0.5pF(**D**)	**GCM0335C1E8R0DD03D**	**GCM1555C1H8R0DZ13D**	**GCM1885C2A8R0DZ13D**	**GCM1885C1H8R0DZ13D**
9.0pF(**9R0**)	±0.5pF(**D**)	**GCM0335C1E9R0DD03D**	**GCM1555C1H9R0DZ13D**	**GCM1885C2A9R0DZ13D**	**GCM1885C1H9R0DZ13D**
10pF(**100**)	±5%(**J**)	**GCM0335C1E100JD03D**	**GCM1555C1H100JZ13D**	**GCM1885C2A100JA16D**	**GCM1885C1H100JA16D**
12pF(**120**)	±5%(**J**)	**GCM0335C1E120JD03D**	**GCM1555C1H120JZ13D**	**GCM1885C2A120JA16D**	**GCM1885C1H120JA16D**
15pF(**150**)	±5%(**J**)	**GCM0335C1E150JD03D**	**GCM1555C1H150JZ13D**	**GCM1885C2A150JA16D**	**GCM1885C1H150JA16D**
18pF(**180**)	±5%(**J**)	**GCM0335C1E180JD03D**	**GCM1555C1H180JZ13D**	**GCM1885C2A180JA16D**	**GCM1885C1H180JA16D**
22pF(**220**)	±5%(**J**)	**GCM0335C1E220JD03D**	**GCM1555C1H220JZ13D**	**GCM1885C2A220JA16D**	**GCM1885C1H220JA16D**
27pF(**270**)	±5%(**J**)	**GCM0335C1E270JD03D**	**GCM1555C1H270JZ13D**	**GCM1885C2A270JA16D**	**GCM1885C1H270JA16D**
33pF(**330**)	±5%(**J**)	**GCM0335C1E330JD03D**	**GCM1555C1H330JZ13D**	**GCM1885C2A330JA16D**	**GCM1885C1H330JA16D**
39pF(**390**)	±5%(**J**)	**GCM0335C1E390JD03D**	**GCM1555C1H390JZ13D**	**GCM1885C2A390JA16D**	**GCM1885C1H390JA16D**
47pF(**470**)	±5%(**J**)	**GCM0335C1E470JD03D**	**GCM1555C1H470JZ13D**	**GCM1885C2A470JA16D**	**GCM1885C1H470JA16D**
56pF(**560**)	±5%(**J**)	**GCM0335C1E560JD03D**	**GCM1555C1H560JZ13D**	**GCM1885C2A560JA16D**	**GCM1885C1H560JA16D**
68pF(**680**)	±5%(**J**)	**GCM0335C1E680JD03D**	**GCM1555C1H680JZ13D**	**GCM1885C2A680JA16D**	**GCM1885C1H680JA16D**
82pF(**820**)	±5%(**J**)	**GCM0335C1E820JD03D**	**GCM1555C1H820JZ13D**	**GCM1885C2A820JA16D**	**GCM1885C1H820JA16D**
100pF(**101**)	±5%(**J**)	**GCM0335C1E101JD03D**	**GCM1555C1H101JZ13D**	**GCM1885C2A101JA16D**	**GCM1885C1H101JA16D**
120pF(**121**)	±5%(**J**)		**GCM1555C1H121JA16D**	**GCM1885C2A121JA16D**	**GCM1885C1H121JA16D**
150pF(**151**)	±5%(**J**)		**GCM1555C1H151JA16D**	**GCM1885C2A151JA16D**	**GCM1885C1H151JA16D**
180pF(**181**)	±5%(**J**)		**GCM1555C1H181JA16D**	**GCM1885C2A181JA16D**	**GCM1885C1H181JA16D**
220pF(**221**)	±5%(**J**)		**GCM1555C1H221JA16D**	**GCM1885C2A221JA16D**	**GCM1885C1H221JA16D**
270pF(**271**)	±5%(**J**)		**GCM1555C1H271JA16D**	**GCM1885C2A271JA16D**	**GCM1885C1H271JA16D**
330pF(**331**)	±5%(**J**)		**GCM1555C1H331JA16D**	**GCM1885C2A331JA16D**	**GCM1885C1H331JA16D**
390pF(**391**)	±5%(**J**)		**GCM1555C1H391JA16D**	**GCM1885C2A391JA16D**	**GCM1885C1H391JA16D**
470pF(**471**)	±5%(**J**)		**GCM1555C1H471JA16D**	**GCM1885C2A471JA16D**	**GCM1885C1H471JA16D**
560pF(**561**)	±5%(**J**)			**GCM1885C2A561JA16D**	**GCM1885C1H561JA16D**
680pF(**681**)	±5%(**J**)			**GCM1885C2A681JA16D**	**GCM1885C1H681JA16D**
820pF(**821**)	±5%(**J**)			**GCM1885C2A821JA16D**	**GCM1885C1H821JA16D**
1000pF(**102**)	±5%(**J**)			**GCM1885C2A102JA16D**	**GCM1885C1H102JA16D**
1200pF(**122**)	±5%(**J**)			**GCM1885C2A122JA16D**	**GCM1885C1H122JA16D**
1500pF(**152**)	±5%(**J**)			**GCM1885C2A152JA16D**	**GCM1885C1H152JA16D**
1800pF(**182**)	±5%(**J**)				**GCM1885C1H182JA16D**
2200pF(**222**)	±5%(**J**)				**GCM1885C1H222JA16D**
2700pF(**272**)	±5%(**J**)				**GCM1885C1H272JA16D**
3300pF(**332**)	±5%(**J**)				**GCM1885C1H332JA16D**
3900pF(**392**)	±5%(**J**)				**GCM1885C1H392JA16D**

The part numbering code is shown in ( ) and Unit is shown in [ ]. < >: EIA [inch] Code

(Part Number)	GC	M	03	3	5C	1E	1R0	C	D03	D
	❶	❷	❸	❹	❺	❻	❼	❽	❾	❿

❶Product ID ❷Series ❸Dimension (L×W) ❹Dimension (T)
❺Temperature Characteristics ❻Rated Voltage ❼Capacitance
❽Capacitance Tolerance ❾Individual Specification Code ❿Package

Packaging Code in Part Number shows STD 180mm Reel Taping.

Temperature Compensating Type

L x W [mm]		2.0x1.25(**21**)<0805>		3.2x1.6(**31**)<1206>	
Rated Volt. [Vdc]		100(**2A**)	50(**1H**)	100(**2A**)	50(**1H**)
TC		C0G(**5C**)			
Capacitance	Tolerance	Part Number			
100pF(**101**)	±5%(**J**)	**GCM2165C2A101JA16D**			
120pF(**121**)	±5%(**J**)	**GCM2165C2A121JA16D**			
150pF(**151**)	±5%(**J**)	**GCM2165C2A151JA16D**			
180pF(**181**)	±5%(**J**)	**GCM2165C2A181JA16D**			
220pF(**221**)	±5%(**J**)	**GCM2165C2A221JA16D**			
270pF(**271**)	±5%(**J**)	**GCM2165C2A271JA16D**			
330pF(**331**)	±5%(**J**)	**GCM2165C2A331JA16D**			
390pF(**391**)	±5%(**J**)	**GCM2165C2A391JA16D**			
470pF(**471**)	±5%(**J**)	**GCM2165C2A471JA16D**			
560pF(**561**)	±5%(**J**)	**GCM2165C2A561JA16D**	**GCM2165C1H561JA16D**		
680pF(**681**)	±5%(**J**)	**GCM2165C2A681JA16D**	**GCM2165C1H681JA16D**		
820pF(**821**)	±5%(**J**)	**GCM2165C2A821JA16D**	**GCM2165C1H821JA16D**		
1000pF(**102**)	±5%(**J**)	**GCM2165C2A102JA16D**	**GCM2165C1H102JA16D**		
1200pF(**122**)	±5%(**J**)	**GCM2165C2A122JA16D**	**GCM2165C1H122JA16D**		
1500pF(**152**)	±5%(**J**)	**GCM2165C2A152JA16D**	**GCM2165C1H152JA16D**		
1800pF(**182**)	±5%(**J**)	**GCM2165C2A182JA16D**	**GCM2165C1H182JA16D**	**GCM3195C2A182JA16D**	
2200pF(**222**)	±5%(**J**)	**GCM2165C2A222JA16D**	**GCM2165C1H222JA16D**	**GCM3195C2A222JA16D**	
2700pF(**272**)	±5%(**J**)	**GCM2165C2A272JA16D**	**GCM2165C1H272JA16D**	**GCM3195C2A272JA16D**	
3300pF(**332**)	±5%(**J**)	**GCM2165C2A332JA16D**	**GCM2165C1H332JA16D**	**GCM3195C2A332JA16D**	
3900pF(**392**)	±5%(**J**)		**GCM2165C1H392JA16D**	**GCM3195C2A392JA16D**	
4700pF(**472**)	±5%(**J**)		**GCM2165C1H472JA16D**	**GCM3195C2A472JA16D**	**GCM3195C1H472JA16D**
5600pF(**562**)	±5%(**J**)		**GCM2195C1H562JA16D**	**GCM3195C2A562JA16D**	**GCM3195C1H562JA16D**
6800pF(**682**)	±5%(**J**)		**GCM2195C1H682JA16D**	**GCM3195C2A682JA16D**	**GCM3195C1H682JA16D**
8200pF(**822**)	±5%(**J**)		**GCM2195C1H822JA16D**	**GCM3195C2A822JA16D**	**GCM3195C1H822JA16D**
10000pF(**103**)	±5%(**J**)		**GCM2195C1H103JA16D**	**GCM3195C2A103JA16D**	**GCM3195C1H103JA16D**
12000pF(**123**)	±5%(**J**)		**GCM2195C1H123JA16D**		**GCM3195C1H123JA16D**
15000pF(**153**)	±5%(**J**)		**GCM2195C1H153JA16D**		**GCM3195C1H153JA16D**
18000pF(**183**)	±5%(**J**)		**GCM21B5C1H183JA16L**		**GCM3195C1H183JA16D**
22000pF(**223**)	±5%(**J**)		**GCM21B5C1H223JA16L**		**GCM3195C1H223JA16D**
27000pF(**273**)	±5%(**J**)				**GCM3195C1H273JA16D**
33000pF(**333**)	±5%(**J**)				**GCM3195C1H333JA16D**
39000pF(**393**)	±5%(**J**)				**GCM3195C1H393JA16D**
47000pF(**473**)	±5%(**J**)				**GCM31M5C1H473JA16L**
56000pF(**563**)	±5%(**J**)				**GCM31M5C1H563JA16L**

The part numbering code is shown in ( ) and Unit is shown in [ ]. < >: EIA [inch] Code

(Part Number) GC | M | 21 | 6 | 5C | 2A | 101 | J | A16 | D
❶ ❷ ❸ ❹ ❺ ❻ ❼ ❽ ❾ ❿

❶Product ID ❷Series ❸Dimension (L×W) ❹Dimension (T)
❺Temperature Characteristics ❻Rated Voltage ❼Capacitance
❽Capacitance Tolerance ❾Individual Specification Code ❿Package

Packaging Code in Part Number shows STD 180mm Reel Taping.

High Dielectric Constant Type

L x W [mm]		0.6x0.3(**03**)<0201>		
Rated Volt. [Vdc]		25(**1E**)	16(**1C**)	10(**1A**)
TC		X7R(**R7**)		
Capacitance	Tolerance	Part Number		
100pF(**101**)	±10%(**K**)	**GCM033R71E101KA03D**		
150pF(**151**)	±10%(**K**)	**GCM033R71E151KA03D**		
220pF(**221**)	±10%(**K**)	**GCM033R71E221KA03D**		
330pF(**331**)	±10%(**K**)	**GCM033R71E331KA03D**		
470pF(**471**)	±10%(**K**)	**GCM033R71E471KA03D**		
680pF(**681**)	±10%(**K**)	**GCM033R71E681KA03D**		
1000pF(**102**)	±10%(**K**)	**GCM033R71E102KA03D**		
1500pF(**152**)	±10%(**K**)	**GCM033R71E152KA03D**		
2200pF(**222**)	±10%(**K**)		**GCM033R71C222KA55D**	
3300pF(**332**)	±10%(**K**)		**GCM033R71C332KA55D**	
4700pF(**472**)	±10%(**K**)			**GCM033R71A472KA03D**
6800pF(**682**)	±10%(**K**)			**GCM033R71A682KA03D**
10000pF(**103**)	±10%(**K**)			**GCM033R71A103KA03D**

L x W [mm]		1.0x0.5(**15**)<0402>			
Rated Volt. [Vdc]		100(**2A**)	50(**1H**)	25(**1E**)	16(**1C**)
TC		X7R(**R7**)			
Capacitance	Tolerance	Part Number			
220pF(**221**)	±10%(**K**)	**GCM155R72A221KA37D**	**GCM155R71H221KA37D**		
330pF(**331**)	±10%(**K**)	**GCM155R72A331KA37D**	**GCM155R71H331KA37D**		
470pF(**471**)	±10%(**K**)	**GCM155R72A471KA37D**	**GCM155R71H471KA37D**		
680pF(**681**)	±10%(**K**)	**GCM155R72A681KA37D**	**GCM155R71H681KA37D**		
1000pF(**102**)	±10%(**K**)	**GCM155R72A102KA37D**	**GCM155R71H102KA37D**		
1500pF(**152**)	±10%(**K**)	**GCM155R72A152KA37D**	**GCM155R71H152KA37D**		
2200pF(**222**)	±10%(**K**)	**GCM155R72A222KA37D**	**GCM155R71H222KA37D**		
3300pF(**332**)	±10%(**K**)	**GCM155R72A332KA37D**	**GCM155R71H332KA37D**		
4700pF(**472**)	±10%(**K**)	**GCM155R72A472KA37D**	**GCM155R71H472KA37D**		
6800pF(**682**)	±10%(**K**)		**GCM155R71H682KA55D**		
10000pF(**103**)	±10%(**K**)		**GCM155R71H103KA55D**	**GCM155R71E103KA37D**	
15000pF(**153**)	±10%(**K**)		**GCM155R71H153KA55D**	**GCM155R71E153KA55D**	
22000pF(**223**)	±10%(**K**)		**GCM155R71H223KA55D**	**GCM155R71E223KA55D**	
33000pF(**333**)	±10%(**K**)			**GCM155R71E333KA55D**	**GCM155R71C333KA37D**
47000pF(**473**)	±10%(**K**)			**GCM155R71E473KA55D**	**GCM155R71C473KA37D**
68000pF(**683**)	±10%(**K**)				**GCM155R71C683KA55D**
0.10µF(**104**)	±10%(**K**)				**GCM155R71C104KA55D**

The part numbering code is shown in ( ) and Unit is shown in [ ]. < >: EIA [inch] Code

High Dielectric Constant Type

L x W [mm]		1.6x0.8(**18**)<0603>			
Rated Volt. [Vdc]		100(**2A**)	50(**1H**)	25(**1E**)	16(**1C**)
TC		X7R(**R7**)/X7S(**C7**)			
Capacitance	Tolerance	Part Number			
1000pF(**102**)	±10%(**K**)	**GCM188R72A102KA37D**	**GCM188R71H102KA37D**		
1500pF(**152**)	±10%(**K**)	**GCM188R72A152KA37D**	**GCM188R71H152KA37D**		
2200pF(**222**)	±10%(**K**)	**GCM188R72A222KA37D**	**GCM188R71H222KA37D**		
3300pF(**332**)	±10%(**K**)	**GCM188R72A332KA37D**	**GCM188R71H332KA37D**		
4700pF(**472**)	±10%(**K**)	**GCM188R72A472KA37D**	**GCM188R71H472KA37D**		
6800pF(**682**)	±10%(**K**)	**GCM188R72A682KA37D**	**GCM188R71H682KA37D**		
10000pF(**103**)	±10%(**K**)	**GCM188R72A103KA37D**	**GCM188R71H103KA37D**		
15000pF(**153**)	±10%(**K**)	**GCM188R72A153KA37D**	**GCM188R71H153KA37D**		
22000pF(**223**)	±10%(**K**)	**GCM188R72A223KA37D**	**GCM188R71H223KA37D**		
33000pF(**333**)	±10%(**K**)		**GCM188R71H333KA55D**	**GCM188R71E333KA37D**	
47000pF(**473**)	±10%(**K**)		**GCM188R71H473KA55D**	**GCM188R71E473KA37D**	
68000pF(**683**)	±10%(**K**)		**GCM188R71H683KA57D**	**GCM188R71E683KA57D**	
0.10µF(**104**)	±10%(**K**)	**GCM188R72A104KA64D**	**GCM188R71H104KA57D**	**GCM188R71E104KA57D**	**GCM188R71C104KA37D**
0.15µF(**154**)	±10%(**K**)		**GCM188R71H154KA64D**	**GCM188R71E154KA37D**	
0.22µF(**224**)	±10%(**K**)		**GCM188R71H224KA64D**	**GCM188R71E224KA55D**	
0.33µF(**334**)	±10%(**K**)				**GCM188R71C334KA37D**
0.47µF(**474**)	±10%(**K**)			**GCM188R71E474KA64D**	**GCM188R71C474KA55D**
1.0µF(**105**)	±10%(**K**)			**GCM188R71E105KA64D**	**GCM188R71C105KA64D**

L x W [mm]		1.6x0.8(**18**)<0603>
Rated Volt. [Vdc]		6.3(**0J**)
TC		X7R(**R7**)
Capacitance	Tolerance	Part Number
2.2µF(**225**)	±10%(**K**)	**GCM188R70J225KE22D**

The part numbering code is shown in ( ) and Unit is shown in [ ]. < >: EIA [inch] Code

(Part Number) GC ❶ M ❷ 18 ❸ 8 ❹ R7 ❺ 2A ❻ 102 ❼ K ❽ A37 ❾ D ❿

❶Product ID ❷Series ❸Dimension (L×W) ❹Dimension (T)
❺Temperature Characteristics ❻Rated Voltage ❼Capacitance
❽Capacitance Tolerance ❾Individual Specification Code ❿Package

Packaging Code in Part Number shows STD 180mm Reel Taping.

