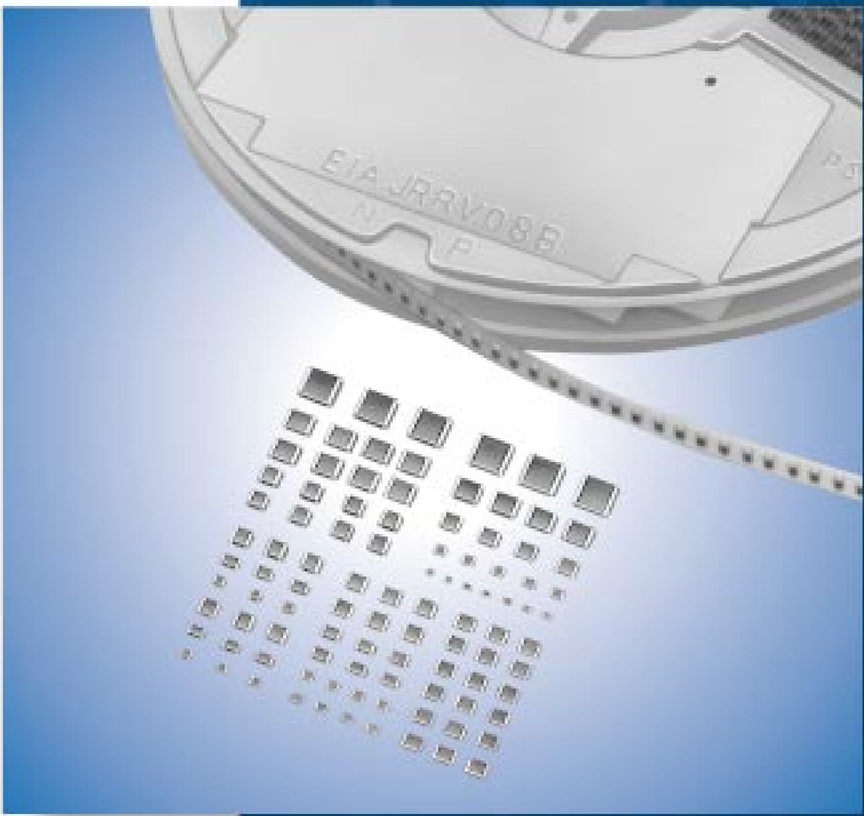
Chip Monolithic Ceramic Capacitors for Automotive



Innovator in Electronics

Murata
Manufacturing Co., Ltd.

Cat.No.C03E

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**	Automotive Tin Plated Layer

❸Dimension (L×W)

Code	Dimension (L×W)	EIA
15	1.0×0.5 mm	0402
18	1.6×0.8 mm	0603
21	2.0×1.25 mm	0805
31	3.2×1.6 mm	1206
32	3.2×2.5 mm	1210

❹Dimension (T)

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

❺Temperature Characteristics

Code	Temperature Characteristics	Temperature Range	Capacitance Change or Temperature Coefficient	Operating Temperature Range
5C	C0G	-55 to 125°C	0±30ppm/°C	-55 to 125°C
R7	X7R	-55 to 125°C	±15%	-55 to 125°C
C7	X7S	-55 to 125°C	±22%	-55 to 125°C

❻Rated Voltage

Code	Rated Voltage
0G	DC4V
0J	DC6.3V
1A	DC10V
1C	DC16V
1E	DC25V
1H	DC50V
2A	DC100V
2D	DC200V

❼Capacitance

Expressed by three figures. 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

❽Capacitance Tolerance

Code	Capacitance Tolerance	TC	Series	Capacitance Step	
C	±0.25pF	CΔ	**GCM**	≦5pF	* 1pF
D	±0.5pF	CΔ	**GCM**	6.0 to 9.0pF	* 1pF
J	±5%	CΔ	**GCM**	≧10pF	E24 Series
K	±10%	X7R	**GCM**	E12 Series	
M	±20%	X7R	**GCM**	E6 Series	

***** E24 series is also available.

❾Individual Specification Code

Expressed by three figures.

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⑩Packaging

Code	Packaging
L	ø178mm Plastic Taping
D	ø178mm Paper Taping
K	ø330mm Plastic Taping
J	ø330mm Paper Taping
E	ø178mm Special Packaging
F	ø330mm Special Packaging
B	Bulk
C	Bulk Case
T	Bulk Tray

Selection Guide of Chip Monolithic Ceramic Capacitors

Start

Application

General Electronics

Function and Circuit

Filtering / Synchronize Circuit / Oscillation Circuit

- Soldering Electrode C0G Char. — **GRM_5C Series** — 0.5pF–0.1µF
- Capacitor Arrays C0G Char. — **GNM_5C Series** — 10pF–360pF

Temperature Compensation

- Soldering Electrode for Temperature Compensation — **GRM_ Series** — 0.5pF–0.1µF
- Capacitor Arrays for Temperature Compensation — **GNM_5C Series** — 10pF–360pF

Bypassing / De-coupling

- Soldering Electrodes Y5V Char. — **GRM_F5 Series** — 2200pF–10µF
- Microchip Y5V Char. — **GMA_F5 Series** — 4700pF–0.1µF
- Capacitor Arrays Y5V Char. — **GNM_F5 Series** — 22000pF–0.15µF
- Low-ESL Y5V Char. — **LLL_F5 Series** — 22000pF–0.68µF

