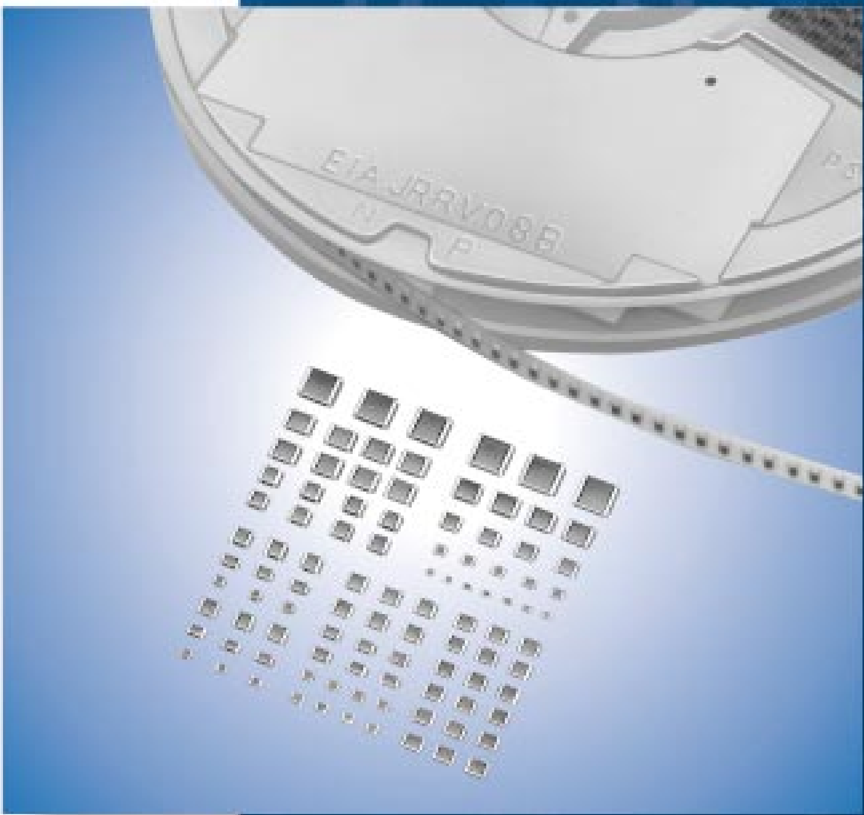
Chip Monolithic Ceramic Capacitors



muRata Innovator in Electronics

Murata Manufacturing Co., Ltd.

Cat.No.C02E-14

CONTENTS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

● Please refer to "Specifications and Test Methods" at the end of each chapter of 11 – 16 .

for EU RoHS Compliant

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

Please check MURATA home page (http://www.murata.com/index.html) in case you can not find the part number on the catalog.

● Part Numbering

Chip Monolithic Ceramic Capacitors

(Part Number) GR 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
GR	**M**	Tin Plated Layer
	4	Only for Information Devices / Tip & Ring
	7	Only for Camera Flash Circuit
ER	**B**	High Frequency Type
GQ	**M**	High Frequency for Flow/Reflow Soldering
GM	**A**	Monolithic Microchip
	D	for Bonding
GN	**M**	Capacitor Array
LL	**L**	Low ESL Wide Width Type
	A	Eight-termination Low ESL Type
	M	Ten-termination Low ESL Type
GJ	**M**	High Frequency Low Loss Type
GA	**2**	for AC250V (r.m.s.)
	3	Safety Standard Recognized Type

❸Dimension (L×W)

Code	Dimension (L×W)	EIA
02	0.4×0.2mm	01005
03	0.6×0.3mm	0201
05	0.5×0.5mm	0202
08	0.8×0.8mm	0303
0D	0.38×0.38mm	015015
0M	0.9×0.6mm	0302
11	1.25×1.0mm	0504
15	1.0×0.5mm	0402
18	1.6×0.8mm	0603
1M	1.37×1.0mm	0504
21	2.0×1.25mm	0805
22	2.8×2.8mm	1111
31	3.2×1.6mm	1206
32	3.2×2.5mm	1210
42	4.5×2.0mm	1808
43	4.5×3.2mm	1812
52	5.7×2.8mm	2211
55	5.7×5.0mm	2220

❹Dimension (T)

Code	Dimension (T)
2	0.2mm
2	2-elements (Array Type)
3	0.3mm
4	4-elements (Array Type)
5	0.5mm
6	0.6mm
7	0.7mm
8	0.8mm
9	0.85mm
A	1.0mm
B	1.25mm
C	1.6mm
D	2.0mm
E	2.5mm
F	3.2mm
M	1.15mm
N	1.35mm
Q	1.5mm
R	1.8mm
S	2.8mm
X	Depends on individual standards.

With the array type GNM series, "Dimension(T)" indicates the number of elements.

Continued on the following page. ↗

Please check MURATA home page (http://www.murata.com/index.html) in case you can not find the part number on the catalog.

Continued from the preceding page.

❺Temperature Characteristics

Temperature Characteristic Codes			Temperature Characteristics			Operating Temperature Range
Code	Public STD Code		Referance Temperature	Temperature Range	Capacitance Change or Temperature Coefficient	
1X	SL *1	JIS	20°C	20 to 85°C	+350 to -1000ppm/°C	-55 to 125°C
2C	CH *1	JIS	20°C	20 to 125°C	0±60ppm/°C	-55 to 125°C
2P	PH *1	JIS	20°C	20 to 85°C	-150±60ppm/°C	-25 to 85°C
2R	RH *1	JIS	20°C	20 to 85°C	-220±60ppm/°C	-25 to 85°C
2S	SH *1	JIS	20°C	20 to 85°C	-330±60ppm/°C	-25 to 85°C
2T	TH *1	JIS	20°C	20 to 85°C	-470±60ppm/°C	-25 to 85°C
3C	CJ *1	JIS	20°C	20 to 125°C	0±120ppm/°C	-55 to 125°C
3P	PJ *1	JIS	20°C	20 to 85°C	-150±120ppm/°C	-25 to 85°C
3R	RJ *1	JIS	20°C	20 to 85°C	-220±120ppm/°C	-25 to 85°C
3S	SJ *1	JIS	20°C	20 to 85°C	-330±120ppm/°C	-25 to 85°C
3T	TJ *1	JIS	20°C	20 to 85°C	-470±120ppm/°C	-25 to 85°C
3U	UJ *1	JIS	20°C	20 to 85°C	-750±120ppm/°C	-25 to 85°C
4C	CK *1	JIS	20°C	20 to 125°C	0±250ppm/°C	-55 to 125°C
5C	C0G *1	EIA	25°C	25 to 125°C	0±30ppm/°C	-55 to 125°C
5G	X8G *1	EIA	25°C	25 to 150°C	0±30ppm/°C	-55 to 150°C
6C	C0H *1	EIA	25°C	25 to 125°C	0±60ppm/°C	-55 to 125°C
6P	P2H *1	EIA	25°C	25 to 85°C	-150±60ppm/°C	-55 to 125°C
6R	R2H *1	EIA	25°C	25 to 85°C	-220±60ppm/°C	-55 to 125°C
6S	S2H *1	EIA	25°C	25 to 85°C	-330±60ppm/°C	-55 to 125°C
6T	T2H *1	EIA	25°C	25 to 85°C	-470±60ppm/°C	-55 to 125°C
7U	U2J *1	EIA	25°C	25 to 125°C	-750±120ppm/°C	-55 to 125°C
B1	B *2	JIS	20°C	-25 to 85°C	±10%	-25 to 85°C
B3	B	JIS	20°C	-25 to 85°C	±10%	-25 to 85°C
C7	X7S	EIA	25°C	-55 to 125°C	±22%	-55 to 125°C
C8	X6S	EIA	25°C	-55 to 105°C	±22%	-55 to 105°C
D7	X7T	EIA	25°C	-55 to 125°C	+22, -33%	-55 to 125°C
D8	X6T	EIA	25°C	-55 to 105°C	+22, -33%	-55 to 105°C
E7	X7U	EIA	25°C	-55 to 125°C	+22, -56%	-55 to 125°C
F1	F *2	JIS	20°C	-25 to 85°C	+30, -80%	-25 to 85°C
F5	Y5V	EIA	25°C	-30 to 85°C	+22, -82%	-30 to 85°C
L8	X8L	EIA	25°C	-55 to 150°C	+15, -40%	-55 to 150°C
R1	R *2	JIS	20°C	-55 to 125°C	±15%	-55 to 125°C
R3	R	JIS	20°C	-55 to 125°C	±15%	-55 to 125°C
R6	X5R	EIA	25°C	-55 to 85°C	±15%	-55 to 85°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	*3	20°C	-25 to 20°C	-4700+1000/-2500ppm/°C	-25 to 85°C
				20 to 85°C	-4700+500/-1000ppm/°C	
W0	-	-	25°C	-55 to 125°C	±10% *4	-55 to 125°C
					+22, -33% *5	

*1 Please refer to table for Capacitance Change under reference temperature.
*2 Capacitance change is specified with 50% rated voltage applied.
*3,*4 Murata Temperature Characteristic Code.
*4 Apply DC350V bias.
*5 No DC bias.

