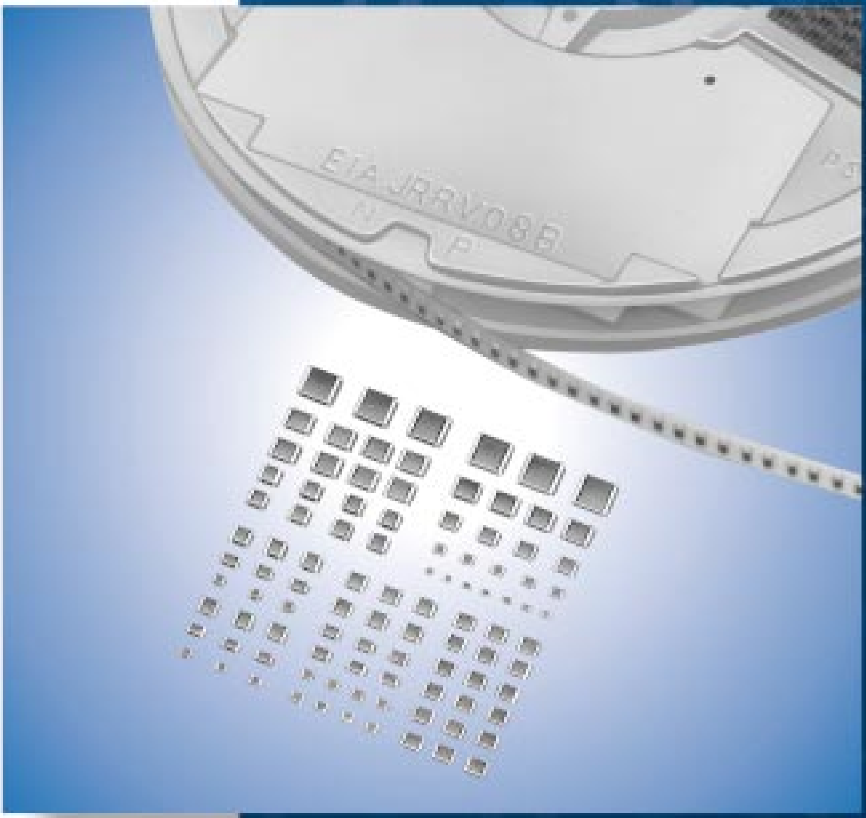
C03E.pdf
08.5.12

Chip Monolithic Ceramic Capacitors for Automotive



muRata *Innovator in Electronics*

Murata
Manufacturing Co., Ltd.

Cat.No.C03E-2

for 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).

CONTENTS

● Part Numbering

Chip Monolithic Ceramic Capacitors

(Part Number) GC M 18 8 B1 1H 102 K A01 K
❶ ❷ ❸ ❹ ❺ ❻ ❼ ❽ ❾ ❿

❶Product ID

❷Series

Product ID	Code	Series
GC	**M**	Power-train, Safety equipment
GR	**M**	For Ultrasonic

❸Dimension (L×W)

Code	Dimension (L×W)	EIA
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

❹Dimension (T)

Code	Dimension (T)
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
R	1.8mm
X	Depends on individual standards.

❺Temperature Characteristics

Temperature Characteristic Codes			Temperature Characteristics			Operating Temperature Range
Code	Public STD Code		Referance 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
9E	ZLM	*1	20°C	-25 to 20°C	-4700+1000/-2500ppm/°C	-25 to 85°C
				20 to 85°C	-4700+500/-1000ppm/°C	

*1 Murata Temperature Characteristic Code.

●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
1A	DC10V
1C	DC16V
1E	DC25V
1H	DC50V
2A	DC100V
2E	DC250V
2J	DC630V

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 which 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

Continued on the following page. ↗

Continued from the preceding page.

❽Capacitance Tolerance

Code	Capacitance Tolerance	TC	Series	Capacitance Step	
C	±0.25pF	C0G	**GCM**	≦5pF	E12+1pF *
D	±0.5pF	C0G	**GCM**	6.0 to 9.0pF	E12+1pF *
J	±5%	C0G	**GCM**	≧10pF	E12 Series
		U2J	**GCM**	E6 Series	
K	±10%	X7S, X7R, ZLM	**GCM, GRM** (only ZLM)	E6 Series	
M	±20%	X7S, X7R	**GCM**	E6 Series	

***** E24 series is also available.

❾Individual Specification Code

Expressed by three figures.

❿Packaging

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

Selection Guide of Chip Monolithic Ceramic Capacitors

Start

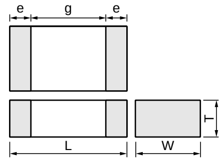
Function	Type	Series
Decoupling, Smoothing	High Capacitance	GRM (X5R, X7R, Y5V etc.) 220pF–100µF
	Array (2 or 4 Elements)	GNM 10pF–2.2µF
Frequency Control/Tuning, Impedance Matching	Class1 TC's;	GRM (C0G) 0.1pF–0.1µF
		GRM (U2J)
High Speed Decoupling	Low Inductance (Reverse Geometory)	LLL 22000pF–4.7µF
	Low Inductance (Multi Termination)	LLA/LLM (From 1GHz) 0.01µF–4.7µF
High Frequency	Low ESR (50V to 500V)	ERB (1MHz to 1GHz) 0.5pF–1000pF
	Low ESR, Ultra Small	GJM (500MHz to 10GHz) 0.1pF–20pF
	Lowest ESR	GQM (500MHz to 10GHz) 0.5pF–100pF
Optical Communications	Wire-Die-Bonding	GMA 100pF–0.1µF GMD 100pF–1µF
Medium Voltage High Frequency Snubber	250V/630V/1kV/2kV/3.15kV Low Dissipation	GRM (U2J) 10pF–10000pF
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
Medium Voltage Only for Camera Frash Circuit	350V High Capacitance	GR7 10000pF–47000pF
Medium Voltage Only for Information Devices / Tip & Ring	2kV High Capacitance	GR4 100pF–10000pF
	Safety Standard Recognized	Type GD 10pF–4700pF Type GF 10pF–4700pF
AC Lines Noise Removal	Safety Standard Recognized	Type GC 100pF–330pF Type GF 470pF–4700pF Type GB 10000pF–33000pF
	AC250V which meet Japanese Law	GA2 470pF–0.1µF
Automotive (Power-train, Safety Equipment)	High Capacitance	GCM (X7R etc.) 0.5µF–10µF
	Class1 TC's;	GCM (C0G etc.) 220pF–10µF
Medium Voltage for Automotive (Power-train, Safety Equipment)	250V/630V Low Dissipation	GRM (U2J) 10pF–10000pF

Chip Monolithic Ceramic Capacitors for Automotive

for Automotive GCM Series

■ Features

1. The GCM series meet AEC-Q200 requirements.
2. Highter 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 degree 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 lead free product.



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 0.3	0.4
GCM188*	1.6 ±0.1	0.8 ±0.1	0.8 ±0.1	0.2 to 0.5	0.5
GCM216	2.0 ±0.15	1.25 ±0.15	0.6 ±0.1	0.2 to 0.7	0.7
GCM219			0.85 ±0.1		
GCM21B			1.25 ±0.15		
GCM319	3.2 ±0.15	1.6 ±0.15	0.85 ±0.1	0.3 to 0.8	1.5
GCM31M			1.15 ±0.1		
GCM31C	3.2 ±0.2	1.6 ±0.2	1.6 ±0.2		
GCM32N	3.2 ±0.3	2.5 ±0.2	1.35 ±0.15	0.3 min.	1.0
GCM32R			1.8 ±0.2		
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)

■ Applications

Automotive electronic equipment (Power-train, safety equipment)

Temperature Compensating Type GCM03 Series

Part Number	**GCM03**
L x W [EIA]	0.6x0.3 [0201]
TC	C0G (**5C**)
Rated Volt.	25 (**1E**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)	
1.0pF(**1R0**)	0.3(**3**)
2.0pF(**2R0**)	0.3(**3**)
3.0pF(**3R0**)	0.3(**3**)
4.0pF(**4R0**)	0.3(**3**)
5.0pF(**5R0**)	0.3(**3**)
6.0pF(**6R0**)	0.3(**3**)
7.0pF(**7R0**)	0.3(**3**)
8.0pF(**8R0**)	0.3(**3**)
9.0pF(**9R0**)	0.3(**3**)
10pF(**100**)	0.3(**3**)
12pF(**120**)	0.3(**3**)
15pF(**150**)	0.3(**3**)
18pF(**180**)	0.3(**3**)
22pF(**220**)	0.3(**3**)
27pF(**270**)	0.3(**3**)
33pF(**330**)	0.3(**3**)
39pF(**390**)	0.3(**3**)
47pF(**470**)	0.3(**3**)
56pF(**560**)	0.3(**3**)
68pF(**680**)	0.3(**3**)
82pF(**820**)	0.3(**3**)
100pF(**101**)	0.3(**3**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

Temperature Compensating Type GCM15 Series

Part Number	**GCM15**
L x W [EIA]	1.0x0.5 [0402]
TC	C0G (**5C**)
Rated Volt.	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)	
0.50pF(**R50**)	0.5(**5**)
1.0pF(**1R0**)	0.5(**5**)
2.0pF(**2R0**)	0.5(**5**)
3.0pF(**3R0**)	0.5(**5**)
4.0pF(**4R0**)	0.5(**5**)
5.0pF(**5R0**)	0.5(**5**)
6.0pF(**6R0**)	0.5(**5**)
7.0pF(**7R0**)	0.5(**5**)
8.0pF(**8R0**)	0.5(**5**)
9.0pF(**9R0**)	0.5(**5**)
10pF(**100**)	0.5(**5**)
12pF(**120**)	0.5(**5**)
15pF(**150**)	0.5(**5**)
18pF(**180**)	0.5(**5**)
22pF(**220**)	0.5(**5**)
27pF(**270**)	0.5(**5**)
33pF(**330**)	0.5(**5**)
39pF(**390**)	0.5(**5**)
47pF(**470**)	0.5(**5**)
56pF(**560**)	0.5(**5**)
68pF(**680**)	0.5(**5**)
82pF(**820**)	0.5(**5**)
100pF(**101**)	0.5(**5**)
120pF(**121**)	0.5(**5**)
150pF(**151**)	0.5(**5**)
180pF(**181**)	0.5(**5**)
220pF(**221**)	0.5(**5**)
270pF(**271**)	0.5(**5**)
330pF(**331**)	0.5(**5**)
390pF(**391**)	0.5(**5**)
470pF(**471**)	0.5(**5**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

Temperature Compensating Type GCM18 Series

Part Number	**GCM18**	
L x W [EIA]	1.6x0.8 [0603]	
TC	C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
0.50pF(**R50**)	0.8(**8**)	0.8(**8**)
1.0pF(**1R0**)	0.8(**8**)	0.8(**8**)
2.0pF(**2R0**)	0.8(**8**)	0.8(**8**)
3.0pF(**3R0**)	0.8(**8**)	0.8(**8**)
4.0pF(**4R0**)	0.8(**8**)	0.8(**8**)

Continued on the following page. ↗

Continued from the preceding page.