Coupling / Time Constant Circuits

- Soldering Electrode X5R/X7R Char. — **GRM_R6, R7 Series** — 220pF–10µF
- Soldering Electrode C0G/C0H Char. — **GRM_6C Series** — 0.5pF–47000pF
- Thin Layer Large Capacitance Type X5R Char. — **GRM_R6 Series** — 47000pF–100µF
- Microchip — **GMA_R7 Series** — 470pF–10000pF
- Capacitor Arrays — **GNM Series** — 390pF–1.0µF
- Low ESL — **LLL Series** — 2200pF–1.0µF

Specific Applications

High Frequency

- High Frequency/ High Power Type Soldering Electrode — **ERF Series** — 0.75pF–1000pF
- High Frequency/ High Power Ribbon Terminal Type — **ERH Series** — 0.75pF–1000pF
- High Frequency Type — **ERA Series** — 0.75pF–1000pF
- High Frequency Ribbon Terminal Type — **ERD Series** — 0.75pF–1000pF
- High Frequency for Flow/Reflow Soldering — **GQM Series** — 0.5pF–100pF

Ultra Thin Circuit

- Thin type Soldering Electrode — **GRM15X Series** — 0.5pF–4700pF

Low Dissipation

- **GJM Series** — 0.5pF–18pF

Ultrasonic Sensors

- ZLM Char. — **GRM2199E Series** — 1000pF/1500pF

Medium Voltage

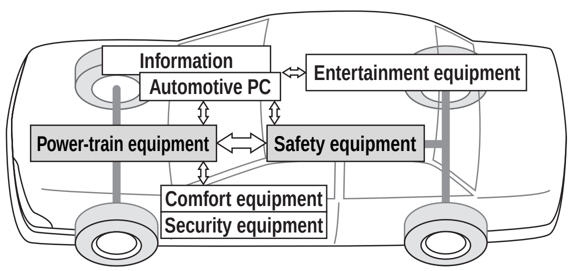
- 630V/1kV/2kV/3.15kV Low-dissipation — **GRM Series** — 10pF–1000pF
- 250V/630V/1kV High-capacitance — **GRM Series** — 220pF–1µF
- 2kV Only for Telecommunication Devices — **GR4 Series** — 100pF–4700pF

Safety Standard Recognized

- AC250V which meet Japanese Law — **GA2 Series** — 470pF–0.1µF
- UL/IEC Safety Standard Recognized — **GA3 Series** — 10pF–33000pF

Automotive (Power-train, Safety equipment)

- **GCM Series*** — 0.5pF–10µF



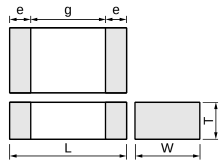
*For other automotive equipment such as comfort, security, information, entertainment, GRM series (for general electronics) are available.

Chip Monolithic Ceramic Capacitors for Automotive

for Automotive GCM Series

■ Features

1. The GCM series meet AEC-Q200 requirements.
2. The GCM series is lead free product.
3. The GCM series is a complete line of chip ceramic capacitors in 16V, 25V, 50V and 100V ratings. These capacitors have temperature characteristics of C0G and X7R.
4. A wide selection of sizes is available, from miniature LxWxT: 1.0x0.5x0.5mm to LxWxT: 3.2x2.5x2.5mm.
5. Stringent dimensional tolerances allow highly reliable, high speed automatic chip replacement on PCBs.
6. The GCM series is available in paper or plastic embossed tape and reel packaging for automatic placement.



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	2.0
GCM32R			1.8 ±0.2		
GCM32D			2.0 ±0.2		1.0
GCM32E			2.5 ±0.2		
GCM43R	4.5 ±0.4	3.2 ±0.3	1.8 ±0.2		2.0
GCM43E			2.5 ±0.2		
GCM55R	5.7 ±0.4	5.0 ±0.4	1.8 ±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 GCM15/18/21/31 Series

TC	C0G (**5C**)						
Part Number	**GCM15**	**GCM18**		**GCM21**		**GCM31**	
L x W [EIA]	1.00x0.50 [0402]	1.60x0.80 [0603]		2.00x1.25 [0805]		3.20x1.60 [1206]	
Rated Volt.	50 (**1H**)	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)							
0.5pF(**R50**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
0.75pF(**R75**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
1.0pF(**1R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
2.0pF(**2R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
3.0pF(**3R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
4.0pF(**4R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
5.0pF(**5R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
6.0pF(**6R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
7.0pF(**7R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
8.0pF(**8R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
9.0pF(**9R0**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
10pF(**100**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
12pF(**120**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
15pF(**150**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
18pF(**180**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
22pF(**220**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
27pF(**270**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
33pF(**330**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
39pF(**390**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
47pF(**470**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
56pF(**560**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
68pF(**680**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				

