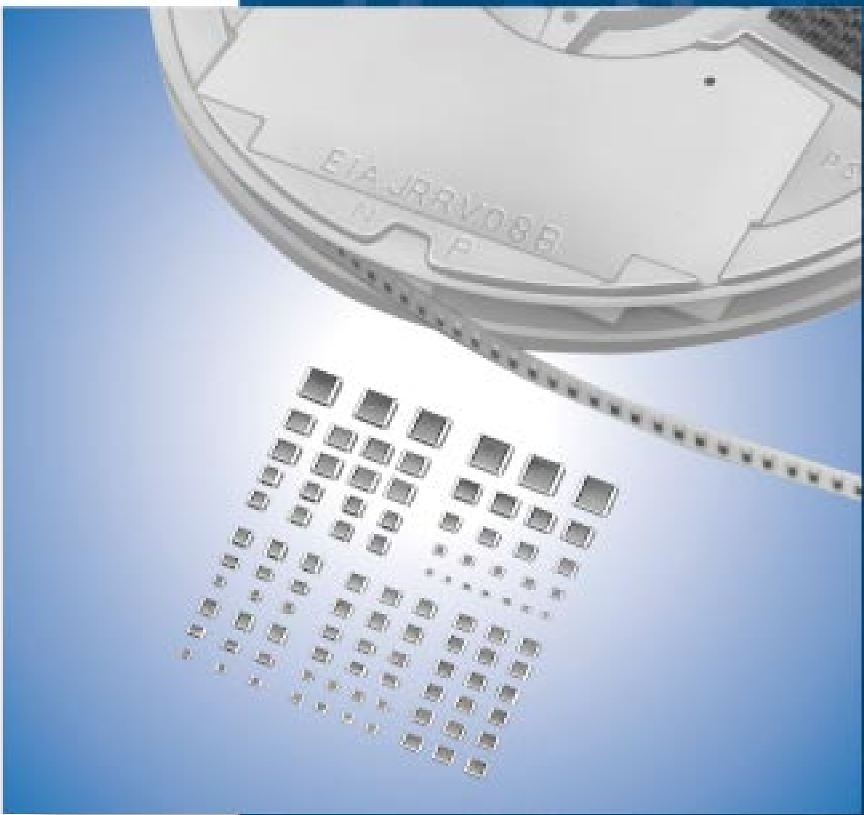
Chip Monolithic Ceramic Capacitors for Automotive



Innovator in Electronics

Murata Manufacturing Co., Ltd.

Cat.No.C03E-1

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
LL	**C**	Low ESL, Power-train, Safety equipment

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
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
5G	X8G	EIA	25°C	25 to 150°C	0±30ppm/°C	-55 to 150°C
C7	X7S	EIA	25°C	-55 to 125°C	±22%	-55 to 125°C
L8	X8L	EIA	25°C	-55 to 150°C	±15% (-55 to 125°C), +15, -40% (125 to 150°C)	-55 to 150°C
R7	X7R	EIA	25°C	-55 to 125°C	±15%	-55 to 125°C
R9	X8R	EIA	25°C	-55 to 150°C	±15%	-55 to 150°C
9E	ZLM	*1	20°C	-25 to 20°C	-4700+100/-2500ppm/°C	-25 to 85°C
				20 to 85°C	-4700+500/-1000ppm/°C	

*1 Murata Temperature Characteristic Code.

❻Rated Voltage

Code	Rated Voltage
1A	DC10V
1C	DC16V
1E	DC25V
1H	DC50V
2A	DC100V

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

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❽Capacitance Tolerance

Code	Capacitance Tolerance	TC	Series	Capacitance Step	
C	±0.25pF	C0G, X8G	**GCM**	≦5pF	E12+1pF *
D	±0.5pF	C0G, X8G	**GCM**	6.0 to 9.0pF	E12+1pF *
J	±5%	C0G, X8G	**GCM**	≧10pF	E12 Series
K	±10%	X7S, X8L, X7R, X8R, ZLM	**GCM**	E6 Series	
M	±20%	X7S, X8L, X7R, X8R	**GCM, LLC**	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

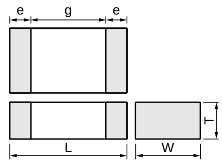
Function	Type	Series
Decoupling, Smoothing	High Capacitance	GRM (X5R, X7R, Y5V, etc.) 220pF–100µF
	Array (2 or 4 Elements)	GNM 10pF–2.2µF
Frequency Control/Tuning, Impedance Matching	Class1 TC's;	GRM (C0G) 0.1pF–0.1µF
		GRM (U2J)
High Speed Decoupling	Low Inductance (Reverse Geometory)	LLL 22000pF–10µF
	Low Inductance (Multi Termination)	LLA/LLM (From 1GHz) 10000pF–4.5µF
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–10000pF
Medium Voltage High Frequency Snubber	250V/630V/1kV/2kV/3.15kV Low Dissipation	GRM (SL, U2J) 5pF–10000pF
Medium Voltage LCD Back Lighting Inverters	3.15kV Low Dissipation	GRM (C0G) 5pF–47pF
Medium Voltage Decoupling, Smoothing	250V/630V/1kV High Capacitance	GRM 220pF–1µF
Medium Voltage Only for Camera Frash Circuit	350V High Capacitance	GR7 10000pF–47000pF
Medium Voltage Only for Telecommunication Devices	2kV High Capacitance	GR4 100pF–4700pF
	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, X8L, X8G etc.) 0.5µF–10µF
	Class1 TC's;	GCM (C0G, CHA etc.) 220pF–10µF
	Low Inductance	LLC 2200pF–2.2µF

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 degrees C, and R9/L8/5G series: -55 to 150 degrees 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			0.6 ±0.1		
GCM219	2.0 ±0.15	1.25 ±0.15	0.85 ±0.1	0.2 to 0.7	0.7
GCM21B			1.25 ±0.15		
GCM319	3.2 ±0.15	1.6 ±0.15	0.85 ±0.1		
GCM31M			1.15 ±0.1	0.3 to 0.8	1.5
GCM31C	3.2 ±0.2	1.6 ±0.2	1.6 ±0.2		
GCM32N			1.35 ±0.15		2.0
GCM32R	3.2 ±0.3	2.5 ±0.2	1.8 ±0.2	0.3	
GCM32D			2.0 ±0.2		1.0
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 GCM15 Series