Part Number	**GCM18**	
L x W [EIA]	1.6x0.8 [0603]	
TC	C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
5.0pF(**5R0**)	0.8(**8**)	0.8(**8**)
6.0pF(**6R0**)	0.8(**8**)	0.8(**8**)
7.0pF(**7R0**)	0.8(**8**)	0.8(**8**)
8.0pF(**8R0**)	0.8(**8**)	0.8(**8**)
9.0pF(**9R0**)	0.8(**8**)	0.8(**8**)
10pF(**100**)	0.8(**8**)	0.8(**8**)
12pF(**120**)	0.8(**8**)	0.8(**8**)
15pF(**150**)	0.8(**8**)	0.8(**8**)
18pF(**180**)	0.8(**8**)	0.8(**8**)
22pF(**220**)	0.8(**8**)	0.8(**8**)
27pF(**270**)	0.8(**8**)	0.8(**8**)
33pF(**330**)	0.8(**8**)	0.8(**8**)
39pF(**390**)	0.8(**8**)	0.8(**8**)
47pF(**470**)	0.8(**8**)	0.8(**8**)
56pF(**560**)	0.8(**8**)	0.8(**8**)
68pF(**680**)	0.8(**8**)	0.8(**8**)
82pF(**820**)	0.8(**8**)	0.8(**8**)
100pF(**101**)	0.8(**8**)	0.8(**8**)
120pF(**121**)	0.8(**8**)	0.8(**8**)
150pF(**151**)	0.8(**8**)	0.8(**8**)
180pF(**181**)	0.8(**8**)	0.8(**8**)
220pF(**221**)	0.8(**8**)	0.8(**8**)
270pF(**271**)	0.8(**8**)	0.8(**8**)
330pF(**331**)	0.8(**8**)	0.8(**8**)
390pF(**391**)	0.8(**8**)	0.8(**8**)
470pF(**471**)	0.8(**8**)	0.8(**8**)
560pF(**561**)	0.8(**8**)	0.8(**8**)
680pF(**681**)	0.8(**8**)	0.8(**8**)
820pF(**821**)	0.8(**8**)	0.8(**8**)
1000pF(**102**)	0.8(**8**)	0.8(**8**)
1200pF(**122**)	0.8(**8**)	0.8(**8**)
1500pF(**152**)	0.8(**8**)	0.8(**8**)
1800pF(**182**)		0.8(**8**)
2200pF(**222**)		0.8(**8**)
2700pF(**272**)		0.8(**8**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

Temperature Compensating Type GCM21 Series

Part Number	**GCM21**	
L x W [EIA]	2.0x1.25 [0805]	
TC	C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
100pF(**101**)	0.6(**6**)	0.6(**6**)
120pF(**121**)	0.6(**6**)	0.6(**6**)
150pF(**151**)	0.6(**6**)	0.6(**6**)
180pF(**181**)	0.6(**6**)	0.6(**6**)

Continued on the following page.

Continued from the preceding page.

Part Number	GCM21	
L x W [EIA]	2.0x1.25 [0805]	
TC	C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
220pF(**221**)	0.6(**6**)	0.6(**6**)
270pF(**271**)	0.6(**6**)	0.6(**6**)
330pF(**331**)	0.6(**6**)	0.6(**6**)
390pF(**391**)	0.6(**6**)	0.6(**6**)
470pF(**471**)	0.6(**6**)	0.6(**6**)
560pF(**561**)	0.6(**6**)	0.6(**6**)
680pF(**681**)	0.6(**6**)	0.6(**6**)
820pF(**821**)	0.6(**6**)	0.6(**6**)
1000pF(**102**)	0.6(**6**)	0.6(**6**)
1200pF(**122**)	0.6(**6**)	0.6(**6**)
1500pF(**152**)	0.6(**6**)	0.6(**6**)
1800pF(**182**)	0.6(**6**)	0.6(**6**)
2200pF(**222**)	0.6(**6**)	0.6(**6**)
2700pF(**272**)	0.6(**6**)	0.6(**6**)
3300pF(**332**)	0.6(**6**)	0.6(**6**)
3900pF(**392**)		0.6(**6**)
4700pF(**472**)		0.6(**6**)
5600pF(**562**)		0.85(**9**)
6800pF(**682**)		0.85(**9**)
8200pF(**822**)		0.85(**9**)
10000pF(**103**)		0.85(**9**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

Temperature Compensating Type GCM31 Series

Part Number	GCM31	
L x W [EIA]	3.2x1.6 [1206]	
TC	C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
1000pF(**102**)	0.85(**9**)	0.85(**9**)
1200pF(**122**)	0.85(**9**)	0.85(**9**)
1500pF(**152**)	0.85(**9**)	0.85(**9**)
1800pF(**182**)	0.85(**9**)	0.85(**9**)
2200pF(**222**)	0.85(**9**)	0.85(**9**)
2700pF(**272**)	0.85(**9**)	0.85(**9**)
3300pF(**332**)	0.85(**9**)	0.85(**9**)
3900pF(**392**)	0.85(**9**)	0.85(**9**)
4700pF(**472**)	0.85(**9**)	0.85(**9**)
5600pF(**562**)	0.85(**9**)	0.85(**9**)
6800pF(**682**)	0.85(**9**)	0.85(**9**)
8200pF(**822**)	0.85(**9**)	0.85(**9**)
10000pF(**103**)	0.85(**9**)	0.85(**9**)
12000pF(**123**)		0.85(**9**)
15000pF(**153**)		0.85(**9**)
18000pF(**183**)		0.85(**9**)
22000pF(**223**)		0.85(**9**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

High Dielectric Constant Type, X7R (R7) Characteristics

TC	X7R (R7)																							
Part Number	GCM03			GCM15				GCM18				GCM21					GCM31					GCM32			
L x W [EIA]	0.6x0.3 [0201]			1.0x0.5 [0402]				1.6x0.8 [0603]				2.0x1.25 [0805]					3.2x1.6 [1206]					3.2x2.5 [1210]			
Rated Volt.	25 (1E)	16 (1C)	10 (1A)	100 (2A)	50 (1H)	25 (1E)	16 (1C)	100 (2A)	50 (1H)	25 (1E)	16 (1C)	100 (2A)	50 (1H)	25 (1E)	16 (1C)	10 (1A)	100 (2A)	50 (1H)	25 (1E)	16 (1C)	10 (1A)	50 (1H)	25 (1E)	16 (1C)	10 (1A)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)																									
100pF (**101**)	0.3 (**3**)																								
150pF (**151**)	0.3 (**3**)																								
220pF (**221**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)																				
330pF (**331**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)																				
470pF (**471**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)																				
680pF (**681**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)																				
1000pF (**102**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)			0.8 (**8**)	0.8 (**8**)			0.6 (**6**)	0.6 (**6**)												
1500pF (**152**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)			0.8 (**8**)	0.8 (**8**)			0.6 (**6**)	0.6 (**6**)												
2200pF (**222**)		0.3 (**3**)		0.5 (**5**)	0.5 (**5**)			0.8 (**8**)	0.8 (**8**)			0.6 (**6**)	0.6 (**6**)												
3300pF (**332**)		0.3 (**3**)		0.5 (**5**)	0.5 (**5**)			0.8 (**8**)	0.8 (**8**)			0.6 (**6**)	0.6 (**6**)												
4700pF (**472**)			0.3 (**3**)	0.5 (**5**)	0.5 (**5**)			0.8 (**8**)	0.8 (**8**)			0.6 (**6**)	0.6 (**6**)												
6800pF (**682**)			0.3 (**3**)		0.5 (**5**)	0.5 (**5**)		0.8 (**8**)	0.8 (**8**)			0.6 (**6**)	0.6 (**6**)												
10000pF (**103**)			0.3 (**3**)		0.5 (**5**)	0.5 (**5**)		0.8 (**8**)	0.8 (**8**)			0.6 (**6**)	0.6 (**6**)												
15000pF (**153**)					0.5 (**5**)	0.5 (**5**)		0.8 (**8**)	0.8 (**8**)	0.8 (**8**)		0.6 (**6**)	0.6 (**6**)												
22000pF (**223**)					0.5 (**5**)	0.5 (**5**)		0.8 (**8**)	0.8 (**8**)	0.8 (**8**)		0.6 (**6**)	0.6 (**6**)												
33000pF (**333**)						0.5 (**5**)	0.5 (**5**)		0.8 (**8**)	0.8 (**8**)		0.85 (**9**)	0.85 (**9**)												
47000pF (**473**)						0.5 (**5**)	0.5 (**5**)		0.8 (**8**)	0.8 (**8**)		1.25 (**B**)	1.25 (**B**)												
68000pF (**683**)							0.5 (**5**)		0.8 (**8**)	0.8 (**8**)	0.8 (**8**)	1.25 (**B**)	1.25 (**B**)												
0.10µF (**104**)							0.5 (**5**)	0.8 (**8**)	0.8 (**8**)	0.8 (**8**)	0.8 (**8**)	1.25 (**B**)	1.25 (**B**)				0.85 (**9**)	0.85 (**9**)							
0.15µF (**154**)										0.8 (**8**)			1.25 (**B**)	1.25 (**B**)			1.15 (**M**)	1.15 (**M**)							
0.22µF (**224**)										0.8 (**8**)			1.25 (**B**)	1.25 (**B**)	0.85 (**9**)		1.15 (**M**)	1.15 (**M**)	0.85 (**9**)						
0.33µF (**334**)											0.8 (**8**)		0.85 (**9**)	1.25 (**B**)	1.25 (**B**)			1.15 (**M**)	0.85 (**9**)						
0.47µF (**474**)										0.8 (**8**)	0.8 (**8**)		1.25 (**B**)	0.85 (**9**)	1.25 (**B**)			1.15 (**M**)	1.15 (**M**)						
0.68µF (**684**)														1.25 (**B**)	0.85 (**9**)			1.15 (**M**)							

Continued on the following page. ↗

muRata

Continued from the preceding page.