High Dielectric Constant Type

L x W [mm]		2.0x1.25(**21**)<0805>			
Rated Volt. [Vdc]		100(**2A**)	50(**1H**)	35(**YA**)	25(**1E**)
TC		X7R(**R7**)			
Capacitance	Tolerance	Part Number			
6800pF(**682**)	±10%(**K**)	**GCM216R72A682KA37D**			
10000pF(**103**)	±10%(**K**)	**GCM216R72A103KA37D**			
15000pF(**153**)	±10%(**K**)	**GCM216R72A153KA37D**			
22000pF(**223**)	±10%(**K**)	**GCM216R72A223KA37D**			
33000pF(**333**)	±10%(**K**)	**GCM219R72A333KA37D**	**GCM219R71H333KA37D**		
47000pF(**473**)	±10%(**K**)	**GCM21BR72A473KA37L**	**GCM21BR71H473KA37L**		
68000pF(**683**)	±10%(**K**)	**GCM21BR72A683KA37L**	**GCM21BR71H683KA37L**		
0.10µF(**104**)	±10%(**K**)	**GCM21BR72A104KA37L**	**GCM21BR71H104KA37L**		
0.15µF(**154**)	±10%(**K**)		**GCM21BR71H154KA37L**		**GCM21BR71E154KA37L**
0.22µF(**224**)	±10%(**K**)		**GCM21BR71H224KA37L**		**GCM21BR71E224KA37L**
0.33µF(**334**)	±10%(**K**)		**GCM219R71H334KA55D**		**GCM21BR71E334KA37L**
0.47µF(**474**)	±10%(**K**)		**GCM21BR71H474KA55L**		**GCM219R71E474KA55D**
0.68µF(**684**)	±10%(**K**)			**GCM21BR7YA684KA55L**	**GCM21BR71E684KA55L**
1.0µF(**105**)	±10%(**K**)			**GCM21BR7YA105KA55L**	**GCM21BR71E105KA56L**
2.2µF(**225**)	±10%(**K**)				**GCM21BR71E225KA73L**

L x W [mm]		2.0x1.25(**21**)<0805>		
Rated Volt. [Vdc]		16(**1C**)	10(**1A**)	6.3(**0J**)
TC		X7R(**R7**)/X7S(**C7**)		
Capacitance	Tolerance	Part Number		
0.68µF(**684**)	±10%(**K**)	**GCM219R71C684KA37D**		
1.0µF(**105**)	±10%(**K**)	**GCM219R71C105KA37D**		
2.2µF(**225**)	±10%(**K**)	**GCM21BR71C225KA64L**	**GCM21BR71A225KA37L**	
4.7µF(**475**)	±10%(**K**)	**GCM21BR71C475KA73L**	**GCM21BC71A475KA73L**	
10µF(**106**)	±10%(**K**)			**GCM21BR70J106KE22L**

L x W [mm]		3.2x1.6(**31**)<1206>			
Rated Volt. [Vdc]		100(**2A**)	50(**1H**)	25(**1E**)	16(**1C**)
TC		X7R(**R7**)			
Capacitance	Tolerance	Part Number			
0.10µF(**104**)	±10%(**K**)	**GCM319R72A104KA37D**			
0.15µF(**154**)	±10%(**K**)	**GCM31MR72A154KA37L**			
0.22µF(**224**)	±10%(**K**)	**GCM31MR72A224KA37L**			
0.33µF(**334**)	±10%(**K**)		**GCM31MR71H334KA37L**		
0.47µF(**474**)	±10%(**K**)		**GCM31MR71H474KA37L**		
0.68µF(**684**)	±10%(**K**)		**GCM31MR71H684KA55L**		
1.0µF(**105**)	±10%(**K**)		**GCM31MR71H105KA55L**		
2.2µF(**225**)	±10%(**K**)		**GCM31CR71H225KA55L**	**GCM31MR71E225KA57L**	
4.7µF(**475**)	±10%(**K**)			**GCM31CR71E475KA55L**	**GCM31CR71C475KA37L**
10µF(**106**)	±10%(**K**)				**GCM31CR71C106KA64L**

L x W [mm]		3.2x1.6(**31**)<1206>	
Rated Volt. [Vdc]		10(**1A**)	6.3(**0J**)
TC		X7R(**R7**)	
Capacitance	Tolerance	Part Number	
10µF(**106**)	±10%(**K**)	**GCM31CR71A106KA64L**	
22µF(**226**)	±20%(**M**)		**GCM31CR70J226ME23L**

The part numbering code is shown in ( ) and Unit is shown in [ ].   < >: EIA [inch] Code

High Dielectric Constant Type

L x W [mm]		3.2x2.5(**32**)<1210>			
Rated Volt. [Vdc]		100(**2A**)	50(**1H**)	25(**1E**)	16(**1C**)
TC		X7R(**R7**)			
Capacitance	Tolerance	Part Number			
1.0µF(**105**)	±10%(**K**)		**GCM32ER71H105KA37L**		
2.2µF(**225**)	±10%(**K**)	**GCM32DR72A225KA64L**			
4.7µF(**475**)	±10%(**K**)		**GCM32ER71H475KA55L**	**GCM32DR71E475KA55L**	
10µF(**106**)	±10%(**K**)			**GCM32ER71E106KA57L**	**GCM32DR71C106KA37L**
22µF(**226**)	±20%(**M**)				**GCM32ER71C226ME19L**

L x W [mm]		3.2x2.5(**32**)<1210>	
Rated Volt. [Vdc]		10(**1A**)	6.3(**0J**)
TC		X7R(**R7**)	
Capacitance	Tolerance	Part Number	
22µF(**226**)	±20%(**M**)	**GCM32ER71A226ME12L**	
47µF(**476**)	±20%(**M**)		**GCM32ER70J476ME19L**

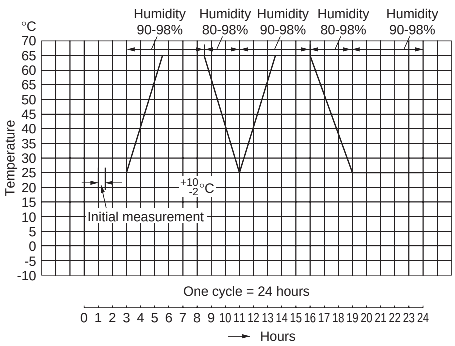
The part numbering code is shown in ( ) and Unit is shown in [ ]. < >: EIA [inch] Code

(Part Number) GC M 32 D R7 2A 225 K A64 L
❶ ❷ ❸ ❹ ❺ ❻ ❼ ❽ ❾ ❿

❶Product ID ❷Series ❸Dimension (L×W) ❹Dimension (T)
❺Temperature Characteristics ❻Rated Voltage ❼Capacitance
❽Capacitance Tolerance ❾Individual Specification Code ❿Package

Packaging Code in Part Number shows STD 180mm Reel Taping.

Specifications and Test Methods

<table>
<tr><th rowspan="2">No.</th><th colspan="2" rowspan="2">AEC-Q200
Test Item</th><th colspan="2">Specifications</th><th rowspan="2">AEC-Q200 Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td>1</td><td colspan="2">Pre- and Post-Stress Electrical Test</td><td colspan="3">–</td></tr>
<tr><td rowspan="5">2</td><td colspan="2">High Temperature Exposure (Storage)</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Set the capacitor for 1000±12 hours at 150±3°C. Let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td></td><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pFmin.: Q≧1000
30pFmax.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.03 max.
W.V.: 16V: 0.05 max.</td></tr>
<tr><td></td><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F *1
(Whichever is smaller)</td></tr>
<tr><td rowspan="5">3</td><td colspan="2">Temperature Cycle</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (18). Perform 1000 cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (°C)</td><td>-55+0/-3</td><td>Room Temp.</td><td>125+3/-0 (ΔC/R7/C7)</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>15±3</td><td>1</td><td>15±3</td><td>1</td></tr></table>
• Initial measurement for high dielectric constant type
Perform a heat treatment at 150^{+0}_{-10} °C for one hour and then let sit for 24±2 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td></td><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pFmin.: Q≧1000
30pFmax.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.03 max.
W.V.: 16V: 0.05 max.</td></tr>
<tr><td></td><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F *1
(Whichever is smaller)</td></tr>
<tr><td>4</td><td colspan="2">Destructive Physical Analysis</td><td colspan="2">No defects or abnormalities</td><td>Per EIA-469</td></tr>
<tr><td rowspan="5">5</td><td colspan="2">Moisture Resistance</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply the 24-hour heat (25 to 65°C) and humidity (80 to 98%) treatment shown below, 10 consecutive times.
Let sit for 24±2 hours at room temperature, then measure.

</td></tr>
<tr><td></td><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±3.0% or ±0.30pF
(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pFmin.: Q≧350
10pF and over, 30pF and below: $Q \geqq 275+\frac{5}{2}C$
10pFmax.: Q≧200+10C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.03 max.
W.V.: 16V: 0.05 max.</td></tr>
<tr><td></td><td>I.R.</td><td colspan="2">*1
More than 10,000MΩ or 500Ω · F
(Whichever is smaller)</td></tr>
<tr><td rowspan="5">6</td><td colspan="2">Biased Humidity</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply the rated voltage and 1.3+0.2/-0Vdc (add 6.8k Ω resistor) at 85±3°C and 80 to 85% humidity for 1000±12 hours.
Remove and let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.</td></tr>
<tr><td></td><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±3.0% or ±0.30pF
(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pF and over: Q≧200
30pF and below: $Q \geqq 100+\frac{10}{3}C$
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.035 max.
W.V.: 16V: 0.05 max.</td></tr>
<tr><td></td><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F *1
(Whichever is smaller)</td></tr>
</table>

*1: The figure indicates typical specification. Please refer to individual specifications.

Continued on the following page.

For Automotive GCM Series
For Automotive Product Information
Medium Voltage for Automotive GCM Series Low Dissipation Factor
Medium Voltage for Automotive GCJ Series Soft Termination Type
Medium Voltage for Automotive Product Information

Specifications and Test Methods

Continued from the preceding page.

No.	AEC-Q200 Test Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	AEC-Q200 Test Method
7	Operational Life		The measured and observed characteristics should satisfy the specifications in the following table.		Apply 200% of the rated voltage for 1000±12 hours at 125±3°C. Let sit for 24±2 hours at room temperature, then measure. *2 The charge/discharge current is less than 50mA. • Initial measurement for high dielectric constant type. Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3°C. Remove and let sit for 24±2 hours at room temperature. Perform initial measurement. *2
		Appearance	No marking defects		
		Capacitance Change	Within ±3.0% or ±0.30pF (Whichever is larger)	Within ±12.5%	
		Q/D.F.	30pFmin.: Q≧350 10pF and over, 30pF and below: Q≧275+$\frac{5}{2}$C 10pFmax.: Q≧200+10C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.035 max. W.V.: 16V: 0.05 max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller) *1		
8	External Visual		No defects or abnormalities		Visual inspection
9	Physical Dimension		Within the specified dimensions		Using calipers
10	Resistance to Solvents	Appearance	No marking defects		Per MIL-STD-202 Method 215 Solvent 1: 1 part (by volume) of isopropyl alcohol 3 parts (by volume) of mineral spirits Solvent 2: Terpene defluxer Solvent 3: 42 parts (by volume) of water 1 part (by volume) of propylene glycol monomethyl ether 1 part (by volume) of monoethanolamine
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		
11	Mechanical Shock	Appearance	No marking defects		Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks). The specified test pulse should be Half-sine and should have a duration: 0.5ms, peak value: 1500g and velocity change: 4.7m/s.
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		
12	Vibration	Appearance	No defects or abnormalities		Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (19). 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 2000Hz. The frequency range, from 10 to 2000Hz and return to 10Hz, should be traversed in approximately 20 minutes. This motion should be applied for 12 items in each 3 mutually perpendicular directions (total of 36 times).
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		
13	Resistance to Soldering Heat		The measured and observed characteristics should satisfy the specifications in the following table.		Immerse the capacitor in a eutectic solder solution at 260±5°C for 10±1 seconds. Let sit at room temperature for 24±2 hours, then measure. • Initial measurement for high dielectric constant type Perform a heat treatment at 150$^{+0}_{-10}$°C for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.
		Appearance	No marking defects		
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pFmin.: Q≧1000 30pFmax.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		

*1: The figure indicates typical specification. Please refer to individual specifications.
*2: Some of the parts are applicable in rated voltage x 150%. Please refer to individual specifications.

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	AEC-Q200 Test Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	AEC-Q200 Test Method
14	Thermal Shock		The measured and observed characteristics should satisfy the specifications in the following table.		Fix the capacitor to the supporting jig in the same manner and under the same conditions as (18). Perform the 300 cycles according to the two heat treatments listed in the following table (maximum transfer time is 20 seconds). Let sit for 24±2 hours at room temperature, then measure. Step / 1 / 2 Temp. (°C) / -55+0/-3 / 125+3/-0 (5C, C7, R7) Time (min.) / 15±3 / 15±3 • Initial measurement for high dielectric constant type Perform a heat treatment at 150+0/-10°C for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.
		Appearance	No marking defects		
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10.0%	
		Q/D.F.	30pF min.: Q≧1000 30pF max.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		
15	ESD	Appearance	No marking defects		Per AEC-Q200-002
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pF min.: Q≧1000 30pF max.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller) *1		
16	Solderability		95% of the terminations are to be soldered evenly and continuously.		(a) Preheat at 155°C for 4 hours. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C. (b) Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C. (c) Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 120 ±5 seconds at 260±5°C.
17	Electrical Characteri-zation	Appearance	No defects or abnormalities		Visual inspection.
		Capacitance Change	Within the specified tolerance		The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table. (1) Temperature Compensating Type Capacitance / Frequency / Voltage C≦1000pF / 1±0.1MHz / 0.5 to 5Vrms C>1000pF / 1±0.1kHz / 1±0.2Vrms (2) High Dielectric Type Capacitance / Frequency / Voltage C≦10μF / 1±0.1kHz / 1±0.2Vrms C>10μF / 120±24Hz / 0.5±0.1Vrms
		Q/D.F.	30pF min.: Q≧1000 30pF max.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25V min.: 0.025 max. W.V.: 16V: 0.035 max	
		I.R.	25°C More than 100,000MΩ or 1,000Ω · F (Whichever is smaller) Max. Operating Temperature···125°C More than 10,000MΩ or 100Ω · F (Whichever is smaller)	*1 25°C More than 10,000MΩ or 500Ω · F (Whichever is smaller) Max. Operating Temperature···125°C More than 1,000MΩ or 10Ω · F (Whichever is smaller)	The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25°C and 125°C and within 2 minutes of charging.
		Dielectric Strength	No failure		No failure should be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.

*1: The figure indicates typical specification. Please refer to individual specifications.

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	AEC-Q200 Test Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	AEC-Q200 Test Method
18	Board Flex	Appearance	No marking defects		Solder the capacitor on the test jig (glass epoxy board) as shown in Fig. 1 using a eutectic solder. Then apply force in the direction shown in Fig. 2 for 5±1sec. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
		Capacitance Change	Within ±5.0% or ±0.5pF (Whichever is larger)	Within ±10.0%	
		Q/D.F.	30pF min.: Q≧1000 30pF max.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	*1 More than 10,000MΩ or 500Ω · F (Whichever is smaller)	Fig. 1	
19	Terminal Strength	Appearance	No marking defects		Solder the capacitor to the test jig (glass epoxy board) as shown in Fig. 3 using a eutectic solder. Then apply *18N force in parallel with the test jig for 60sec. 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. *2N (GCM03/15)
		Capacitance Change	Within the specified tolerance		
		Q/D.F.	30pF min.: Q≧1000 30pF max.: Q≧400+20C C: Nominal Capacitance (pF)	*1 W.V.: 25Vmin.: 0.025 max. W.V.: 16V: 0.035 max.	
		I.R.	*1 More than 10,000MΩ or 500Ω · F (Whichever is smaller)		
20	Beam Load Test		The chip should endure the following force. < Chip L dimension: 2.5mm max. > Chip thickness > 0.5mm rank: 20N Chip thickness ≦ 0.5mm rank: 8N < Chip L dimension: 3.2mm min. > Chip thickness < 1.25mm rank: 15N Chip thickness ≧ 1.25mm rank: 54.5N		Place the capacitor in the beam load fixture as in Fig. 4. Apply force. < Chip Length: 2.5mm max. > Speed at which to supply the Stress Load: 0.5mm / sec. < Chip Length: 3.2mm min. > Speed at which to supply the Stress Load: 2.5mm / sec.

No. 18 Board Flex

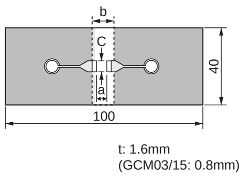


Fig. 1

Type	a	b	c
GCM03	0.3	0.9	0.3
GCM15	0.5	1.5	0.6
GCM18	0.6	2.2	0.9
GCM21	0.8	3.0	1.3
GCM31	2.0	4.4	1.7
GCM32	2.0	4.4	2.6

(in mm)

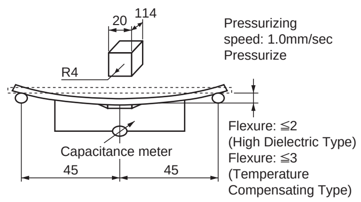


Fig. 2

No. 19 Terminal Strength

Type	a	b	c
GCM03	0.3	0.9	0.3
GCM15	0.4	1.5	0.5
GCM18	1.0	3.0	1.2
GCM21	1.2	4.0	1.65
GCM31	2.2	5.0	2.0
GCM32	2.2	5.0	2.9

(in mm)

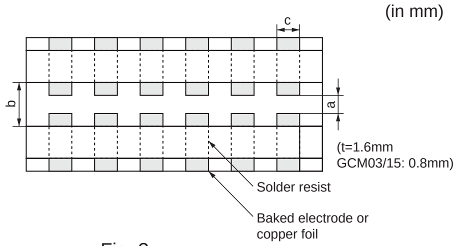
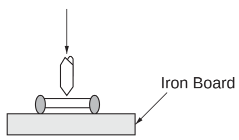


Fig. 3

No. 20 Beam Load Test



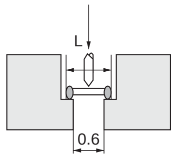


Fig. 4

*1: The figure indicates typical specification. Please refer to individual specifications.

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Specifications and Test Methods

Continued from the preceding page.

No.	AEC-Q200 Test Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	AEC-Q200 Test Method
21	Capacitance Temperature Character-istics	Capacitance Change	Within the specified tolerance (Table A)	C7: Within ±22% (-55°C to +125°C) R7: Within ±15% (-55°C to +125°C)	The capacitance change should be measured after 5 min. at each specified temperature stage. (1) Temperature Compensating Type The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from steps 1 through 5 (ΔC: +25°C to +125°C: other temperature coefficient: +25°C to +85°C) the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as shown in Table A. 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. Step 1: 25±2; Step 2: -55±3; Step 3: 25±2; Step 4: 125±3; Step 5: 25±2 (Temperature (°C)) (2) High Dielectric Constant Type The ranges of capacitance change compared with the above 25°C value over the temperature ranges shown in the table should be within the specified ranges. · Initial measurement for high dielectric constant type. Perform a heat treatment at 150+0/-10°C for one hour and then set for 24±2 hours at room temperature. Perform the initial measurement.
		Temperature Coefficient	Within the specified tolerance (Table A)		
		Capacitance Drift	Within ±0.2% or ±0.05 pF (Whichever is larger) * Do not apply to 1X/25V		

Step	Temperature (°C)
1	25±2
2	-55±3
3	25±2
4	125±3
5	25±2

*1: The figure indicates typical specification. Please refer to individual specifications.

Table A

Char.	Nominal Values (ppm/°C) Note1	Capacitance Change from 25°C (%)					
		-55		-30		-10	
		Max.	Min.	Max.	Min.	Max.	Min.
5C	0±30	0.58	-0.24	0.40	-0.17	0.25	-0.11

Note 1: Nominal values denote the temperature coefficient within a range of 25°C to 125°C (for 5C).

Package

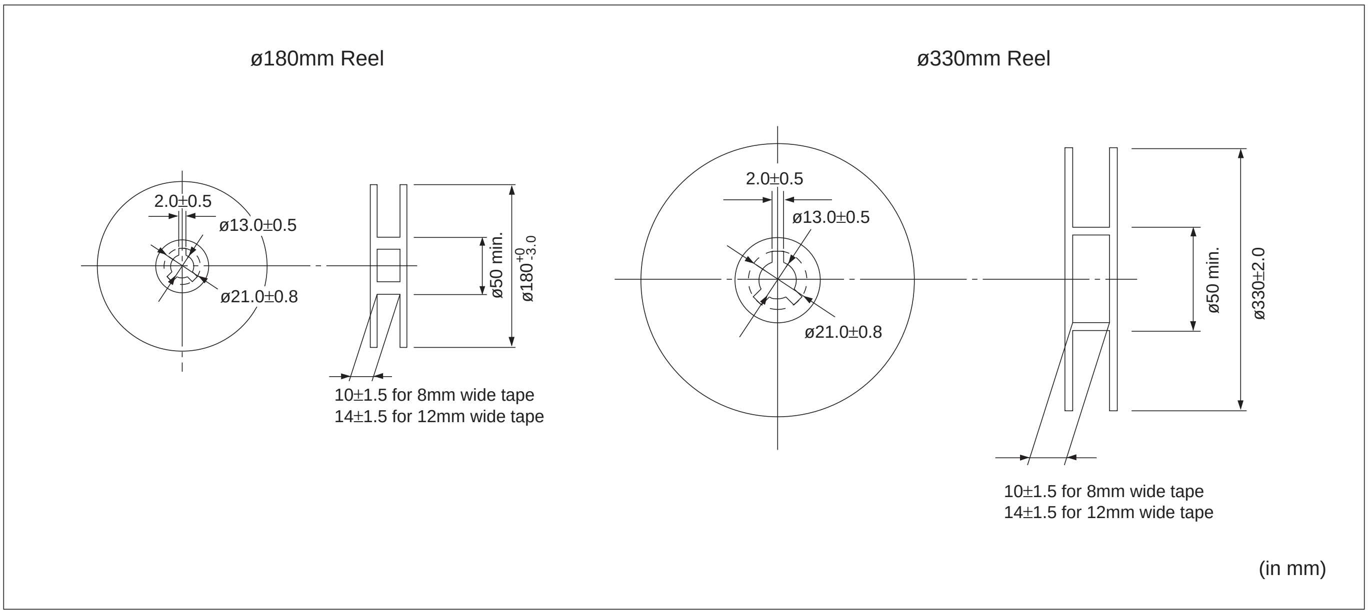
■ Minimum Quantity Guide

Part Number	Dimensions (mm)			Quantity (pcs.)					
				ø180mm reel		ø330mm reel		Bulk Case	Bulk Bag
	L	W	T	Paper Tape Packaging Code: **D**	Embossed Tape Packaging Code: **L**	Paper Tape Packaging Code: **J**	Embossed Tape Packaging Code: **K**	Packaging Code: **C**	Packaging Code: **B**
GCM03	0.6	0.3	0.3	15,000	-	50,000	-	-	1,000
GCM15	1.0	0.5	0.5	10,000	-	50,000	-	50,000	1,000
GCM18	1.6	0.8	0.8	4,000	-	10,000	-	15,000 [1)]	1,000
GCM21	2.0	1.25	0.6	4,000	-	10,000	-	10,000	1,000
			0.85	4,000	-	10,000	-	-	1,000
			1.25	-	3,000	-	10,000	5,000 [1)]	1,000
GCM31	3.2	1.6	0.85	4,000	-	10,000	-	-	1,000
			1.15	-	3,000	-	10,000	-	1,000
			1.6	-	2,000	-	6,000	-	1,000
GCM32	3.2	2.5	1.15	-	3,000	-	10,000	-	1,000
			1.35	-	2,000	-	8,000	-	1,000
			1.6	-	2,000	-	6,000	-	1,000
			1.8/2.0/2.5	-	1,000	-	4,000	-	1,000

1) There are part numbers without bulk case.