Part Number	**GCM15**
L x W [EIA]	1.00x0.50 [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**)	0.50(**5**)
0.75pF(**R75**)	0.50(**5**)
1.0pF(**1R0**)	0.50(**5**)
1.2pF(**1R2**)	0.50(**5**)
1.5pF(**1R5**)	0.50(**5**)
1.8pF(**1R8**)	0.50(**5**)
2.0pF(**2R0**)	0.50(**5**)
2.2pF(**2R2**)	0.50(**5**)
2.7pF(**2R7**)	0.50(**5**)
3.0pF(**3R0**)	0.50(**5**)
3.3pF(**3R3**)	0.50(**5**)
3.9pF(**3R9**)	0.50(**5**)
4.0pF(**4R0**)	0.50(**5**)
4.7pF(**4R7**)	0.50(**5**)
5.0pF(**5R0**)	0.50(**5**)
5.6pF(**5R6**)	0.50(**5**)
6.0pF(**6R0**)	0.50(**5**)
6.8pF(**6R8**)	0.50(**5**)
7.0pF(**7R0**)	0.50(**5**)
8.0pF(**8R0**)	0.50(**5**)
8.2pF(**8R2**)	0.50(**5**)
9.0pF(**9R0**)	0.50(**5**)
10pF(**100**)	0.50(**5**)

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Part Number	**GCM15**
L x W [EIA]	1.00x0.50 [0402]
TC	C0G (**5C**)
Rated Volt.	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)	
12pF(**120**)	0.50(**5**)
15pF(**150**)	0.50(**5**)
18pF(**180**)	0.50(**5**)
22pF(**220**)	0.50(**5**)
27pF(**270**)	0.50(**5**)
33pF(**330**)	0.50(**5**)
39pF(**390**)	0.50(**5**)
47pF(**470**)	0.50(**5**)
56pF(**560**)	0.50(**5**)
68pF(**680**)	0.50(**5**)
82pF(**820**)	0.50(**5**)
100pF(**101**)	0.50(**5**)
120pF(**121**)	0.50(**5**)
150pF(**151**)	0.50(**5**)
180pF(**181**)	0.50(**5**)
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**)

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]	1.60x0.80 [0603]			
TC	C0G (**5C**)		X8G (**5G**)	
Rated Volt.	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)				
0.50pF(**R50**)	0.80(**8**)	0.80(**8**)		
0.75pF(**R75**)	0.80(**8**)	0.80(**8**)		
1.0pF(**1R0**)	0.80(**8**)	0.80(**8**)		
1.2pF(**1R2**)	0.80(**8**)	0.80(**8**)		
1.5pF(**1R5**)	0.80(**8**)	0.80(**8**)		
1.8pF(**1R8**)	0.80(**8**)	0.80(**8**)		
2.0pF(**2R0**)	0.80(**8**)	0.80(**8**)		
2.2pF(**2R2**)	0.80(**8**)	0.80(**8**)		
2.7pF(**2R7**)	0.80(**8**)	0.80(**8**)		
3.0pF(**3R0**)	0.80(**8**)	0.80(**8**)		
3.3pF(**3R3**)	0.80(**8**)	0.80(**8**)		
3.9pF(**3R9**)	0.80(**8**)	0.80(**8**)		
4.0pF(**4R0**)	0.80(**8**)	0.80(**8**)		
4.7pF(**4R7**)	0.80(**8**)	0.80(**8**)		
5.0pF(**5R0**)	0.80(**8**)	0.80(**8**)		
5.6pF(**5R6**)	0.80(**8**)	0.80(**8**)		
6.0pF(**6R0**)	0.80(**8**)	0.80(**8**)		
6.8pF(**6R8**)	0.80(**8**)	0.80(**8**)		
7.0pF(**7R0**)	0.80(**8**)	0.80(**8**)		

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Part Number	GCM18			
L x W [EIA]	1.60x0.80 [0603]			
TC	C0G (**5C**)		X8G (**5G**)	
Rated Volt.	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)				
8.0pF(**8R0**)	0.80(**8**)	0.80(**8**)		
8.2pF(**8R2**)	0.80(**8**)	0.80(**8**)		
9.0pF(**9R0**)	0.80(**8**)	0.80(**8**)		
10pF(**100**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
12pF(**120**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
15pF(**150**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
18pF(**180**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
22pF(**220**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
27pF(**270**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
33pF(**330**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
39pF(**390**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
47pF(**470**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
56pF(**560**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
68pF(**680**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
82pF(**820**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
100pF(**101**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
120pF(**121**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
150pF(**151**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
180pF(**181**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
220pF(**221**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
270pF(**271**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
330pF(**331**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
390pF(**391**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
470pF(**471**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
560pF(**561**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
680pF(**681**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
820pF(**821**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
1000pF(**102**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
1200pF(**122**)		0.80(**8**)		0.80(**8**)
1500pF(**152**)		0.80(**8**)		0.80(**8**)
1800pF(**182**)		0.80(**8**)		0.80(**8**)
2200pF(**222**)		0.80(**8**)		0.80(**8**)
2700pF(**272**)		0.80(**8**)		0.80(**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]	2.00x1.25 [0805]			
TC	C0G (**5C**)		X8G (**5G**)	
Rated Volt.	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)				
7.0pF(**7R0**)	0.85(**9**)	0.60(**6**)		
8.0pF(**8R0**)	0.85(**9**)	0.60(**6**)		
8.2pF(**8R2**)	0.85(**9**)	0.60(**6**)		
9.0pF(**9R0**)	0.85(**9**)	0.60(**6**)		
10pF(**100**)	0.85(**9**)	0.60(**6**)		
12pF(**120**)	0.85(**9**)	0.60(**6**)		