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TC	C0G (**5C**)						
Part Number	**GCM15**	**GCM18**		**GCM21**		**GCM31**	
L x W [EIA]	1.00x0.50 [0402]	1.60x0.80 [0603]		2.00x1.25 [0805]		3.20x1.60 [1206]	
Rated Volt.	50 (**1H**)	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)							
82pF(**820**)	0.50(**5**)	0.80(**8**)	0.80(**8**)				
100pF(**101**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
120pF(**121**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
150pF(**151**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
180pF(**181**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
220pF(**221**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
270pF(**271**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
330pF(**331**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
390pF(**391**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
470pF(**471**)	0.50(**5**)	0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
560pF(**561**)		0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
680pF(**681**)		0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
820pF(**821**)		0.80(**8**)	0.80(**8**)	0.60(**6**)	0.60(**6**)		
1000pF(**102**)		0.80(**8**)	0.80(**8**)	0.85(**9**)	0.60(**6**)		
1200pF(**122**)			0.80(**8**)	0.85(**9**)	0.60(**6**)		
1500pF(**152**)			0.80(**8**)	0.85(**9**)	0.60(**6**)		
1800pF(**182**)			0.80(**8**)		0.60(**6**)	0.85(**9**)	
2200pF(**222**)			0.80(**8**)		0.60(**6**)	0.85(**9**)	
2700pF(**272**)			0.80(**8**)		0.60(**6**)	0.85(**9**)	
3300pF(**332**)					0.60(**6**)	0.85(**9**)	
3900pF(**392**)					0.60(**6**)	0.85(**9**)	
4700pF(**472**)					0.60(**6**)	0.85(**9**)	
5600pF(**562**)					0.85(**9**)	0.85(**9**)	
6800pF(**682**)					0.85(**9**)		
8200pF(**822**)					0.85(**9**)		
10000pF(**103**)					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 GCM15/18/21/31/32 Series

TC	X7R (**R7**)												
Part Number	**GCM15**		**GCM18**			**GCM21**			**GCM31**				**GCM32**
L x W [EIA]	1.00x0.50 [0402]		1.60x0.80 [0603]			2.00x1.25 [0805]			3.20x1.60 [1206]				3.20x2.50 [1210]
Rated Volt.	50 (**1H**)	25 (**1E**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	16 (**1C**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)													
220pF(**221**)	0.50(**5**)												
270pF(**271**)	0.50(**5**)												
330pF(**331**)	0.50(**5**)												
390pF(**391**)	0.50(**5**)												
470pF(**471**)	0.50(**5**)												
560pF(**561**)	0.50(**5**)												
680pF(**681**)	0.50(**5**)												
820pF(**821**)	0.50(**5**)												
1000pF(**102**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							

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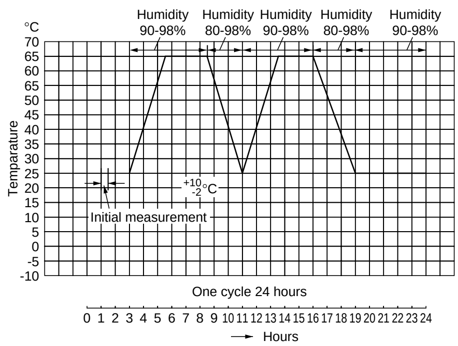
TC	X7R (**R7**)												
Part Number	**GCM15**		**GCM18**			**GCM21**			**GCM31**				**GCM32**
L x W [EIA]	1.00x0.50 [0402]		1.60x0.80 [0603]			2.00x1.25 [0805]			3.20x1.60 [1206]				3.20x2.50 [1210]
Rated Volt.	50 (**1H**)	25 (**1E**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	16 (**1C**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)													
1200pF(**122**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							
1500pF(**152**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							
1800pF(**182**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							
2200pF(**222**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							
2700pF(**272**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							
3300pF(**332**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							
3900pF(**392**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							
4700pF(**472**)	0.50(**5**)		0.80(**8**)	0.80(**8**)		0.6(**6**)							
5600pF(**562**)		0.50(**5**)	0.80(**8**)	0.80(**8**)		0.6(**6**)							
6800pF(**682**)		0.50(**5**)	0.80(**8**)	0.80(**8**)		0.6(**6**)							
8200pF(**822**)		0.50(**5**)	0.80(**8**)	0.80(**8**)		0.6(**6**)							
10000pF(**103**)		0.50(**5**)	0.80(**8**)	0.80(**8**)		0.6(**6**)							
12000pF(**123**)		0.50(**5**)		0.80(**8**)		0.6(**6**)							
15000pF(**153**)		0.50(**5**)		0.80(**8**)		0.6(**6**)							
18000pF(**183**)		0.50(**5**)		0.80(**8**)		0.6(**6**)							
22000pF(**223**)		0.50(**5**)		0.80(**8**)		0.6(**6**)							
27000pF(**273**)		0.50(**5**)		0.80(**8**)		0.85(**9**)							
33000pF(**333**)		0.50(**5**)		0.80(**8**)		0.85(**9**)							
39000pF(**393**)		0.50(**5**)		0.80(**8**)		0.85(**9**)							
47000pF(**473**)		0.50(**5**)		0.80(**8**)		1.25(**B**)							
56000pF(**563**)				0.80(**8**)		1.25(**B**)							
68000pF(**683**)				0.80(**8**)		1.25(**B**)							
82000pF(**823**)				0.80(**8**)		1.25(**B**)							
0.10µF(**104**)				0.80(**8**)		1.25(**B**)							
0.12µF(**124**)						1.25(**B**)							
0.15µF(**154**)					0.80(**8**)	1.25(**B**)			1.15(**M**)				
0.18µF(**184**)					0.80(**8**)	1.25(**B**)			1.15(**M**)				
0.22µF(**224**)					0.80(**8**)	1.25(**B**)			1.15(**M**)				
0.27µF(**274**)							1.25(**B**)			1.15(**M**)			
0.33µF(**334**)							1.25(**B**)			1.15(**M**)			
0.39µF(**394**)							1.25(**B**)			1.15(**M**)			
0.47µF(**474**)							1.25(**B**)			1.15(**M**)			
0.56µF(**564**)							1.25(**B**)			1.6(**C**)			
0.68µF(**684**)							1.25(**B**)			1.6(**C**)			
0.82µF(**824**)							1.25(**B**)			1.6(**C**)			
1.0µF(**105**)							1.25(**B**)			1.15(**M**)	1.15(**M**)		
1.5µF(**155**)								1.25(**B**)			1.15(**M**)		
2.2µF(**225**)											1.15(**M**)		
3.3µF(**335**)												1.6(**C**)	
4.7µF(**475**)												1.6(**C**)	
10µF(**106**)													2.00(**D**)

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.