■ Tape Carrier Packaging

1. Dimensions of Reel



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Package

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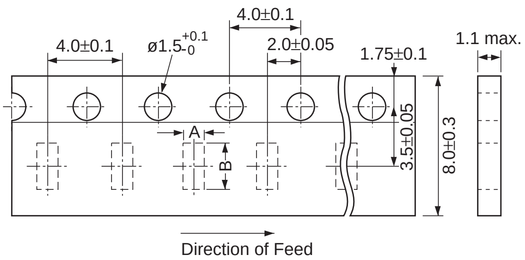
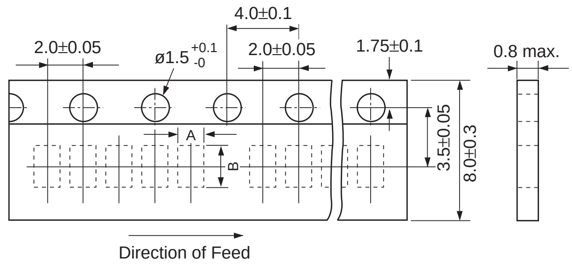
2. Dimensions of Paper Tape

8mm width 4mm pitch Tape



8mm width 2mm pitch Tape



Part Number	A	B
GCM18	1.05±0.1	1.85±0.1
GCM21 (T≦0.85mm)	1.55±0.15	2.3±0.15
GCM31 (T≦0.85mm)	2.0±0.2	3.6±0.2
GCM32 (T=0.85mm)	2.8±0.2	3.6±0.2

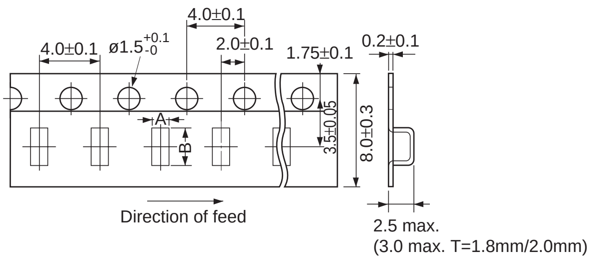
Part Number	A*	B*
GCM03	0.37	0.67
GCM15	0.65	1.15

*Nominal Value

(in mm)

3. Dimensions of Embossed Tape

8mm width 4mm pitch Tape



Part Number	A	B
GCM21 (T=1.25mm)	1.45±0.2	2.25±0.2
GCM31 (T≧1.15mm)	1.9±0.2	3.5±0.2
GCM32 (T≧1.15mm)	2.8±0.2	3.5±0.2

(in mm)

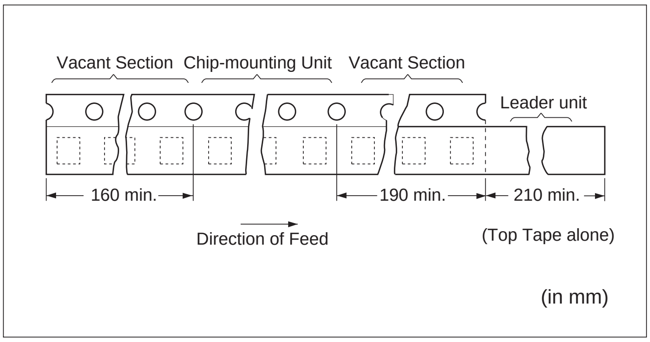
Continued on the following page.

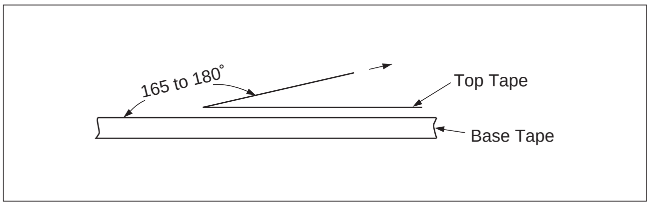
Package

Continued from the preceding page.

4. Taping Method
   (1) Tapes for capacitors are wound clockwise. The sprocket holes are to the right as the tape is pulled toward the user.
   (2) Part of the leader and part of the empty tape should be attached to the end of the tape as follows.
   (3) The top tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.
   (4) Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.
   (5) The top tape and bottom tape should not protrude beyond the edges of the tape and should not cover sprocket holes.
   (6) Cumulative tolerance of sprocket holes, 10 pitches: ±0.3mm.
   (7) Peeling off force: 0.1 to 0.6N* in the direction shown right.

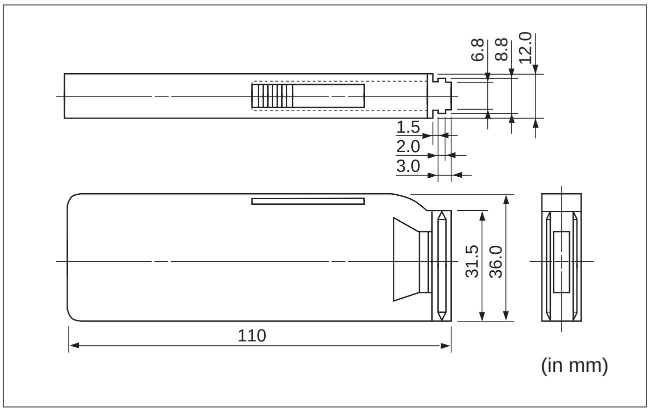
*GCM03: 0.05 to 0.5N





■ Dimensions of Bulk Case Packaging

The bulk case uses antistatic materials. Please contact Murata for details.



⚠Caution

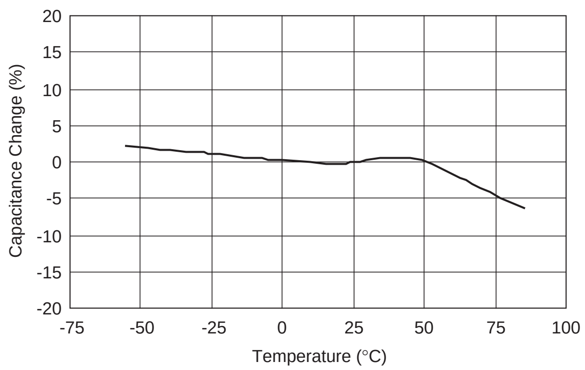
■ Storage and Operation Conditions

1. The performance of chip monolithic ceramic capacitors may be affected by the storage conditions.
   1-1. Store capacitors in the following conditions:
   Temperature of +5°C to +40°C and a Relative Humidity of 20% to 70%.
   (1) Sunlight, dust, rapid temperature changes, corrosive gas atmosphere or high temperature and humidity conditions during storage may affect solderability and packaging performance.
   Please use product within six months of receipt.
   (2) Please confirm solderability before using after six months. Store the capacitors without opening the original bag. Even if the storage period is short, do not exceed the specified atmospheric conditions.
   1-2. Corrosive gas can react with the termination (external) electrodes or lead wires of capacitors, and result in poor solderability. Do not store the capacitors in an atmosphere consisting of corrosive gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas, etc.).
   1-3. Due to moisture condensation caused by rapid humidity changes, or the photochemical change caused by direct sunlight on the terminal electrodes and/or the resin/epoxy coatings, the solderability and electrical performance may deteriorate. Do not store capacitors under direct sunlight or in high humidity conditions.

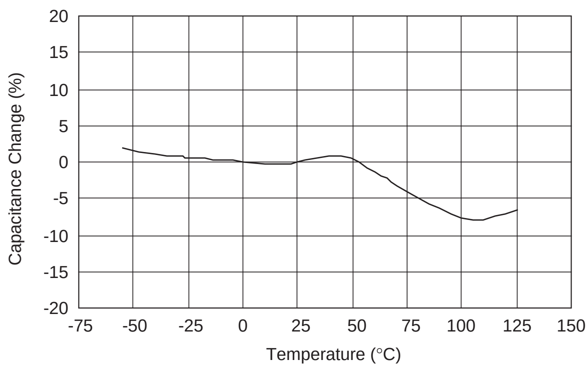
■ Rating

1. Temperature Dependent Characteristics
1. The electrical characteristics of the capacitor can change with temperature.
   1-1. For capacitors having larger temperature dependency, the capacitance may change with temperature changes.
   The following actions are recommended in order to ensure suitable capacitance values.
   (1) Select a suitable capacitance for the operating temperature range.
   (2) The capacitance may change within the rated temperature.
   When you use a high dielectric constant type capacitor in a circuit that needs a tight (narrow) capacitance tolerance (e.g., a time-constant circuit), please carefully consider the characteristics of these capacitors, such as their aging, voltage, and temperature characteristics.
   In addition, check capacitors using your actual appliances at the intended environment and operating conditions.

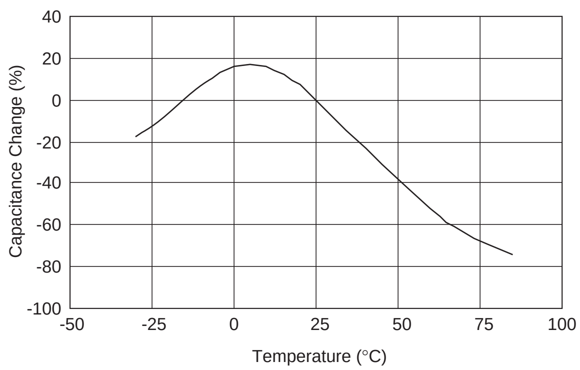
Typical Temperature Characteristics R6(X5R)



Typical Temperature Characteristics R7(X7R)



Typical Temperature Characteristics F5(Y5V)



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⚠Caution

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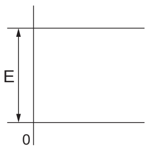
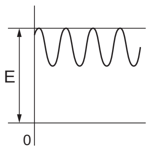
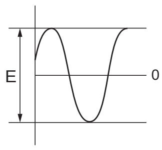
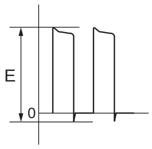
2. Measurement of Capacitance

1. Measure capacitance with the voltage and frequency specified in the product specifications.
   1-1. The output voltage of the measuring equipment may decrease occasionally when capacitance is high. Please confirm whether a prescribed measured voltage is impressed to the capacitor.
   1-2. The capacitance values of high dielectric constant type capacitors change depending on the AC voltage applied. Please consider the AC voltage characteristics when selecting a capacitor to be used in an AC circuit.

3. Applied Voltage

1. Do not apply a voltage to the capacitor that exceeds the rated voltage as called out in the specifications.
   1-1. Applied voltage between the terminals of a capacitor shall be less than or equal to the rated voltage.
   (1) When AC voltage is superimposed on DC voltage, the zero-to-peak voltage shall not exceed the rated DC voltage.
   When AC voltage or pulse voltage is applied, the peak-to-peak voltage shall not exceed the rated DC voltage.
   (2) Abnormal voltages (surge voltage, static electricity, pulse voltage, etc.) shall not exceed the rated DC voltage.

Typical Voltage Applied to the DC Capacitor

DC Voltage	DC Voltage+AC	AC Voltage	Pulse Voltage
			

(E: Maximum possible applied voltage.)

   1-2. Influence of overvoltage
   Overvoltage that is applied to the capacitor may result in an electrical short circuit caused by the breakdown of the internal dielectric layers.
   The time duration until breakdown depends on the applied voltage and the ambient temperature.

4. Applied Voltage and Self-heating Temperature

1. When the capacitor is used in a high-frequency voltage, pulse voltage, application, be sure to take into account self-heating may be caused by resistant factors of the capacitor.
   1-1. The load should be contained to the level such that when measuring at atmospheric temperature of 25°C, the product's self-heating remains below 20°C and the surface temperature of the capacitor in the actual circuit remains within the maximum operating temperature.

Continued on the following page.

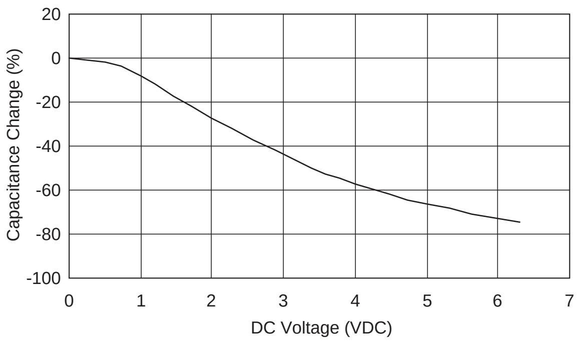
⚠Caution

Continued from the preceding page.

5. DC Voltage and AC Voltage Characteristics

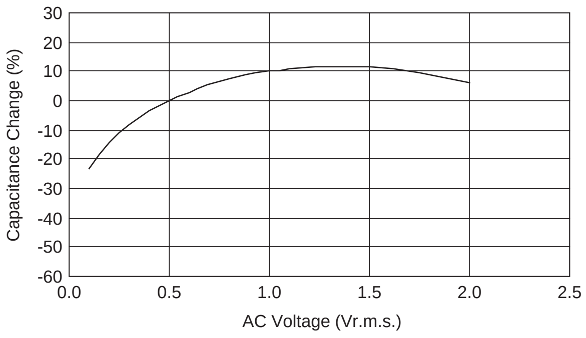
1. The capacitance value of a high dielectric constant type capacitor changes depending on the DC voltage applied. Please consider the DC voltage characteristics when a capacitor is selected for use in a DC circuit.
   1-1. The capacitance of ceramic capacitors may change sharply depending on the applied voltage (see figure).
   Please confirm the following in order to secure the capacitance.
   (1) Determine whether the capacitance change caused by the applied voltage is within the allowed range.
   (2) In the DC voltage characteristics, the rate of capacitance change becomes larger as voltage increases, even if the applied voltage is below the rated voltage. When a high dielectric constant type capacitor is in a circuit that needs a tight (narrow) capacitance tolerance (e.g., a time-constant circuit), please carefully consider the characteristics of these capacitors, such as their aging, voltage, and temperature characteristics. In addition, check capacitors using your actual appliances at the intended environment and operating conditions.

[DC Voltage Characteristics]



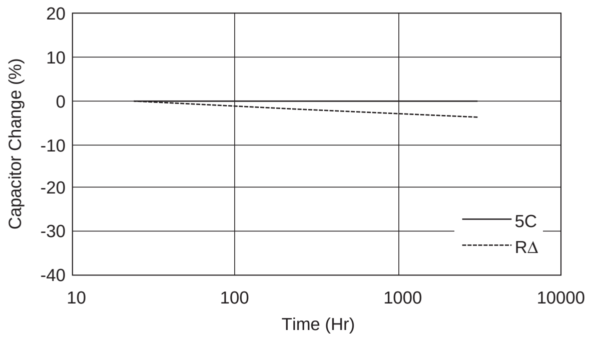
2. The capacitance values of high dielectric constant type capacitors change depending on the AC voltage applied. Please consider the AC voltage characteristics when selecting a capacitor to be used in an AC circuit.

[AC Voltage Characteristics]



6. Capacitance Aging

1. The high dielectric constant type capacitors have the characteristic in which the capacitance value decreases with the passage of time.
   When you use a high dielectric constant type capacitors in a circuit that needs a tight (narrow) capacitance tolerance (e.g., a time-constant circuit), please carefully consider the characteristics of these capacitors, such as their aging, voltage, and temperature characteristics. In addition, check capacitors using your actual appliances at the intended environment and operating conditions.



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⚠Caution

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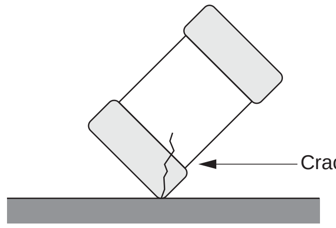
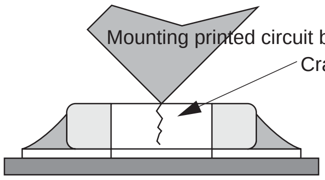
7. Vibration and Shock

1. Please confirm the kind of vibration and/or shock, its condition, and any generation of resonance.
   Please mount the capacitor so as not to generate resonance, and do not allow any impact on the terminals.
2. Mechanical shock due to being dropped may cause damage or a crack in the dielectric material of the capacitor.
   Do not use a dropped capacitor because the quality and reliability may be deteriorated.
3. When printed circuit boards are piled up or handled, the corner of another printed circuit board should not be allowed to hit the capacitor, in order to avoid a crack or other damage to the capacitor.



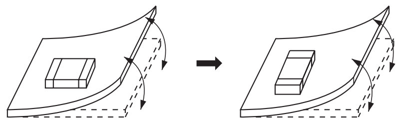


■ Soldering and Mounting

1. Mounting Position

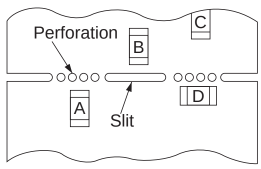
1. Confirm the best mounting position and direction that minimizes the stress imposed on the capacitor during flexing or bending the printed circuit board.
   1-1. Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[Component Direction]



Locate chip horizontal to the direction in which stress acts.

[Chip Mounting Close to Board Separation Point]



Chip arrangement
Worst A-C-(B~D) Best

Continued on the following page.

⚠Caution

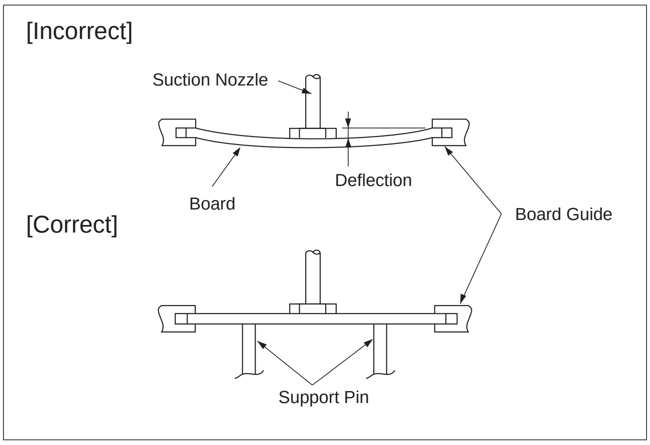
Continued from the preceding page.

2. Information before Mounting

1. Do not re-use capacitors that were removed from the equipment.
2. Confirm capacitance characteristics under actual applied voltage.
3. Confirm the mechanical stress under actual process and equipment use.
4. Confirm the rated capacitance, rated voltage and other electrical characteristics before assembly.
5. Prior to use, confirm the Solderability of capacitors that were in long-term storage.
6. Prior to measuring capacitance, carry out a heat treatment for capacitors that were in long-term storage.
7. The use of Sn-Zn based solder will deteriorate the reliability of the MLCC.
   Please contact our sales representative or product engineers on the use of Sn-Zn based solder in advance.

3. Maintenance of the Mounting (pick and place) Machine

1. Make sure that the following excessive forces are not applied to the capacitors.
   1-1. In mounting the capacitors on the printed circuit board, any bending force against them shall be kept to a minimum to prevent them from any bending damage or cracking. Please take into account the following precautions and recommendations for use in your process.
   (1) Adjust the lowest position of the pickup nozzle so as not to bend the printed circuit board.
   (2) Adjust the nozzle pressure within a static load of 1N to 3N during mounting.



2. Dirt particles and dust accumulated between the suction nozzle and the cylinder inner wall prevent the nozzle from moving smoothly. This imposes greater force upon the chip during mounting, causing cracked chips. Also, the locating claw, when worn out, imposes uneven forces on the chip when positioning, causing cracked chips. The suction nozzle and the locating claw must be maintained, checked and replaced periodically.

Continued on the following page.

⚠Caution

Continued from the preceding page.

4-1. Reflow Soldering

1. When sudden heat is applied to the components, the mechanical strength of the components will decrease because a sudden temperature change causes deformation inside the components. In order to prevent mechanical damage to the components, preheating is required for both the components and the PCB board. Preheating conditions are shown in table 1. It is required to keep the temperature differential between the solder and the components surface (ΔT) as small as possible.
2. Solderability of tin plating termination chips might be deteriorated when a low temperature soldering profile where the peak solder temperature is below the melting point of tin is used. Please confirm the solderability of tin plated termination chips before use.
3. When components are immersed in solvent after mounting, be sure to maintain the temperature difference (ΔT) between the component and the solvent within the range shown in table 1.