TC	X7R (**R7**)																								
Part Number	**GCM03**			**GCM15**				**GCM18**				**GCM21**					**GCM31**					**GCM32**			
L x W [EIA]	0.6x0.3 [0201]			1.0x0.5 [0402]				1.6x0.8 [0603]				2.0x1.25 [0805]					3.2x1.6 [1206]					3.2x2.5 [1210]			
Rated Volt.	25 (**1E**)	16 (**1C**)	10 (**1A**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)																									
1.0µF (**105**)														1.25 (**B**)	0.85 (**9**)			1.15 (**M**)	1.15 (**M**)			2.5 (**E**)			
2.2µF (**225**)														1.25 (**B**)	1.25 (**B**)	1.25 (**B**)		1.6 (**C**)	1.15 (**M**)				2.5 (**E**)		
4.7µF (**475**)																			1.6 (**C**)	1.6 (**C**)		2.5 (**E**)	2.00 (**D**)		
10µF (**106**)																				1.6 (**C**)	1.6 (**C**)		2.5 (**E**)	2.0 (**D**)	
22µF (**226**)																									2.5 (**E**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
The tolerance will be changed to L: 3.2±0.2, W: 1.6±0.2, T: 1.15±0.15 for GCM31 25V 2.2µF type.

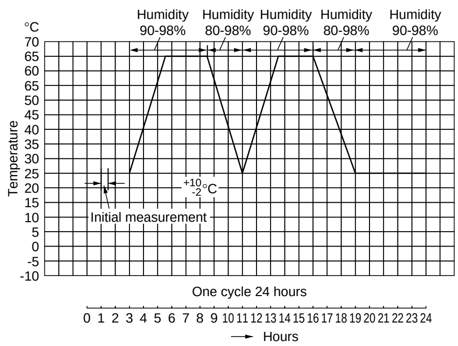
High Dielectric Constant Type, X7S (C7) Characteristics

TC	X7S (**C7**)		
Part Number	**GCM18**		**GCM21**
L x W [EIA]	1.6x0.8 [0603]		2.0x1.25 [0805]
Rated Volt.	16 (**1C**)	10 (**1A**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)			
0.68µF(**684**)	0.8(**8**)		
1.0µF(**105**)		0.8(**8**)	
4.7µF(**475**)			1.25(**B**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

muRata

Specifications and Test Methods

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="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">Sit 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 the 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">*1
More than 10,000MΩ or 500Ω · F
(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≧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≧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>

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
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 monomethylether 1 part (by volume) of monoethanolomine
		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		

Continued on the following page.

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-Q200-004
		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 is 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 Chatacteri-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.

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

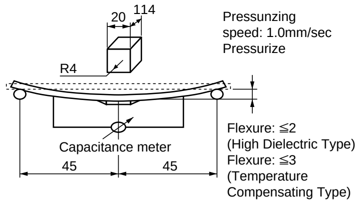
<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200
Test Item</th><th colspan="2">Specifications</th><th rowspan="2">AEC-Q200 Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td rowspan="4">18</td><td rowspan="4">Board
Flex</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply a 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.
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>**GCM03**</td><td>0.3</td><td>0.9</td><td>0.3</td></tr>
<tr><td>**GCM15**</td><td>0.5</td><td>1.5</td><td>0.6</td></tr>
<tr><td>**GCM18**</td><td>0.6</td><td>2.2</td><td>0.9</td></tr>
<tr><td>**GCM21**</td><td>0.8</td><td>3.0</td><td>1.3</td></tr>
<tr><td>**GCM31**</td><td>2.0</td><td>4.4</td><td>1.7</td></tr>
<tr><td>**GCM32**</td><td>2.0</td><td>4.4</td><td>2.6</td></tr>
</table>
(in mm)


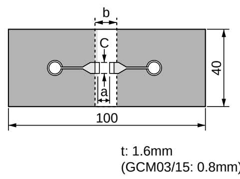
Fig. 2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000
30pF max.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.025 max.
W.V.: 16V: 0.035 max.</td></tr>
<tr><td>I.R.</td><td>*1
More than 10,000MΩ or 500Ω · F
(Whichever is smaller)</td><td>

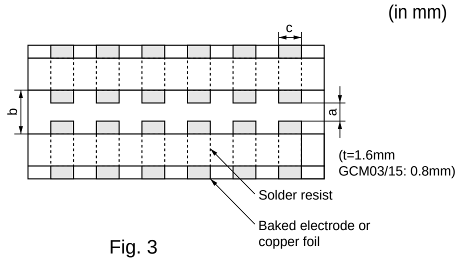
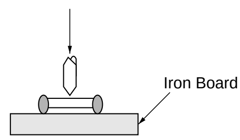
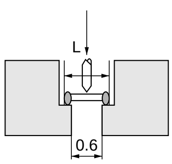
Fig. 1</td></tr>
<tr><td rowspan="4">19</td><td rowspan="4">Terminal
Strength</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 3 using a eutectic solder. Then apply *18N force in parallel with the test 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)
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>**GCM03**</td><td>0.3</td><td>0.9</td><td>0.3</td></tr>
<tr><td>**GCM15**</td><td>0.4</td><td>1.5</td><td>0.5</td></tr>
<tr><td>**GCM18**</td><td>1.0</td><td>3.0</td><td>1.2</td></tr>
<tr><td>**GCM21**</td><td>1.2</td><td>4.0</td><td>1.65</td></tr>
<tr><td>**GCM31**</td><td>2.2</td><td>5.0</td><td>2.0</td></tr>
<tr><td>**GCM32**</td><td>2.2</td><td>5.0</td><td>2.9</td></tr>
</table>
(in mm)


Fig. 3</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000
30pF max.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>*1
W.V.: 25Vmin.: 0.025 max.
W.V.: 16V: 0.035 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">*1
More than 10,000MΩ or 500Ω · F
(Whichever is smaller)</td></tr>
<tr><td>20</td><td colspan="2">Beam Load Test</td><td colspan="2">The chip endure 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</td><td>Place the capacitor in the beam load fixture as Fig. 4.
Apply a force.
< Chip Length: 2.5mm max. >


Speed supplied the Stress Load: 0.5mm / sec.
< Chip Length: 3.2mm min. >


Speed supplied the Stress Load: 2.5mm / sec.
Fig. 4</td></tr>
</table>

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
21	Capacitance Temperature Character-istics	Capacitance Change	Within the specified tolerance (Table A)	C7: Withn ±22% (-55°C to +125°C) R7: Withn ±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 step1 through 5 (ΔC: +25°C to +125°C: other temp. coeffs.: +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 Coefficent	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 inspection. Please refer to individual specifications.
*2: Some of the parts are applicable in rated voltage x 150%. 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).

Chip Monolithic Ceramic Capacitors for Automotive

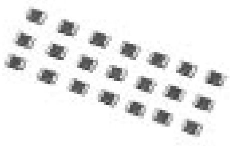
for Ultrasonic Sensors GRM Series

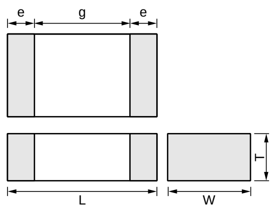
■ Features

1. Proper to compensate for ultrasonic sensor
2. Small chip size and high cap. value

■ Applications

Ultrasonic sensor
(Back sonar, Corner sonar and etc.)

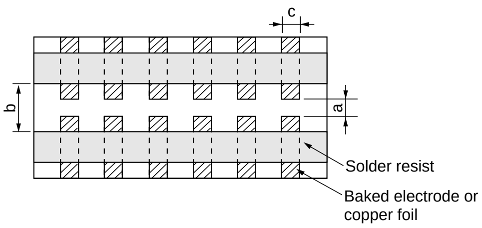




Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRM219	2.0 ±0.1	1.25 ±0.1	0.85 ±0.1	0.2 to 0.7	0.7

Part Number	TC Code	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM2199E2A102KD42	ZLM (Murata)	100	1000 ±10%	2.0	1.25	0.85
GRM2199E2A152KD42	ZLM (Murata)	100	1500 ±10%	2.0	1.25	0.85

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature</td><td>−25 to +85℃</td><td>Reference Temperature: 20°C</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td>Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when 300% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>More than 10,000MΩ</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 20℃ and 75%RH max. and within 2 minutes of charging.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/D.F. should be measured at 20℃ with 1±0.1kHz in frequency and 1±0.2Vrms in voltage.</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>0.01 max.</td></tr>
<tr><td>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td>Within $-4{,}700^{+1{,}000}_{-2{,}500}$ ppm/℃ (at −25 to +20℃)
Within $-4{,}700^{+500}_{-1{,}000}$ ppm/℃ (at +20 to +85℃)</td><td>The temperature coefficient is determined using the capacitance measured in step 1 as a reference.
When cycling the temperature sequentially from step 1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient.
The capacitance change should be measured after 5 min. at each specified temperature stage.
<table>
<tr><th>Step</th><th>Temperature (℃)</th></tr>
<tr><td>1</td><td>20±2</td></tr>
<tr><td>2</td><td>−25±3</td></tr>
<tr><td>3</td><td>20±2</td></tr>
<tr><td>4</td><td>85±3</td></tr>
<tr><td>5</td><td>20±2</td></tr>
</table></td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply 10N force in the direction of the arrow.
The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.


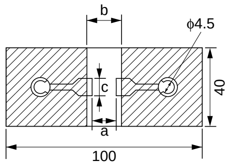
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>**GRM21**</td><td>1.2</td><td>4.0</td><td>1.65</td></tr>
</table>
(in mm)
Fig. 1</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10).
The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.</td><td>0.01 max.</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specifications	Test Method
12	Deflection		No cracking or marking defects should occur.	Solder the capacitor to the test jig (glass epoxy boards) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. 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.