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 Tempersture 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>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
(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 (19). 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</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 48±4 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>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
(Whichever is smaller)</td></tr>
<tr><td>4</td><td colspan="2">Destructive Phisical 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>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
(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 resister) 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>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 1,000Ω or 50Ω • F
(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. 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 48±4 hours at room temperature. Perform initial measurement.
		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)	W.V. : 25Vmin. : 0.035 max. W.V. : 16V : 0.05 max.	
		I.R.	More than 1,000MΩ or 50Ω • F (Whichever is smaller)		
8	External Visual		No defects or abnormalities		Visual inspection
9	Phisical 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)	R7 W.V. : 25Vmin. : 0.025 max. W.V. : 16V : 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω • F (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/D.F.	30pFmin. : Q≧1000 30pFmax. : Q≧400+20C C : Nominal Capacitance (pF)	R7 W.V. : 25Vmin. : 0.025 max. W.V. : 16V : 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω • F (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/D.F.	30pFmin. : Q≧1000 30pFmax. : Q≧400+20C C : Nominal Capacitance (pF)	R7 W.V. : 25Vmin. : 0.025 max. W.V. : 16V : 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω • F (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. • Initial measurement for high dielectric constant type Perform a heat treatment at 150^{+0}_{-10}°C for one hour and then let sit for 48±4 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)	R7 W.V. : 25Vmin. : 0.025 max. W.V. : 16V : 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω • F (Whichever is smaller)		

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="5">14</td><td rowspan="5">Thermal Shock</td><td></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 (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
<table><tr><th>Step</th><th>1</th><th>2</th></tr><tr><td>Temp. (°C)</td><td>-55+0/-3</td><td>125+3/-0</td></tr><tr><td>Time (min.)</td><td>15±3</td><td>15±3</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 48±4 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td><td>R7
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>R7
W.V. : 25Vmin. : 0.025 max.
W.V. : 16V : 0.035 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω • F
(Whichever is smaller)</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">ESD</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Per AEC-Q200-004</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>R7
W.V. : 25Vmin. : 0.025 max.
W.V. : 16V : 0.035 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω • F
(Whichever is smaller)</td></tr>
<tr><td rowspan="3">16</td><td rowspan="3" colspan="2">Solderability</td><td rowspan="3" colspan="2">95% of the terminations is to be soldered evenly and continuously.</td><td>(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.</td></tr>
<tr><td>(b) Shall 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.</td></tr>
<tr><td>(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.</td></tr>
<tr><td rowspan="6">17</td><td rowspan="6">Electrical Chatacteri-zation</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td>Visual inspection.</td></tr>
<tr><td>Capacitance Change</td><td colspan="2">Within the specified tolerance</td><td rowspan="2">The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table.
<table><tr><th>Char. / Item</th><th>ΔC
(1000pF and below)</th><th>ΔC
(more than 1000pF)
R7 (C≦10μF)</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vrms</td><td>1±0.2Vrms</td></tr></table></td></tr>
<tr><td>Q/D.F.</td><td>30pF min. : Q≧1000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>R7
W.V. : 25V min. : 0.025 max.
W.V. : 16V : 0.035 max</td></tr>
<tr><td>I.R. 25°C</td><td>More than 100,000MΩ or 1,000Ω • F
(Whichever is smaller)</td><td>More than 10,000MΩ or 500Ω • F
(Whichever is smaller)</td><td rowspan="2">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>I.R. 125°C</td><td>More than 10,000MΩ or 100Ω • F
(Whichever is smaller)</td><td>More than 1,000MΩ or 10Ω • F
(Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td><td>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.</td></tr>
</table>

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Specifications and Test Methods

Continued from the preceding page.

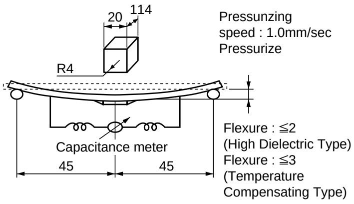
<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">AEC-Q200 Test Item</th><th colspan="2">Specifications</th><th rowspan="2">AEC-Q200 Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td rowspan="4">18</td><td rowspan="4">Board Flex</td><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 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>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)


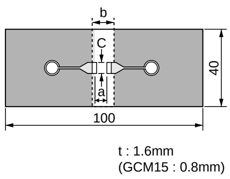
Fig. 2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td><td>R7 : Within ±10.0%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min. : Q≧1000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>R7
W.V. : 25Vmin. : 0.025 max.
W.V. : 16V : 0.035 max.</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 500Ω • F
(Whichever is smaller)</td><td>