Continued on the following page.

Continued from the preceding page.

●Capacitance Change from each temperature

JIS Code

Murata Code	Capacitance Change from 20°C (%)					
	–55°C		–25°C		–10°C	
	Max.	Min.	Max.	Min.	Max.	Min.
1X	–	–	–	–	–	–
2C	0.82	–0.45	0.49	–0.27	0.33	–0.18
2P	–	–	1.32	0.41	0.88	0.27
2R	–	–	1.70	0.72	1.13	0.48
2S	–	–	2.30	1.22	1.54	0.81
2T	–	–	3.07	1.85	2.05	1.23
3C	1.37	–0.90	0.82	–0.54	0.55	–0.36
3P	–	–	1.65	0.14	1.10	0.09
3R	–	–	2.03	0.45	1.35	0.30
3S	–	–	2.63	0.95	1.76	0.63
3T	–	–	3.40	1.58	2.27	1.05
3U	–	–	4.94	2.84	3.29	1.89
4C	2.56	–1.88	1.54	–1.13	1.02	–0.75

EIA Code

Murata Code	Capacitance Change from 25°C (%)					
	–55°C		–30°C		–10°C	
	Max.	Min.	Max.	Min.	Max.	Min.
5C/5G	0.58	–0.24	0.40	–0.17	0.25	–0.11
6C	0.87	–0.48	0.59	–0.33	0.38	–0.21
6P	2.33	0.72	1.61	0.50	1.02	0.32
6R	3.02	1.28	2.08	0.88	1.32	0.56
6S	4.09	2.16	2.81	1.49	1.79	0.95
6T	5.46	3.28	3.75	2.26	2.39	1.44
7U	8.78	5.04	6.04	3.47	3.84	2.21

❻Rated Voltage

Code	Rated Voltage
0G	DC4V
0J	DC6.3V
1A	DC10V
1C	DC16V
1E	DC25V
1H	DC50V
2A	DC100V
2D	DC200V
2E	DC250V
YD	DC300V
2H	DC500V
2J	DC630V
3A	DC1kV
3D	DC2kV
3F	DC3.15kV
BB	DC350V (for Camera Flash Circuit)
E2	AC250V
GB	X2; AC250V (Safety Standard Recognized Type GB)
GC	X1/Y2; AC250V (Safety Standard Recognized Type GC)
GD	Y3; AC250V (Safety Standard Recognized Type GD)
GF	Y2, X1/Y2; AC250V (Safety Standard Recognized Type GF)

❼Capacitance

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

Ex.)

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

Continued on the following page.

Please check MURATA home page (http://www.murata.com/index.html) in case you can not find the part number on the catalog.

Continued from the preceding page.

❽Capacitance Tolerance

Code	Capacitance Tolerance	TC	Series	Capacitance Step	
W	±0.05pF	CΔ	**GRM/GJM**	≦9.9pF	0.1pF
B	±0.1pF	CΔ	**GRM/GJM**	≦9.9pF	0.1pF
			GQM	≦1pF	0.1pF
				1.1 to 9.9pF	1pF and E24 Series
			ERB	≦9.9pF	1pF and E24 Series
C	±0.25pF	CΔ	**GRM/GJM**	≦9.9pF	0.1pF
		except CΔ	**GRM**	≦5pF	* 1pF
		CΔ	**ERB**	≦9.9pF	1pF and E24 Series
			GQM	≦1pF	0.1pF
				1.1 to 9.9pF	1pF and E24 Series
D	±0.5pF	CΔ	**GRM/GJM**	5.1 to 9.9pF	0.1pF
		except CΔ	**GRM**	5.1 to 9.9pF	* 1pF
		CΔ	**ERB/GQM**	5.1 to 9.9pF	1pF and E24 Series
G	±2%	CΔ	**GJM**	≧10pF	E12 Series
		CΔ	**GQM/ERB**	≧10pF	E24 Series
J	±5%	CΔ–SL	**GRM/GA3**	≧10pF	E12 Series
		CΔ	**ERB/GQM/GJM**	≧10pF	E24 Series
K	±10%	B, R, X7R, X5R, ZLM	**GRM/GR7/GA3**	E6 Series	
		C0G	**GNM**	E6 Series	
		B, R, X7R, X5R, ZLM	**GR4, GMD**	E12 Series	
M	±20%	B, R, X7R, X7S	**GRM/GMA**	E6 Series	
		X5R, X7R, X7S	**GNM**	E3 Series	
		X7R	**GA2**	E3 Series	
		X5R, X7R, X7S, X6S	**LLL/LLA/LLM**	E3 Series	
Z	+80%, -20%	F, Y5V	**GRM**	E3 Series	
R	Depends on individual standards.				

***** E24 series is also available.

❾Individual Specification Code

Expressed by three figures.

❿Packaging

Code	Packaging
L	ø180mm Embossed Taping
D	ø180mm Paper Taping
E	ø180mm Paper Taping (LLL15)
K	ø330mm Embossed Taping
J	ø330mm Paper Taping
F	ø330mm Paper Taping (LLL15)
B	Bulk
C	Bulk Case
T	Bulk Tray

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 etc.)
High Speed Decoupling	Low Inductance (Reverse Geometory)	LLL 2200pF–10µF
	Low Inductance (Multi Termination)	LLA/LLM (From 1GHz) 0.01µF–4.7µF
High Frequency	Low ESR (50V to 500V)	ERB (1MHz to 1GHz) 0.5pF–1000pF
	Low ESR, Ultra Small	GJM (500MHz to 10GHz) 0.1pF–33pF
	Lowest ESR	GQM (500MHz to 10GHz) 0.1pF–100pF
Optical Communications	Wire-Die-Bonding	GMA 100pF–0.47µF GMD 100pF–1µF
Ultrasonic Sensors	Class1 TC's;	GRM (ZLM) 1000pF, 1500pF
Medium Voltage High Frequency Snubber	250V/630V/1kV/2kV/3.15kV Low Dissipation	GRM (U2J) 10pF–10000pF
Medium Voltage LCD Backlight Inverter	3.15kV Low Dissipation	GRM (C0G) 5pF–47pF
Medium Voltage Decoupling, Smoothing	250V/630V/1kV High Capacitance	GRM (X7R) 220pF–1µF
Medium Voltage Only for Camera Frash Circuit	350V High Capacitance	GR7 10000pF–47000pF
Medium Voltage Only for Information Devices / Tip & Ring	2kV High Capacitance	GR4 100pF–10000pF
	Safety Standard Recognized	Type GD 10pF–4700pF Type GF 10pF–4700pF
AC Lines Noise Removal	Safety Standard Recognized	Type GC 100pF–330pF Type GF 470pF–4700pF Type GB 10000pF–33000pF
	AC250V which meet Japanese Law	GA2 470pF–0.1µF
Automotive (Power-train, Safety Equipment)	High Capacitance	GCM (X7R etc.) 0.5µF–10µF
	Class1 TC's;	GCM (C0G etc.) 220pF–10µF
Medium Voltage for Automotive (Power-train, Safety Equipment)	250V/630V Low Dissipation	GCM (U2J) 10pF–10000pF