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Part Number	GCM21			
L x W [EIA]	2.00x1.25 [0805]			
TC	C0G (**5C**)		X8G (**5G**)	
Rated Volt.	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)				
15pF(**150**)	0.85(**9**)	0.60(**6**)		
18pF(**180**)	0.85(**9**)	0.60(**6**)		
22pF(**220**)	0.85(**9**)	0.60(**6**)		
27pF(**270**)	0.85(**9**)	0.60(**6**)		
33pF(**330**)	0.85(**9**)	0.60(**6**)		
39pF(**390**)	0.85(**9**)	0.60(**6**)		
47pF(**470**)	0.85(**9**)	0.60(**6**)		
56pF(**560**)	0.85(**9**)	0.60(**6**)		
68pF(**680**)	0.85(**9**)	0.60(**6**)		
82pF(**820**)	0.85(**9**)	0.60(**6**)		
100pF(**101**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
120pF(**121**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
150pF(**151**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
180pF(**181**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
220pF(**221**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
270pF(**271**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
330pF(**331**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
390pF(**391**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
470pF(**471**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
560pF(**561**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
680pF(**681**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
820pF(**821**)	0.60(**6**)	0.60(**6**)	0.60(**6**)	0.60(**6**)
1000pF(**102**)	0.85(**9**)	0.60(**6**)	0.85(**9**)	0.60(**6**)
1200pF(**122**)	0.85(**9**)	0.60(**6**)	0.85(**9**)	0.60(**6**)
1500pF(**152**)	0.85(**9**)	0.60(**6**)	0.85(**9**)	0.60(**6**)
1800pF(**182**)		0.60(**6**)		0.60(**6**)
2200pF(**222**)		0.60(**6**)		0.60(**6**)
2700pF(**272**)		0.60(**6**)		0.60(**6**)
3300pF(**332**)		0.60(**6**)		0.60(**6**)
3900pF(**392**)		0.60(**6**)		0.60(**6**)
4700pF(**472**)		0.60(**6**)		0.60(**6**)
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**)

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]	3.20x1.60 [1206]	
TC	C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
12pF(**120**)	0.85(**9**)	
15pF(**150**)	0.85(**9**)	
18pF(**180**)	0.85(**9**)	
22pF(**220**)	0.85(**9**)	

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Part Number	**GCM31**	
L x W [EIA]	3.20x1.60 [1206]	
TC	C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
27pF(**270**)	0.85(**9**)	
33pF(**330**)	0.85(**9**)	
39pF(**390**)	0.85(**9**)	
47pF(**470**)	0.85(**9**)	
56pF(**560**)	0.85(**9**)	
68pF(**680**)	0.85(**9**)	
82pF(**820**)	0.85(**9**)	
100pF(**101**)	0.85(**9**)	
120pF(**121**)	0.85(**9**)	
150pF(**151**)	0.85(**9**)	
180pF(**181**)	0.85(**9**)	
220pF(**221**)	0.85(**9**)	
270pF(**271**)	0.85(**9**)	
330pF(**331**)	0.85(**9**)	
390pF(**391**)	0.85(**9**)	
470pF(**471**)	0.85(**9**)	
560pF(**561**)	0.85(**9**)	0.60(**6**)
680pF(**681**)	0.85(**9**)	0.60(**6**)
820pF(**821**)	1.15(**M**)	0.85(**9**)
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**)
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, X7R (R7) Characteristics

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.	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)																						
220pF (**221**)	0.50 (**5**)	0.50 (**5**)																				

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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.	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)																						
330pF (**331**)	0.50 (**5**)	0.50 (**5**)																				
470pF (**471**)	0.50 (**5**)	0.50 (**5**)																				
680pF (**681**)	0.50 (**5**)	0.50 (**5**)																				
1000pF (**102**)	0.50 (**5**)	0.50 (**5**)			0.80 (**8**)	0.80 (**8**)			0.60 (**6**)	0.60 (**6**)												
1500pF (**152**)	0.50 (**5**)	0.50 (**5**)			0.80 (**8**)	0.80 (**8**)			0.60 (**6**)	0.60 (**6**)												
2200pF (**222**)	0.50 (**5**)	0.50 (**5**)			0.80 (**8**)	0.80 (**8**)			0.60 (**6**)	0.60 (**6**)												
3300pF (**332**)	0.50 (**5**)	0.50 (**5**)			0.80 (**8**)	0.80 (**8**)			0.60 (**6**)	0.60 (**6**)												
4700pF (**472**)	0.50 (**5**)	0.50 (**5**)			0.80 (**8**)	0.80 (**8**)			0.60 (**6**)	0.60 (**6**)												
6800pF (**682**)		0.50 (**5**)	0.50 (**5**)		0.80 (**8**)	0.80 (**8**)			0.60 (**6**)	0.60 (**6**)												
10000pF (**103**)		0.50 (**5**)	0.50 (**5**)		0.80 (**8**)	0.80 (**8**)			0.60 (**6**)	0.60 (**6**)												
15000pF (**153**)		0.50 (**5**)	0.50 (**5**)		0.80 (**8**)	0.80 (**8**)	0.80 (**8**)		0.60 (**6**)	0.60 (**6**)												
22000pF (**223**)		0.50 (**5**)	0.50 (**5**)		0.80 (**8**)	0.80 (**8**)	0.80 (**8**)		0.60 (**6**)	0.60 (**6**)												
33000pF (**333**)			0.50 (**5**)	0.50 (**5**)		0.80 (**8**)	0.80 (**8**)		0.85 (**9**)	0.85 (**9**)												
47000pF (**473**)			0.50 (**5**)	0.50 (**5**)		0.80 (**8**)	0.80 (**8**)		1.25 (**B**)	1.25 (**B**)												
68000pF (**683**)				0.50 (**5**)		0.80 (**8**)		0.80 (**8**)	1.25 (**B**)	1.25 (**B**)												
0.10µF (**104**)				0.50 (**5**)		0.80 (**8**)		0.80 (**8**)	1.25 (**B**)	1.25 (**B**)				0.85 (**9**)	1.15 (**M**)							
0.15µF (**154**)							0.80 (**8**)			1.25 (**B**)	1.25 (**B**)			1.15 (**M**)	1.15 (**M**)							
0.22µF (**224**)							0.80 (**8**)			1.25 (**B**)	1.25 (**B**)			1.15 (**M**)	1.15 (**M**)	0.85 (**9**)						
0.33µF (**334**)								0.80 (**8**)		0.85 (**9**)	1.25 (**B**)	1.25 (**B**)			1.15 (**M**)	0.85 (**9**)						
0.47µF (**474**)							0.80 (**8**)	0.80 (**8**)		1.25 (**B**)	1.25 (**B**)	1.25 (**B**)			1.15 (**M**)	1.15 (**M**)						
0.68µF (**684**)											1.25 (**B**)											
1.0µF (**105**)											1.25 (**B**)					1.15 (**M**)			2.50 (**E**)			
1.5µF (**155**)												1.25 (**B**)			1.60 (**C**)	1.15 (**M**)						
2.2µF (**225**)											1.25 (**B**)	1.25 (**B**)	1.25 (**B**)		1.60 (**C**)	1.15 (**M**)				2.50 (**E**)		
3.3µF (**335**)												1.25 (**B**)				1.15 (**M**)						
4.7µF (**475**)																1.60 (**C**)	1.60 (**C**)					