Type	a	b	c
GRM21	1.2	4.0	1.65

(in mm)

Fig. 2

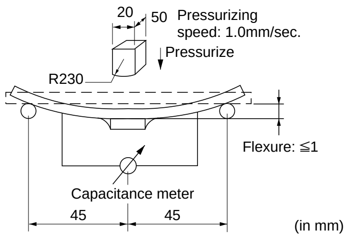


Fig.3

No.	Item		Specifications	Test Method
13	Solderability of Termination		75% of the terminations are to be soldered evenly and continuously.	Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120℃ for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5℃ or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.
14	Resistance to Soldering Heat	Appearance	No defects or abnormalities	Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 24±2 hours, then measure.
		Capacitance Change	Within ±7.5%	
		D.F.	0.01 max.	
		I.R.	More than 10,000MΩ	
		Dielectric Strength	No failure	
15	Temperature Cycle	Appearance	No defects or abnormalities	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure.
		Capacitance Change	Within ±7.5%	
		D.F.	0.01 max.	
		I.R.	More than 10,000MΩ	
		Dielectric Strength	No failure	
16	Humidity, Steady State	Appearance	No defects or abnormalities	Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure.
		Capacitance Change	Within ±12.5%	
		D.F.	0.02 max.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	No failure	
17	Humidity Load	Appearance	No defects or abnormalities	Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	Within ±12.5%	
		D.F.	0.02 max.	
		I.R.	More than 500MΩ	
18	High Temperature Load	Appearance	No defects or abnormalities	Apply 200% of the rated voltage for 1,000±12 hours at 85±3℃. Let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	Within ±12.5%	
		D.F.	0.02 max.	
		I.R.	More than 1,000MΩ	

Temperature cycle table (No. 15):

Step	1	2	3	4
Temp. (℃)	-25^{+0}_{-3}	Room Temp.	85^{+3}_{-0}	Room Temp.
Time (min.)	30±3	2 to 3	30±3	2 to 3

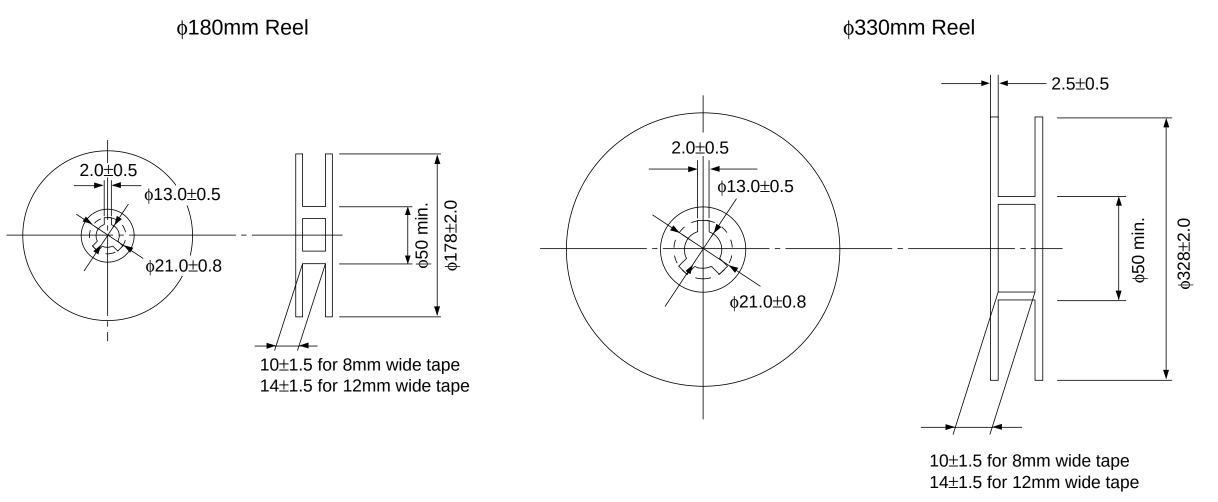
■ Minimum Quantity Guide

Part Number	Dimensions (mm)			Quantity (pcs.)					
				ø180mm reel		ø330mm reel		Bulk Case Packaging Code: C	Bulk Bag Packaging Code: B
	L	W	T	Paper Tape Packaging Code: D	Embossed Tape Packaging Code: L	Paper Tape Packaging Code: J	Embossed Tape Packaging Code: K		
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	1,000
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
GRM21 (For Ultrasonic)	2.0	1.25	0.85	4,000	-	10,000	-	-	1,000

1) 68000pF/0.1µF of R7 50V are not available by bulk case.

■ Tape Carrier Packaging

1. Dimensions of Reel



(in mm)

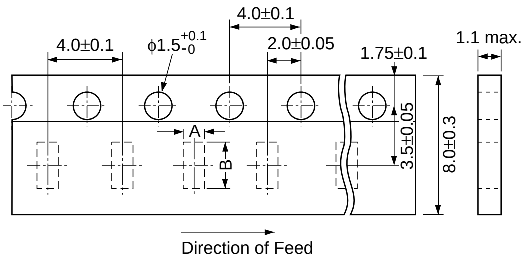
Continued on the following page.

Package

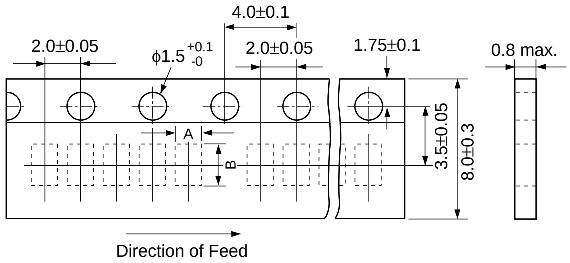
Continued from the preceding page.

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, GRM21 (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

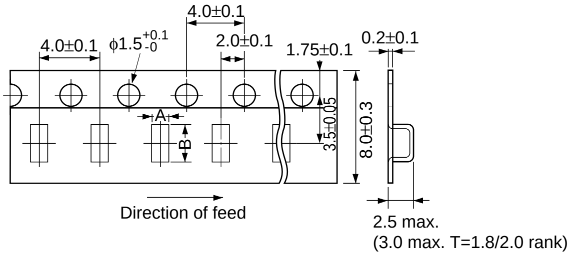
Part Number	A*	B*
GCM03	0.37	0.67
GCM15	0.65	1.15

*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

*Nominal Value

(in mm)

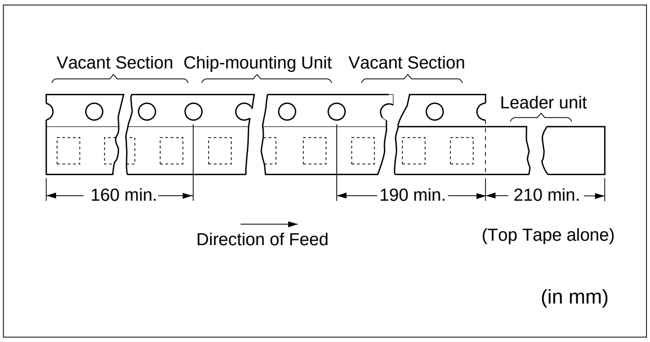
Continued on the following page.

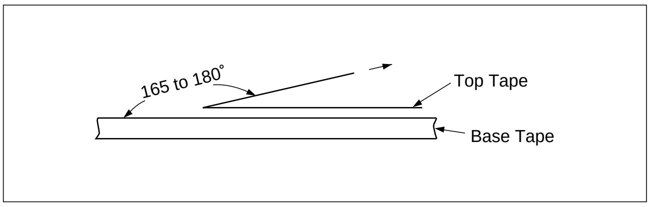
Continued from the preceding page.

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 sprocked holes.
(6) Cumulative tolerance of sprocket holes, 10 pitches: ±0.3mm.
(7) Peeling off force: 0.1 to 0.6N* in the direction shown below.

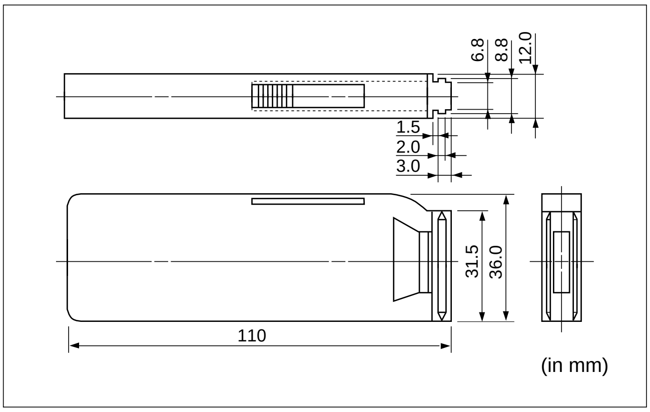
*GCM03: 0.05 to 0.5N





■ Dimensions of Bulk Case Packaging

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



⚠Caution

■ ⚠Caution (Storage and Operating Condition)

Chip monolithic ceramic capacitors (chips) can experience degradation of termination solderability when subjected to high temperature or humidity, or if exposed to sulfur or chlorine gases.
Storage environment must be at an ambient temperature of 5-40 degree C and an ambient humidity of 20-70%RH.
Use chip within 6 months. If 6 months or more have elapsed, check solderability before use.

Insulation Resistance should be deteriorated on specific condition of high humiditiy or incorrosion gas such as hydrogen sulfide, sulfurous acid gas, cholorine. Those condition are not suitable for use.

Use of Sn-Zn based solder will deteriorate reliability of MLCC.
Please contact murata factory for the use of Sn-Zn based solder in advance.

Do not use under the condition that causes condensation. Use dampproof countermeasure if using under the condition that causes condensation.

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 (Handling)

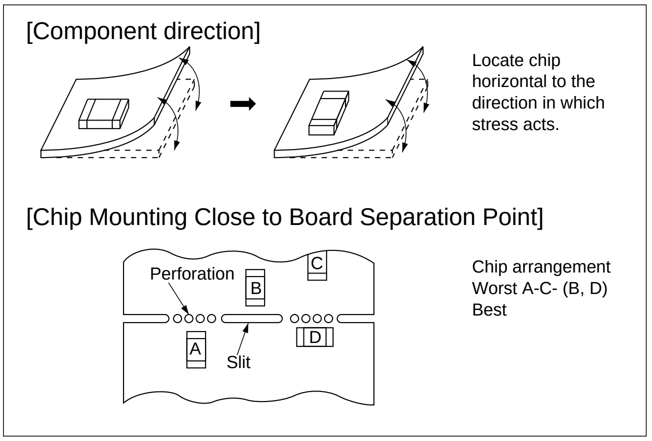
1. Inspection
   Thrusting force of the test probe can flex the PCB, resulting in cracked chips or open solder joints.
   Provide support pins on the back side of the PCB to prevent warping or flexing.
2. Board Separation (or depanalization)
   (1) Board flexing at the time of separation causes cracked chips or broken solder.
   (2) Severity of stresses imposed on the chip at the time of board break is in the order of: Pushback<Slitter<V Slot<Perforator.
   (3) Board separation must be performed using special jigs, not with hands.
3. Reel and bulk case
   In the handling of reel and case, please be careful and do not drop it.
   Do not use chips from a case which has been dropped.