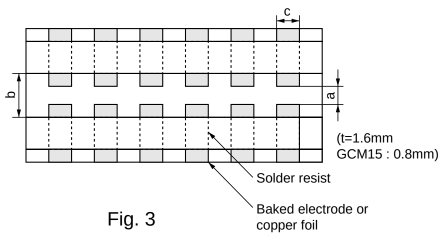
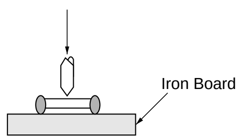
Fig. 1</td></tr>
<tr><td rowspan="4">19</td><td rowspan="4">Terminal Strength</td><td>Appearance</td><td colspan="2">No marking defects</td><td rowspan="4">Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 3 using a eutectic solder. Then apply *18N force in parallel with the test 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 (GCM15)
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></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>R7
W.V. : 25Vmin. : 0.025 max.
W.V. : 16V : 0.035 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω • F
(Whichever is smaller)</td></tr>
<tr><td>20</td><td colspan="2">Beam Load Test</td><td colspan="2">Destruction value should be exceed following one.
< 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. >


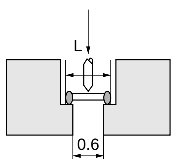
< Chip Length : 3.2mm min. >


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

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Specifications and Test Methods

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<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="3">21</td><td rowspan="3">Capacitance Temperature Character-istics</td><td>Capacitance Change</td><td>Within the specified tolerance.
(Table A)</td><td>R7 : Withn ±15%
(-55°C to +125°C)</td><td rowspan="3">The capacitance change should be measured after 5 min. at each specified temperature stage.
(1) Temperature Compensating Type
The temperature coefficient is determind 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 Table A. The capacitance drift is caluculated by dividing the differences between the maximum and minimum measured values in the 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 (for ΔC to R7)</td></tr>
<tr><td>3</td><td>25±2</td></tr>
<tr><td>4</td><td>125±3 (for ΔC / R7), 85±3 (for other TC)</td></tr>
<tr><td>5</td><td>25±2</td></tr>
</table>
(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 48±4 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td>Temperature Coefficent</td><td>Within the specified tolerance.
(Table A)</td><td rowspan="2"></td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05 pF
(Whichever is larger.)
* Not apply to 1X/25V</td></tr>
</table>

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 ΔC)/85°C (for other TC).

Package

■ Packaging Code

Packaging Type	Tape Carrier Packaging	Bulk Case Packaging	Bulk Packaging / Bulk Packaging in a bag
Packaging Code	**D, L, K, J**	**C**	**B**

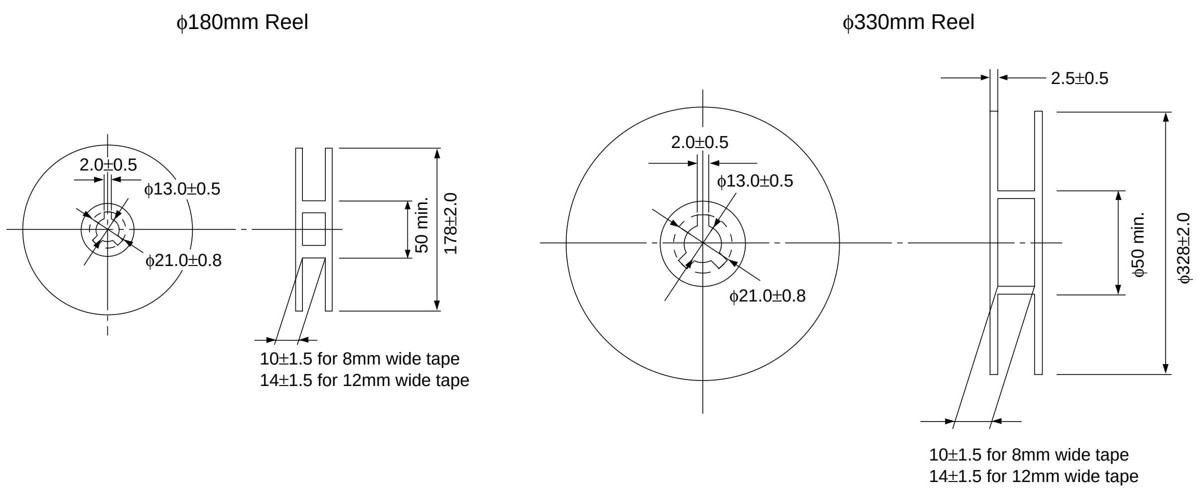
■ Minimum Quantity Guide

Part Number		Dimensions (mm)			Quantity (pcs.)					
					ø180mm reel		ø330mm reel		Bulk Case	Bulk Bag
		L	W	T	Paper Tape	Plastic Tape	Paper Tape	Plastic Tape		
For Flow/Reflow	**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
For Reflow	**GCM03**	0.6	0.3	0.3	15,000	-	50,000	-	-	1,000
	GCM155	1.0	0.5	0.5	10,000	-	50,000	-	50,000	1,000
	GCM32	3.2	2.5	1.15	-	3,000	-	10,000	-	1,000
				1.35	-	2,000	-	8,000	-	1,000
				1.8/1.6	-	1,000	-	4,000	-	1,000
	GCM43	4.5	3.2	1.15	-	1,000	-	5,000	-	1,000
				1.35/1.6 1.8/2.0	-	1,000	-	4,000	-	1,000
	GCM55	5.7	5.0	1.15	-	1,000	-	5,000	-	1,000
				1.35/1.6 1.8/2.0	-	1,000	-	4,000	-	1,000
				2.5	-	500	-	2,000	-	500
				3.2	-	300	-	1,500	-	500

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

■ Tape Carrier Packaging

1. Dimensions of Reel



(in mm)

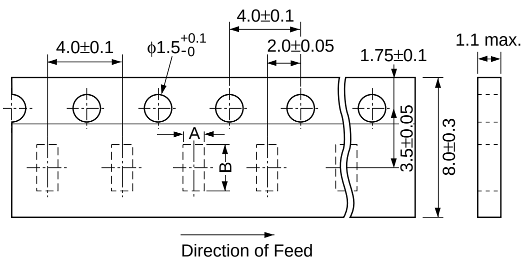
Continued on the following page.