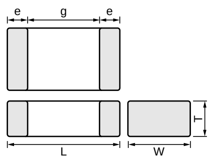
murata

Chip Monolithic Ceramic Capacitors

for General Purpose GRM Series (Temperature Compensating Type)

Part Number	Dimensions (mm) L	W	T	e	g min.
GRM022	0.4 ±0.02	0.2 ±0.02	0.2 ±0.02	0.07 to 0.14	0.13
GRM033	0.6 ±0.03	0.3 ±0.03	0.3 ±0.03	0.1 to 0.2	0.2
GRM15X	1.0 ±0.05	0.5 ±0.05	0.25 ±0.05	0.1 to 0.3	0.4
GRM153			0.3 ±0.03		
GRM155			0.5 ±0.05	0.15 to 0.35	0.3
GRM185	1.6 ±0.1	0.8 ±0.1	0.5 +0/-0.1	0.2 to 0.5	0.5
GRM188*			0.8 ±0.1		
GRM216	2.0 ±0.1	1.25 ±0.1	0.6 ±0.1	0.2 to 0.7	0.7
GRM219			0.85 ±0.1		
GRM21A			1.0 +0/-0.2		
GRM21B			1.25 ±0.1		
GRM316	3.2 ±0.15	1.6 ±0.15	0.6 ±0.1	0.3 to 0.8	1.5
GRM319			0.85 ±0.1		
GRM31M			1.15 ±0.1		
GRM31C	3.2 ±0.2	1.6 ±0.2	1.6 ±0.2		
GRM329	3.2 ±0.3	2.5 ±0.2	0.85 ±0.1	0.3 min.	1.0
GRM32A			1.0 +0/-0.2		
GRM32M			1.15 ±0.1		
GRM32N			1.35 ±0.15		
GRM32C			1.6 ±0.2		
GRM32R			1.8 ±0.2		
GRM32D			2.0 ±0.2		
GRM32E			2.5 ±0.2		

* Bulk Case : 1.6 ±0.07(L)×0.8 ±0.07(W)×0.8 ±0.07(T)



■ Features

1. Highter resistance of solder-leaching due to the Ni-barriered termination, applicable for reflow-soldering, and flow-soldering (GRM18/21/31 type only).
2. The GRM series is lead free product.
3. Smaller size and higher capacitance value.
4. High reliability and no polarity.
5. Excellent pulse responsibility and noise reduction due to the low impedance at high frequency.
6. The GRM series is available in paper or embossed tape and reel packaging for automatic placement. Bulk case packaging is also available for GRM15/18/21(T=0.6,1.25).
7. Ta replacement.

■ Applications

General electronic equipment

Temperature Compensating Type C0G(5C) Characteristics

Part Number		GRM02		GRM03	GRM15
L x W [EIA]		0.4x0.2 [01005]		0.6x0.3 [0201]	1.0x0.5 [0402]
Rated Volt.		16 (**1C**)	6.3 (**0J**)	50 (**1H**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension					
0.10pF(**R10**)	**W, B**			0.3(**3**)	0.5(**5**)
0.20pF(**R20**)	**W, B**	0.2(**2**)		0.3(**3**)	0.5(**5**)
0.30pF(**R30**)	**W, B**	0.2(**2**)		0.3(**3**)	0.5(**5**)
0.40pF(**R40**)	**W, B**	0.2(**2**)		0.3(**3**)	0.5(**5**)
0.50pF(**R50**)	**W, B**	0.2(**2**)		0.3(**3**)	0.5(**5**)
0.60pF(**R60**)	**W, B**	0.2(**2**)		0.3(**3**)	0.5(**5**)
0.70pF(**R70**)	**W, B**	0.2(**2**)		0.3(**3**)	0.5(**5**)
0.80pF(**R80**)	**W, B**	0.2(**2**)		0.3(**3**)	0.5(**5**)
0.90pF(**R90**)	**W, B**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.0pF(**1R0**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.1pF(**1R1**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.2pF(**1R2**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.3pF(**1R3**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.4pF(**1R4**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.5pF(**1R5**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.6pF(**1R6**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.7pF(**1R7**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.8pF(**1R8**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
1.9pF(**1R9**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.0pF(**2R0**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.1pF(**2R1**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.2pF(**2R2**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)

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

Continued on the following page. ↗

Continued from the preceding page.

Part Number		GRM02		GRM03	GRM15
L x W [EIA]		0.4x0.2 [01005]		0.6x0.3 [0201]	1.0x0.5 [0402]
Rated Volt.		16 (**1C**)	6.3 (**0J**)	50 (**1H**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension					
2.3pF(**2R3**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.4pF(**2R4**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.5pF(**2R5**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.6pF(**2R6**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.7pF(**2R7**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.8pF(**2R8**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
2.9pF(**2R9**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.0pF(**3R0**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.1pF(**3R1**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.2pF(**3R2**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.3pF(**3R3**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.4pF(**3R4**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.5pF(**3R5**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.6pF(**3R6**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.7pF(**3R7**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.8pF(**3R8**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
3.9pF(**3R9**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.0pF(**4R0**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.1pF(**4R1**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.2pF(**4R2**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.3pF(**4R3**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.4pF(**4R4**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.5pF(**4R5**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.6pF(**4R6**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.7pF(**4R7**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.8pF(**4R8**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
4.9pF(**4R9**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.0pF(**5R0**)	**W, B, C**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.1pF(**5R1**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.2pF(**5R2**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.3pF(**5R3**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.4pF(**5R4**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.5pF(**5R5**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.6pF(**5R6**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.7pF(**5R7**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.8pF(**5R8**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
5.9pF(**5R9**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.0pF(**6R0**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.1pF(**6R1**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.2pF(**6R2**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.3pF(**6R3**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.4pF(**6R4**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.5pF(**6R5**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.6pF(**6R6**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.7pF(**6R7**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.8pF(**6R8**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
6.9pF(**6R9**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.0pF(**7R0**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.1pF(**7R1**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.2pF(**7R2**)	**W, B, C, D**	0.2(**2**)		0.3(**3**)	0.5(**5**)

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

Continued on the following page.

muRata

Continued from the preceding page.

Part Number		GRM02		GRM03	GRM15
L x W [EIA]		0.4x0.2 [01005]		0.6x0.3 [0201]	1.0x0.5 [0402]
Rated Volt.		16 (**1C**)	6.3 (**0J**)	50 (**1H**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension					
7.3pF(**7R3**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.4pF(**7R4**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.5pF(**7R5**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.6pF(**7R6**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.7pF(**7R7**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.8pF(**7R8**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
7.9pF(**7R9**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.0pF(**8R0**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.1pF(**8R1**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.2pF(**8R2**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.3pF(**8R3**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.4pF(**8R4**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.5pF(**8R5**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.6pF(**8R6**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.7pF(**8R7**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.8pF(**8R8**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
8.9pF(**8R9**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.0pF(**9R0**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.1pF(**9R1**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.2pF(**9R2**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.3pF(**9R3**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.4pF(**9R4**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.5pF(**9R5**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.6pF(**9R6**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.7pF(**9R7**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.8pF(**9R8**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
9.9pF(**9R9**)	W, B, C, D	0.2(**2**)		0.3(**3**)	0.5(**5**)
10pF(**100**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
12pF(**120**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
15pF(**150**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
18pF(**180**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
22pF(**220**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
27pF(**270**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
33pF(**330**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
39pF(**390**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
47pF(**470**)	J	0.2(**2**)		0.3(**3**)	0.5(**5**)
56pF(**560**)	J		0.2(**2**)	0.3(**3**)	0.5(**5**)
68pF(**680**)	J		0.2(**2**)	0.3(**3**)	0.5(**5**)
82pF(**820**)	J		0.2(**2**)	0.3(**3**)	0.5(**5**)
100pF(**101**)	J		0.2(**2**)	0.3(**3**)	0.5(**5**)
120pF(**121**)	J				0.5(**5**)
150pF(**151**)	J				0.5(**5**)
180pF(**181**)	J				0.5(**5**)
220pF(**221**)	J				0.5(**5**)
270pF(**271**)	J				0.5(**5**)
330pF(**331**)	J				0.5(**5**)
390pF(**391**)	J				0.5(**5**)
470pF(**471**)	J				0.5(**5**)
560pF(**561**)	J				0.5(**5**)
680pF(**681**)	J				0.5(**5**)

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

Continued on the following page.