Table 1

Part Number	Temperature Differential
GRM03/15/18/21/31	ΔT≦190°C
GCM32	ΔT≦130°C

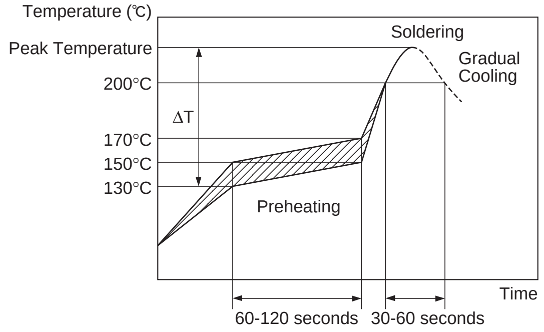
Recommended Conditions

	Pb-Sn Solder		Lead Free Solder
	Infrared Reflow	Vapor Reflow	
Peak Temperature	230 to 250°C	230 to 240°C	240 to 260°C
Atmosphere	Air	Air	Air or N_2

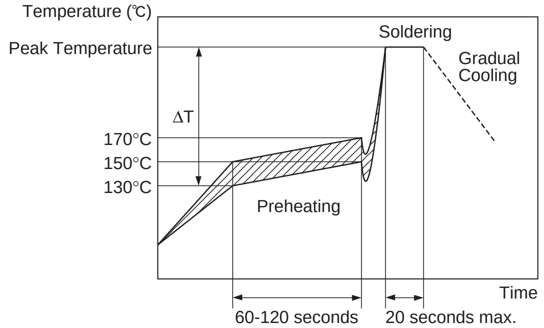
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Reflow Soldering]

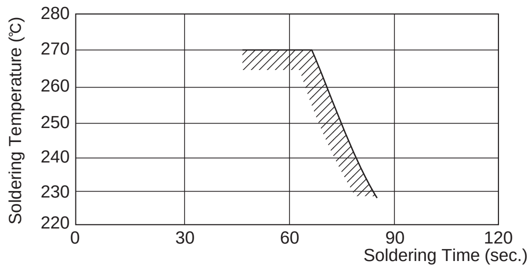
Infrared Reflow



Vapor Reflow

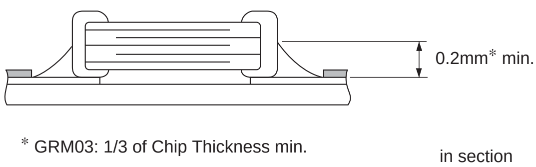


[Allowable Reflow Soldering Temperature and Time]



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

4. Optimum Solder Amount for Reflow Soldering
   - 4-1. Overly thick application of solder paste results in a excessive solder fillet height. This makes the chip more susceptible to mechanical and thermal stress on the board and may cause the chips to crack.
   - 4-2. Too little solder paste results in a lack of adhesive strength on the outer electrode, which may result in chips breaking loose from the PCB.
   - 4-3. Make sure the solder has been applied smoothly to the end surface to a height of 0.2mm* min.



* GRM03: 1/3 of Chip Thickness min.

Inverting the PCB

Make sure not to impose any abnormal mechanical shocks to the PCB.

Continued on the following page.

⚠Caution

Continued from the preceding page.

4-2. Flow Soldering

1. When sudden heat is applied to the components, the mechanical strength of the components will decrease because a sudden temperature change causes deformation inside the components. In order to prevent mechanical damage in the components, preheating should be required for both of the components and the PCB board.
   Preheating conditions are shown in table 2. It is required to keep temperature differential between the solder and the components surface (ΔT) as small as possible.
2. Excessively long soldering time or high soldering temperature can result in leaching of the outer electrodes, causing poor adhesion or a reduction in capacitance value due to loss of contact between electrodes and end termination.
3. When components are immersed in solvent after mounting, be sure to maintain the temperature difference (ΔT) between the component and solvent within the range shown in the table 2.
4. Do not apply flow soldering to chips not listed in table 2.

Table 2

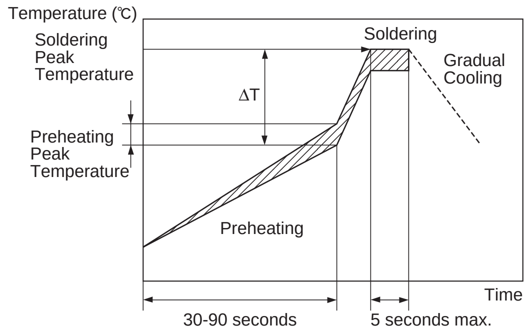
Part Number	Temperature Differential
GCM18/21/31	ΔT≦150°C

Recommended Conditions

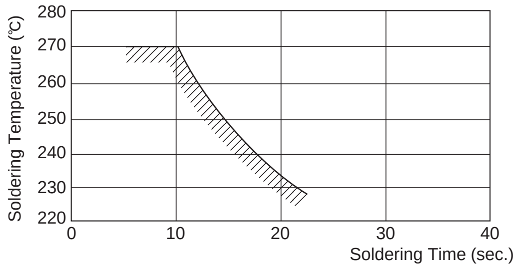
	Pb-Sn Solder	Lead Free Solder
Preheating Peak Temperature	90 to 110°C	100 to 120°C
Soldering Peak Temperature	240 to 250°C	250 to 260°C
Atmosphere	Air	N_2

Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Flow Soldering]

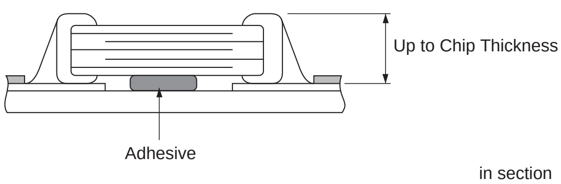


[Allowable Flow Soldering Temperature and Time]



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

5. Optimum Solder Amount for Flow Soldering
   5-1. The top of the solder fillet should be lower than the thickness of components. If the solder amount is excessive, the risk of cracking is higher during board bending or any other stressful condition.



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⚠Caution

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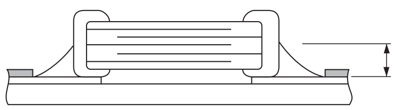
4-3. Correction with a Soldering Iron

1. When sudden heat is applied to the components when using a soldering iron, the mechanical strength of the components will decrease because the extreme temperature change can cause deformations inside the components. In order to prevent mechanical damage to the components, preheating is required for both the components and the PCB board. Preheating conditions (The "Temperature of the Soldering Iron Tip," "Preheating Temperature," "Temperature Differential" between the iron tip and the components and the PCB), should be within the conditions of table 3. It is required to keep the temperature differential between the soldering iron and the component surfaces (ΔT) as small as possible.
2. After soldering, do not allow the component/PCB to cool down rapidly.
3. The operating time for the re-working should be as short as possible. When re-working time is too long, it may cause solder leaching, and that will cause a reduction in the adhesive strength of the terminations.
4. Optimum solder amount when re-working with a soldering iron
   - 4-1. In the case of sizes smaller than 0603, (GCM03/15/18), the top of the solder fillet should be lower than 2/3 of the thickness of the component or 0.5mm whichever is smaller. In the case of 0805 and larger sizes, (GCM21/31/32), the top of the solder fillet should be lower than 2/3 of the thickness of the component. If the solder amount is excessive, the risk of cracking is higher during board bending or under any other stressful condition.
   - 4-2. A soldering iron with a tip of ø3mm or smaller should be used. It is also necessary to keep the soldering iron from touching the components during the re-work.
   - 4-3. Solder wire with ø0.5mm or smaller is required for soldering.

Table 3

Part Number	Temperature of Soldering Iron Tip	Preheating Temperature	Temperature Differential (ΔT)	Atmosphere
GCM03/15/18/21/31	350°C max.	150°C min.	ΔT≦190°C	Air
GCM32	280°C max.	150°C min.	ΔT≦130°C	Air

*Applicable for both Pb-Sn and Lead Free Solder.
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu



4-4. Leaded Component Insertion

1. If the PCB is flexed when leaded components (such as transformers and ICs) are being mounted, chips may crack and solder joints may break.
   Before mounting leaded components, support the PCB using backup pins or special jigs to prevent warping.

5. Washing

Excessive ultrasonic oscillation during cleaning can cause the PCBs to resonate, resulting in cracked chips or broken solder joints. Take note not to vibrate PCBs.

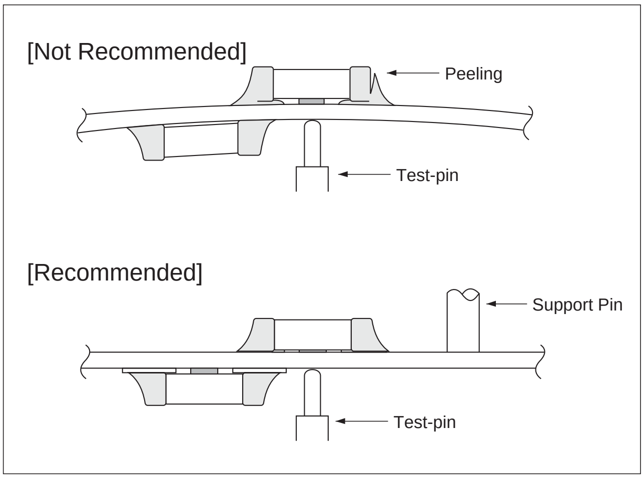
Continued on the following page.

⚠Caution

Continued from the preceding page.

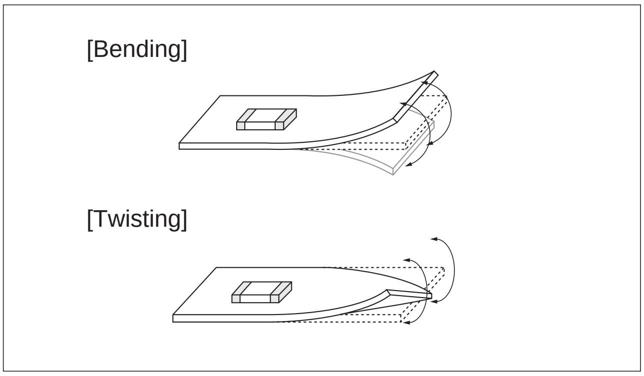
6. Electrical Test on Printed Circuit Board

1. Confirm position of the support pin or specific jig, when inspecting the electrical performance of a capacitor after mounting on the printed circuit board.
   1-1. Avoid bending the printed circuit board by the pressure of a test pin, etc.
   The thrusting force of the test probe can flex the PCB, resulting in cracked chips or open solder joints.
   Provide support pins on the back side of the PCB to prevent warping or flexing.
   1-2. Avoid vibration of the board by shock when a test pin contacts a printed circuit board.

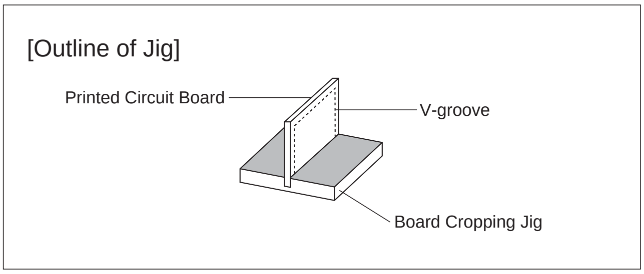


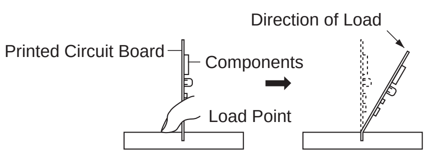
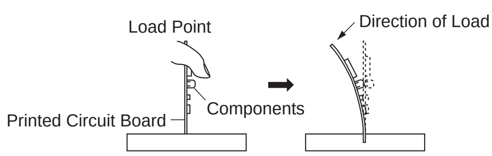
7. Printed Circuit Board Cropping

1. After mounting a capacitor on a printed circuit board, do not apply any stress to the capacitor that is caused by bending or twisting the board.
   1-1. In cropping the board, the stress as shown at right may cause the capacitor to crack.
   Try not to apply this type of stress to a capacitor.



2. Check of the cropping method for the printed circuit board in advance.
   2-1. Printed circuit board cropping shall be carried out by using a jig or an apparatus to prevent the mechanical stress that can occur to the board.
   (1) Example of a suitable jig
   Recommended example: the board should be pushed as close to the cropping jig as possible and from the back side of board in order to minimize the compressive stress applied to the capacitor.
   Not recommended example: when the board is pushed at a point far from the cropping jig and from the front side of board as below, the capacitor may form a crack caused by the tensile stress applied to capacitor.



Recommended	Not recommended
	

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⚠Caution

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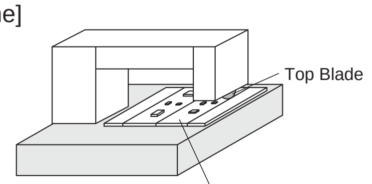
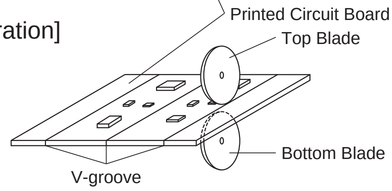
(2) Example of a suitable machine
An outline of a printed circuit board cropping machine is shown as follows. Along the lines with the V-grooves on the printed circuit board, the top and bottom blades are aligned to one another when cropping the board.
The misalignment of the position between top and bottom blades may cause the capacitor to crack.

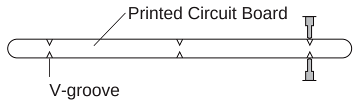
[Outline of Machine]

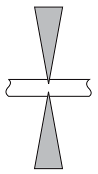
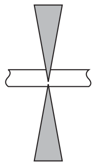
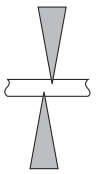
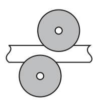


[Principle of Operation]



[Cross-section Diagram]



Recommended	Not Recommended		
	Top-bottom Misalignment	Left-right Misalignment	Front-rear Misalignment
Top Blade  Bottom Blade	Top Blade  Bottom Blade	Top Blade  Bottom Blade	Top Blade  Bottom Blade

■ Others

1. Under Operation of Equipment
   1-1. Do not touch a capacitor directly with bare hands during operation in order to avoid the danger of an electric shock.
   1-2. Do not allow the terminals of a capacitor to come in contact with any conductive objects (short-circuit). Do not expose a capacitor to a conductive liquid, including any acid or alkali solutions.
   1-3. Confirm the environment in which the equipment will operate is under the specified conditions. Do not use the equipment under the following environments.
   (1) Being spattered with water or oil.
   (2) Being exposed to direct sunlight.
   (3) Being exposed to Ozone, ultraviolet rays or radiation.
   (4) Being exposed to toxic gas (e.g., hydrogen sulfide, sulfur dioxide, chlorine, ammonia gas, etc.)
   (5) Any vibrations or mechanical shocks exceeding the specified limits.
   (6) Moisture condensing environments.
   1-4. Use damp proof countermeasures if using under any conditions that can cause condensation.
2. Others
   2-1. In an Emergency
   (1) If the equipment should generate smoke, fire or smell, immediately turn off or unplug the equipment. If the equipment is not turned off or unplugged, the hazards may be worsened by supplying continuous power.
   (2) In this type of situation, do not allow face and hands to come in contact with the capacitor or burns may be caused by the capacitor's high temperature.
   2-2. Disposal of Waste
   When capacitors are disposed, they must be burned or buried by an industrial waste vendor with the appropriate licenses.
   2-3. Circuit Design
   GRM, GCM, GMA/D, LLL/A/M, GQM, GJM, GNM Series capacitors in this catalog are not safety certified products.
   2-4. Remarks
   Failure to follow the cautions may result, worst case, in a short circuit and smoking when the product is used.
   The above notices are for standard applications and conditions. Contact us when the products are used in special mounting conditions.
   Select optimum conditions for operation as they determine the reliability of the product after assembly.
   The data herein are given in typical values, not guaranteed ratings.

Notice

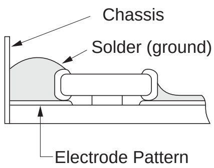
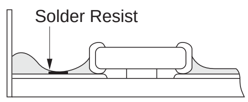
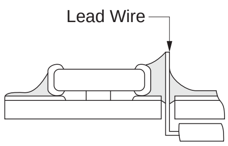
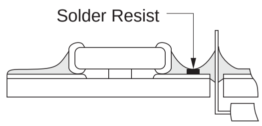
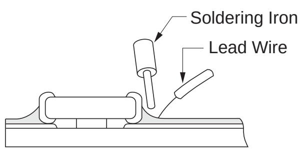
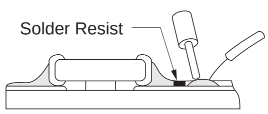
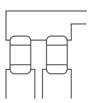
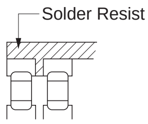
■ Rating

1. Operating Temperature
   1. The operating temperature limit depends on the capacitor.
      1-1. Do not apply temperatures exceeding the upper operating temperature.
      It is necessary to select a capacitor with a suitable rated temperature that will cover the operating temperature range.
      It is also necessary to consider the temperature distribution in equipment and the seasonal temperature variable factor.
      1-2. Consider the self-heating factor of the capacitor.
      The surface temperature of the capacitor shall be the upper operating temperature or less when including the self-heating factors.
2. Atmosphere Surroundings (gaseous and liquid)
   1. Restriction on the operating environment of capacitors.
      1-1. Capacitors, when used in the above, unsuitable, operating environments may deteriorate due to the corrosion of the terminations and the penetration of moisture into the capacitor.
      1-2. The same phenomenon as the above may occur when the electrodes or terminals of the capacitor are subject to moisture condensation.
      1-3. The deterioration of characteristics and insulation resistance due to the oxidization or corrosion of terminal electrodes may result in breakdown when the capacitor is exposed to corrosive or volatile gases or solvents for long periods of time.
3. Piezo-electric Phenomenon
   1. When using high dielectric constant type capacitors in AC or pulse circuits, the capacitor itself vibrates at specific frequencies and noise may be generated.
   Moreover, when the mechanical vibration or shock is added to the capacitor, noise may occur.

■ Soldering and Mounting

1. PCB Design
1. Notice for Pattern Forms
   1-1. Unlike leaded components, chip components are susceptible to flexing stresses since they are mounted directly on the substrate.
   They are also more sensitive to mechanical and thermal stresses than leaded components.
   Excess solder fillet height can multiply these stresses and cause chip cracking. When designing substrates, take land patterns and dimensions into consideration to eliminate the possibility of excess solder fillet height.
   1-2. It is possible for the chip to be cracked by the expansion and shrinkage of a metal board. Please contact us if you want to use our ceramic capacitors on a metal board such as aluminum.

Pattern Forms

	Prohibited	Correct
Placing Close to Chassis		
Placing of Chip Components and Leaded Components		
Placing of Leaded Components after Chip Component		
Lateral Mounting		

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Notice

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2. Land Dimensions

2-1. Chip capacitor can be cracked due to the stress of PCB bending, etc. if the land area is larger than needed and has an excess amount of solder.
Please refer to the land dimensions in table 1 for flow soldering, table 2 for reflow soldering.
Please confirm the suitable land dimension by evaluating of the actual SET / PCB.

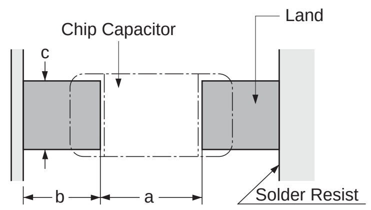


Table 1 Flow Soldering Method

Dimensions / Part Number	Chip (L×W)	a	b	c
GCM18	1.6×0.8	0.6 to 1.0	0.8 to 0.9	0.6 to 0.8
GCM21	2.0×1.25	1.0 to 1.2	0.9 to 1.0	0.8 to 1.1
GCM31	3.2×1.6	2.2 to 2.6	1.0 to 1.1	1.0 to 1.4

(in mm)

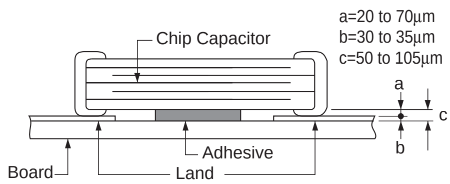
Table 2 Reflow Soldering Method

Dimensions / Part Number	Chip (L×W)	a	b	c
GCM03	0.6×0.3	0.2 to 0.3	0.2 to 0.35	0.2 to 0.4
GCM15	1.0×0.5	0.3 to 0.5	0.35 to 0.45	0.4 to 0.6
GCM18	1.6×0.8	0.6 to 0.8	0.6 to 0.7	0.6 to 0.8
GCM21	2.0×1.25	1.0 to 1.2	0.6 to 0.7	0.8 to 1.1
GCM31	3.2×1.6	2.2 to 2.4	0.8 to 0.9	1.0 to 1.4
GCM32	3.2×2.5	2.0 to 2.4	1.0 to 1.2	1.8 to 2.3

(in mm)

2. Adhesive Application

1. Thin or insufficient adhesive can cause the chips to loosen or become disconnected during flow soldering.
The amount of adhesive must be more than dimension c, shown in the drawing at right, to obtain the correct bonding strength.
The chip's electrode thickness and land thickness must also be taken into consideration.
2. Low viscosity adhesive can cause chips to slip after mounting. The adhesive must have a viscosity of 5000Pa • s (500ps) min. (at 25°C).
3. Adhesive Coverage



Part Number	Adhesive Coverage*
GCM18	0.05mg min.
GCM21	0.1mg min.
GCM31	0.15mg min.