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

■ ⚠Caution (Soldering and Mounting)

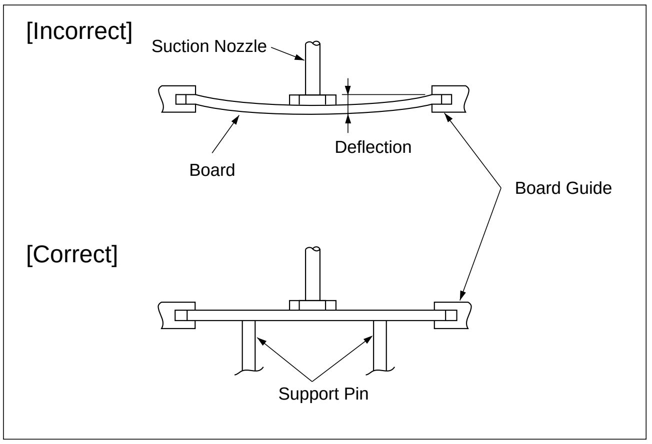
1. Mounting Position

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



2. Chip Placing

- An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips. So adjust the suction nozzle's bottom dead point by correcting warp in the board. Normally, the suction bottom dead point must be set on the upper surface of the board. Nozzle pressure for chip mounting must be a 1 to 3N static load.
- Dirt particles and dust accumulated between the suction nozzle and the cylinder inner wall prevent the nozzle from moving smoothly. This imposes great force on the chip during mounting, causing cracked chips. And 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.

3. Reflow Soldering

- When the sudden heat is given to the components, the mechanical strength of the components should go down because remarkable temperature change causes deformity of components inside. 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 1.
  It is required to keep temperature differential between the soldering and the components surface (ΔT) as small as possible.
- Solderability of Tin plating termination chip might be deteriorated when low temperature soldering profile where peak solder temperature is 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
GCM03/15/18/21/31, GRM21	ΔT≦190°C
GCM32	ΔT≦130°C

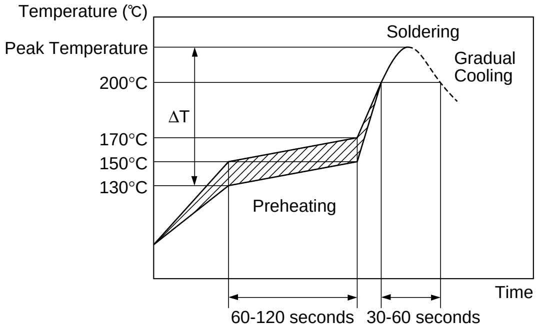
Recommended Conditions

	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

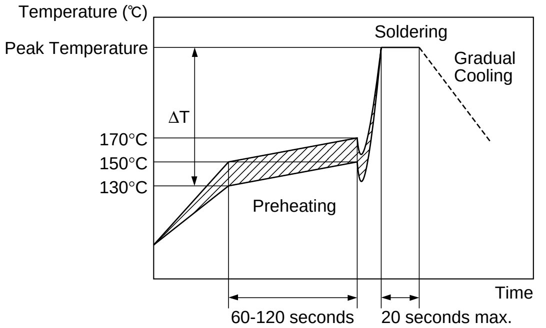
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Reflow Soldering]

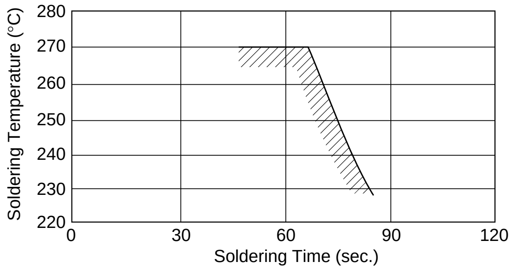
Infrared Reflow



Vapor Reflow



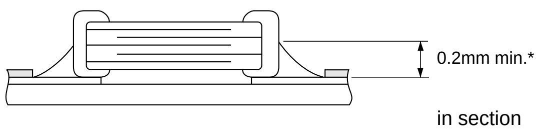
[Allowable Soldering Temperature and Time]



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

- 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]



* GCM03: 1/3 of chip thickness min.

Inverting the PCB

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

Continued on the following page.

⚠Caution

Continued from the preceding page.

4. Leaded Component Insertion

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. Flow Soldering

- When the sudden heat is given to the components, the mechanical strength of the components should go down because remarkable temperature change causes deformity of components inside. And an excessively long soldering time or high soldering temperature results 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.
- In order to prevent mechanical damage in the components, preheating shoud 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 small 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.
Don't apply flow soldering to chips not listed in Table 2.

Table 2

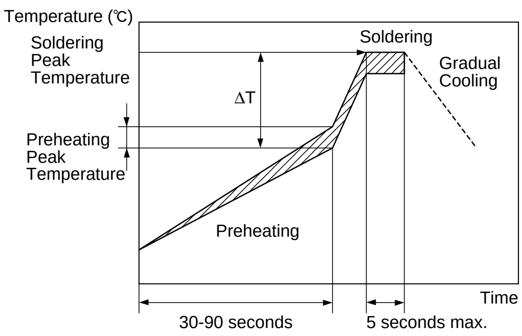
Part Number	Temperature Differential
GCM18/21/31, GRM21	ΔT≦150°C

Recommended Conditions

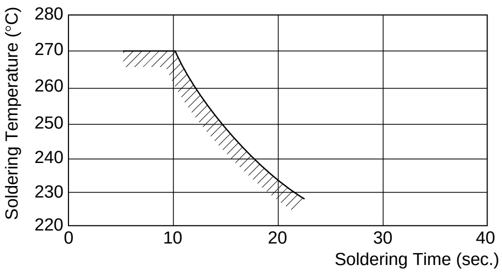
	Pb-Sn Solder	Lead Free Solder
Preheating Peak Temperature	90-110°C	100-120°C
Soldering Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N_2

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

[Standard Conditions for Flow Soldering]

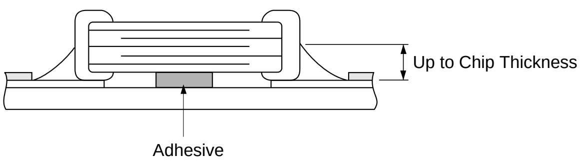


[Allowable Soldering Temperature and Time]



In 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 excessively big, the risk of cracking is higher during board bending or under any other stressful conditions.



Continued on the following page.

⚠Caution

Continued from the preceding page.

6. Correction with a Soldering Iron

(1) For Chip Type Capacitors

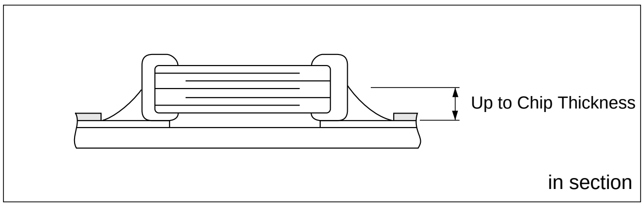
● When the sudden heat is given to the components by soldering iron, the mechanical strength of the components should go down because remarkable temperature change causes deformity of components inside. In order to prevent mechanical damage in the components, preheating should be required for both of the components and the PCB board. Preheating conditions are shown in table 3. It is required to keep temperature differential between the soldering and the components surface (ΔT) as small as possible. After soldering, it is not allowed to cool it down rapidly.

Table 3

Part Number	Temperature Differential	Peak Temperature	Atmosphere
GCM15/18/21/31 GRM21	ΔT≦190℃	300°C max. 3 seconds max. / termination	Air
GCM32	ΔT≦130℃	270°C max. 3 seconds max. / termination	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 Corrections Are Made Using a Soldering Iron
The top of the solder fillet should be lower than the thickness of components. If the solder amount is excessively big, the risk of cracking is higher during board bending or under any other stressful conditions.
Soldering iron ø3mm or smaller should be required. And it is necessary to keep a distance between the soldering iron and the components without direct touch. Thread solder with ø0.5mm or smaller is required for soldering.



● Please carry it out after having confirmed that there is not abnormality such as product cracks by mounter beforehand.

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 PRODUCTS IS USED.

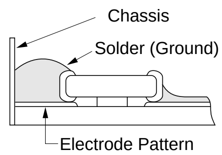
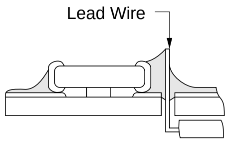
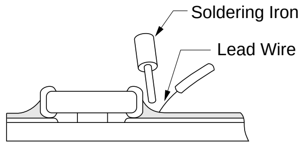
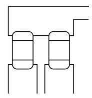
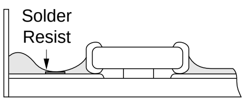
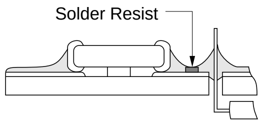
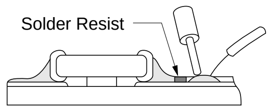
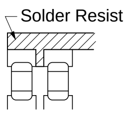
■ Notice (Soldering and Mounting)

1. PCB Design

(1) Notice for Pattern Forms

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.
It causes breaking a chip to mount on metal substrate when heat stress increased, because there are different of thermal expansion coefficient between metal substrate and chip. Please contact us in the case of mounting metal substrate beforehand.

Pattern Forms

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

Continued on the following page.

Notice

Continued from the preceding page.

(2) Land Dimensions
Excessive amount of solder gives much stress to the components. Appropriate land pattern size can reduce the amount of solder and the mechanical stress to the components. Recommended land pattern dimension for flow and reflow are shown in Table 1 and Table 2 respectively.