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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.	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)																						
6.8µF (**685**)																		1.60 (**C**)				
10µF (**106**)																		1.60 (**C**)			2.00 (**D**)	
22µF (**226**)																						2.50 (**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]	1.60x0.80 [0603]		2.00x1.25 [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**)	0.80(**8**)		
1.0µF(**105**)	0.80(**8**)	0.80(**8**)	
4.7µF(**475**)			1.25(**B**)

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

High Dielectric Constant Type, X8L (L8) Characteristics

TC	X8L (**L8**)					
Part Number	**GCM18**		**GCM21**		**GCM31**	
L x W [EIA]	1.60x0.80 [0603]		2.00x1.25 [0805]		3.20x1.60 [1206]	
Rated Volt.	50 (**1H**)	16 (**1C**)	50 (**1H**)	16 (**1C**)	50 (**1H**)	16 (**1C**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)						
15000pF(**153**)	0.80(**8**)					
22000pF(**223**)	0.80(**8**)					
33000pF(**333**)	0.80(**8**)					
47000pF(**473**)	0.80(**8**)					
68000pF(**683**)	0.80(**8**)		1.25(**B**)			
0.10µF(**104**)	0.80(**8**)		1.25(**B**)		1.15(**M**)	
0.15µF(**154**)		0.80(**8**)	1.25(**B**)		1.15(**M**)	
0.22µF(**224**)		0.80(**8**)	1.25(**B**)		1.15(**M**)	
0.33µF(**334**)			1.25(**B**)	1.25(**B**)	1.15(**M**)	
0.47µF(**474**)				1.25(**B**)	1.15(**M**)	
0.68µF(**684**)				1.25(**B**)	1.60(**C**)	
1.0µF(**105**)				1.25(**B**)	1.60(**C**)	
1.5µF(**155**)						1.15(**M**)
2.2µF(**225**)						1.15(**M**)

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

High Dielectric Constant Type, X8R (R9) Characteristics

TC	X8R (**R9**)		
Part Number	**GCM18**	**GCM21**	**GCM31**
L x W [EIA]	1.60x0.80 [0603]	2.00x1.25 [0805]	3.20x1.60 [1206]
Rated Volt.	50 (**1H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)			
33000pF(**333**)	0.80(**8**)		
47000pF(**473**)	0.80(**8**)		
68000pF(**683**)		1.25(**B**)	
0.10μF(**104**)		1.25(**B**)	
0.15μF(**154**)			1.15(**M**)
0.22μF(**224**)			1.15(**M**)
0.33μF(**334**)			1.15(**M**)

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

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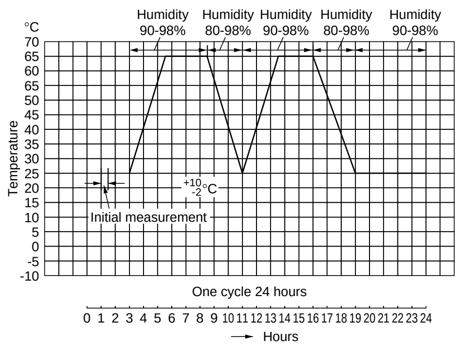
Specifications and Test Methods

<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 rowspan="4"></td><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>Within ±10.0%</td></tr>
<tr><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>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)
150+3/-0 (L8/R9/5G)</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 rowspan="4"></td><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>Within ±10.0%</td></tr>
<tr><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>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F *1
(Whichever is smaller)</td></tr>
<tr><td>4</td><td colspan="2">Destructive Physical Analysis</td><td colspan="2">No defects or abnormalities</td><td>Per EIA-469</td></tr>
<tr><td rowspan="5">5</td><td colspan="2">Moisture Resistance</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply the 24-hour heat (25 to 65°C) and humidity (80 to 98%) treatment shown below, 10 consecutive times.
Let sit for 24±2 hours at room temperature, then measure.
</td></tr>
<tr><td rowspan="4"></td><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3.0% or ±0.30pF
(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><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>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F *1
(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 rowspan="4"></td><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3.0% or ±0.30pF
(Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><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>I.R.</td><td colspan="2">More than 1,000Ω or 50Ω · F *1
(Whichever is smaller)</td></tr>
</table>

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Specifications and Test Methods

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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		

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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) 150+3/-0 (L8, R9, 5G) 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) Max. Operating Temperature···150°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) Max. Operating Temperature···150°C More than 1,000MΩ or 1Ω · 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.

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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="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.

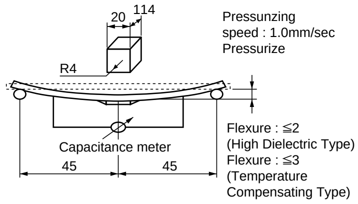
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>GCM15</td><td>0.5</td><td>1.5</td><td>0.6</td></tr>
<tr><td>GCM18</td><td>0.6</td><td>2.2</td><td>0.9</td></tr>
<tr><td>GCM21</td><td>0.8</td><td>3.0</td><td>1.3</td></tr>
<tr><td>GCM31</td><td>2.0</td><td>4.4</td><td>1.7</td></tr>
<tr><td>GCM32</td><td>2.0</td><td>4.4</td><td>2.6</td></tr></table>
(in mm)


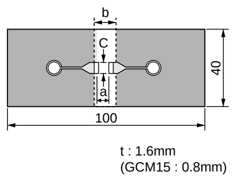
Fig. 2</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td><td>Within ±10.0%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min. : Q≧1000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>*1
W.V. : 25Vmin. : 0.025 max.
W.V. : 16V : 0.035 max.</td></tr>
<tr><td>I.R.</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 (GCM15)

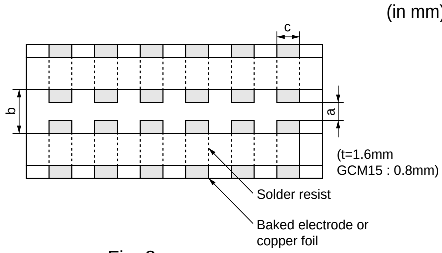
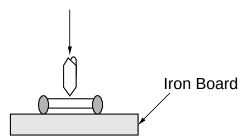
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>GCM15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr>
<tr><td>GCM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr>
<tr><td>GCM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr>
<tr><td>GCM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr>
<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>*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. >


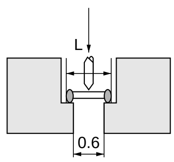
Speed supplied the Stress Load : 0.5mm / sec.
< Chip Length : 3.2mm min. >


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

Continued on the following page.