*Nominal Value

3. Adhesive Curing

1. Insufficient curing of the adhesive can cause chips to disconnect during flow soldering and causes deterioration in the insulation resistance between the outer electrodes due to moisture absorption.
Control curing temperature and time in order to prevent insufficient hardening.

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Notice

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4. Flux Application

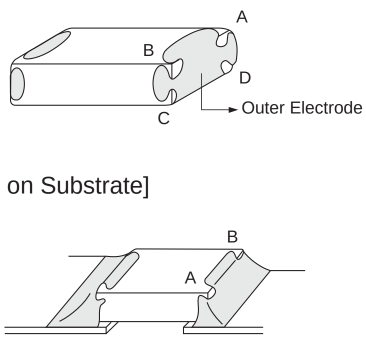
1. An excessive amount of flux generates a large quantity of flux gas, which can cause a deterioration of solderability, so apply flux thinly and evenly throughout. (A foaming system is generally used for flow soldering).
2. Flux containing too high a percentage of halide may cause corrosion of the outer electrodes unless there is sufficient cleaning. Use flux with a halide content of 0.1% max.
3. Do not use strong acidic flux.
4. Do not use water-soluble flux.
   (*Water-soluble flux can be defined as non-rosin type flux including wash-type flux and non-wash-type flux.)

5. Flow Soldering

● Set temperature and time to ensure that leaching of the outer electrode does not exceed 25% of the chip end area as a single chip (full length of the edge A-B-C-D shown at right) and 25% of the length A-B shown as mounted on substrate.

[As a Single Chip]

[As Mounted on Substrate]



6. Washing

1. Please evaluate a capacitor using actual cleaning equipment and conditions to confirm the quality and select the applicable solvent.
2. Unsuitable cleaning solvent may leave residual flux or other foreign substances, causing deterioration of electrical characteristics and the reliability of the capacitors.
3. Select the proper cleaning conditions.
   3-1. Improper cleaning conditions (excessive or insufficient) may result in the deterioration of the performance of the capacitors.

7. Coating

1. A crack may be caused in the capacitor due to the stress of the thermal contraction of the resin during curing process.
   The stress is affected by the amount of resin and curing contraction.
   Select a resin with low curing contraction.
   The difference in the thermal expansion coefficient between a coating resin or a molding resin and the capacitor may cause the destruction and deterioration of the capacitor such as a crack or peeling, and lead to the deterioration of insulation resistance or dielectric breakdown.
   Select a resin for which the thermal expansion coefficient is as close to that of the capacitor as possible.
   A silicone resin can be used as an under-coating to buffer against the stress.
2. Select a resin that is less hygroscopic.
   Using hygroscopic resins under high humidity conditions may cause the deterioration of the insulation resistance of a capacitor.
   An epoxy resin can be used as a less hygroscopic resin.

Notice

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■ Others

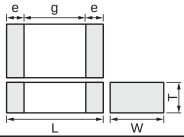
1. Transportation
   1. The performance of a capacitor may be affected by the conditions during transportation.
      1-1. The capacitors shall be protected against excessive temperature, humidity and mechanical force during transportation.
         (1) Climatic condition
            • low air temperature: -40°C
            • change of temperature air/air: -25°C/+25°C
            • low air pressure: 30 kPa
            • change of air pressure: 6 kPa/min.
         (2) Mechanical condition
            Transportation shall be done in such a way that the boxes are not deformed and forces are not directly passed on to the inner packaging.
      1-2. Do not apply excessive vibration, shock, and pressure to the capacitor.
         (1) When excessive mechanical shock or pressure is applied to a capacitor, chipping or cracking may occur in the ceramic body of the capacitor.
         (2) When the sharp edge of an air driver, a soldering iron, tweezers, a chassis, etc. impacts strongly on the surface of the capacitor, the capacitor may crack and short-circuit.
      1-3. Do not use a capacitor to which excessive shock was applied by dropping, etc.
         A capacitor dropped accidentally during processing may be damaged.

Chip Monolithic Ceramic Capacitors (Medium Voltage)

Chip Monolithic Ceramic Capacitors for Automotive

muRata

Medium Voltage for Automotive GCM Series Low Dissipation Factor



Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GCM21A	2.0 ±0.2	1.25 ±0.2	1.0 +0,-0.3	0.3	0.7
GCM21B			1.25 ±0.2		
GCM31A	3.2 ±0.2	1.6 ±0.2	1.0 +0,-0.3		1.5
GCM31B			1.25 +0,-0.3		
GCM31C			1.6 ±0.2		
GCM32A	3.2 ±0.2	2.5 ±0.2	1.0 +0,-0.3		
GCM32B			1.25 +0,-0.3		
GCM32Q			1.5 +0,-0.3		
GCM32D			2.0 +0,-0.3		
GCM43Q	4.5 ±0.4	3.2 ±0.3	1.5 +0,-0.3		2.2
GCM43D			2.0 +0,-0.3		
GCM55Q	5.7 ±0.4	5.0 ±0.4	1.5 +0,-0.3		3.2
GCM55D			2.0 +0,-0.3		

■ Features

1. The GCM series meet AEC-Q200 requirements.
2. Low-loss and suitable for high-frequency circuits.
3. Murata's original internal electrode structure realizes high flash-over voltage.
4. A new monolithic structure for small, surface-mountable devices capable of operating at high voltage levels.
5. Sn-plated external electrodes allow good solderability.
6. Use the GCM21/31 type with flow or reflow soldering, and other types with reflow soldering only.

■ Applications

Ideal for use on high-frequency pulse circuits such as snubber circuits for DC-DC converters.

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GCM21A7U2E101JX01D	DC250	U2J (EIA)	100 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E121JX01D	DC250	U2J (EIA)	120 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E151JX01D	DC250	U2J (EIA)	150 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E181JX01D	DC250	U2J (EIA)	180 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E221JX01D	DC250	U2J (EIA)	220 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E271JX01D	DC250	U2J (EIA)	270 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E331JX01D	DC250	U2J (EIA)	330 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E391JX01D	DC250	U2J (EIA)	390 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E471JX01D	DC250	U2J (EIA)	470 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E561JX01D	DC250	U2J (EIA)	560 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E681JX01D	DC250	U2J (EIA)	680 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E821JX01D	DC250	U2J (EIA)	820 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E102JX01D	DC250	U2J (EIA)	1000 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E122JX01D	DC250	U2J (EIA)	1200 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E152JX01D	DC250	U2J (EIA)	1500 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E182JX01D	DC250	U2J (EIA)	1800 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21A7U2E222JX01D	DC250	U2J (EIA)	2200 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GCM21B7U2E272JX03L	DC250	U2J (EIA)	2700 ±5%	2.0	1.25	1.25	0.7	0.3 min.
GCM31A7U2E272JX01D	DC250	U2J (EIA)	2700 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM21B7U2E332JX03L	DC250	U2J (EIA)	3300 ±5%	2.0	1.25	1.25	0.7	0.3 min.
GCM31A7U2E332JX01D	DC250	U2J (EIA)	3300 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM21B7U2E392JX03L	DC250	U2J (EIA)	3900 ±5%	2.0	1.25	1.25	0.7	0.3 min.
GCM31A7U2E392JX01D	DC250	U2J (EIA)	3900 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM21B7U2E472JX03L	DC250	U2J (EIA)	4700 ±5%	2.0	1.25	1.25	0.7	0.3 min.
GCM31A7U2E472JX01D	DC250	U2J (EIA)	4700 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM21B7U2E562JX03L	DC250	U2J (EIA)	5600 ±5%	2.0	1.25	1.25	0.7	0.3 min.
GCM31A7U2E562JX01D	DC250	U2J (EIA)	5600 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31B7U2E682JX01L	DC250	U2J (EIA)	6800 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31B7U2E822JX01L	DC250	U2J (EIA)	8200 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31B7U2E103JX01L	DC250	U2J (EIA)	10000 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31A7U2J100JX01D	DC630	U2J (EIA)	10 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J120JX01D	DC630	U2J (EIA)	12 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J150JX01D	DC630	U2J (EIA)	15 ±5%	3.2	1.6	1.0	1.5	0.3 min.

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Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GCM31A7U2J180JX01D	DC630	U2J (EIA)	18 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J220JX01D	DC630	U2J (EIA)	22 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J270JX01D	DC630	U2J (EIA)	27 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J330JX01D	DC630	U2J (EIA)	33 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J390JX01D	DC630	U2J (EIA)	39 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J470JX01D	DC630	U2J (EIA)	47 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J560JX01D	DC630	U2J (EIA)	56 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J680JX01D	DC630	U2J (EIA)	68 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J820JX01D	DC630	U2J (EIA)	82 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J101JX01D	DC630	U2J (EIA)	100 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J121JX01D	DC630	U2J (EIA)	120 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J151JX01D	DC630	U2J (EIA)	150 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J181JX01D	DC630	U2J (EIA)	180 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J221JX01D	DC630	U2J (EIA)	220 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J271JX01D	DC630	U2J (EIA)	270 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J331JX01D	DC630	U2J (EIA)	330 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J391JX01D	DC630	U2J (EIA)	390 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J471JX01D	DC630	U2J (EIA)	470 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J561JX01D	DC630	U2J (EIA)	560 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J681JX01D	DC630	U2J (EIA)	680 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J821JX01D	DC630	U2J (EIA)	820 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J102JX01D	DC630	U2J (EIA)	1000 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2J122JX01D	DC630	U2J (EIA)	1200 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM32A7U2J122JX01D	DC630	U2J (EIA)	1200 ±5%	3.2	2.5	1.0	1.5	0.3 min.
GCM31A7U2J152JX01D	DC630	U2J (EIA)	1500 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM32A7U2J152JX01D	DC630	U2J (EIA)	1500 ±5%	3.2	2.5	1.0	1.5	0.3 min.
GCM31A7U2J182JX01D	DC630	U2J (EIA)	1800 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM32A7U2J182JX01D	DC630	U2J (EIA)	1800 ±5%	3.2	2.5	1.0	1.5	0.3 min.
GCM31A7U2J222JX01D	DC630	U2J (EIA)	2200 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM32A7U2J222JX01D	DC630	U2J (EIA)	2200 ±5%	3.2	2.5	1.0	1.5	0.3 min.
GCM31B7U2J272JX01L	DC630	U2J (EIA)	2700 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31B7U2J332JX01L	DC630	U2J (EIA)	3300 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31C7U2J392JX03L	DC630	U2J (EIA)	3900 ±5%	3.2	1.6	1.6	1.5	0.3 min.
GCM31C7U2J472JX03L	DC630	U2J (EIA)	4700 ±5%	3.2	1.6	1.6	1.5	0.3 min.
GCM32B7U2J562JX01L	DC630	U2J (EIA)	5600 ±5%	3.2	2.5	1.25	1.5	0.3 min.
GCM32Q7U2J682JX01L	DC630	U2J (EIA)	6800 ±5%	3.2	2.5	1.5	1.5	0.3 min.
GCM32D7U2J822JX01L	DC630	U2J (EIA)	8200 ±5%	3.2	2.5	2.0	1.5	0.3 min.
GCM32D7U2J103JX01L	DC630	U2J (EIA)	10000 ±5%	3.2	2.5	2.0	1.5	0.3 min.
GCM43Q7U2J123JX01L	DC630	U2J (EIA)	12000 ±5%	4.5	3.2	1.5	2.2	0.3 min.
GCM43D7U2J153JX01L	DC630	U2J (EIA)	15000 ±5%	4.5	3.2	2.0	2.2	0.3 min.
GCM43D7U2J183JX01L	DC630	U2J (EIA)	18000 ±5%	4.5	3.2	2.0	2.2	0.3 min.
GCM43D7U2J223JX01L	DC630	U2J (EIA)	22000 ±5%	4.5	3.2	2.0	2.2	0.3 min.
GCM55Q7U2J273JX01L	DC630	U2J (EIA)	27000 ±5%	5.7	5.0	1.5	3.2	0.3 min.
GCM55D7U2J333JX01L	DC630	U2J (EIA)	33000 ±5%	5.7	5.0	2.0	3.2	0.3 min.
GCM55D7U2J393JX01L	DC630	U2J (EIA)	39000 ±5%	5.7	5.0	2.0	3.2	0.3 min.
GCM55D7U2J473JX01L	DC630	U2J (EIA)	47000 ±5%	5.7	5.0	2.0	3.2	0.3 min.
GCM31A7U3A100JX01D	DC1000	U2J (EIA)	10 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A120JX01D	DC1000	U2J (EIA)	12 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A150JX01D	DC1000	U2J (EIA)	15 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A180JX01D	DC1000	U2J (EIA)	18 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A220JX01D	DC1000	U2J (EIA)	22 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A270JX01D	DC1000	U2J (EIA)	27 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A330JX01D	DC1000	U2J (EIA)	33 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A390JX01D	DC1000	U2J (EIA)	39 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A470JX01D	DC1000	U2J (EIA)	47 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A560JX01D	DC1000	U2J (EIA)	56 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A680JX01D	DC1000	U2J (EIA)	68 ±5%	3.2	1.6	1.0	1.5	0.3 min.

Continued on the following page.

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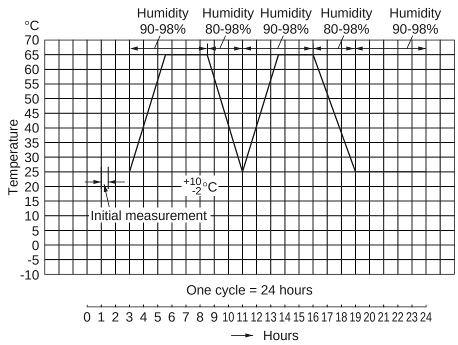
Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GCM31A7U3A820JX01D	DC1000	U2J (EIA)	82 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A101JX01D	DC1000	U2J (EIA)	100 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A121JX01D	DC1000	U2J (EIA)	120 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A151JX01D	DC1000	U2J (EIA)	150 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A181JX01D	DC1000	U2J (EIA)	180 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A221JX01D	DC1000	U2J (EIA)	220 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A271JX01D	DC1000	U2J (EIA)	270 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U3A331JX01D	DC1000	U2J (EIA)	330 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31B7U3A391JX01L	DC1000	U2J (EIA)	390 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31B7U3A471JX01L	DC1000	U2J (EIA)	470 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31B7U3A561JX01L	DC1000	U2J (EIA)	560 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31B7U3A681JX01L	DC1000	U2J (EIA)	680 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GCM31C7U3A821JX03L	DC1000	U2J (EIA)	820 ±5%	3.2	1.6	1.6	1.5	0.3 min.
GCM31C7U3A102JX03L	DC1000	U2J (EIA)	1000 ±5%	3.2	1.6	1.6	1.5	0.3 min.
GCM32B7U3A122JX01L	DC1000	U2J (EIA)	1200 ±5%	3.2	2.5	1.25	1.5	0.3 min.
GCM32Q7U3A152JX01L	DC1000	U2J (EIA)	1500 ±5%	3.2	2.5	1.5	1.5	0.3 min.
GCM32D7U3A182JX01L	DC1000	U2J (EIA)	1800 ±5%	3.2	2.5	2.0	1.5	0.3 min.
GCM32D7U3A222JX01L	DC1000	U2J (EIA)	2200 ±5%	3.2	2.5	2.0	1.5	0.3 min.
GCM43Q7U3A272JX01L	DC1000	U2J (EIA)	2700 ±5%	4.5	3.2	1.5	2.2	0.3 min.
GCM43Q7U3A332JX01L	DC1000	U2J (EIA)	3300 ±5%	4.5	3.2	1.5	2.2	0.3 min.
GCM43D7U3A392JX01L	DC1000	U2J (EIA)	3900 ±5%	4.5	3.2	2.0	2.2	0.3 min.
GCM43D7U3A472JX01L	DC1000	U2J (EIA)	4700 ±5%	4.5	3.2	2.0	2.2	0.3 min.
GCM55Q7U3A562JX01L	DC1000	U2J (EIA)	5600 ±5%	5.7	5.0	1.5	3.2	0.3 min.
GCM55Q7U3A682JX01L	DC1000	U2J (EIA)	6800 ±5%	5.7	5.0	1.5	3.2	0.3 min.
GCM55D7U3A822JX01L	DC1000	U2J (EIA)	8200 ±5%	5.7	5.0	2.0	3.2	0.3 min.
GCM55D7U3A103JX01L	DC1000	U2J (EIA)	10000 ±5%	5.7	5.0	2.0	3.2	0.3 min.

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">AEC-Q200 Test Item</th><th>Specifications</th><th>AEC-Q200 Test Method</th></tr>
<tr><td>1</td><td colspan="2">Pre- and Post-Stress Electrical Test</td><td colspan="2">–</td></tr>
<tr><td rowspan="5">2</td><td colspan="2">High Temperature Exposure (Storage)</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Set the capacitor for 1000±12 hours at 150±3°C. Let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr>
<tr><td></td><td>Q</td><td>Q≧1000</td></tr>
<tr><td></td><td>I.R.</td><td>More than 10,000MΩ or 500MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td rowspan="5">3</td><td colspan="2">Temperature Cycle</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (19). Perform 1000 cycles according to the 4 heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure.
<table>
<tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Temp. (°C)</td><td>-55+0/-3</td><td>Room Temp.</td><td>125+3/-0</td><td>Room Temp.</td></tr>
<tr><td>Time (min.)</td><td>15±3</td><td>1</td><td>15±3</td><td>1</td></tr>
</table></td></tr>
<tr><td></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr>
<tr><td></td><td>Q</td><td>Q≧1000</td></tr>
<tr><td></td><td>I.R.</td><td>More than 10,000MΩ or 500MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td>4</td><td colspan="2">Destructive Physical Analysis</td><td>No defects or abnormalities</td><td>Per EIA-469</td></tr>
<tr><td rowspan="5">5</td><td colspan="2">Moisture Resistance</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply the 24-hour heat (25 to 65°C) and humidity (80 to 98%) treatment shown below, 10 consecutive times.
Let sit for 24±2 hours at room temperature, then measure.