Continued from the preceding page.

Part Number		GRM02		GRM03	GRM15
L x W [EIA]		0.4x0.2 [01005]		0.6x0.3 [0201]	1.0x0.5 [0402]
Rated Volt.		16 (**1C**)	6.3 (**0J**)	50 (**1H**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension					
820pF(**821**)	**J**				0.5(**5**)
1000pF(**102**)	**J**				0.5(**5**)

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

Part Number		GRM18		GRM21		GRM31	
L x W [EIA]		1.6x0.8 [0603]		2.0 x1.25 [0805]		3.2x1.6 [1206]	
Rated Volt.		100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension							
0.10pF(**R10**)	**B**		0.8(**8**)				
0.20pF(**R20**)	**B**		0.8(**8**)				
0.30pF(**R30**)	**C**		0.8(**8**)				
0.40pF(**R40**)	**C**		0.8(**8**)				
0.50pF(**R50**)	**C**	0.8(**8**)	0.8(**8**)				
0.60pF(**R60**)	**C**	0.8(**8**)	0.8(**8**)				
0.70pF(**R70**)	**C**	0.8(**8**)	0.8(**8**)				
0.80pF(**R80**)	**C**	0.8(**8**)	0.8(**8**)				
0.90pF(**R90**)	**C**	0.8(**8**)	0.8(**8**)				
1.0pF(**1R0**)	**C**	0.8(**8**)	0.8(**8**)				
2.0pF(**2R0**)	**C**	0.8(**8**)	0.8(**8**)				
3.0pF(**3R0**)	**C**	0.8(**8**)	0.8(**8**)				
4.0pF(**4R0**)	**C**	0.8(**8**)	0.8(**8**)				
5.0pF(**5R0**)	**C**	0.8(**8**)	0.8(**8**)				
6.0pF(**6R0**)	**D**	0.8(**8**)	0.8(**8**)				
7.0pF(**7R0**)	**D**	0.8(**8**)	0.8(**8**)				
8.0pF(**8R0**)	**D**	0.8(**8**)	0.8(**8**)				
9.0pF(**9R0**)	**D**	0.8(**8**)	0.8(**8**)				
10pF(**100**)	**J**	0.8(**8**)	0.8(**8**)				
12pF(**120**)	**J**	0.8(**8**)	0.8(**8**)				
15pF(**150**)	**J**	0.8(**8**)	0.8(**8**)				
18pF(**180**)	**J**	0.8(**8**)	0.8(**8**)				
22pF(**220**)	**J**	0.8(**8**)	0.8(**8**)				
27pF(**270**)	**J**	0.8(**8**)	0.8(**8**)				
33pF(**330**)	**J**	0.8(**8**)	0.8(**8**)				
39pF(**390**)	**J**	0.8(**8**)	0.8(**8**)				
47pF(**470**)	**J**	0.8(**8**)	0.8(**8**)				
56pF(**560**)	**J**	0.8(**8**)	0.8(**8**)				
68pF(**680**)	**J**	0.8(**8**)	0.8(**8**)				
82pF(**820**)	**J**	0.8(**8**)	0.8(**8**)				
100pF(**101**)	**J**	0.8(**8**)	0.8(**8**)				
120pF(**121**)	**J**	0.8(**8**)	0.8(**8**)				
150pF(**151**)	**J**	0.8(**8**)	0.8(**8**)				
180pF(**181**)	**J**	0.8(**8**)	0.8(**8**)				
220pF(**221**)	**J**	0.8(**8**)	0.8(**8**)				
270pF(**271**)	**J**	0.8(**8**)	0.8(**8**)				
330pF(**331**)	**J**	0.8(**8**)	0.8(**8**)				

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

Continued on the following page.

Continued from the preceding page.

Part Number		**GRM18**		**GRM21**		**GRM31**	
L x W [EIA]		1.6x0.8 [0603]		2.0 x1.25 [0805]		3.2x1.6 [1206]	
Rated Volt.		100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension							
390pF(**391**)	**J**	0.8(**8**)	0.8(**8**)				
470pF(**471**)	**J**	0.8(**8**)	0.8(**8**)				
560pF(**561**)	**J**	0.8(**8**)	0.8(**8**)				
680pF(**681**)	**J**	0.8(**8**)	0.8(**8**)				
820pF(**821**)	**J**	0.8(**8**)	0.8(**8**)				
1000pF(**102**)	**J**	0.8(**8**)	0.8(**8**)				
1200pF(**122**)	**J**	0.8(**8**)	0.8(**8**)				
1500pF(**152**)	**J**	0.8(**8**)	0.8(**8**)				
1800pF(**182**)	**J**		0.8(**8**)	0.6(**6**)			
2200pF(**222**)	**J**		0.8(**8**)	0.6(**6**)			
2700pF(**272**)	**J**		0.8(**8**)	0.6(**6**)			
3300pF(**332**)	**J**		0.8(**8**)	0.6(**6**)			
3900pF(**392**)	**J**		0.8(**8**)			0.85(**9**)	
4700pF(**472**)	**J**				0.6(**6**)	0.85(**9**)	
5600pF(**562**)	**J**				0.85(**9**)	0.85(**9**)	
6800pF(**682**)	**J**				0.85(**9**)	0.85(**9**)	
8200pF(**822**)	**J**				0.85(**9**)	0.85(**9**)	
10000pF(**103**)	**J**				0.85(**9**)	0.85(**9**)	
12000pF(**123**)	**J**				0.85(**9**)		
15000pF(**153**)	**J**				0.85(**9**)		
18000pF(**183**)	**J**				1.25(**B**)		
22000pF(**223**)	**J**				1.25(**B**)		
27000pF(**273**)	**J**						0.85(**9**)
33000pF(**333**)	**J**						0.85(**9**)
39000pF(**393**)	**J**						0.85(**9**)
47000pF(**473**)	**J**						1.15(**M**)
56000pF(**563**)	**J**						1.15(**M**)
68000pF(**683**)	**J**						1.6(**C**)
82000pF(**823**)	**J**						1.6(**C**)
0.10µF(**104**)	**J**						1.6(**C**)

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

Temperature Compensating Type C0G(5C) Characteristics Low Profile

Part Number		**GRM15**
L x W [EIA]		1.0x0.5 [0402]
Rated Volt.		50 (**1H**)
TC		C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension		
120pF(**121**)	**J**	0.3(**3**)
150pF(**151**)	**J**	0.3(**3**)
180pF(**181**)	**J**	0.3(**3**)
220pF(**221**)	**J**	0.3(**3**)
270pF(**271**)	**J**	0.3(**3**)
330pF(**331**)	**J**	0.3(**3**)
390pF(**391**)	**J**	0.3(**3**)

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

Continued on the following page.

Continued from the preceding page.