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="3">21</td><td rowspan="3">Capacitance Temperature Character-istics</td><td>Capacitance Change</td><td>Within the specified tolerance (Table A)</td><td>C7 : Withn ±22%
(-55°C to +125°C)
L8 : Withn +15/-40%
(-55°C to +150°C)
R7 : Withn ±15%
(-55°C to +125°C)
R9 : Withn ±15%
(-55°C to +150°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 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.
<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 (ΔC / R7 / C7), 150±3 (L8 / R9 / 5G)</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 24±2 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)
* Do not apply to 1X/25V</td></tr>
</table>

*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/5G	0±30	0.58	-0.24	0.40	-0.17	0.25	-0.11

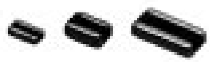
Note 1 : Nominal values denote the temperature coefficient within a range of 25°C to 125°C (for 5C)/150°C (for 5G).

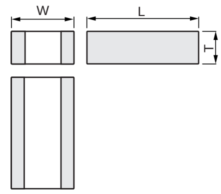
Chip Monolithic Ceramic Capacitors for Automotive

for Automotive Low ESL LLC Series Capacitors

■ Features
1. Low ESL, good for noise reduction for high frequency
2. Small, high cap

■ Applications
1. High speed micro processor
2. High frequency digital equipment



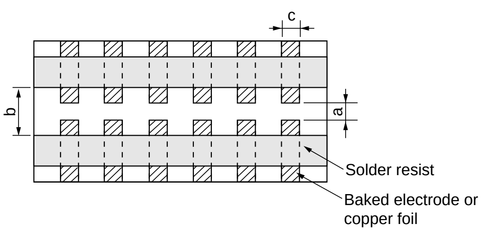


Part Number	Dimensions (mm)		
	L	W	T
LLC185	1.6 ±0.1	0.8 ±0.1	0.6 max.
LLC216	2.0 ±0.1	1.25 ±0.1	0.6 ±0.1
LLC219			0.85 ±0.1
LLC317	3.2 ±0.15	1.6 ±0.15	0.7 ±0.1
LLC31M			1.15 ±0.1

TC	X7R (**R7**)											
Part Number	**LLC18**				**LLC21**				**LLC31**			
L x W [EIA]	1.60x0.80 [0603]				2.00x1.25 [0805]				3.20x1.60 [1206]			
Rated Volt.	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	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)												
2200pF(**222**)	0.50(**5**)											
3300pF(**332**)	0.50(**5**)											
4700pF(**472**)	0.50(**5**)				0.60(**6**)							
6800pF(**682**)		0.50(**5**)			0.60(**6**)							
10000pF(**103**)		0.50(**5**)	0.50(**5**)		0.60(**6**)				0.70(**7**)			
15000pF(**153**)		0.50(**5**)	0.50(**5**)		0.60(**6**)				0.70(**7**)	0.70(**7**)		
22000pF(**223**)		0.50(**5**)	0.50(**5**)		0.60(**6**)	0.60(**6**)			0.70(**7**)	0.70(**7**)		
33000pF(**333**)			0.50(**5**)		0.85(**9**)	0.85(**9**)	0.60(**6**)		0.70(**7**)	0.70(**7**)		
47000pF(**473**)			0.50(**5**)			0.85(**9**)	0.60(**6**)		0.70(**7**)	0.70(**7**)		
68000pF(**683**)			0.50(**5**)			0.85(**9**)	0.60(**6**)		0.70(**7**)	0.70(**7**)		
0.10µF(**104**)				0.50(**5**)		0.85(**9**)	0.85(**9**)		1.15(**M**)	1.15(**M**)	0.70(**7**)	
0.15µF(**154**)						0.85(**9**)	0.85(**9**)		1.15(**M**)	1.15(**M**)	0.70(**7**)	
0.22µF(**224**)							0.85(**9**)	0.60(**6**)		1.15(**M**)	0.70(**7**)	
0.33µF(**334**)								0.60(**6**)		1.15(**M**)	1.15(**M**)	
0.47µF(**474**)								0.85(**9**)		1.15(**M**)	1.15(**M**)	0.70(**7**)
0.68µF(**684**)											1.15(**M**)	0.70(**7**)
1.0µF(**105**)											1.15(**M**)	0.70(**7**)
1.5µF(**155**)												1.15(**M**)
2.2µF(**225**)												1.15(**M**)

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

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 Range</td><td>R7 : −55 to +125℃</td><td></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 dimension</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 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>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ 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 25℃ at the frequency and voltage shown in the table.
<table><tr><th>Item \ Char.</th><th>R7</th></tr><tr><td>Frequency</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>1±0.2Vr.m.s.</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V, 10V</th><th>6.3V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr></table></td></tr>
<tr><td>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td><table><tr><th>Char.</th><th>Temp. Range (℃)</th><th>Reference Temp.</th><th>Cap. Change.</th></tr><tr><td>R7</td><td>−55 to +125</td><td>25℃</td><td>Within ±15%</td></tr></table></td><td>The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table should be within the specified ranges.
The capacitance change should be measured after 5 min. at each specified temperature stage.</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No mechanical defect</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. *5N: LLC18
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>**LLC18**</td><td>0.3</td><td>1.2</td><td>2.0</td></tr><tr><td>**LLC21**</td><td>0.6</td><td>1.6</td><td>2.4</td></tr><tr><td>**LLC31**</td><td>1.0</td><td>3.0</td><td>3.7</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><table><tr><th>Char.</th><th>25V min.</th><th>16V, 10V</th><th>6.3V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr></table></td></tr>
</table>

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Specifications and Test Methods

Continued from the preceding page.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="2">12</td><td colspan="2" rowspan="2">Deflection</td><td>No crack or marked defect should occur.</td><td rowspan="2">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 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.