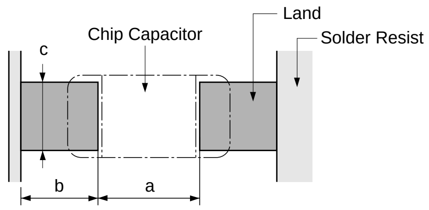


Table 1 Flow Soldering Method

Part Number \ Dimensions	Dimensions (L×W)	a	b	c
GCM18	1.6×0.8	0.6–1.0	0.8–0.9	0.6–0.8
GCM21, GRM21	2.0×1.25	1.0–1.2	0.9–1.0	0.8–1.1
GCM31	3.2×1.6	2.2–2.6	1.0–1.1	1.0–1.4

(in mm)

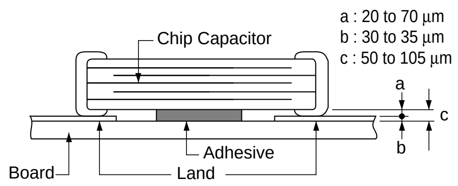
Table 2 Reflow Soldering Method

Part Number \ Dimensions	Dimensions (L×W)	a	b	c
GCM03	0.6×0.3	0.2–0.3	0.2–0.35	0.2–0.4
GCM15	1.0×0.5	0.3–0.5	0.35–0.45	0.4–0.6
GCM18	1.6×0.8	0.6–0.8	0.6–0.7	0.6–0.8
GCM21, GRM21	2.0×1.25	1.0–1.2	0.6–0.7	0.8–1.1
GCM31	3.2×1.6	2.2–2.4	0.8–0.9	1.0–1.4
GCM32	3.2×2.5	2.0–2.4	1.0–1.2	1.8–2.3

(in mm)

2. Adhesive Application

- Thin or insufficient adhesive causes chips to loosen or become disconnected when flow soldered.
  The amount of adhesive must be more than dimension c shown in the drawing below to obtain enough bonding strength.
  The chip's electrode thickness and land thickness must be taken into consideration.
- Low viscosity adhesive causes chips to slip after mounting. Adhesive must have a viscosity of 5000Pa·s (500ps) min. (at 25°C)
- Adhesive Coverage*



Part Number	Adhesive Coverage*
GCM18	0.05mg min.
GCM21, GRM21	0.1mg min.
GCM31	0.15mg min.

*Nominal Value

3. Adhesive Curing

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

Inverting the PCB

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

Continued on the following page.

Continued from the preceding page.

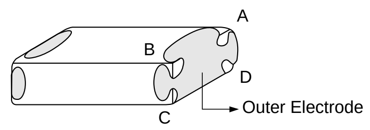
4. Flux Application

- 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 percentage of halide may cause corrosion of the outer electrodes unless 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 resin type flux including wash-type flux and non-wash-type flux.)

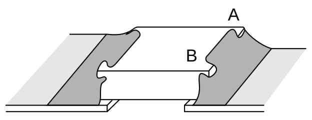
5. Flow Soldering

- 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 below) and 25% of the length A-B shown below as mounted on substrate.

[As a Single Chip]



[As Mounted on Substrate]

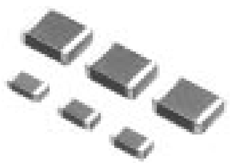


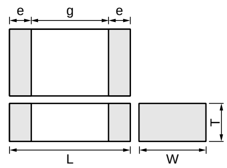
■ Notice (Other)

1. Resin Coating
   When selecting resin materials, select those with low contraction.
2. Circuit Design
   These capacitors on this catalog are not safety recognized products
3. Remarks
   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 here in are given in typical values, not guaranteed ratings.

Chip Monolithic Ceramic Capacitors for Automotive

Medium Voltage for Automotive GCM Series Low Dissipation Factor





■ 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 realize good solderability.
6. Use the GCM21/31 type with flow or reflow soldering, and other types with reflow soldering only.

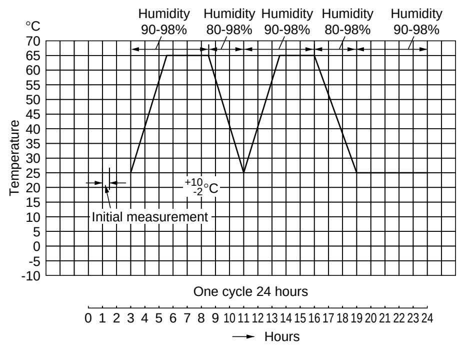
Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GCM21A	2.0 ±0.2	1.25 ±0.2	1.0 +0,-0.3	0.3	0.7
GCM31A	3.2 ±0.2	1.6 ±0.2	1.0 +0,-0.3	0.3	1.5
GCM31B	3.2 ±0.2	1.6 ±0.2	1.25 +0,-0.3	0.3	1.5
GCM32A	3.2 ±0.2	2.5 ±0.2	1.0 +0,-0.3	0.3	1.5

■ 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.
GCM21A7U2E151JX01D	DC250	U2J (EIA)	150 ±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.
GCM21A7U2E331JX01D	DC250	U2J (EIA)	330 ±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.
GCM21A7U2E681JX01D	DC250	U2J (EIA)	680 ±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.
GCM21A7U2E152JX01D	DC250	U2J (EIA)	1500 ±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.
GCM31A7U2E332JX01D	DC250	U2J (EIA)	3300 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GCM31A7U2E472JX01D	DC250	U2J (EIA)	4700 ±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.
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.
GCM31A7U2J150JX01D	DC630	U2J (EIA)	15 ±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.
GCM31A7U2J330JX01D	DC630	U2J (EIA)	33 ±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.
GCM31A7U2J680JX01D	DC630	U2J (EIA)	68 ±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.
GCM31A7U2J151JX01D	DC630	U2J (EIA)	150 ±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.
GCM31A7U2J331JX01D	DC630	U2J (EIA)	330 ±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.
GCM31A7U2J681JX01D	DC630	U2J (EIA)	680 ±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.
GCM32A7U2J152JX01D	DC630	U2J (EIA)	1500 ±5%	3.2	2.5	1.0	1.5	0.3 min.
GCM32A7U2J222JX01D	DC630	U2J (EIA)	2200 ±5%	3.2	2.5	1.0	1.5	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">Sit 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 ±2.5% or ±0.25pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≧1000</td></tr>
<tr><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 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></td></tr>
<tr><td rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≧1000</td></tr>
<tr><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 rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3.0% or ±0.3pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≧350</td></tr>
<tr><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 rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3.0% or ±0.3pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≧200</td></tr>
<tr><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 120% of the rated voltage 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.</td></tr>
<tr><td rowspan="4"></td><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3.0% or ±0.3pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≧350</td></tr>
<tr><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</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 monomethylether 1 part (by volume) of monoethanolomine
		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	
		I.R.	More than 10,000MΩ or 500MΩ · µF (Whichever is smaller)	
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	
		I.R.	More than 10,000MΩ or 500MΩ · µF (Whichever is smaller)	
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-Q200-004
		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 is 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±0.1MHz</td><td>AC0.5 to 5V(r.m.s.)</td></tr><tr><td>C≧1000pF</td><td>1±0.1kHz</td><td>AC1±0.2V(r.m.s.)</td></tr></table></td></tr>
<tr><td>Q</td><td>Q≧1000</td></tr>
<tr><td>I.R.</td><td>25°C
More than 100,000MΩ or 1,000MΩ · μF
(Whichever is smaller)

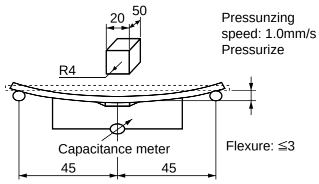
Max. Operating Temperature···125°C
More than 10,000MΩ or 100MΩ · μF
(Whichever is smaller)</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25°C and 125°C and within 2 minutes of charging.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td><td>No failure should be observed when voltage in 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="4">18</td><td rowspan="4">Board Flex</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Solder the capacitor on the test jig (glass epoxy board) 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>GCM21</td><td>0.8</td><td>3.0</td><td>1.3</td></tr><tr><td>GCM31</td><td>2.0</td><td>4.4</td><td>1.7</td></tr><tr><td>GCM32</td><td>2.0</td><td>4.4</td><td>2.6</td></tr></table>(in mm)


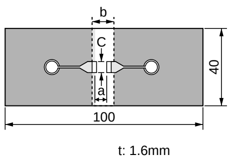
Fig. 2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≧1000</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 500MΩ · μF
(Whichever is smaller)


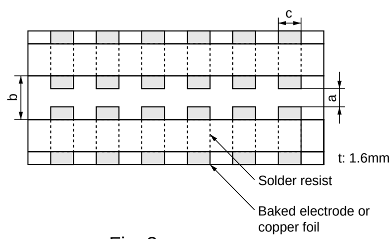
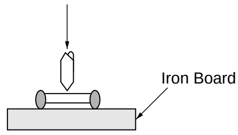
Fig. 1</td></tr>
<tr><td rowspan="4">19</td><td rowspan="4">Terminal Strength</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 3 using a eutectic solder. Then apply 18N force in parallel with the test jig for 60 seconds.
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>GCM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GCM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GCM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr></table>(in mm)


Fig. 3</td></tr>
<tr><td>Capacitance Change</td><td>Within the specified tolerance</td></tr>
<tr><td>Q</td><td>Q≧1000</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 500MΩ · μF
(Whichever is smaller)</td></tr>
</table>

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>20</td><td colspan="2">Beam Load Test</td><td>The chip endure 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</td><td>Place the capacitor in the beam load fixture as Fig. 4.
Apply a force.
< Chip L dimension: 2.5mm max. >

< Chip L dimension: 3.2mm min. >

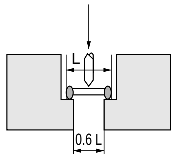
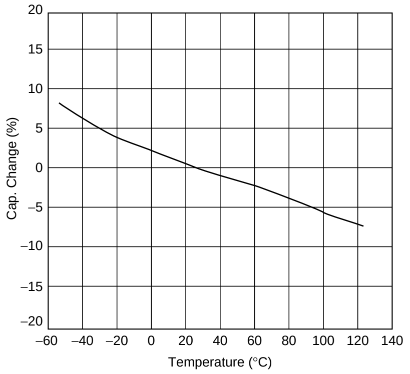



Fig. 4
Speed supplied the Stress Load: 2.5mm / s</td></tr>
<tr><td rowspan="2">21</td><td rowspan="2">Capacitance Temperature Character-istics</td><td>Capacitance Change</td><td>-750±120 ppm/°C
(Temp. Range: +25 to +125°C)
-750±120, -347 ppm/°C
(Temp. Range: -55 to +25°C)</td><td rowspan="2">The capacitance change should be measured after 5 min. 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 step1 through 5 the capacitance should be within the specified tolerance for the temperature coefficient. The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.
<table><tr><th>Step</th><th>Temperature (°C)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>-55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table></td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.5% or ±0.05 pF
(Whichever is larger)</td></tr>
</table>

■ Capacitance - Temperature Characteristics

U2J Characteristics



Package

Taping is standard packaging method.