Part Number		GRM15
L x W [EIA]		1.0x0.5 [0402]
Rated Volt.		50 (**1H**)
TC		C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension		
470pF(**471**)	**J**	0.3(**3**)

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

Temperature Compensating Type U2J(7U) Characteristics

Part Number		GRM03		GRM15		GRM18		GRM21		GRM31
L x W [EIA]		0.6x0.3 [0201]		1.0x0.5 [0402]		1.6x0.8 [0603]		2.0x1.25 [0805]		3.2x1.6 [1206]
Rated Volt.		50 (**1H**)	25 (**1E**)	50 (**1H**)	10 (**1A**)	50 (**1H**)	10 (**1A**)	50 (**1H**)	10 (**1A**)	50 (**1H**)
TC		U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)
Capacitance, Capacitance Tolerance and T Dimension										
1.0pF(**1R0**)	**C**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
2.0pF(**2R0**)	**C**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
3.0pF(**3R0**)	**C**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
4.0pF(**4R0**)	**C**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
5.0pF(**5R0**)	**C**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
6.0pF(**6R0**)	**D**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
7.0pF(**7R0**)	**D**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
8.0pF(**8R0**)	**D**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
9.0pF(**9R0**)	**D**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
10pF(**100**)	**J**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
12pF(**120**)	**J**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
15pF(**150**)	**J**	0.3(**3**)		0.5(**5**)		0.8(**8**)				
18pF(**180**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
22pF(**220**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
27pF(**270**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
33pF(**330**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
39pF(**390**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
47pF(**470**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
56pF(**560**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
68pF(**680**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
82pF(**820**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
100pF(**101**)	**J**		0.3(**3**)	0.5(**5**)		0.8(**8**)				
120pF(**121**)	**J**			0.5(**5**)		0.8(**8**)				
150pF(**151**)	**J**			0.5(**5**)		0.8(**8**)				
180pF(**181**)	**J**			0.5(**5**)		0.8(**8**)				
220pF(**221**)	**J**					0.8(**8**)				
270pF(**271**)	**J**					0.8(**8**)				
330pF(**331**)	**J**					0.8(**8**)				
390pF(**391**)	**J**					0.8(**8**)				
470pF(**471**)	**J**					0.8(**8**)				
560pF(**561**)	**J**					0.8(**8**)				
680pF(**681**)	**J**					0.8(**8**)				
1000pF(**102**)	**J**					0.8(**8**)				
1200pF(**122**)	**J**				0.5(**5**)	0.8(**8**)				
1500pF(**152**)	**J**				0.5(**5**)	0.8(**8**)				
1800pF(**182**)	**J**				0.5(**5**)	0.8(**8**)				

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

Continued on the following page.

Continued from the preceding page.

Part Number		GRM03		GRM15		GRM18		GRM21		GRM31
L x W [EIA]		0.6x0.3 [0201]		1.0x0.5 [0402]		1.6x0.8 [0603]		2.0x1.25 [0805]		3.2x1.6 [1206]
Rated Volt.		50 (**1H**)	25 (**1E**)	50 (**1H**)	10 (**1A**)	50 (**1H**)	10 (**1A**)	50 (**1H**)	10 (**1A**)	50 (**1H**)
TC		U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)	U2J (**7U**)
Capacitance, Capacitance Tolerance and T Dimension										
2200pF(**222**)	**J**				0.5(**5**)	0.8(**8**)				
2700pF(**272**)	**J**				0.5(**5**)	0.8(**8**)				
3300pF(**332**)	**J**				0.5(**5**)	0.8(**8**)				
3900pF(**392**)	**J**				0.5(**5**)	0.8(**8**)				
4700pF(**472**)	**J**				0.5(**5**)	0.8(**8**)				
5600pF(**562**)	**J**					0.8(**8**)				
6800pF(**682**)	**J**					0.8(**8**)				
8200pF(**822**)	**J**					0.8(**8**)				
10000pF(**103**)	**J**					0.8(**8**)				
12000pF(**123**)	**J**						0.8(**8**)	0.6(**6**)		
15000pF(**153**)	**J**						0.8(**8**)	0.6(**6**)		
18000pF(**183**)	**J**						0.8(**8**)	0.6(**6**)		
22000pF(**223**)	**J**						0.8(**8**)	0.85(**9**)		
27000pF(**273**)	**J**							0.85(**9**)		
33000pF(**333**)	**J**							1.0(**A**)		
39000pF(**393**)	**J**							1.25(**B**)		
47000pF(**473**)	**J**							1.25(**B**)		
56000pF(**563**)	**J**								0.85(**9**)	0.85(**9**)
68000pF(**683**)	**J**								1.25(**B**)	1.15(**M**)
82000pF(**823**)	**J**								1.25(**B**)	1.15(**M**)
0.10µF(**104**)	**J**								1.25(**B**)	1.15(**M**)

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

Temperature Compensating Type P2H(6P) Characteristics

Part Number		GRM15	GRM18
L x W [EIA]		1.0x0.5 [0402]	1.6x0.8 [0603]
Rated Volt.		50 (**1H**)	50 (**1H**)
TC		P2H (**6P**)	P2H (**6P**)
Capacitance, Capacitance Tolerance and T Dimension			
1.0pF(**1R0**)	**C**	0.5(**5**)	0.8(**8**)
2.0pF(**2R0**)	**C**	0.5(**5**)	0.8(**8**)
3.0pF(**3R0**)	**C**	0.5(**5**)	0.8(**8**)
4.0pF(**4R0**)	**C**	0.5(**5**)	0.8(**8**)
5.0pF(**5R0**)	**C**	0.5(**5**)	0.8(**8**)
6.0pF(**6R0**)	**D**	0.5(**5**)	0.8(**8**)
7.0pF(**7R0**)	**D**	0.5(**5**)	0.8(**8**)
8.0pF(**8R0**)	**D**	0.5(**5**)	0.8(**8**)
9.0pF(**9R0**)	**D**	0.5(**5**)	0.8(**8**)
10pF(**100**)	**J**	0.5(**5**)	0.8(**8**)
12pF(**120**)	**J**	0.5(**5**)	0.8(**8**)
15pF(**150**)	**J**	0.5(**5**)	0.8(**8**)
18pF(**180**)	**J**	0.5(**5**)	0.8(**8**)
22pF(**220**)	**J**	0.5(**5**)	0.8(**8**)
27pF(**270**)	**J**	0.5(**5**)	0.8(**8**)
33pF(**330**)	**J**		0.8(**8**)

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

Continued on the following page.

Continued from the preceding page.

Part Number		GRM15	GRM18
L x W [EIA]		1.0x0.5 [0402]	1.6x0.8 [0603]
Rated Volt.		50 (**1H**)	50 (**1H**)
TC		P2H (**6P**)	P2H (**6P**)
Capacitance, Capacitance Tolerance and T Dimension			
39pF(**390**)	**J**		0.8(**8**)
47pF(**470**)	**J**		0.8(**8**)
56pF(**560**)	**J**		0.8(**8**)
68pF(**680**)	**J**		0.8(**8**)
82pF(**820**)	**J**		0.8(**8**)
100pF(**101**)	**J**		0.8(**8**)
120pF(**121**)	**J**		0.8(**8**)
150pF(**151**)	**J**		0.8(**8**)

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

Temperature Compensating Type R2H(6R) Characteristics

Part Number		GRM03	GRM15	GRM18
L x W [EIA]		0.6x0.3 [0201]	1.0x0.5 [0402]	1.6x0.8 [0603]
Rated Volt.		25 (**1E**)	50 (**1H**)	50 (**1H**)
TC		R2H (**6R**)	R2H (**6R**)	R2H (**6R**)
Capacitance, Capacitance Tolerance and T Dimension				
1.0pF(**1R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
2.0pF(**2R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
3.0pF(**3R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
4.0pF(**4R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
5.0pF(**5R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
6.0pF(**6R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
7.0pF(**7R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
8.0pF(**8R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
9.0pF(**9R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
10pF(**100**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
12pF(**120**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
15pF(**150**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
18pF(**180**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
22pF(**220**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
27pF(**270**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
33pF(**330**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
39pF(**390**)	**J**	0.3(**3**)		0.8(**8**)
47pF(**470**)	**J**	0.3(**3**)		0.8(**8**)
56pF(**560**)	**J**	0.3(**3**)		0.8(**8**)
68pF(**680**)	**J**	0.3(**3**)		0.8(**8**)
82pF(**820**)	**J**	0.3(**3**)		0.8(**8**)
100pF(**101**)	**J**	0.3(**3**)		0.8(**8**)
120pF(**121**)	**J**			0.8(**8**)
150pF(**151**)	**J**			0.8(**8**)
180pF(**181**)	**J**			0.8(**8**)