Package

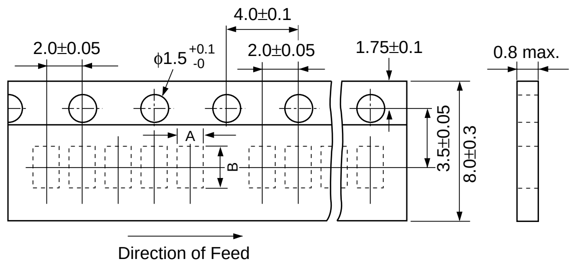
Continued from the preceding page.

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 (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

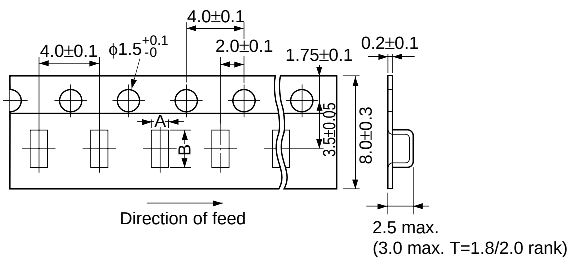
Part Number	A*	B*
GCM03	0.37	0.67
GCM15	0.65	1.15

*Nominal Value

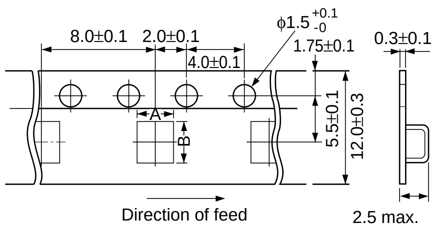
(in mm)

3. Dimensions of Plastic Tape

8mm width 4mm pitch Tape



12mm width 8mm 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

Part Number	A*	B*
GCM43	3.6	4.9
GCM55	5.2	6.1

*Nominal Value

(in mm)

Continued on the following page.

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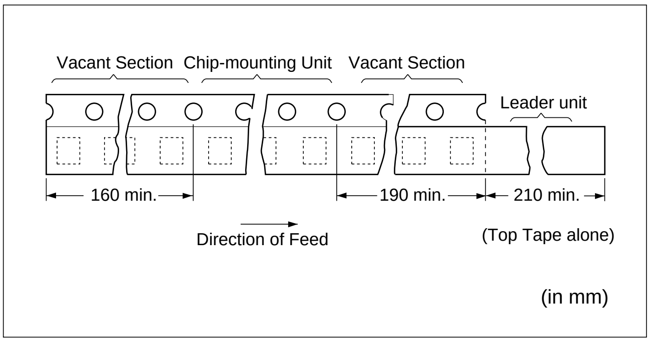
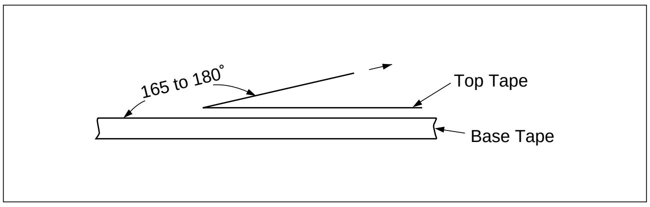
4. Taping Method

(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 shall be attached to the end of the tape as follows.
(3) The top tape and base tape are not atteached 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 shall not protrude beyond the edges of the tape and shall 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.

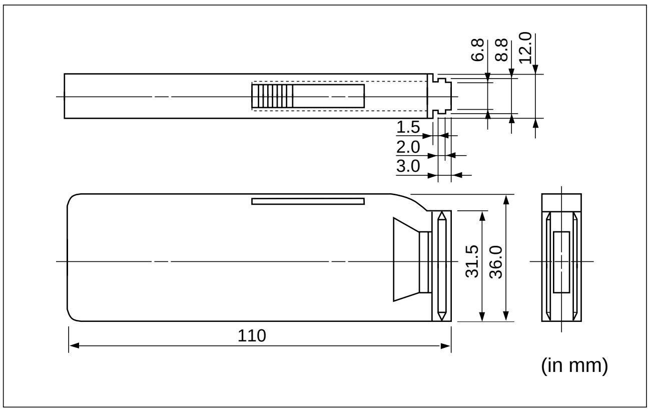
*GCM03 : 0.05 to 0.5N





■ Dimensions of Bulk Case Packaging

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



⚠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.
(Reference Data 1. Solderability)
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCT IS USED.

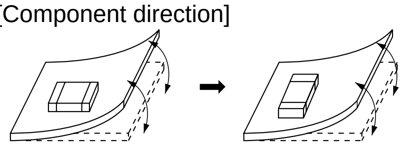
⚠Caution

■ Soldering and Mounting

1. Mounting Position

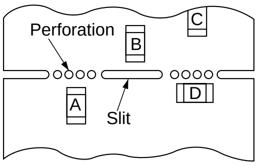
Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[Component direction]



Locate chip horizontal to the direction in which stress acts.