</td></tr>
<tr><td></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±3.0% or ±0.3pF
(Whichever is larger)</td></tr>
<tr><td></td><td>Q</td><td>Q≧350</td></tr>
<tr><td></td><td>I.R.</td><td>More than 10,000MΩ or 500MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td rowspan="5">6</td><td colspan="2">Biased Humidity</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply the rated voltage and DC1.3+0.2/-0V (add 6.8kΩ resistor) at 85±3°C and 80 to 85% humidity for 1000±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.</td></tr>
<tr><td></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±3.0% or ±0.3pF
(Whichever is larger)</td></tr>
<tr><td></td><td>Q</td><td>Q≧200</td></tr>
<tr><td></td><td>I.R.</td><td>More than 1,000MΩ or 50MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td rowspan="5">7</td><td colspan="2">Operational Life</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply voltage as in the Table for 1000±12 hours at 125±3°C. Let sit for 24±2 hours at room temperature, then measure.
<table>
<tr><th>Rated Voltage</th><th>Applied Voltage</th></tr>
<tr><td>DC250V</td><td>150% of the rated voltage</td></tr>
<tr><td>DC630V, DC1kV</td><td>120% of the rated voltage</td></tr>
</table>
The charge/discharge current is less than 50mA.</td></tr>
<tr><td></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±3.0% or ±0.3pF
(Whichever is larger)</td></tr>
<tr><td></td><td>Q</td><td>Q≧350</td></tr>
<tr><td></td><td>I.R.</td><td>More than 1,000MΩ or 50MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td>8</td><td colspan="2">External Visual</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>9</td><td colspan="2">Physical Dimension</td><td>Within the specified dimensions</td><td>Using calipers and micrometers</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	AEC-Q200 Test Item		Specifications	AEC-Q200 Test Method
10	Resistance to Solvents	Appearance	No marking defects	Per MIL-STD-202 Method 215 Solvent 1: 1 part (by volume) of isopropyl alcohol 3 parts (by volume) of mineral spirits Solvent 2: Terpene defluxer Solvent 3: 42 parts (by volume) of water 1 part (by volume) of propylene glycol monomethyl ether 1 part (by volume) of monoethanolamine
		Capacitance Change	Within the specified tolerance	
		Q	Q≧1000	
		I.R.	More than 10,000MΩ or 500MΩ · μF (Whichever is smaller)	
11	Mechanical Shock	Appearance	No marking defects	Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks). The specified test pulse should be Half-sine and should have a duration: 0.5ms, peak value: 1500g and velocity change: 4.7m/s.
		Capacitance Change	Within the specified tolerance	
		Q	Q≧1000	
12	Vibration	Appearance	No defects or abnormalities	Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (19). 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 2000Hz. The frequency range, from 10 to 2000Hz and return to 10Hz, should be traversed in approximately 20 minutes. This motion should be applied for 12 items in each 3 mutually perpendicular directions (total of 36 times).
		Capacitance Change	Within the specified tolerance	
		Q	Q≧1000	
13	Resistance to Soldering Heat		The measured and observed characteristics should satisfy the specifications in the following table.	Immerse the capacitor in a eutectic solder solution at 260±5°C for 10±1 seconds. Let sit at room temperature for 24±2 hours, then measure.
		Appearance	No marking defects	
		Capacitance Change	Within the specified tolerance	
		Q	Q≧1000	
		I.R.	More than 10,000MΩ or 500MΩ · μF (Whichever is smaller)	
14	Thermal Shock		The measured and observed characteristics should satisfy the specifications in the following table.	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (19). Perform the 300 cycles according to the two heat treatments listed in the following table (maximum transfer time is 20 seconds). Let sit for 24±2 hours at room temperature, then measure. Step / 1 / 2 Temp. (°C) / -55+0/-3 / 125+3/-0 Time (min.) / 15±3 / 15±3
		Appearance	No marking defects	
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	
		Q	Q≧1000	
		I.R.	More than 10,000MΩ or 500MΩ · μF (Whichever is smaller)	
15	ESD	Appearance	No marking defects	Per AEC-Q200-002
		Capacitance Change	Within the specified tolerance	
		Q	Q≧1000	
		I.R.	More than 10,000MΩ or 500MΩ · μF (Whichever is smaller)	
16	Solderability		95% of the terminations are to be soldered evenly and continuously.	(a) Preheat at 155°C for 4 hours. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.
				(b) Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.
				(c) Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 120 ±5 seconds at 260±5°C.

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Specifications and Test Methods

Continued from the preceding page.

No.	AEC-Q200 Test Item		Specifications	AEC-Q200 Test Method
17	Electrical Characteri-zation	Appearance	No defects or abnormalities	Visual inspection.
		Capacitance Change	Within the specified tolerance	The capacitance/Q should be measured at 25°C at the frequency and voltage shown in the table.
		Q	Q≧1000	
		I.R.	25°C More than 100,000MΩ or 1,000MΩ · μF (Whichever is smaller) Max. Operating Temperature···125°C More than 10,000MΩ or 100MΩ · μF (Whichever is smaller)	The insulation resistance should be measured with DC500±50V (DC250±25V in case of rated voltage: DC250V) at 25°C and 125°C and within 2 minutes of charging.
		Dielectric Strength	No failure	No failure should be observed when voltage as in the Table is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.

Capacitance	Frequency	Voltage
C<1000pF	1±0.2MHz	AC0.5 to 5V(r.m.s.)
C≧1000pF	1±0.2kHz	AC1±0.2V(r.m.s.)

Rated Voltage	Test Voltage
DC250V	200% of the rated voltage
DC630V	150% of the rated voltage
DC1kV	130% of the rated voltage

No.	AEC-Q200 Test Item		Specifications	AEC-Q200 Test Method
18	Board Flex	Appearance	No marking defects	Solder the capacitor on the test jig (glass epoxy board) as shown in Fig. 1 using eutectic solder. Then apply force in the direction shown in Fig. 2 for 5±1 seconds. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
		Capacitance Change	Within ±5.0% or ±0.5pF (Whichever is larger)	

Type	a	b	c
GCM21	0.8	3.0	1.3
GCM31	2.0	4.4	1.7
GCM32	2.0	4.4	2.6
GCM43	3.0	6.0	3.3
GCM55	4.2	7.2	5.1

(in mm)

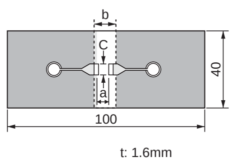


Fig. 1

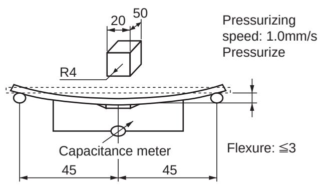


Fig. 2

No.	AEC-Q200 Test Item		Specifications	AEC-Q200 Test Method
19	Terminal Strength	Appearance	No marking defects	Solder the capacitor to the test jig (glass epoxy board) as shown in Fig. 3 using a eutectic solder. Then apply 18N force in parallel with the test jig for 60 seconds. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
		Capacitance Change	Within the specified tolerance	
		Q	Q≧1000	
		I.R.	More than 10,000MΩ or 500MΩ · μF (Whichever is smaller)	

Type	a	b	c
GCM21	1.2	4.0	1.65
GCM31	2.2	5.0	2.0
GCM32	2.2	5.0	2.9
GCM43	3.5	7.0	3.7
GCM55	4.5	8.0	5.6

(in mm)

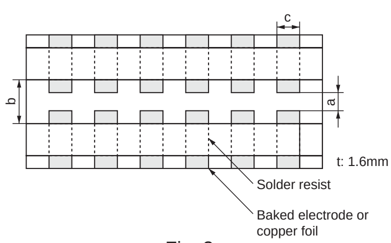
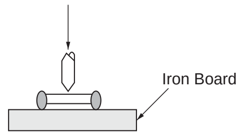
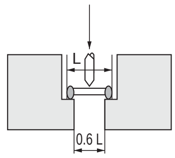


Fig. 3

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	AEC-Q200 Test Item		Specifications	AEC-Q200 Test Method
20	Beam Load Test		The chip should endure the following force. < Chip L dimension: 2.5mm max. > Chip thickness > 0.5mm rank: 20N Chip thickness ≦ 0.5mm rank: 8N < Chip L dimension: 3.2mm min. > Chip thickness < 1.25mm rank: 15N Chip thickness ≧ 1.25mm rank: 54.5N	Place the capacitor in the beam load fixture as in Fig. 4. Apply force. < Chip L dimension: 2.5mm max. >  < Chip L dimension: 3.2mm min. >  Fig. 4 Speed at which to supply the Stress Load: 2.5mm / s
21	Capacitance Temperature Character-istics	Capacitance Change	-750±120 ppm/°C (Temp. Range: +25 to +125°C) -750±120, -347 ppm/°C (Temp. Range: -55 to +25°C)	The capacitance change should be measured after 5 minutes at each specified temperature stage. The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from steps 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.
		Capacitance Drift	Within ±0.5% or ±0.05 pF (Whichever is larger)	

Step	Temperature (°C)
1	25±2
2	-55±3
3	25±2
4	125±3
5	25±2

Chip Monolithic Ceramic Capacitors for Automotive

muRata

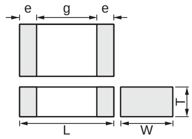
Medium Voltage for Automotive GCJ Series Soft Termination Type

■ Features

1. The GCJ series meet AEC-Q200 requirements.
2. Improved endurance against board bending stress.
3. Reduce board bending stress by conductive polymer termination.
4. Use the GCJ21/31 type with flow or reflow soldering, and other types with reflow soldering only.

■ Applications

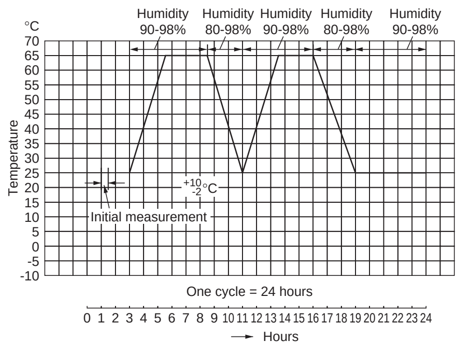
Automotive electronic equipment (power-train, safety equipment)



Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GCJ21A	2.0 ±0.2	1.25 ±0.2	1.0 +0,-0.3	0.3 min.	0.7
GCJ21B			1.25 ±0.2		
GCJ31B	3.2 ±0.2	1.6 ±0.2	1.25 +0,-0.3		1.2
GCJ31C			1.6 ±0.2		
GCJ32Q	3.2 ±0.3	2.5 ±0.2	1.5 +0,-0.3		
GCJ32D			2.0 +0,-0.3		
GCJ43Q	4.5 ±0.4	3.2 ±0.3	1.5 +0,-0.3		2.2
GCJ43D			2.0 +0,-0.3		
GCJ55D	5.7 ±0.4	5.0 ±0.4	2.0 +0,-0.3		3.2

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GCJ21AR72E102KXJ1D	DC250	X7R (EIA)	1000pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GCJ21AR72E152KXJ1D	DC250	X7R (EIA)	1500pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GCJ21AR72E222KXJ1D	DC250	X7R (EIA)	2200pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GCJ21AR72E332KXJ1D	DC250	X7R (EIA)	3300pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GCJ21AR72E472KXJ1D	DC250	X7R (EIA)	4700pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GCJ21AR72E682KXJ1D	DC250	X7R (EIA)	6800pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GCJ21BR72E103KXJ3L	DC250	X7R (EIA)	10000pF ±10%	2.0	1.25	1.25	0.7	0.3 min.
GCJ31BR72E153KXJ1L	DC250	X7R (EIA)	15000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GCJ31BR72E223KXJ1L	DC250	X7R (EIA)	22000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GCJ31CR72E333KXJ3L	DC250	X7R (EIA)	33000pF ±10%	3.2	1.6	1.6	1.2	0.3 min.
GCJ31CR72E473KXJ3L	DC250	X7R (EIA)	47000pF ±10%	3.2	1.6	1.6	1.2	0.3 min.
GCJ32QR72E683KXJ1L	DC250	X7R (EIA)	68000pF ±10%	3.2	2.5	1.5	1.2	0.3 min.
GCJ32DR72E104KXJ1L	DC250	X7R (EIA)	0.10µF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GCJ43QR72E154KXJ1L	DC250	X7R (EIA)	0.15µF ±10%	4.5	3.2	1.5	2.2	0.3 min.
GCJ43DR72E224KXJ1L	DC250	X7R (EIA)	0.22µF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GCJ55DR72E334KXJ1L	DC250	X7R (EIA)	0.33µF ±10%	5.7	5.0	2.0	3.2	0.3 min.
GCJ55DR72E474KXJ1L	DC250	X7R (EIA)	0.47µF ±10%	5.7	5.0	2.0	3.2	0.3 min.
GCJ31BR72J102KXJ1L	DC630	X7R (EIA)	1000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GCJ31BR72J152KXJ1L	DC630	X7R (EIA)	1500pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GCJ31BR72J222KXJ1L	DC630	X7R (EIA)	2200pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GCJ31BR72J332KXJ1L	DC630	X7R (EIA)	3300pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GCJ31BR72J472KXJ1L	DC630	X7R (EIA)	4700pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GCJ32QR72J682KXJ1L	DC630	X7R (EIA)	6800pF ±10%	3.2	2.5	1.5	1.2	0.3 min.
GCJ32QR72J103KXJ1L	DC630	X7R (EIA)	10000pF ±10%	3.2	2.5	1.5	1.2	0.3 min.
GCJ32DR72J153KXJ1L	DC630	X7R (EIA)	15000pF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GCJ32DR72J223KXJ1L	DC630	X7R (EIA)	22000pF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GCJ43DR72J333KXJ1L	DC630	X7R (EIA)	33000pF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GCJ43DR72J473KXJ1L	DC630	X7R (EIA)	47000pF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GCJ55DR72J104KXJ1L	DC630	X7R (EIA)	0.10µF ±10%	5.7	5.0	2.0	3.2	0.3 min.

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">AEC-Q200 Test Item</th><th>Specifications</th><th>AEC-Q200 Test Method</th></tr>
<tr><td>1</td><td colspan="2">Pre- and Post-Stress Electrical Test</td><td colspan="2">–</td></tr>
<tr><td rowspan="5">2</td><td colspan="2">High Temperature Exposure (Storage)</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Set the capacitor for 1000±12 hours at 150±3°C. Let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 100MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td rowspan="5">3</td><td colspan="2">Temperature Cycle</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (19). Perform the 1000 cycles according to the 4 heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure.<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (°C)</td><td>-55+0/-3</td><td>Room Temp.</td><td>125+3/-0</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>15±3</td><td>1</td><td>15±3</td><td>1</td></tr></table>•Pretreatment
Perform the heat treatment at 150+0/-10°C for 60±5 minutes and then let sit for 24±2 hours at room temperature.</td></tr>
<tr><td rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 100MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td>4</td><td colspan="2">Destructive Physical Analysis</td><td>No defects or abnormalities</td><td>Per EIA-469</td></tr>
<tr><td rowspan="5">5</td><td colspan="2">Moisture Resistance</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply the 24-hour heat (25 to 65°C) and humidity (80 to 98%) treatment shown below, 10 consecutive times.
Let sit for 24±2 hours at room temperature, then measure.
</td></tr>
<tr><td rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 100MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td rowspan="5">6</td><td colspan="2">Biased Humidity</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply the rated voltage and DC1.3+0.2/-0V (add 6.8kΩ resistor) at 85±3°C and 80 to 85% humidity for 1000±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.
•Pretreatment
Perform the heat treatment at 150+0/-10°C for 60±5 minutes and then let sit for 24±2 hours at room temperature.</td></tr>
<tr><td rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 10MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td rowspan="5">7</td><td colspan="2">Operational Life</td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply voltage as in the Table for 1000±12 hours at 125±3°C.
Let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.<table><tr><th>Rated Voltage</th><th>Applied Voltage</th></tr><tr><td>DC250V</td><td>150% of the rated voltage</td></tr><tr><td>DC630V</td><td>120% of the rated voltage</td></tr></table>•Pretreatment
Apply test voltage for 60±5 minutes at test temperature.
Remove and let sit for 24±2 hours at room temperature.</td></tr>
<tr><td rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 10MΩ · μF
(Whichever is smaller)</td></tr>
<tr><td>8</td><td colspan="2">External Visual</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>9</td><td colspan="2">Physical Dimension</td><td>Within the specified dimensions</td><td>Using calipers and micrometers</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	AEC-Q200 Test Item		Specifications	AEC-Q200 Test Method
10	Resistance to Solvents	Appearance	No marking defects	Per MIL-STD-202 Method 215 Solvent 1: 1 part (by volume) of isopropyl alcohol 3 parts (by volume) of mineral spirits Solvent 2: Terpene defluxer Solvent 3: 42 parts (by volume) of water 1 part (by volume) of propylene glycol monomethyl ether 1 part (by volume) of monoethanolamine
		Capacitance Change	Within the specified tolerance	
		D.F.	0.025 max.	
		I.R.	More than 10,000MΩ or 100MΩ · µF (Whichever is smaller)	
11	Mechanical Shock	Appearance	No marking defects	Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks). The specified test pulse should be Half-sine and should have a duration: 0.5ms, peak value: 1500g and velocity change: 4.7m/s.
		Capacitance Change	Within the specified tolerance	
		D.F.	0.025 max.	
12	Vibration	Appearance	No defects or abnormalities	Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (19). 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 2000Hz. The frequency range, from 10 to 2000Hz and return to 10Hz, should be traversed in approximately 20 minutes. This motion should be applied for 12 items in each 3 mutually perpendicular directions (total of 36 times).
		Capacitance Change	Within the specified tolerance	
		D.F.	0.025 max.	
13	Resistance to Soldering Heat		The measured and observed characteristics should satisfy the specifications in the following table.	Immerse the capacitor in a eutectic solder solution at 260±5°C for 10±1 seconds. Let sit at room temperature for 24±2 hours, then measure. •Pretreatment Perform the heat treatment at 150+0/-10°C for 60±5 minutes and then let sit for 24±2 hours at room temperature.
		Appearance	No marking defects	
		Capacitance Change	Within ±10%	
		D.F.	0.025 max.	
		I.R.	More than 10,000MΩ or 100MΩ · µF (Whichever is smaller)	
14	Thermal Shock		The measured and observed characteristics should satisfy the specifications in the following table.	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (19). Perform the 300 cycles according to the two heat treatments listed in the following table (maximum transfer time is 20 seconds). Let sit for 24±2 hours at room temperature, then measure. Step: 1 / 2 Temp. (°C): -55+0/-3 / 125+3/-0 Time (min.): 15±3 / 15±3 •Pretreatment Perform the heat treatment at 150+0/-10°C for 60±5 minutes and then let sit for 24±2 hours at room temperature.
		Appearance	No marking defects	
		Capacitance Change	Within ±10%	
		D.F.	0.025 max.	
		I.R.	More than 10,000MΩ or 100MΩ · µF (Whichever is smaller)	
15	ESD	Appearance	No marking defects	Per AEC-Q200-002
		Capacitance Change	Within the specified tolerance	
		D.F.	0.025 max.	
		I.R.	More than 10,000MΩ or 100MΩ · µF (Whichever is smaller)	
16	Solderability		95% of the terminations are to be soldered evenly and continuously.	(a) Preheat at 155°C for 4 hours. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C. (b) Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C. (c) Should be placed into steam aging for 8 hours±15 minutes. After preheating, immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 120 ±5 seconds at 260±5°C.

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

<table>
<tr><th>No.</th><th colspan="2">AEC-Q200 Test Item</th><th>Specifications</th><th>AEC-Q200 Test Method</th></tr>
<tr><td rowspan="5">17</td><td rowspan="5">Electrical Characteri-zation</td><td>Appearance</td><td>No defects or abnormalities</td><td>Visual inspection.</td></tr>
<tr><td>Capacitance Change</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/Q should be measured at 25°C at the frequency and voltage shown in the table.<table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>C<1000pF</td><td>1±0.2MHz</td><td>AC0.5 to 5V(r.m.s.)</td></tr><tr><td>C≧1000pF</td><td>1±0.2kHz</td><td>AC1±0.2V(r.m.s.)</td></tr></table></td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>25°C
More than 10,000MΩ or 100MΩ · μF
(Whichever is smaller)

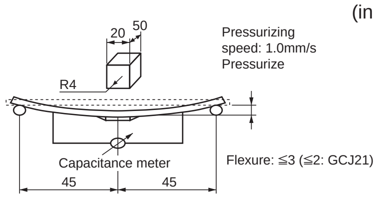
Max. Operating Temperature···125°C
More than 1,000MΩ or 10MΩ · μF
(Whichever is smaller)</td><td>The insulation resistance should be measured with DC500±50V (DC250±25V in case of rated voltage: DC250V) at 25°C and 125°C and within 2 minutes of charging.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td><td>No failure should be observed when voltage as in the Table is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.<table><tr><th>Rated Voltage</th><th>Test Voltage</th></tr><tr><td>DC250V</td><td>200% of the rated voltage</td></tr><tr><td>DC630V</td><td>150% of the rated voltage</td></tr></table></td></tr>
<tr><td rowspan="3">18</td><td rowspan="3">Board Flex</td><td>Appearance</td><td>No marking defects</td><td rowspan="3">Solder the capacitor on the test jig (glass epoxy board) as shown in Fig. 1 using a eutectic solder. Then apply a force in the direction shown in Fig. 2 for 5±1 seconds. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>**GCJ21**</td><td>0.8</td><td>3.0</td><td>1.3</td></tr><tr><td>**GCJ31**</td><td>2.0</td><td>4.4</td><td>1.7</td></tr><tr><td>**GCJ32**</td><td>2.0</td><td>4.4</td><td>2.6</td></tr><tr><td>**GCJ43**</td><td>3.0</td><td>6.0</td><td>3.3</td></tr><tr><td>**GCJ55**</td><td>4.2</td><td>7.2</td><td>5.1</td></tr></table>(in mm)


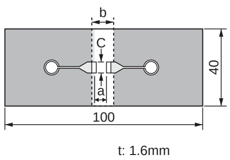
Fig. 2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td></td><td>

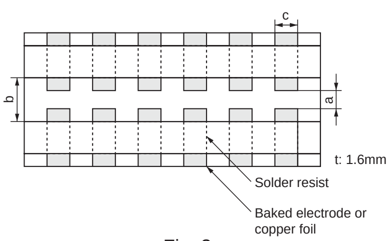
Fig. 1</td></tr>
<tr><td rowspan="4">19</td><td rowspan="4">Terminal Strength</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Solder the capacitor to the test jig (glass epoxy board) as shown in Fig. 3 using a eutectic solder. Then apply 18N force in parallel with the test jig for 60 seconds.
The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>**GCJ21**</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>**GCJ31**</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>**GCJ32**</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>**GCJ43**</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>**GCJ55**</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table>(in mm)


Fig. 3</td></tr>
<tr><td>Capacitance Change</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 100MΩ · μF
(Whichever is smaller)</td></tr>
</table>

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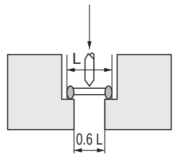
Specifications and Test Methods

Continued from the preceding page.