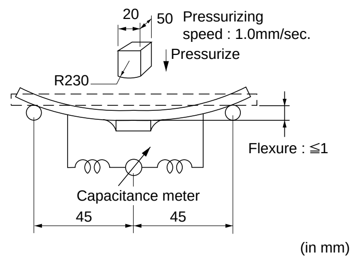
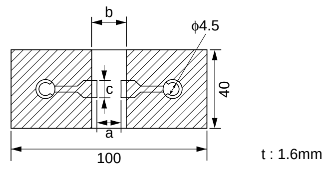



Fig. 3</td></tr>
<tr><td><table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>**LLC18**</td><td>0.3</td><td>1.2</td><td>2.0</td></tr><tr><td>**LLC21**</td><td>0.6</td><td>1.6</td><td>2.4</td></tr><tr><td>**LLC31**</td><td>1.0</td><td>3.0</td><td>3.7</td></tr></table>(in mm)
Fig. 2</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td>75% of the terminations are to be soldered evenly and continuously.</td><td>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℃.</td></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 48±4 hours , then measure.

•Initial measurement.
Perform a heat treatment at 150^{+0}_{-10}℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>R7 : Within ±7.5%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V, 10V</th><th>6.3V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10).
Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 48±4 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. (℃)</td><td>Min. Operating Temp. $^{+0}_{-3}$</td><td>Room Temp.</td><td>Max. Operating Temp. $^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>•Initial measurement.
Perform a heat treatment at 150^{+0}_{-10}℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>R7 : Within ±7.5%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V, 10V</th><th>6.3V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">Humidity, Steady State</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="4">Let the capacitor sit at 40±2℃ and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 48±4 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>R7 : Within ±12.5%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V, 10V</th><th>6.3V</th></tr><tr><td>R7</td><td>0.05 max.</td><td>0.05 max.</td><td>0.075 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td rowspan="5">17</td><td rowspan="5">Humidity Load</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance Change</td><td>R7 : Within ±12.5%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V, 10V</th><th>6.3V</th></tr><tr><td>R7</td><td>0.05 max.</td><td>0.05 max.</td><td>0.075 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 500MΩ or 25Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</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">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="5">18</td><td rowspan="5">High Temperature Load</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">Apply 200% of the rated voltage for 1,000±12 hours at maximum operating temperature ±3℃. Let sit for 48±4 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.

•Initial measurement.
Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3℃.
Remove and let sit for 48±4 hours at room temperature.
Perform initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>R7 : Within ±12.5%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V, 10V</th><th>6.3V</th></tr><tr><td>R7</td><td>0.05 max.</td><td>0.05 max.</td><td>0.075 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>

Package

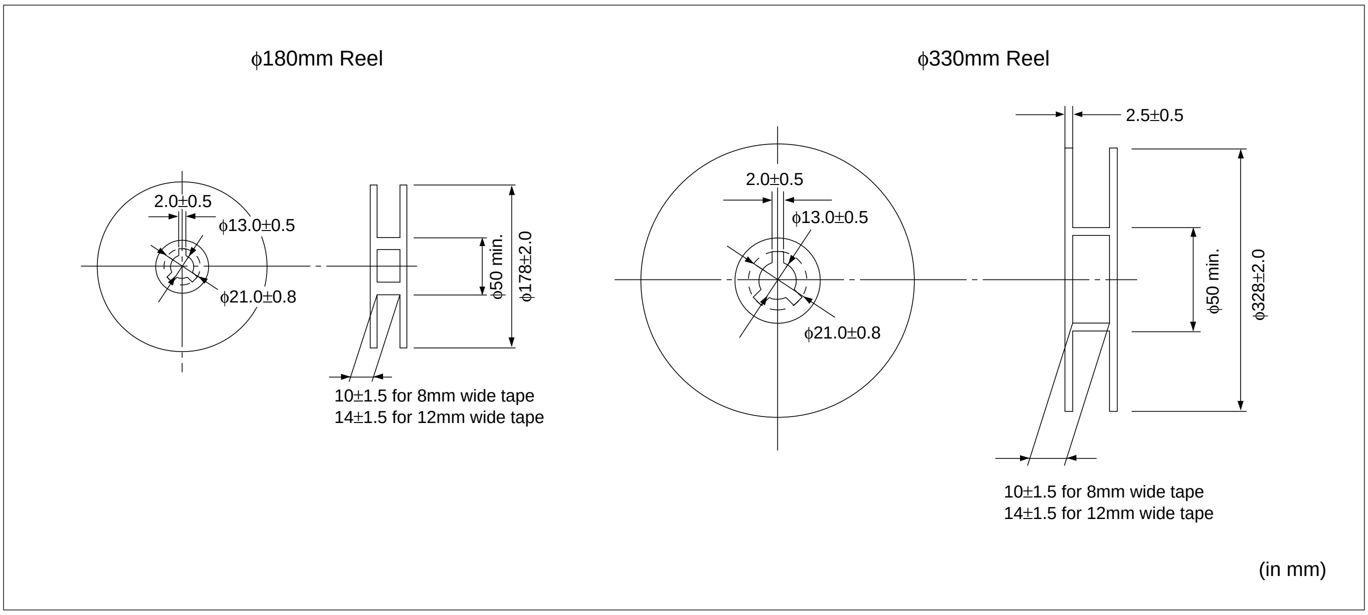
■ Minimum Quantity Guide

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		
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
			1.6/1.8 2.0/2.5	-	1,000	-	4,000	-	1,000
LLC18	0.8	1.6	0.6	-	4,000	-	10,000	-	1,000
LLC21	1.25	2.0	0.6	-	4,000	-	10,000	-	1,000
			0.85	-	3,000	-	10,000	-	1,000
LLC31	1.6	3.2	0.7	-	4,000	-	10,000	-	1,000
			1.15	-	3,000	-	10,000	-	1,000

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

■ Tape Carrier Packaging

1. Dimensions of Reel



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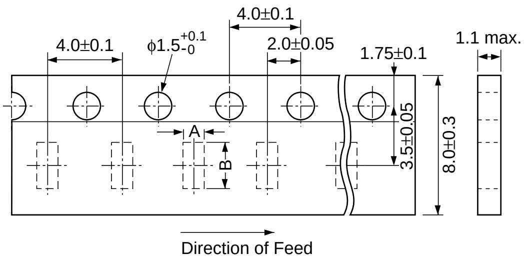
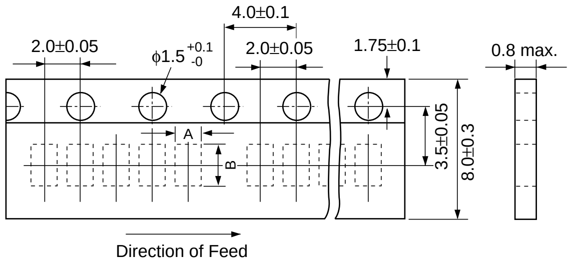
2. Dimensions of Paper Tape