[Chip Mounting Close to Board Separation Point]

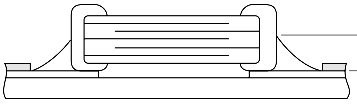


Chip arrangement
Worst A-C- (B, D) Best

2. Solder

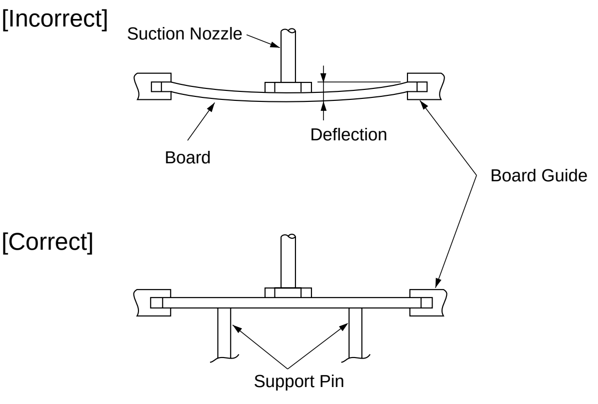
- Overly thick application of solder paste results in excessive fillet height solder.
  This makes the chip more susceptible to mechanical and thermal stress on the board and may cause cracked chips.
- Too little solder paste results in a lack of adhesive strength on the outer electrode, which may result 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]



3. 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, 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

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4. Reflow Soldering

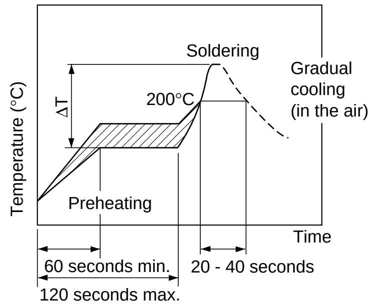
- Sudden heating of the chip results in distortion due to excessive expansion and construction forces within the chip causing cracked chips. So when preheating, keep temperature differential, ΔT, within the range shown in Table 1. The smaller the ΔT, the less stress on the chip.
- When components are immersed in solvent after mounting, be sure to maintain the temperature difference (ΔT) between the component and solvent within the range shown in the above table.

Table 1

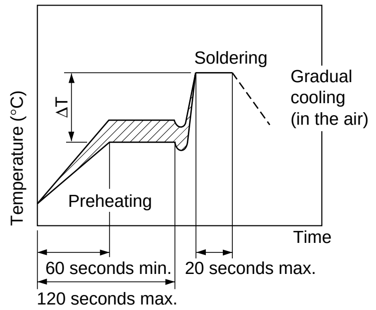
Part Number	Temperature Differential
GCM03/15/18/21/31	ΔT≦190°C
GCM32/43/55	ΔT≦130°C

[Standard Conditions for Reflow Soldering]

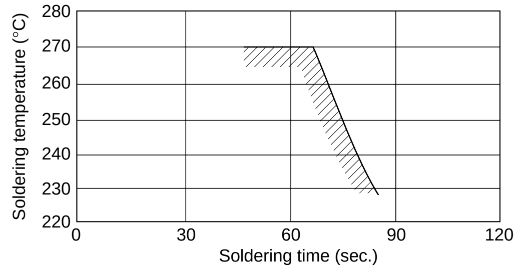
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]



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

Inverting the PCB

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

5. 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 prevent warping.

Continued on the following page.

⚠Caution

Continued from the preceding page.

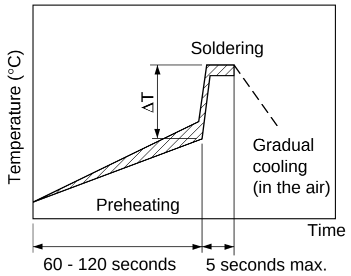
6. Flow Soldering

- Sudden heating of the chip results in thermal distortion causing cracked chips. 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.
- When preheating, keep temperature differential between solder temperature and chip surface temperature, ΔT, within the range shown in Table 2. The smaller the ΔT, the less stress on the chip.
  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.

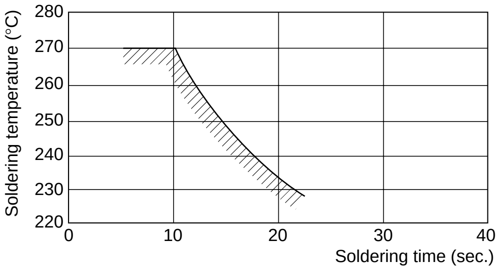
Table 2

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

[Standard Conditions for Flow Soldering]

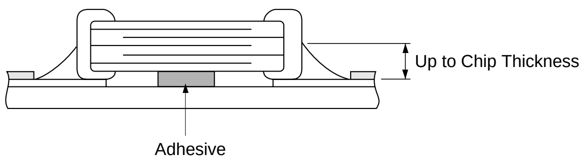


[Allowable Soldering Temperature and Time]



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

- Optimum Solder Amount for Flow Soldering



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⚠Caution

Continued from the preceding page.