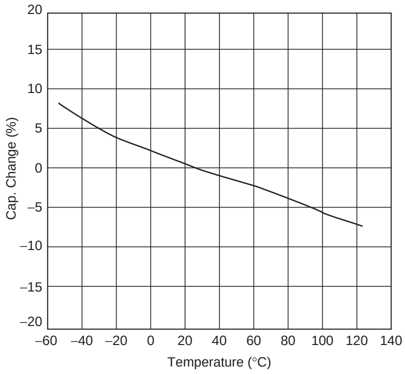
No.	AEC-Q200 Test Item		Specifications	AEC-Q200 Test Method
20	Beam Load Test		The chip should endure the following force. Chip thickness < 1.25mm rank: 15N Chip thickness ≧ 1.25mm rank: 54.5N	Place the capacitor in the beam load fixture as in Fig. 4. Apply force.  Fig. 4 Speed at which to supply the Stress Load: 2.5mm / s
21	Capacitance Temperature Character-istics	Capacitance Change	Within ±15%	The capacitance change should be measured after 5 minutes at each specified temperature stage. Step / Temperature (°C): 1: 25±2; 2: -55±3; 3: 25±2; 4: 125±3; 5: 25±2 The ranges of capacitance change compared with the above 25°C value over the temperature ranges shown in the table should be within the specified ranges. •Pretreatment Perform the heat treatment at 150+0/-10°C for 60±5 minutes and then let sit for 24±2 hours at room temperature. Perform the initial measurement.

Step	Temperature (°C)
1	25±2
2	-55±3
3	25±2
4	125±3
5	25±2

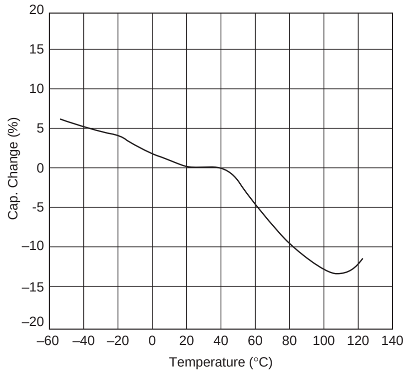
Medium Voltage Data (Typical Example)

■ Capacitance - Temperature Characteristics

U2J Characteristics

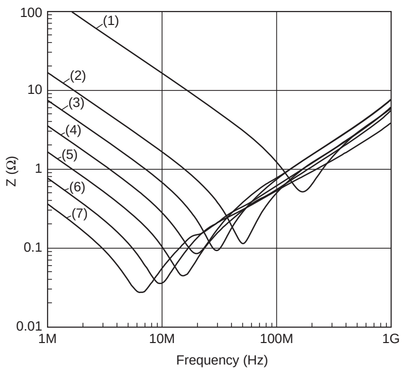


X7R Characteristics

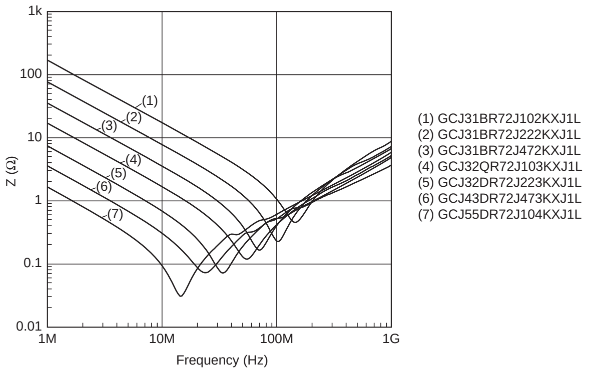


■ Impedance - Frequency Characteristics

X7R Characteristics DC250V



X7R Characteristics DC630V



Package

Taping is standard packaging method.

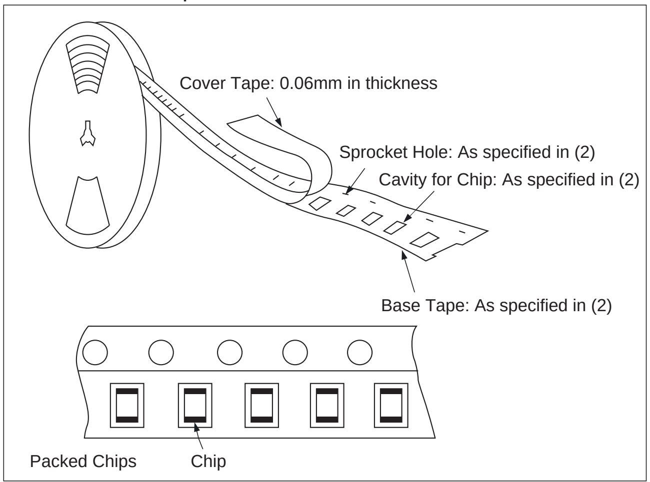
■ Minimum Quantity Guide

Part Number		Dimensions (mm)			Quantity (pcs.) ø180mm Reel	
		L	W	T	Paper Tape	Embossed Tape
Medium Voltage	GCJ21/GCM21	2.0	1.25	1.0	4,000	-
				1.25	-	3,000
	GCJ31/GCM31	3.2	1.6	1.0	4,000	-
				1.25	-	3,000
				1.6	-	2,000
	GCJ32/GCM32	3.2	2.5	1.0	4,000	-
				1.25	-	3,000
				1.5	-	2,000
				2.0	-	1,000
	GCJ43/GCM43	4.5	3.2	1.5	-	1,000
				2.0	-	1,000
	GCJ55/GCM55	5.7	5.0	1.5	-	1,000
				2.0	-	1,000

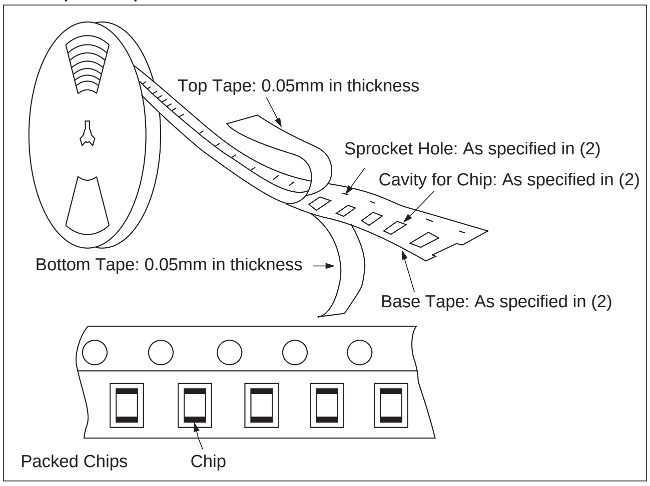
■ Tape Carrier Packaging

(1) Appearance of Taping

① Embossed Tape



② Paper Tape



Continued on the following page.

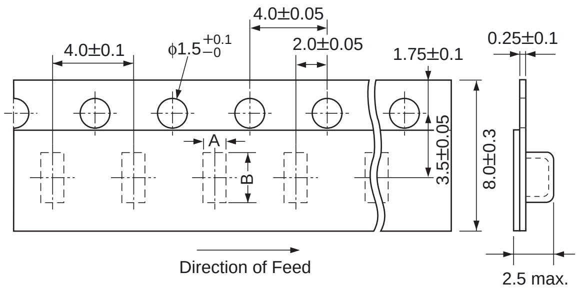
Package

Continued from the preceding page.

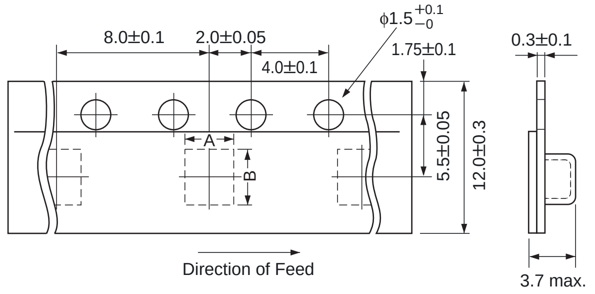
(2) Dimensions of Tape

① Embossed Tape

8mm width 4mm pitch Tape



12mm width 8mm/4mm pitch Tape



Part Number	A*	B*
GCJ21/GCM21 (T≧1.25mm)	1.45	2.25
GCJ31/GCM31 (T≧1.25mm)	2.0	3.6
GCJ32/GCM32 (T≧1.25mm)	2.9	3.6

*Nominal Value

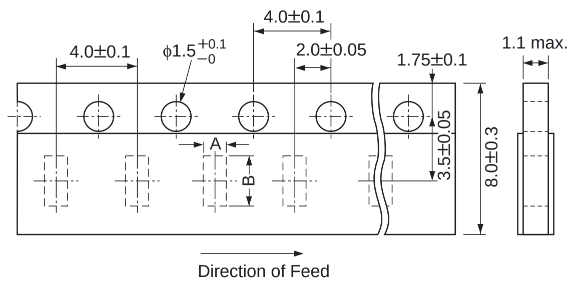
Part Number	A*	B*
GCJ43/GCM43	3.6	4.9
GCJ55/GCM55	5.4	6.1

*Nominal Value

(in mm)

② Paper Tape

8mm width 4mm pitch Tape

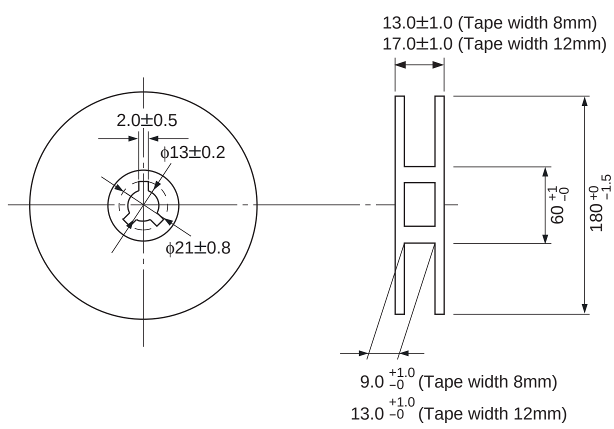


Part Number	A*	B*
GCJ21/GCM21 (T=1.0mm)	1.45	2.25
GCM31 (T=1.0mm)	2.0	3.6
GCM32 (T=1.0mm)	2.9	3.6

*Nominal Value

(in mm)

(3) Dimensions of Reel



(in mm)

Continued on the following page.

Package

Continued from the preceding page.

(4) Taping Method

① Tapes for capacitors are wound clockwise. The sprocket holes are to the right as the tape is pulled toward the user.

② Part of the leader and part of the empty tape should be attached to the end of the tape as shown at right.

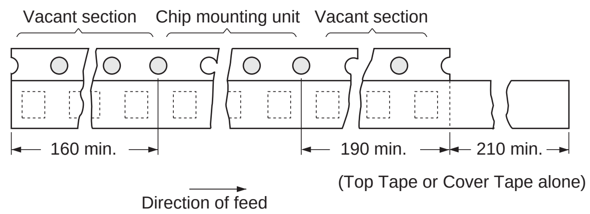
③ The top tape or cover tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

④ Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.

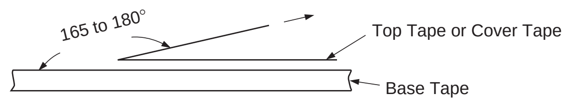
⑤ The top tape or cover tape and bottom tape should not protrude beyond the edges of the tape and should not cover sprocket holes.

⑥ Cumulative tolerance of sprocket holes, 10 pitches: ±0.3mm.

⑦ Peeling off force: 0.1 to 0.6N in the direction shown at right.



(in mm)



⚠Caution

■ Storage and Operating Conditions

Operating and storage environment

Do not use or store capacitors in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. In addition, avoid exposure to moisture. Before cleaning, bonding or molding this product, verify that these processes do not affect product quality by testing the performance of a cleaned, bonded or molded product in the intended equipment. Store the capacitors where the temperature and relative humidity do not exceed 5 to 40 degrees centigrade and 20 to 70%.

Use capacitors within 6 months of delivery.
Check the solderability after 6 months or more.

FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND CAUSE FUMING OR PARTIAL DISPERSION WHEN THE PRODUCT IS USED.

■ Handling

1. Vibration and impact
   Do not expose a capacitor to excessive shock or vibration during use.
2. Do not directly touch the chip capacitor, especially the ceramic body. Residue from hands/fingers may create a short circuit environment.

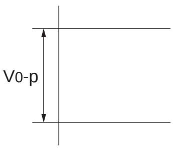
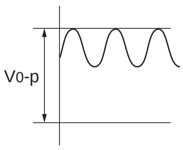
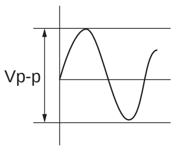
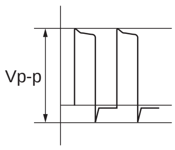
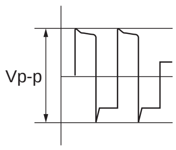
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND CAUSE FUMING OR PARTIAL DISPERSION WHEN THE PRODUCT IS USED.

⚠Caution

■ Rating

1. Operating Voltage

When DC-rated capacitors are to be used in AC or ripple current circuits, be sure to maintain the Vp-p value of the applied voltage or the Vo-p which contains DC bias within the rated voltage range.
When the voltage is applied to the circuit, starting or stopping may generate irregular voltage for a transit period because of resonance or switching. Be sure to use a capacitor with a rated voltage range that includes these irregular voltages.
When DC-rated capacitors are to be used in input circuits from commercial power source (AC filter), be sure to use Safety Recognized Capacitors because various regulations on withstand voltage or impulse withstand established for each type of equipment should be taken into consideration.

Voltage	DC Voltage	DC+AC Voltage	AC Voltage	Pulse Voltage (1)	Pulse Voltage (2)
Positional Measurement					

2. Operating Temperature, Self-generated Heat, and Load Reduction at High-frequency Voltage Condition

Keep the surface temperature of the capacitor below the upper limit of its rated operating temperature range.
Be sure to take into account the heat generated by the capacitor itself. When the capacitor is used in a high-frequency voltage, pulse voltage, it may self-generate heat due to dielectric loss.

(1) In the case of X7R char.

Applied voltage load should be such that self-generated heat is within 20°C on the condition of atmosphere temperature 25°C. When measuring, use a thermocouple of low thermal capacity -K of ø0.1mm in conditions where the capacitor is not affected by radiant heat from other components or surrounding ambient fluctuations.
Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running. Otherwise, accurate measurement cannot be ensured.)

Continued on the following page.

⚠Caution

Continued from the preceding page.

(2) In the case of U2J char.

Due to the low self-heating characteristics of low-dissipation capacitors, the allowable electric power of these capacitors is generally much higher than that of X7R characteristic capacitors.

When a high-frequency voltage that causes 20°C self heating to the capacitor is applied, it will exceed the capacitor's allowable electric power.

The frequency of the applied sine wave voltage should be less than 500kHz. The applied voltage should be less than the value shown in figure below.

In the case of non-sine wave that includes a harmonic frequency, please contact our sales representatives or product engineers. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running. Otherwise, accurate measurement cannot be ensured.)

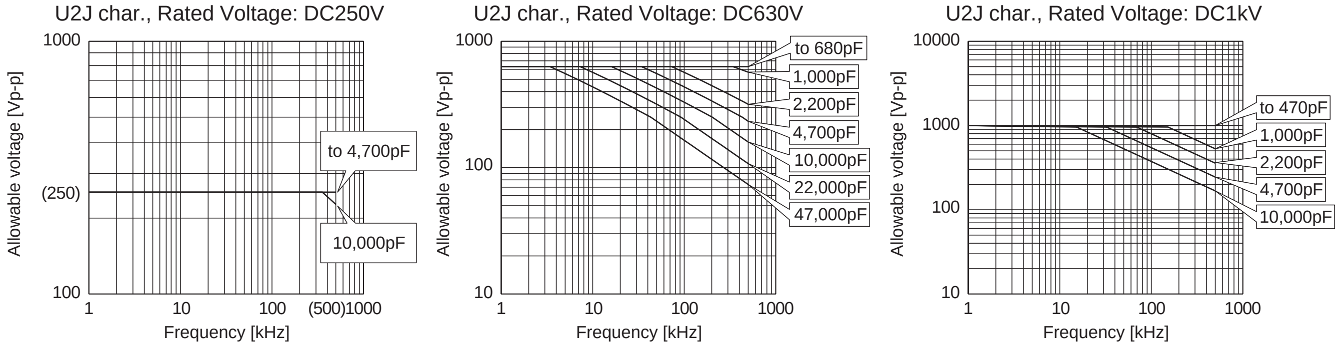
<Capacitor Selection Tool>

We are also offering free software the capacitor selection tool: "Murata Medium Voltage Capacitors Selection Tool by Voltage Form," which will assist you in selecting a suitable capacitor.

The software can be downloaded from Murata's Web site: (http://www.murata.com/products/design_support/mmcsv/index.html)

By inputting capacitance values and applied voltage waveform of the specific capacitor series, this software will calculate the capacitor's power consumption and list suitable capacitors (non-sine wave is also available).

The temperature of the surface
of capacitor: 125˚C or less (including self-heating)

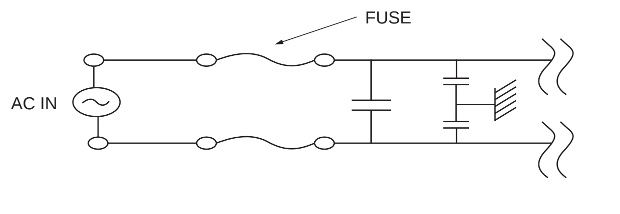


Sine-wave frequency VS allowable voltage

3. Fail-safe

Failure of a capacitor may result in a short circuit. Be sure to provide an appropriate fail-safe function such as a fuse on your product to help eliminate possible electric shock, fire, or fumes.

Please consider using fuses on each AC line if the capacitors are used between the AC input lines and earth (line bypass capacitors), to prepare for the worst case, such as a short circuit.



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⚠Caution

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4. Test Condition for AC Withstanding Voltage

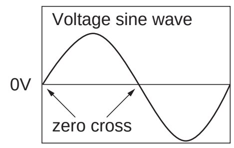
(1) Test Equipment

Tests for AC withstanding voltage should be made with equipment capable of creating a wave similar to a 50/60 Hz sine wave.
If a distorted sine wave or overload exceeding the specified voltage value is applied, a defect may be caused.

(2) Voltage Applied Method

The capacitor's leads or terminals should be firmly connected to the output of the withstanding voltage test equipment, and then the voltage should be raised from near zero to the test voltage. If the test voltage is applied directly to the capacitor without raising it from near zero, it should be applied with the zero cross.* At the end of the test time, the test voltage should be reduced to near zero, and then the capacitor's leads or terminals should be taken off the output of the withstanding voltage test equipment. If the test voltage is applied directly to the capacitor without raising it from near zero, surge voltage may occur and cause a defect.

*ZERO CROSS is the point where voltage sine wave pass 0V (see the figure at right).



FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND CAUSE FUMING OR PARTIAL DISPERSION WHEN THE PRODUCT IS USED.

⚠Caution

■ Solder and Mounting

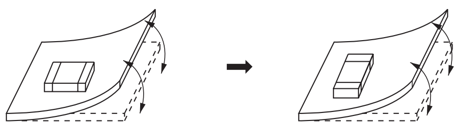
1. Vibration and Impact
   Do not expose a capacitor to excessive shock or vibration during use.

2. Circuit Board Material
   In the case that a ceramic chip capacitor is soldered on a metal board, such as an aluminum board, the stress of heat expansion and contraction might cause cracking of the ceramic capacitor, due to the difference of thermal expansion coefficient between the metal board and the ceramic chip.

3. Land Layout for Cropping PC Board

Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

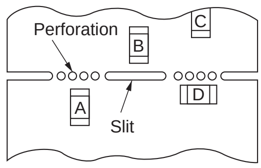
[Component Direction]



Locate chip horizontal to the direction in which stress acts.