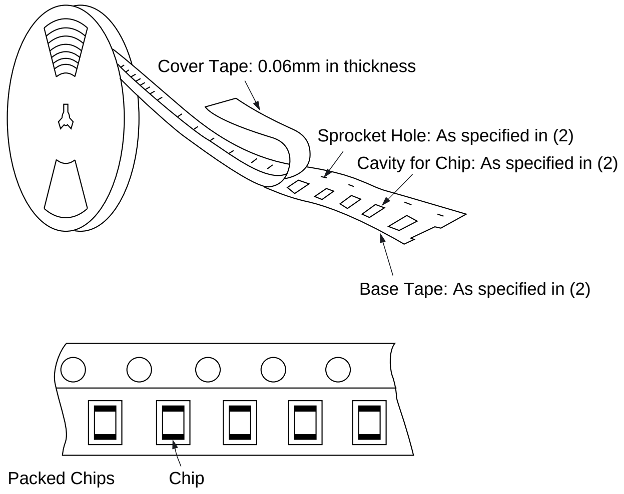
■ Minimum Quantity Guide

Part Number		Dimensions (mm)			Quantity (pcs.) ø180mm Reel	
		L	W	T	Paper Tape	Embossed Tape
Medium voltage	**GCM21**	2.0	1.25	1.0	4,000	-
	GCM31	3.2	1.6	1.0	4,000	-
				1.25	-	3,000
	GCM32	3.2	2.5	1.0	4,000	-

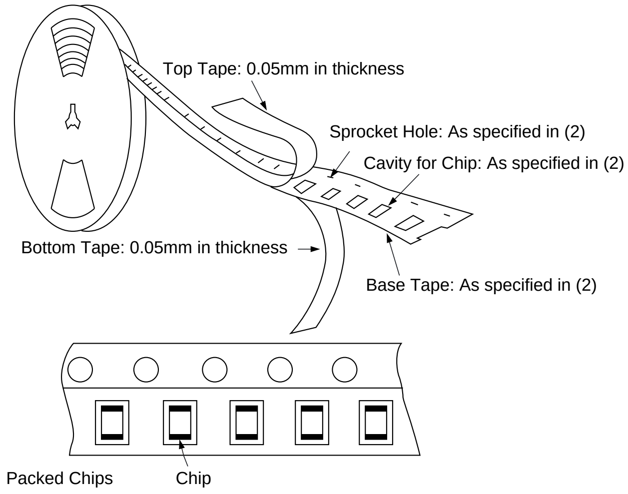
■ Tape Carrier Packaging

(1) Appearance of Taping

① Embossed Tape



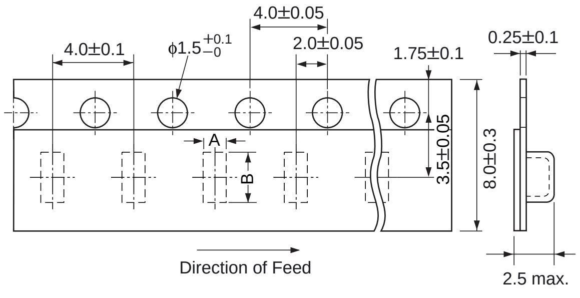
② Paper Tape



(2) Dimensions of Tape

① Embossed Tape

8mm width 4mm pitch Tape



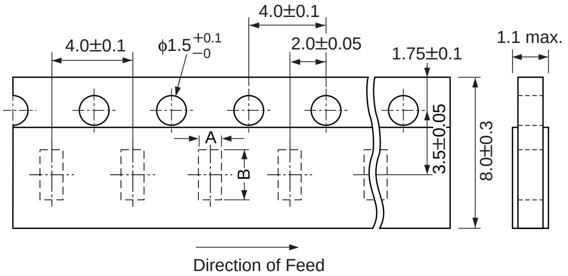
Part Number	A*	B*
GCM31 (T≧1.25mm)	2.0	3.6

*Nominal Value

(in mm)

② Paper Tape

8mm width 4mm pitch Tape



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

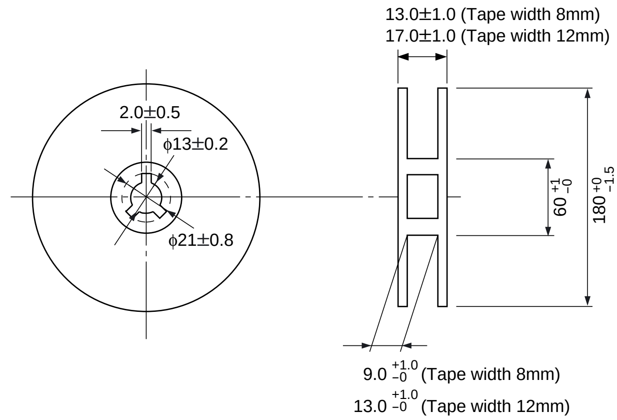
*Nominal Value

(in mm)

Continued on the following page. ↗

Continued from the preceding page.

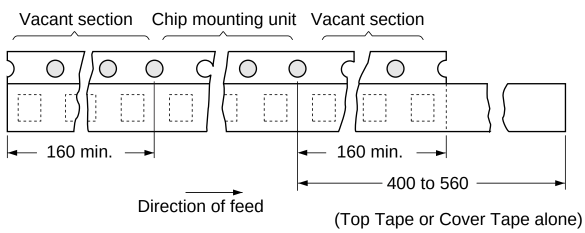
(3) Dimensions of Reel



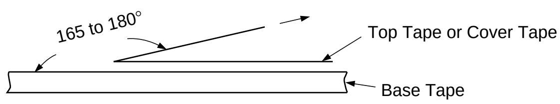
(in mm)

(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. And 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 after delivered. 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

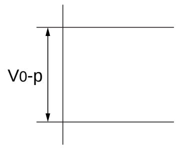
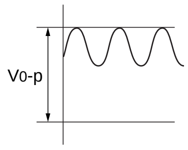
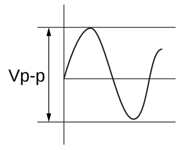
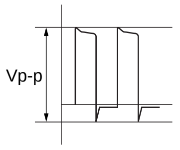
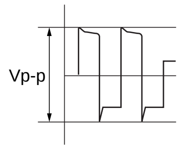
1. Vibration and impact
   Do not expose a capacitor to excessive shock or vibration during use.
2. Do not directly touch the chip capacitor, especially the ceramic body. Residue from hands/fingers may create a short circuit environment.

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.

■ Rating

1. Operating Voltage

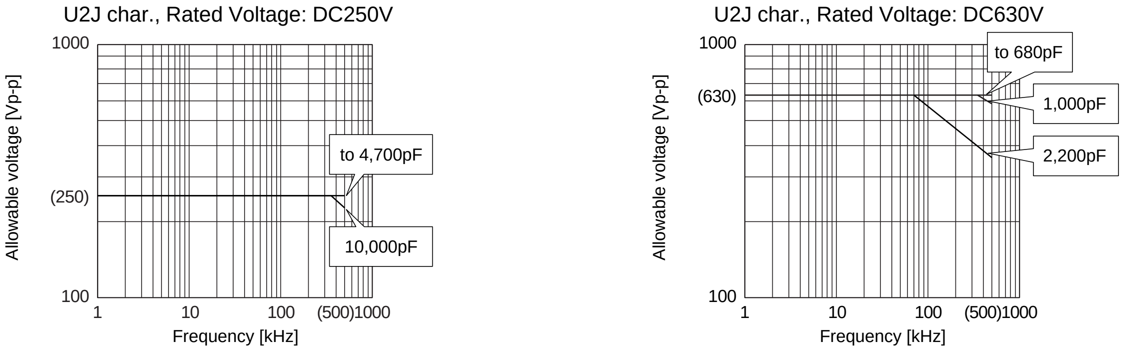
When DC-rated capacitors are to be used in AC or ripple current circuits, be sure to maintain the Vp-p value of the applied voltage or the Vo-p which contains DC bias within the rated voltage range.
When the voltage is applied to the circuit, starting or stopping may generate irregular voltage for a transit period because of resonance or switching. Be sure to use a capacitor with a rated voltage range that includes these irregular voltages.

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 a 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.
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 case of non-sine wave which 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.)

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



The sine-wave frequency VS allowable voltage

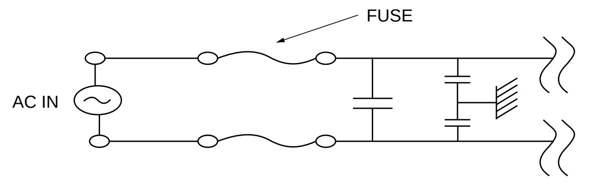
Continued on the following page.

⚠Caution

Continued from the preceding page.

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.



4. Test condition for AC withstanding Voltage

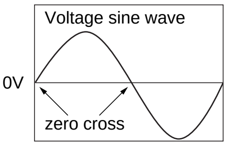
(1) Test Equipment

Tests for AC withstanding voltage should be made with equipment capable of creating a wave similar to a 50/60 Hz sine wave.
If the 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.

■ Solder and Mounting

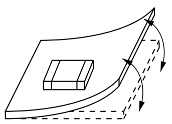
1. Vibration and Impact
   Do not expose a capacitor to excessive shock or vibration during use.

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

3. Land Layout for Cropping PC Board

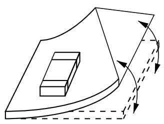
Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[Component Direction]



<Examples to be avoided>

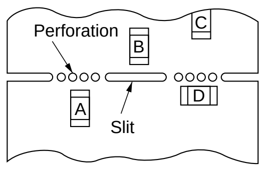
➡



Locate chip horizontal to the direction in which stress acts.