7. Correction with a Soldering Iron

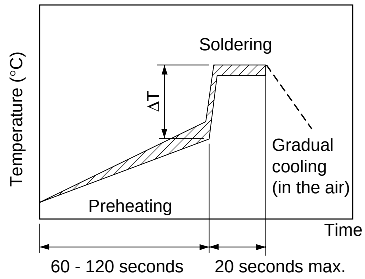
(1) For Chip Type Capacitors

- Sudden heating of the chip results in distortion due to a high internal temperature differential, causing cracked chips. When preheating, keep temperature differential, ΔT, within the range shown in Table 3. The smaller the ΔT, the less stress on the chip.

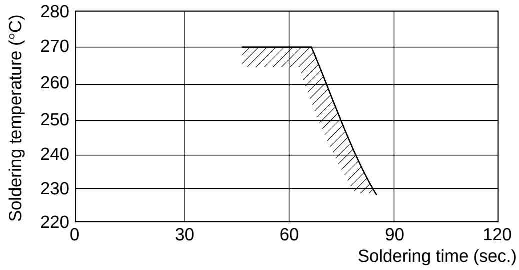
Table 3

Part Number	Temperature Differential
GCM15, GCM18/21/31	ΔT≦190°C
GCM32/43/55	ΔT≦130°C

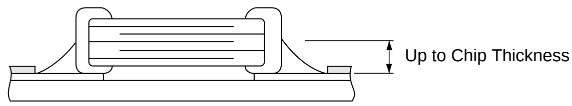
[Standard Conditions for Soldering Iron Temperature]



[Allowable time and Temperature for Making Corrections with a Soldering Iron]



- Optimum Solder Amount when Corrections Are Made Using a Soldering Iron



8. 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

⚠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 Depane-lization)
   - Board flexing at the time of separation causes cracked chips or broken solder.
   - Severity of stresses imposed on the chip at the time of board break is in the order of : Pushback<Slitter<V Slot<Perforator.
   - Board separation must be performed using special jigs, not with hands.
3. Reel and bulk case
   - In the handling of reel and case, please pay attentionnot to drop it.
     Please do not use chip of the case which dropped.

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

Notice

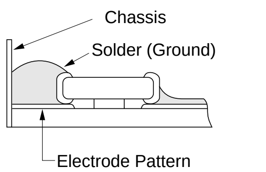
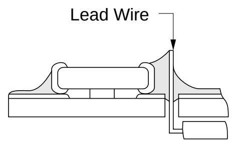
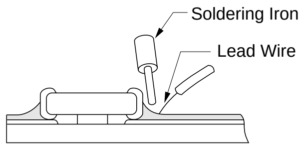
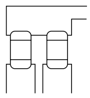
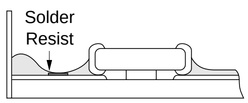
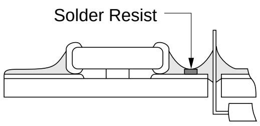
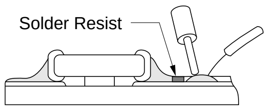
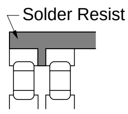
■ Soldering and Mounting

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.

Pattern Forms

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

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(2) Land Dimensions

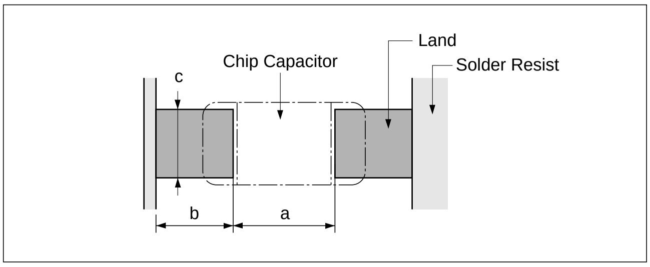


Table 1 Flow Soldering Method

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	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)

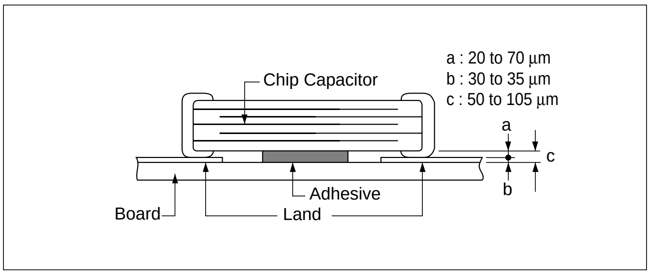
Table 2 Reflow Soldering Method

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	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
GCM43	4.5×3.2	3.0–3.5	1.2–1.4	2.3–3.0
GCM55	5.7×5.0	4.0–4.6	1.4–1.6	3.5–4.8

(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)



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.

Notice

Continued from the preceding page.

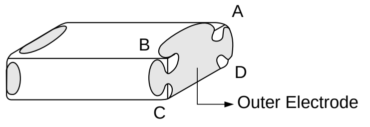
4. Flux Application

- 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 a percentage of halide may cause corrosion of the outer electrodes unless sufficiently cleaned. Use flux with a halide content of 0.2w% max.
  But do not use strongly acidic flux.
  Wash thoroughly because water-soluble flux causes deteriorated insulation resistance between outer electrodes unless sufficiently cleaned.

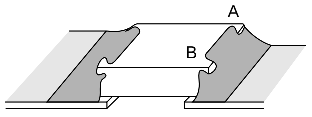
5. Flow Soldering

- 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]



■ 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.

⚠Note:

1. Export Control
〈For customers outside Japan〉
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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 to 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 in the above
3. Product specifications in this catalog are as of April 2004. 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.
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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.
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