<Examples to be avoided> <Examples of improvements>

[Chip Mounting Close to Board Separation Point]



Chip arrangement
Worst A>C>B~D Best

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⚠Caution

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4. Reflow Soldering

- When sudden heat is given to the components, the mechanical strength of the components will diminish because remarkable temperature change causes deformity of the components inside. In order to prevent mechanical damage in the components, preheating should be required for both the components and the PCB board. Preheating conditions are shown in Table 1. It is required to keep temperature differential between the soldering and the components surface (ΔT) as low as possible.
- Solderability of tin plating termination chip might be deteriorated when low temperature soldering profile where peak solder temperature below the tin melting point is used. Please confirm the solderability of tin plating termination chip before use.
- When components are immersed in solvent after mounting, be sure to maintain the temperature difference (ΔT) between the component and solvent within the range shown in the Table 1.

Table 1

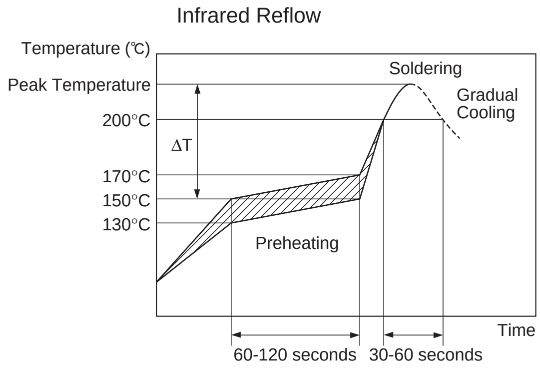
Part Number	Temperature Differential
G□□21/31	ΔT≦190℃
G□□32/43/55	ΔT≦130℃

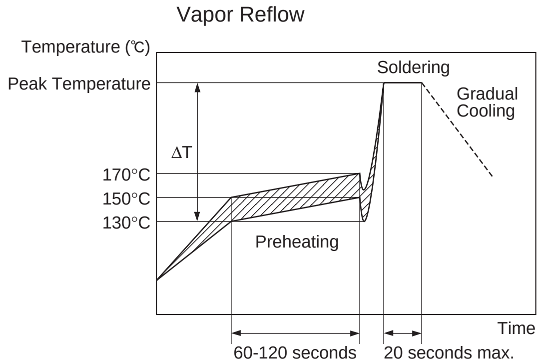
Recommended Conditions

	Pb-Sn Solder		Lead Free Solder
	Infrared Reflow	Vapor Reflow	
Peak Temperature	230-250°C	230-240°C	240-260°C
Atmosphere	Air	Air	Air or N_2

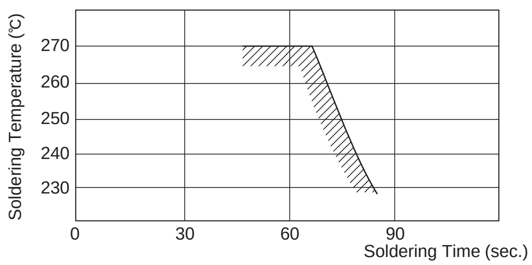
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Reflow Soldering]





[Allowable Soldering Temperature and Time]

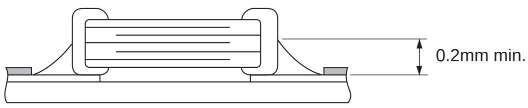


In the case of repeated soldering, the accumulated soldering time must be within the range shown above.

Optimum Solder Amount for Reflow Soldering

- Overly thick application of solder paste results in excessive fillet height solder.
  This makes the chip more susceptible to mechanical and thermal stress on the board and may cause cracked chips.
- Too little solder paste results in a lack of adhesive strength on the outer electrode, which may result in chips breaking loose from the PCB.
- Make sure the solder has been applied smoothly to the end surface to a height of 0.2mm min.

[Optimum Solder Amount for Reflow Soldering]



Inverting the PCB

Make sure not to impose an abnormal mechanical shock on the PCB.

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⚠Caution

Continued from the preceding page.

5. Flow Soldering

- When sudden heat is given to the components, the mechanical strength of the components could diminish because remarkable temperature change causes deformity of the components inside. And an excessively long soldering time or high soldering temperature results in leaching by the outer electrodes, causing poor adhesion or a reduction in capacitance value due to loss of contact between electrodes and end termination.
- In order to prevent mechanical damage in the components, preheating should be required for both of the components and the PCB board. Preheating conditions are shown in Table 2. It is required to keep temperature differential between the soldering and the components surface (ΔT) as low as possible.
- When components are immersed in solvent after mounting, be sure to maintain the temperature difference between the component and solvent within the range shown in Table 2.
  Do not apply flow soldering to chips not listed in Table 2.

Table 2

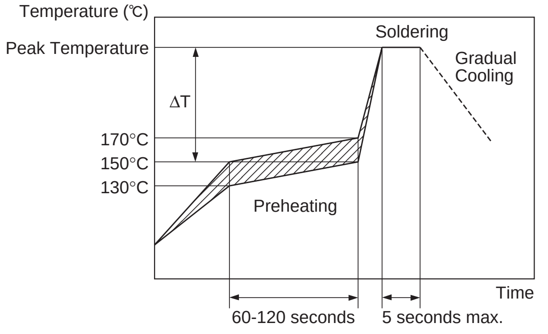
Part Number	Temperature Differential
G□□21/31	ΔT≦150℃

Recommended Conditions

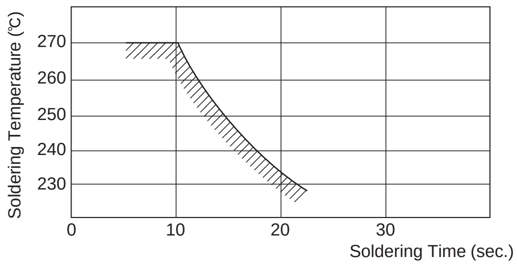
	Pb-Sn Solder	Lead Free Solder
Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N_2

Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Flow Soldering]

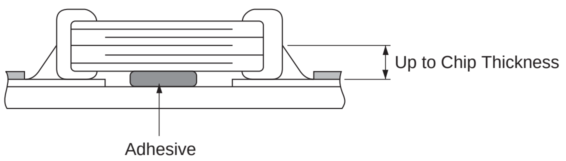


[Allowable Soldering Temperature and Time]



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

- Optimum Solder Amount for Flow Soldering
  The top of the solder fillet should be lower than the thickness of components. If the solder amount is excessive, the risk of cracking is higher during board bending or under any other stressful conditions.



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⚠Caution

Continued from the preceding page.

6. Correction with a Soldering Iron

● When sudden heat is applied to the components by use of a soldering iron, the mechanical strength of the components will diminish because extreme temperature change causes deformations inside the components.
In order to prevent mechanical damage to the components, preheating is required for both the components and the PCB board.
Preheating conditions, (The "Temperature of the Soldering Iron tip," "Preheating Temperature," "Temperature Differential" between iron tip and the components and the PCB), should be within the conditions of table 3.

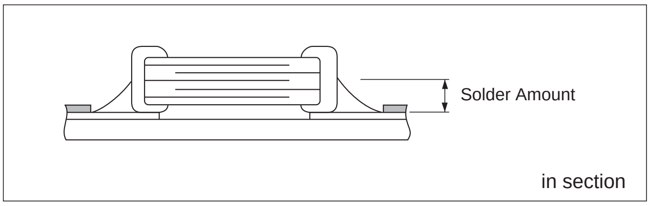
It is required to keep the temperature differential between the soldering iron and the components surface (ΔT) as low as possible.
After soldering, do not allow the component/PCB to cool down rapidly.
The operating time for the re-working should be as short as possible. When re-working time is too long, it may cause solder leaching, and that will cause a reduction of the adhesive strength of the terminations.

Table 3

Part Number	Temperature of Soldering Iron tip	Preheating Temperature	Temperature Differential (ΔT)	Atmosphere
G□□21/31	350°C max.	150°C min.	ΔT≦190℃	air
G□□32/43/55	280°C max.	150°C min.	ΔT≦130℃	air

*Applicable for both Pb-Sn and Lead Free Solder.
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

● Optimum solder amount when re-working Using a Soldering Iron
In the case of larger sizes than G□□21, the top of the solder fillet should be lower than 2/3 of the thickness of the component.
If the solder amount is excessive, the risk of cracking is higher during board bending or under any other stressful conditions.
A soldering iron ø3mm or smaller should be used.
It is also necessary to keep the soldering iron from touching the components during the re-work.
Solder wire with ø0.5mm or smaller is required for soldering.



7. Washing

Excessive output of ultrasonic oscillation during cleaning causes PCBs to resonate, resulting in cracked chips or broken solder. Take note not to vibrate PCBs.

FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCT IS USED.

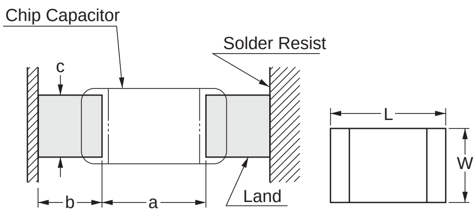
Notice

■ Notice (Soldering and Mounting)

1. Construction of Board Pattern

After installing chips, if solder is excessively applied to the circuit board, mechanical stress will cause destruction resistance characteristics to diminish. To prevent this, be extremely careful in determining shape and dimension before designing the circuit board diagram.

Construction and Dimensions of Pattern (Example)



Flow Soldering

L×W	a	b	c
2.0×1.25	1.0-1.2	0.9-1.0	0.8-1.1
3.2×1.6	2.2-2.6	1.0-1.1	1.0-1.4

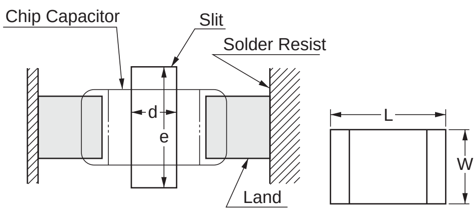
Flow soldering : 3.2×1.6 or less available.

Reflow Soldering

L×W	a	b	c
2.0×1.25	1.0-1.2	0.6-0.7	0.8-1.1
3.2×1.6	2.2-2.4	0.8-0.9	1.0-1.4
3.2×2.5	2.0-2.4	1.0-1.2	1.8-2.3
4.5×3.2	2.8-3.4	1.2-1.4	2.3-3.0
5.7×5.0	4.0-4.6	1.4-1.6	3.5-4.8

(in mm)

Dimensions of Slit (Example)

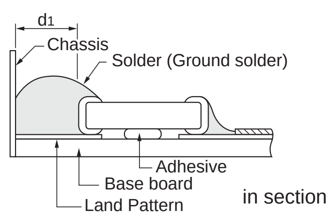
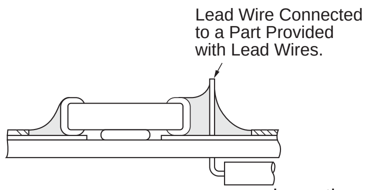
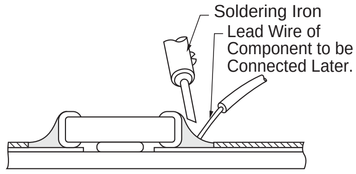
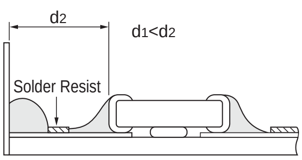
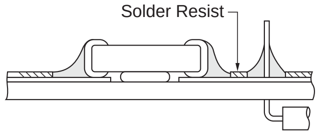
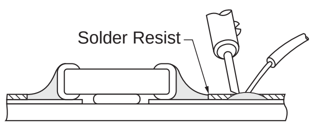


L×W	d	e
2.0×1.25	-	-
3.2×1.6	1.0-2.0	3.2-3.7
3.2×2.5	1.0-2.0	4.1-4.6
4.5×3.2	1.0-2.8	4.8-5.3
5.7×5.0	1.0-4.0	6.6-7.1

(in mm)

Preparing a slit helps flux cleaning and resin coating on the back of the capacitor.
However, the length of the slit design should be as short as possible to prevent the mechanical damage in the capacitor.
A longer slit design might receive more severe mechanical stress from the PCB.
Recommendable slit design is shown in the Table.

Land Layout to Prevent Excessive Solder

	Mounting Close to a Chassis	Mounting with Leaded Components	Mounting Leaded Components Later
Examples of Prohibition	 in section	 in section	 in section
Examples of Improvements by the Land Division	 in section	 in section	 in section

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Notice

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2. Mounting of Chips

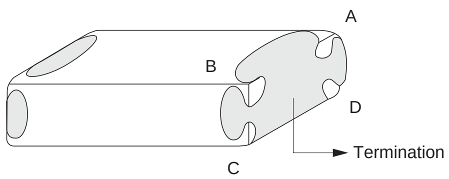
- Thickness of adhesives applied
  Keep thickness of adhesives applied (50-105µm or more) to reinforce the adhesive contact considering the thickness of the termination or capacitor (20-70µm) and the land pattern (30-35µm).

- Mechanical shock of the chip placer
  When the positioning claws and pick-up nozzle are worn, the load is applied to the chip while positioning is concentrated in one position, thus causing cracks, breakage, faulty positioning accuracy, etc.
  Careful checking and maintenance are necessary to prevent unexpected trouble.
  An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips. Please set the suction nozzle's bottom dead point on the upper surface of the board.

3. Soldering

(1) Limit the loss of effective area of the terminations and conditions needed for soldering.

Depending on the conditions of the soldering temperature and/or immersion (melting time), effective areas may be lost in some part of the terminations.
To prevent this, be careful in soldering so that any possible loss of the effective area on the terminations will securely remain at a maximum of 25% on all edge length A-B-C-D-A of part with A, B, C, D, shown in the Figure below.



(2) Flux Application

- An excessive amount of flux generates a large quantity of flux gas, causing deteriorated solderability, so apply flux thinly and evenly throughout.
  (A foaming system is generally used for flow soldering.)
- Flux containing too high a percentage of halide may cause corrosion of the outer electrodes without sufficient cleaning. Use flux with a halide content of 0.2% max.
- Do not use strong acidic flux.
- Do not use water-soluble flux.*
  (*Water-soluble flux can be defined as non-rosin type flux including wash-type flux and non-wash-type flux.)

(3) Solder
The use of Sn-Zn based solder will deteriorate the reliability of the MLCC.
Please contact our sales representative or product engineers on the use of Sn-Zn based solder in advance.

Continued on the following page.

Notice

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4. Cleaning

Please confirm there is no problem in the reliability of the product beforehand when cleaning it with the intended equipment.
The residue after cleaning might cause a decrease in the surface resistance of the chip and corrosion of the electrode part, etc. As a result it might cause reliability to deteriorate. Please confirm beforehand that there is no problem with the intended equipment in ultrasonic cleansing.

5. Resin Coating

Please use it after confirming there is no influence on the product with the intended equipment beforehand when using resin coating and molding.
A cracked chip might be caused at the cooling/heating cycle by the amount of resin spreading and/or bias thickness.
The resin for coating and molding must be selected so that the stress is low when stiffening and the hygroscopic content is low as possible.

■ Rating

1. Capacitance change of capacitor

(1) In the case of X7R char.
Capacitors have an aging characteristic, whereby the capacitor continually decreases its capacitance slightly if the capacitor is left on for a long time. Moreover, capacitance might change greatly depending on the surrounding temperature or an applied voltage. Therefore, it is not likely to be suitable for use in a time-constant circuit.
Please contact us if you need detailed information.

(2) In the case of U2J char.
Capacitance might change a little depending on the surrounding temperature or an applied voltage.
Please contact us if you intend to use this product in a strict time-constant circuit.

2. Performance check by equipment

Before using a capacitor, check that there is no problem in the equipment's performance and the specifications.
Generally speaking, CLASS 2 (X7R char.) ceramic capacitors have voltage dependence characteristics and temperature dependence characteristics in capacitance. Therefore, the capacitance value may change depending on the operating condition in the equipment.
Accordingly, be sure to confirm the apparatus performance of receiving influence in a capacitance value change of a capacitor, such as leakage current and noise suppression characteristics.
Moreover, check the surge-proof ability of a capacitor in the equipment, if needed, because the surge voltage may exceed the specific value by the inductance of the circuit.

EMICON-FUN!

Please check Murata's newsletter!
You can learn about electric parts with fun.
http://www.murata.com/products/emicon_fun/

EMICON COLUMN introduce hand-made columns with know-how of capacitors, inductors and EMI suppression filters.
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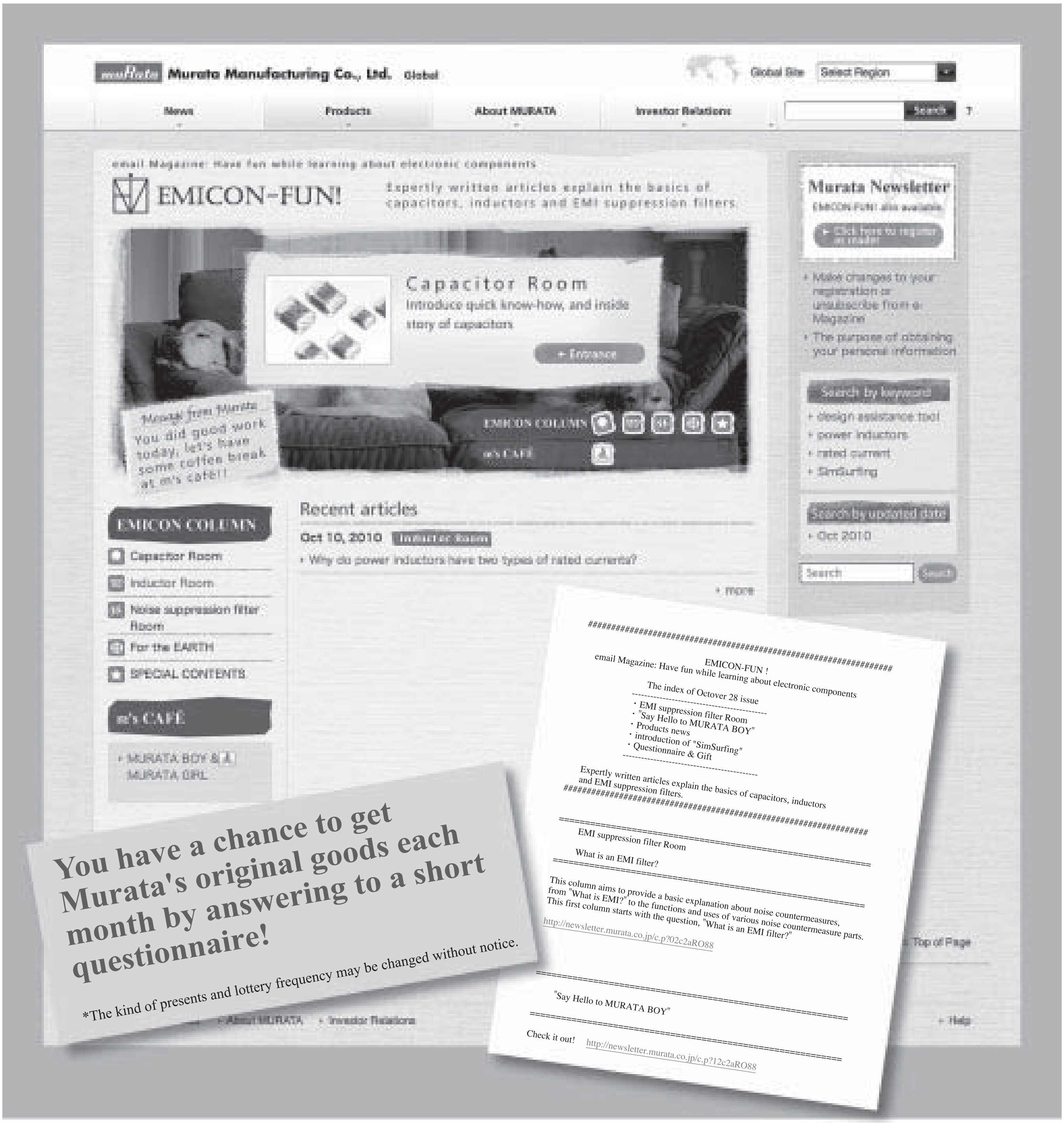
This banner is the entrance of register form



⚠Note:

1. Export Control
   <For customers outside Japan>
   No Murata products should be used or sold, through any channels, for use in the design, development, production, utilization, maintenance or operation of, or otherwise contribution to (1) any weapons (Weapons of Mass Destruction [nuclear, chemical or biological weapons or missiles] or conventional weapons) or (2) goods or systems specially designed or intended for military end-use or utilization by military end-users.
   <For customers in Japan>
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   ② Aerospace equipment
   ③ Undersea equipment
   ④ Power plant equipment
   ⑤ Medical equipment
   ⑥ Transportation equipment (vehicles, trains, ships, etc.)
   ⑦ Traffic signal equipment
   ⑧ Disaster prevention / crime prevention equipment
   ⑨ Data-processing equipment
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