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

Temperature Compensating Type S2H(6S) Characteristics

Part Number		**GRM03**	**GRM15**	**GRM18**
L x W [EIA]		0.6x0.3 [0201]	1.0x0.5 [0402]	1.6x0.8 [0603]
Rated Volt.		25 (**1E**)	50 (**1H**)	50 (**1H**)
TC		S2H (**6S**)	S2H (**6S**)	S2H (**6S**)
Capacitance, Capacitance Tolerance and T Dimension				
1.0pF(**1R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
2.0pF(**2R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
3.0pF(**3R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
4.0pF(**4R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
5.0pF(**5R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
6.0pF(**6R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
7.0pF(**7R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
8.0pF(**8R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
9.0pF(**9R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
10pF(**100**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
12pF(**120**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
15pF(**150**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
18pF(**180**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
22pF(**220**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
27pF(**270**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
33pF(**330**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
39pF(**390**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
47pF(**470**)	**J**	0.3(**3**)		0.8(**8**)
56pF(**560**)	**J**	0.3(**3**)		0.8(**8**)
68pF(**680**)	**J**	0.3(**3**)		0.8(**8**)
82pF(**820**)	**J**	0.3(**3**)		0.8(**8**)
100pF(**101**)	**J**	0.3(**3**)		0.8(**8**)
120pF(**121**)	**J**			0.8(**8**)
150pF(**151**)	**J**			0.8(**8**)
180pF(**181**)	**J**			0.8(**8**)
220pF(**221**)	**J**			0.8(**8**)

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

Temperature Compensating Type T2H(6T) Characteristics

Part Number		**GRM03**	**GRM15**	**GRM18**
L x W [EIA]		0.6x0.3 [0201]	1.0x0.5 [0402]	1.6x0.8 [0603]
Rated Volt.		25 (**1E**)	50 (**1H**)	50 (**1H**)
TC		T2H (**6T**)	T2H (**6T**)	T2H (**6T**)
Capacitance, Capacitance Tolerance and T Dimension				
1.0pF(**1R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
2.0pF(**2R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
3.0pF(**3R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
4.0pF(**4R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
5.0pF(**5R0**)	**C**	0.3(**3**)	0.5(**5**)	0.8(**8**)
6.0pF(**6R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
7.0pF(**7R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
8.0pF(**8R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)

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

Continued on the following page. ↗

Continued from the preceding page.

Part Number		**GRM03**	**GRM15**	**GRM18**
L x W [EIA]		0.6x0.3 [0201]	1.0x0.5 [0402]	1.6x0.8 [0603]
Rated Volt.		25 (**1E**)	50 (**1H**)	50 (**1H**)
TC		T2H (**6T**)	T2H (**6T**)	T2H (**6T**)
Capacitance, Capacitance Tolerance and T Dimension				
9.0pF(**9R0**)	**D**	0.3(**3**)	0.5(**5**)	0.8(**8**)
10pF(**100**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
12pF(**120**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
15pF(**150**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
18pF(**180**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
22pF(**220**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
27pF(**270**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
33pF(**330**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
39pF(**390**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
47pF(**470**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
56pF(**560**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
68pF(**680**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
82pF(**820**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
100pF(**101**)	**J**	0.3(**3**)	0.5(**5**)	0.8(**8**)
120pF(**121**)	**J**			0.8(**8**)
150pF(**151**)	**J**			0.8(**8**)
180pF(**181**)	**J**			0.8(**8**)
220pF(**221**)	**J**			0.8(**8**)
270pF(**271**)	**J**			0.8(**8**)
330pF(**331**)	**J**			0.8(**8**)
390pF(**391**)	**J**			0.8(**8**)
470pF(**471**)	**J**			0.8(**8**)

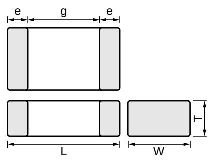
The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

Chip Monolithic Ceramic Capacitors

for General Purpose GRM Series (High Dielectric Constant Type)

Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRM022	0.4 ±0.02	0.2 ±0.02	0.2 ±0.02	0.07 to 0.14	0.13
GRM033	0.6 ±0.03	0.3 ±0.03	0.3 ±0.03	0.1 to 0.2	0.2
GRM15X	1.0 ±0.05	0.5 ±0.05	0.25 ±0.05	0.1 to 0.3	0.4
GRM153			0.3 ±0.03		
GRM155			0.5 ±0.05	0.15 to 0.35	0.3
GRM185	1.6 ±0.1	0.8 ±0.1	0.5 +0/-0.1	0.2 to 0.5	0.5
GRM188*			0.8 ±0.1		
GRM216	2.0 ±0.1	1.25 ±0.1	0.6 ±0.1	0.2 to 0.7	0.7
GRM219			0.85 ±0.1		
GRM21A			1.0 +0/-0.2		
GRM21B			1.25 ±0.1		
GRM316	3.2 ±0.15	1.6 ±0.15	0.6 ±0.1	0.3 to 0.8	1.5
GRM319			0.85 ±0.1		
GRM31M			1.15 ±0.1		
GRM31C	3.2 ±0.2	1.6 ±0.2	1.6 ±0.2		
GRM329	3.2 ±0.3	2.5 ±0.2	0.85 ±0.1	0.3 min.	1.0
GRM32A			1.0 +0/-0.2		
GRM32M			1.15 ±0.1		
GRM32N			1.35 ±0.15		
GRM32C			1.6 ±0.2		
GRM32R			1.8 ±0.2		
GRM32D			2.0 ±0.2		
GRM32E			2.5 ±0.2		

* Bulk Case : 1.6 ±0.07(L)×0.8 ±0.07(W)×0.8 ±0.07(T)



■ Features

1. Highter resistance of solder-leaching due to the Ni-barriered termination, applicable for reflow-soldering, and flow-soldering (GRM18/21/31 type only).
2. The GRM series is lead free product.
3. Smaller size and higher capacitance value.
4. High reliability and no polarity.
5. Excellent pulse responsibility and noise reduction due to the low impedance at high frequency.
6. The GRM series is available in paper or embossed tape and reel packaging for automatic placement. Bulk case packaging is also available for GRM15/18/21(T=0.6,1.25).
7. Ta replacement.

■ Applications

General electronic equipment

High Dielectric Constant Type X5R(R6) Characteristics

Part Number		GRM02		GRM03		GRM15			GRM18					GRM21			GRM31				GRM32	
L x W [EIA]		0.4x0.2 [01005]		0.6x0.3 [0201]		1.0x0.5 [0402]			1.6x0.8 [0603]					2.0x1.25 [0805]			3.2x1.6 [1206]				3.2x2.5 [1210]	
Rated Volt.		10 (**1A**)	6.3 (**0J**)	10 (**1A**)	6.3 (**0J**)	50 (**1H**)	16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	25 (**1E**)	16 (**1C**)	6.3 (**0J**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	6.3 (**0J**)	25 (**1E**)	16 (**1C**)
TC		X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)
Capacitance, Capacitance Tolerance and T Dimension																						
68pF (**680**)	**K**	0.2 (**2**)																				
100pF (**101**)	**K**	0.2 (**2**)																				
150pF (**151**)	**K**	0.2 (**2**)																				
220pF (**221**)	**K**	0.2 (**2**)																				
330pF (**331**)	**K**	0.2 (**2**)																				
470pF (**471**)	**K**	0.2 (**2**)																				
680pF (**681**)	**K**		0.2* (**2**)																			
1000pF (**102**)	**K**		0.2* (**2**)			0.5 (**5**)			0.8 (**8**)													
1500pF (**152**)	**K**		0.2* (**2**)	0.3 (**3**)																		

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).
**: In case of Rated Volt.6.3V, Capacitance Tolerance should be M.
GRM21B Series 6.3V/22µF (L: 2.0±0.15, W: 1.25±0.15, T: 1.25±0.15mm)
GRM31C Series 6.3V/100µF (L: 3.2±0.3, W: 1.6±0.3, T: 1.6±0.3mm)

Continued on the following page. ↗

Continued from the preceding page.