<Examples of improvements>

[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.

4. Reflow Soldering

- When the sudden heat is given to the components, the mechanical strength of the components should go down because remarkable temperature change causes deformity of components inside. 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 1. It is required to keep temperature differential between the soldering and the components surface (ΔT) as small as possible.
- Solderability of Tin plating termination chip might be deteriorated when low temperature soldering profile where peak solder temperature is 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	ΔT≦130℃

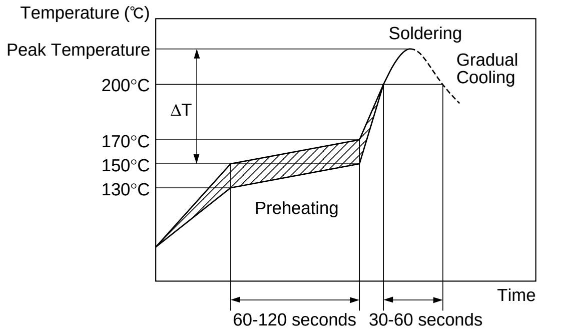
Recommended Conditions

	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

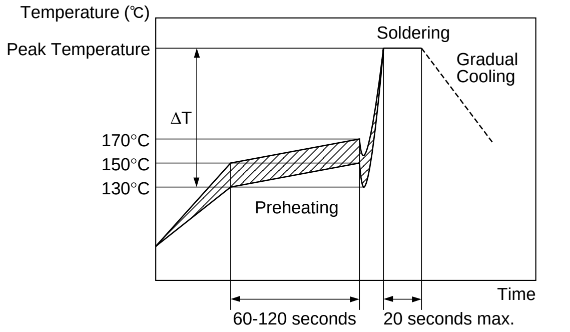
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Reflow Soldering]

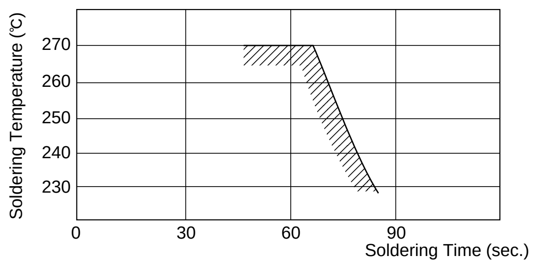
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]

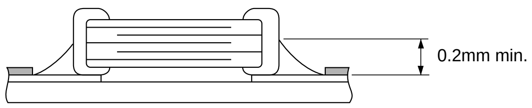


In case of repeated soldering, the accumulated soldering time must be within the range shown above.

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]



in section

Inverting the PCB

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

Continued on the following page.

Continued from the preceding page.

5. Flow Soldering

- When the sudden heat is given to the components, the mechanical strength of the components should go down because remarkable temperature change causes deformity of 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 small 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

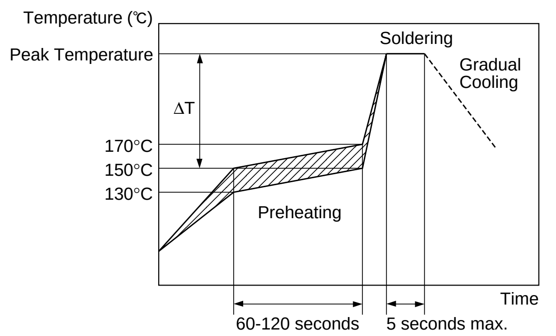
Part Number	Temperature Differential
G□□21/31	ΔT≦150℃

Recommended Conditions

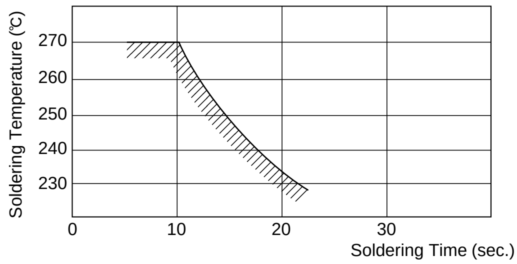
	Pb-Sn Solder	Lead Free Solder
Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N_2

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

[Standard Conditions for Flow Soldering]

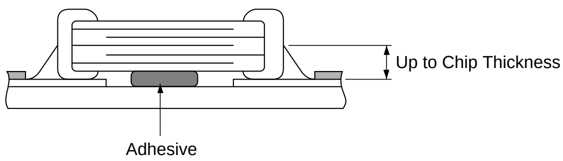


[Allowable Soldering Temperature and Time]



In 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 excessively big, the risk of cracking is higher during board bending or under any other stressful conditions.



in section

Continued on the following page.

⚠Caution

Continued from the preceding page.

6. Correction with a Soldering Iron

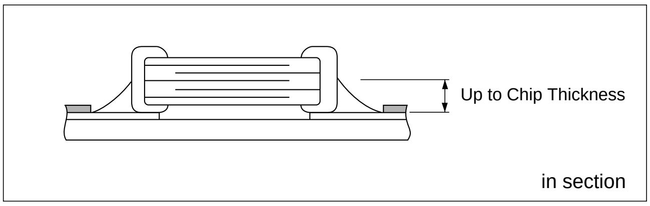
- When sudden heat is applied to the components by soldering iron, the mechanical strength of the components should go down because remarkable temperature change causes deformity of components inside. In order to prevent mechanical damage in the components, preheating should be required for both of the components and the PCB board. Preheating conditions are shown in Table 3. It is required to keep temperature differential between the soldering and the components surface (ΔT) as small as possible. After soldering, should is not be allowed to cool down rapidly.

Table 3

Part Number	Temperature Differential	Peak Temperature	Atmosphere
G□□21/31	ΔT≦190℃	300°C max. 3 sec. max. / termination (both sides total 6 sec. max.)	Air
G□□32	ΔT≦130℃	270°C max. 3 sec. max. / termination (both sides total 6 sec. max.)	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 Corrections Are Made Using a Soldering Iron
The top of the solder fillet should be lower than the thickness of components. If the solder amount is excessively big, the risk of cracking is higher during board bending or under any other stressful conditions. Soldering iron ø3mm or smaller should be required. And it is necessary to keep a distance between the soldering iron and the components without direct touch. Thread solder 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.

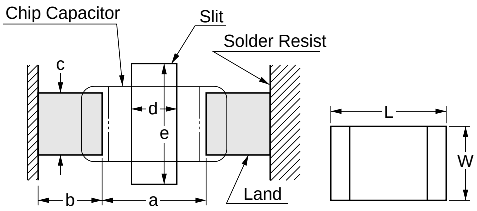
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCT IS USED.

■ Solder 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 lower. To prevent this, be extremely careful in determining shape and dimension before designing the circuit board diagram.

Construction and Dimensions of Pattern (Example)



Preparing slit helps flux cleaning and resin coating on the back of the capacitor.

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

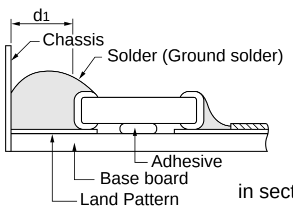
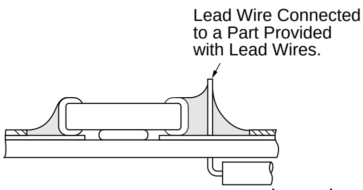
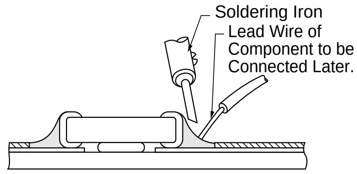
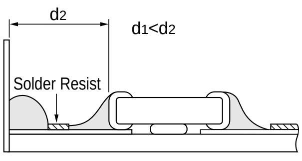
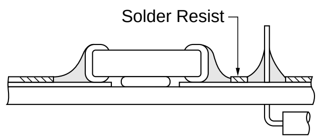
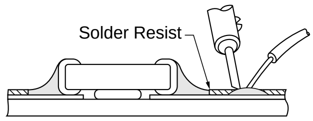
Flow soldering : 3.2×1.6 or less available.

Reflow Soldering

L×W	a	b	c	d	e
2.0×1.25	1.0-1.2	0.9-1.0	0.8-1.1	-	-
3.2×1.6	2.2-2.4	0.8-0.9	1.0-1.4	1.0-2.0	3.2-3.7
3.2×2.5	2.0-2.4	1.0-1.2	1.8-2.3	1.0-2.0	4.1-4.6

(in mm)

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

Continued on the following page.

Notice

Continued from the preceding page.

2. Mounting of Chips

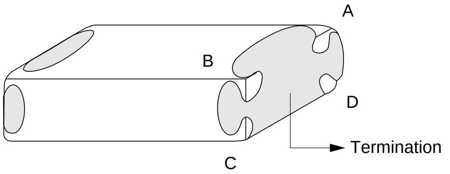
- Thickness of adhesives applied
  Keep thickness of adhesives applied (50-105μm or more) to reinforce the adhesive contact considering the thickness of the termination or capacitor (20-70μm) and the land pattern (30-35μm).

- 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 of losing 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 percentage of halide may cause corrosion of the outer electrodes unless 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 resin type flux including wash-type flux and non-wash-type flux.)

Continued on the following page.

Continued from the preceding page.

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 it might cause the decrease in the surface resistance of the chip and the 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 a intended equipment beforehand when the 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 as the stress is small when stiffening and the hygroscopic is low as possible.

■ Rating

1. Capacitance change of capacitor
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.
Moreover, check the surge-proof ability of a capacitor in the equipment, if needed, because the surge voltage may exceed specific value by the inductance of the circuit.

⚠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>
   For products which are controlled items subject to the “Foreign Exchange and Foreign Trade Law” of Japan, the export license specified by the law is required for export.
2. Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.
   ① Aircraft equipment
   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
   ⑩ Application of similar complexity and/or reliability requirements to the applications listed above
3. Product specifications in this catalog are as of March 2007. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.
4. Please read rating and ⚠CAUTION (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.
5. This catalog has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.
6. Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.
7. No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.

muRata Murata Manufacturing Co., Ltd.

http://www.murata.com/

Head Office
1-10-1, Higashi Kotari, Nagaokakyo-shi, Kyoto 617-8555, Japan
Phone: 81-75-951-9111

International Division
3-29-12, Shibuya, Shibuya-ku, Tokyo 150-0002, Japan
Phone: 81-3-5469-6123 Fax: 81-3-5469-6155 E-mail: intl@murata.co.jp