8mm width 4mm pitch Tape



8mm width 2mm pitch Tape



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

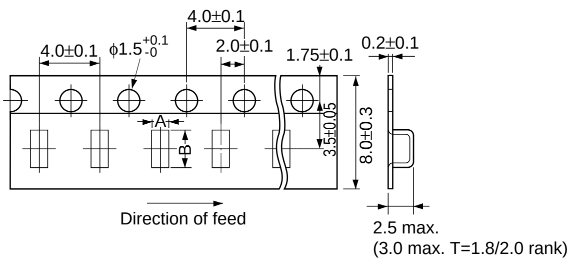
Part Number	A*	B*
GCM15	0.65	1.15

*Nominal Value

(in mm)

3. Dimensions of Embossed Tape

8mm width 4mm pitch Tape



Part Number	A	B
LLC18	1.0±0.1	1.8±0.1
GCM21, LLC21 (T=1.25mm)	1.45±0.2	2.25±0.2
GCM31, LLC31 (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

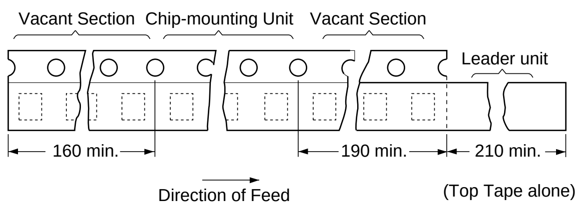
(in mm)

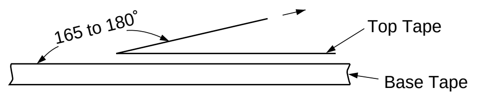
Continued on the following page.

Package

Continued from the preceding page.

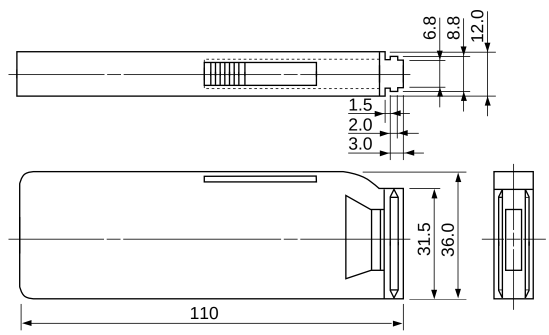
4. Taping Method
   (1) Tapes for capacitors are wound clockwise. The sprocket holes are to the right as the tape is pulled toward the user.
   (2) Part of the leader and part of the empty tape should be attached to the end of the tape as follows.
   (3) The top tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.
   (4) Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.
   (5) The top tape and bottom tape should not protrude beyond the edges of the tape and should not cover 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.





■ 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 degrees 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.

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

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.

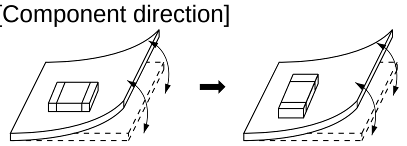
⚠Caution

■ ⚠Caution (Soldering and Mounting)

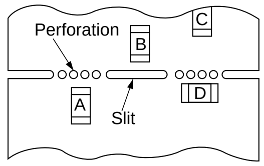
1. Mounting Position

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

[Component direction]



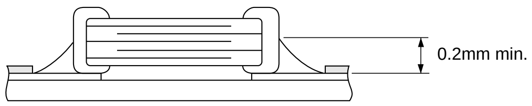
[Chip Mounting Close to Board Separation Point]



2. Solder (Paste Printing)

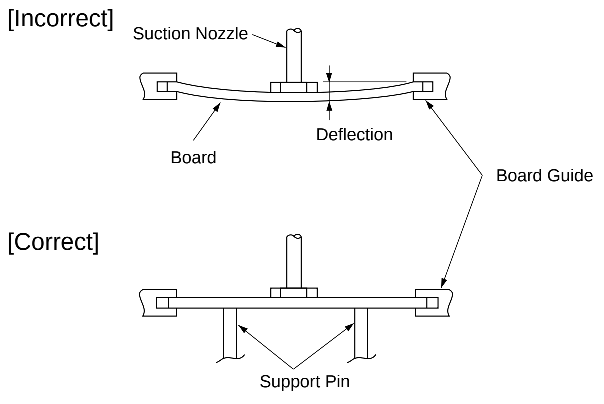
- Overly thick application of solder paste results in excessive fillet height solder.
  This makes the chip more susceptible to mechanical and thermal stress on the board and may cause cracked chips.
- Too little solder paste results in a lack of adhesive strength on the outer electrode, which may result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



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⚠Caution

Continued from the preceding page.

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
GCM15/18/21/31, LLC18/21/31	ΔT≦190°C
GCM32	ΔT≦130°C

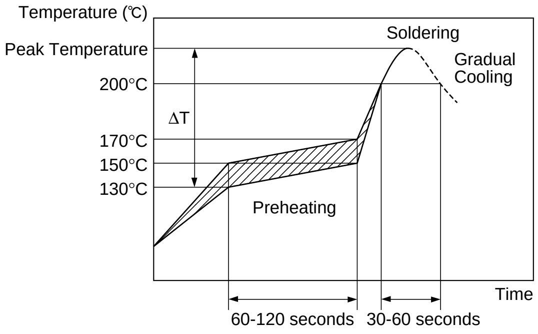
Recommended Conditions

	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

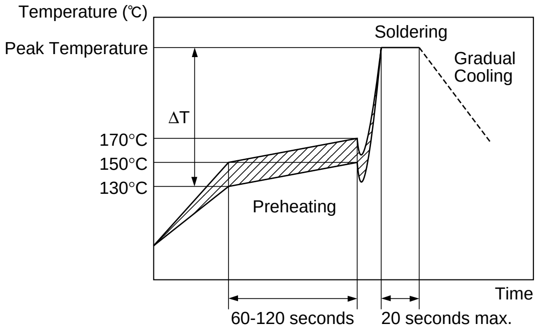
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Reflow Soldering]