Part Number		GRM02		GRM03		GRM15			GRM18					GRM21			GRM31				GRM32	
L x W [EIA]		0.4x0.2 [01005]		0.6x0.3 [0201]		1.0x0.5 [0402]			1.6x0.8 [0603]					2.0x1.25 [0805]			3.2x1.6 [1206]				3.2x2.5 [1210]	
Rated Volt.		10 (**1A**)	6.3 (**0J**)	10 (**1A**)	6.3 (**0J**)	50 (**1H**)	16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	25 (**1E**)	16 (**1C**)	6.3 (**0J**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	6.3 (**0J**)	25 (**1E**)	16 (**1C**)
TC		X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)
Capacitance, Capacitance Tolerance and T Dimension																						
2200pF (**222**)	**K**		0.2* (**2**)	0.3 (**3**)		0.5 (**5**)			0.8 (**8**)													
3300pF (**332**)	**K**		0.2* (**2**)	0.3 (**3**)																		
4700pF (**472**)	**K**		0.2* (**2**)	0.3 (**3**)		0.5 (**5**)			0.8 (**8**)													
6800pF (**682**)	**K**		0.2* (**2**)	0.3 (**3**)																		
10000pF (**103**)	**K**		0.2* (**2**)	0.3 (**3**)			0.5 (**5**)		0.8 (**8**)													
15000pF (**153**)	**K**				0.3* (**3**)																	
22000pF (**223**)	**K**				0.3* (**3**)		0.5 (**5**)		0.8 (**8**)													
33000pF (**333**)	**K**				0.3* (**3**)		0.5 (**5**)															
47000pF (**473**)	**K**				0.3* (**3**)		0.5 (**5**)															
68000pF (**683**)	**K**				0.3* (**3**)		0.5 (**5**)															
0.10µF (**104**)	**K**				0.3* (**3**)		0.5 (**5**)			0.8 (**8**)												
0.15µF (**154**)	**K**							0.5* (**5**)				0.8 (**8**)										
0.22µF (**224**)	**K**							0.5* (**5**)		0.8 (**8**)												
0.33µF (**334**)	**K**							0.5* (**5**)														
0.47µF (**474**)	**K**							0.5* (**5**)		0.8* (**8**)												
0.68µF (**684**)	**K**							0.5* (**5**)														
1µF (**105**)	**K**							0.5* (**5**)		0.8* (**8**)												
2.2µF (**225**)	**K**										0.8* (**8**)			1.25* (**B**)			1.6 (**C**)					
4.7µF (**475**)	**K**												0.8* (**8**)	1.25* (**B**)								
10µF (**106**)	**K, M****												0.8* (**8**)		1.25* (**B**)			1.6* (**C**)				
22µF (**226**)	**M**															1.25* (**B**)			1.6* (**C**)		2.5* (**E**)	
47µF (**476**)	**M**																			1.6* (**C**)		2.5* (**E**)
100µF (**107**)	**M**																			1.6* (**C**)		

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).
**: In case of Rated Volt.6.3V, Capacitance Tolerance should be M.
GRM21B Series 6.3V/22µF (L: 2.0±0.15, W: 1.25±0.15, T: 1.25±0.15mm)
GRM31C Series 6.3V/100µF (L: 3.2±0.3, W: 1.6±0.3, T: 1.6±0.3mm)

High Dielectric Constant Type X6S/X6T(C8/D8) Characteristics

Part Number		GRM03		GRM15		GRM18		GRM21			GRM31			GRM32	
L x W [EIA]		0.6x0.3 [0201]		1.0x0.5 [0402]		1.6x0.8 [0603]		2.0x1.25 [0805]			3.2x1.6 [1206]			3.2x2.5 [1210]	
Rated Volt.		6.3 (**0J**)	4 (**0G**)	6.3 (**0J**)	4 (**0G**)	10 (**1A**)	4 (**0G**)	25 (**1E**)	10 (**1A**)	4 (**0G**)	10 (**1A**)	4 (**0G**)		10 (**1A**)	6.3 (**0J**)
TC		X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6T (**D8**)	X6S (**C8**)	X6S (**C8**)
Capacitance, Capacitance Tolerance and T Dimension															
15000pF(**153**)	**K**	0.3*(**3**)													
22000pF(**223**)	**K**	0.3*(**3**)													
33000pF(**333**)	**K**	0.3*(**3**)													
47000pF(**473**)	**K**	0.3*(**3**)													
0.10µF(**104**)	**K**		0.3*(**3**)												
0.15µF(**154**)	**K**			0.5*(**5**)											
0.22µF(**224**)	**K**			0.5*(**5**)											
0.33µF(**334**)	**K**			0.5*(**5**)											
0.47µF(**474**)	**K**			0.5*(**5**)											
0.68µF(**684**)	**K**				0.5*(**5**)										
1.0µF(**105**)	**K**				0.5*(**5**)										
2.2µF(**225**)	**K**					0.8*(**8**)									
4.7µF(**475**)	**K**						0.8*(**8**)	1.25*(**B**)							
10µF(**106**)	**K**								1.25*(**B**)						
22µF(**226**)	**M**									1.25*(**B**)	1.6*(**C**)				
47µF(**476**)	**M**											1.6*(**C**)		2.5*(**E**)	
100µF(**107**)	**M**												1.6*(**C**)		2.5*(**E**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).
GRM21B Series 4V/22µF (L: 2.0±0.15, W: 1.25±0.15, T: 1.25±0.15mm)
GRM31C Series 4V/100µF (L: 3.2±0.3, W: 1.6±0.3, T: 1.6±0.3mm)

High Dielectric Constant Type X7R/X7T/X7U(R7/D7/E7) Characteristics

Part Number		GRM02	GRM03			GRM15				GRM18					GRM21						GRM31					GRM32				
L x W [EIA]		0.4x0.2 [01005]	0.6x0.3 [0201]			1.0x0.5 [0402]				1.6x0.8 [0603]					2.0x1.25 [0805]						3.2x1.6 [1206]					3.2x2.5 [1210]				
Rated Volt.		10 (**1A**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	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**)	4 (**0G**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	10 (**1A**)	4 (**0G**)	100 (**2A**)	50 (**1H**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7U (**E7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7U (**E7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7T (**D7**)	X7U (**E7**)
Capacitance, Capacitance Tolerance and T Dimension																														
68pF (**680**)	**K**	0.2 (**2**)																												
100pF (**101**)	**K**	0.2 (**2**)	0.3 (**3**)																											
150pF (**151**)	**K**	0.2 (**2**)	0.3 (**3**)																											
220pF (**221**)	**K**	0.2 (**2**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)			0.8 (**8**)	0.8 (**8**)																			
330pF (**331**)	**K**	0.2 (**2**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)			0.8 (**8**)	0.8 (**8**)																			
470pF (**471**)	**K**	0.2 (**2**)	0.3 (**3**)			0.5 (**5**)	0.5 (**5**)			0.8 (**8**)	0.8 (**8**)																			

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).
GRM21B Series 100V/0.47µF, 25V/2.2µF, 16V/4.7µF, 10V/10µF, 4V/22µF (L: 2.0±0.15, W: 1.25±0.15, T: 1.25±0.15mm)
GRM31M Series 100V/0.68µF, 25V/2.2µF (L: 3.2±0.2, W: 1.6±0.2, T: 1.15±0.15mm)

Continued on the following page. ↗

Continued from the preceding page.