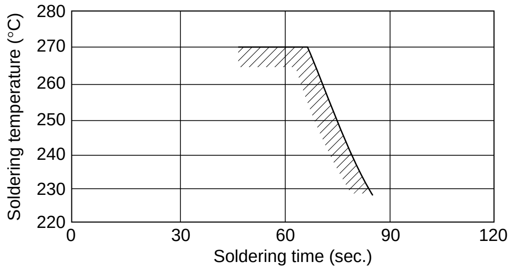
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]



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

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 to 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

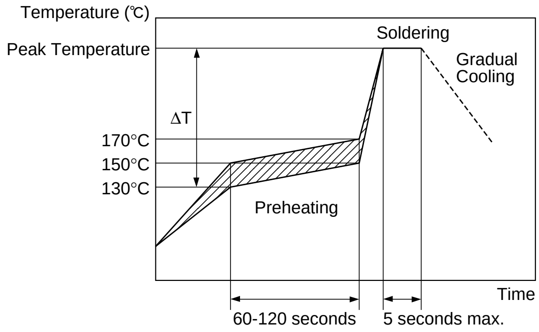
Part Number	Temperature Differential
GCM18/21/31, LLC21/31	ΔT≦150°C

Recommended Conditions

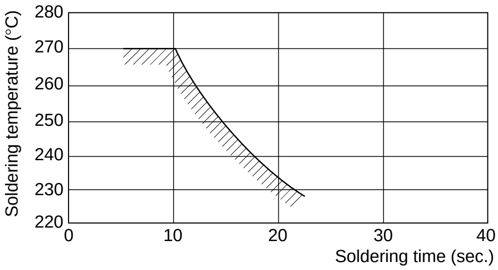
	Pb-Sn Solder	Lead Free Solder
Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N_2

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

[Standard Conditions for Flow Soldering]

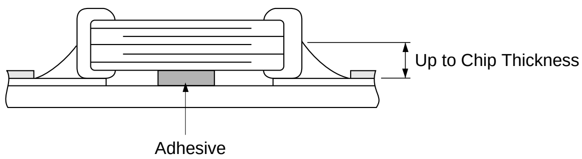


[Allowable Soldering Temperature and Time]



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

- Optimum Solder Amount for Flow Soldering



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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.

[Standard Conditions for Soldering Iron Temperature]

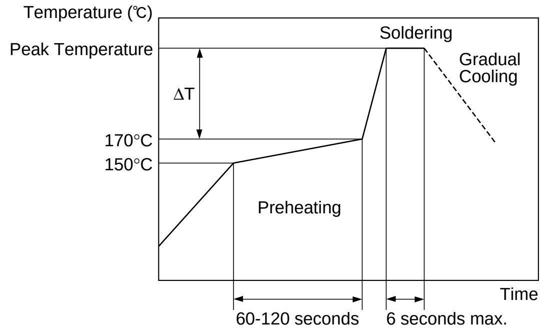
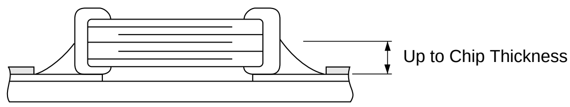


Table 3

Part Number	Temperature Differential	Peak Temperature	Atmosphere
GCM15/18/21/31 **LLC18/21/31**	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



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 depanelization)
(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.

Notice

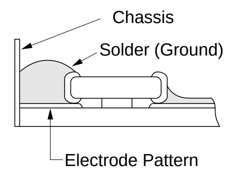
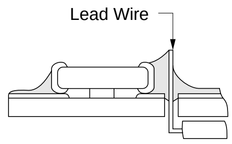
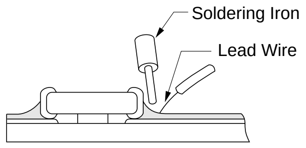
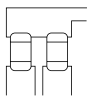
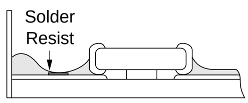
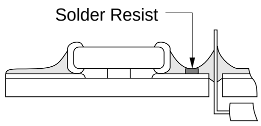
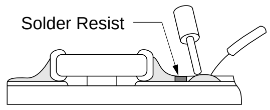
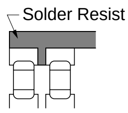
■ Notice (Soldering and Mounting)

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.
In case of chip size 4.5x3.2mm or bigger size, there is a possibility the chip may crack due to the expansion and shrinkage of the metal board. Please contact to Murata if you want to use the ceramic capacitor on metal board such as Aluminum.

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

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.

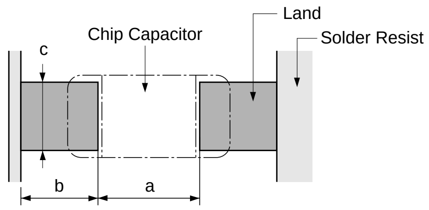


Table 1 Flow Soldering Method

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	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
LLC21	1.25×2.0	0.4–0.7	0.5–0.7	1.4–1.8
LLC31	1.6×3.2	0.6–1.0	0.8–0.9	2.6–2.8

(in mm)

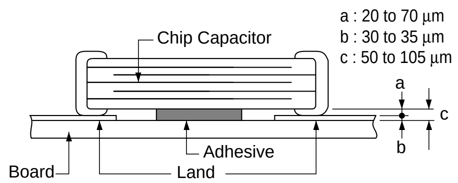
Table 2 Reflow Soldering Method

Part Number \ Dimensions	Dimensions (L×W)	a	b	c
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
LLC18	0.8×1.6	0.2–0.4	0.3–0.4	1.0–1.4
LLC21	1.25×2.0	0.4–0.6	0.3–0.5	1.4–1.8
LLC31	1.6×3.2	0.6–0.8	0.6–0.7	2.6–2.8

(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)
- Adhesive Coverage*



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

*Nominal Value

Continued on the following page.

Notice

Continued from the preceding page.

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.

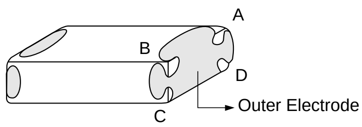
4. Flux Application

- 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.

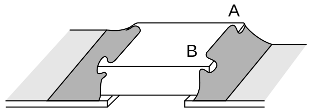
5. Flow Soldering

- 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]



■ Notice (Other)

1. Resin Coating
   When selecting resin materials,select those with low contraction.
2. Circuit Design
   The capacitors listed in the previous sections of 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 herein are given in typical valuse, not guaranteed ratings.

⚠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 November 2005. 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.
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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