Part Number		GRM02	GRM03			GRM15				GRM18					GRM21						GRM31					GRM32				
L x W [EIA]		0.4x0.2 [01005]	0.6x0.3 [0201]			1.0x0.5 [0402]				1.6x0.8 [0603]					2.0x1.25 [0805]						3.2x1.6 [1206]					3.2x2.5 [1210]				
Rated Volt.		10 (1A)	25 (1E)	16 (1C)	10 (1A)	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)	4 (0G)	100 (2A)	50 (1H)	25 (1E)	10 (1A)	4 (0G)	100 (2A)	50 (1H)	10 (1A)	6.3 (0J)	4 (0G)
TC		X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7U (E7)	X7R (R7)	X7R (R7)	X7R (R7)	X7R (R7)	X7U (E7)	X7R (R7)	X7R (R7)	X7R (R7)	X7T (D7)	X7U (E7)
Capacitance, Capacitance Tolerance and T Dimension																														
680pF (**681**)	K		0.3 (3)			0.5 (5)	0.5 (5)			0.8 (8)	0.8 (8)																			
1000pF (**102**)	K		0.3 (3)			0.5 (5)	0.5 (5)			0.8 (8)	0.8 (8)																			
1500pF (**152**)	K		0.3 (3)			0.5 (5)	0.5 (5)			0.8 (8)	0.8 (8)																			
2200pF (**222**)	K			0.3 (3)		0.5 (5)	0.5 (5)			0.8 (8)	0.8 (8)																			
3300pF (**332**)	K			0.3 (3)		0.5 (5)	0.5 (5)			0.8 (8)	0.8 (8)																			
4700pF (**472**)	K				0.3 (3)	0.5 (5)	0.5 (5)			0.8 (8)	0.8 (8)																			
6800pF (**682**)	K				0.3 (3)		0.5 (5)			0.8 (8)	0.8 (8)																			
10000pF (**103**)	K				0.3 (3)		0.5 (5)			0.8 (8)	0.8 (8)																			
15000pF (**153**)	K						0.5 (5)				0.8 (8)				1.25 (B)															
22000pF (**223**)	K						0.5 (5)				0.8 (8)				1.25 (B)															
33000pF (**333**)	K							0.5 (5)			0.8 (8)				1.25 (B)															
47000pF (**473**)	K							0.5 (5)			0.8 (8)				1.25 (B)															
68000pF (**683**)	K								0.5 (5)		0.8 (8)										1.15 (M)									
0.10µF (**104**)	K								0.5 (5)	0.8 (8)	0.8 (8)																			
0.15µF (**154**)	K											0.8 (8)				1.25 (B)					1.15 (M)									
0.22µF (**224**)	K											0.8 (8)			1.0 (A)	1.25 (B)														
0.33µF (**334**)	K												0.8 (8)		1.0 (A)	0.85 (9)														
0.47µF (**474**)	K											0.8* (8)			1.25 (B)	1.25 (B)														
0.68µF (**684**)	K													0.8 (8)			0.85 (9)				1.15 (M)	1.15 (M)								
1.0µF (**105**)	K												0.8* (8)			1.25 (B)					1.6 (C)									
2.2µF (**225**)	K													0.8* (8)			1.25* (B)						1.15 (M)			2.5 (E)				
4.7µF (**475**)	K																	1.25* (B)				1.6 (C)					2.5 (E)			
10µF (**106**)	K																		1.25* (B)				1.6* (C)							
22µF (**226**)	M																			1.25* (B)				1.6* (C)					1.35* (N)	

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).
GRM21B Series 100V/0.47µF, 25V/2.2µF, 16V/4.7µF, 10V/10µF, 4V/22µF (L: 2.0±0.15, W: 1.25±0.15, T: 1.25±0.15mm)
GRM31M Series 100V/0.68µF, 25V/2.2µF (L: 3.2±0.2, W: 1.6±0.2, T: 1.15±0.15mm)

Continued on the following page.

Continued from the preceding page.

Part Number		GRM02	GRM03			GRM15				GRM18					GRM21						GRM31					GRM32				
L x W [EIA]		0.4x0.2 [01005]	0.6x0.3 [0201]			1.0x0.5 [0402]				1.6x0.8 [0603]					2.0x1.25 [0805]						3.2x1.6 [1206]					3.2x2.5 [1210]				
Rated Volt.		10 (**1A**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	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**)	4 (**0G**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	10 (**1A**)	4 (**0G**)	100 (**2A**)	50 (**1H**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7U (**E7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7U (**E7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7T (**D7**)	X7U (**E7**)
Capacitance, Capacitance Tolerance and T Dimension																														
47µF (**476**)	**M**																								1.6* (**C**)			2.5* (**E**)		
100µF (**107**)	**M**																													2.5* (**E**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).
GRM21B Series 100V/0.47µF, 25V/2.2µF, 16V/4.7µF, 10V/10µF, 4V/22µF (L: 2.0±0.15, W: 1.25±0.15, T: 1.25±0.15mm)
GRM31M Series 100V/0.68µF, 25V/2.2µF (L: 3.2±0.2, W: 1.6±0.2, T: 1.15±0.15mm)

High Dielectric Constant Type Y5V(F5) Characteristics

Part Number		GRM15				GRM18		GRM21	GRM31	GRM32
L x W [EIA]		1.0x0.5 [0402]				1.6x0.8 [0603]		2.0x1.25 [0805]	3.2x1.6 [1206]	3.2x2.5 [1210]
Rated Volt.		50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	6.3 (**0J**)	100 (**2A**)
TC		Y5V (**F5**)	Y5V (**F5**)	Y5V (**F5**)	Y5V (**F5**)	Y5V (**F5**)	Y5V (**F5**)	Y5V (**F5**)	Y5V (**F5**)	Y5V (**F5**)
Capacitance, Capacitance Tolerance and T Dimension										
1000pF(**102**)	**Z**	0.5(**5**)				0.8(**8**)				
2200pF(**222**)	**Z**	0.5(**5**)				0.8(**8**)				
4700pF(**472**)	**Z**	0.5(**5**)				0.8(**8**)				
10000pF(**103**)	**Z**	0.5(**5**)				0.8(**8**)				
22000pF(**223**)	**Z**		0.5(**5**)			0.8(**8**)				
47000pF(**473**)	**Z**		0.5(**5**)			0.8(**8**)				
0.10µF(**104**)	**Z**		0.5(**5**)			0.8(**8**)				1.35(**N**)
0.22µF(**224**)	**Z**			0.5(**5**)		0.8(**8**)				
0.47µF(**474**)	**Z**			0.5(**5**)			0.8(**8**)	0.85(**9**)		
1.0µF(**105**)	**Z**				0.5*(**5**)					
100µF(**107**)	**Z**								1.6*(**C**)	

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).

High Dielectric Constant Type X5R(R6) Characteristics Low Profile

Part Number		GRM15	GRM18		GRM21			GRM31	
L x W [EIA]		1.0x0.5 [0402]	1.6x0.8 [0603]		2.0x1.25 [0805]			3.2x1.6 [1206]	
Rated Volt.		4 (**0G**)	16 (**1C**)	6.3 (**0J**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	25 (**1E**)	16 (**1C**)
TC		X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)
Capacitance, Capacitance Tolerance and T Dimension									
1.0µF(**105**)	**K, M****	0.3*(**3**)	0.5*(**5**)		0.6*(**6**)		0.85(**9**)		
2.2µF(**225**)	**K**			0.5*(**5**)	0.85*(**9**)			0.6*(**6**)	
4.7µF(**475**)	**K**					0.85*(**9**)		0.85*(**9**)	
10µF(**106**)	**K**						0.85*(**9**)		0.85*(**9**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).
**: In case of Rated Volt.4V, Capacitance Tolerance should be M.
GRM219 Series 10V/10µF (L: 2.0±0.2, W: 1.25±0.2, T: 0.85±0.1mm)

High Dielectric Constant Type X6S(C8) Characteristics Low Profile

Part Number		GRM18		GRM21			GRM31
L x W [EIA]		1.6x0.8 [0603]		2.0x1.25 [0805]			3.2x1.6 [1206]
Rated Volt.		10 (**1A**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	16 (**1C**)
TC		X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)	X6S (**C8**)
Capacitance, Capacitance Tolerance and T Dimension							
1.0µF(**105**)	**K**	0.5*(**5**)		0.6*(**6**)			
2.2µF(**225**)	**K**		0.5*(**5**)	0.85*(**9**)			0.6*(**6**)
4.7µF(**475**)	**K**				0.85*(**9**)		0.85*(**9**)
10µF(**106**)	**K**					0.85*(**9**)	

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).
GRM219 Series 6.3V/10µF (L: 2.0±0.2, W: 1.25±0.2, T: 0.85±0.1mm)

High Dielectric Constant Type X7R/X7T(R7/D7) Characteristics Low Profile

Part Number		GRM15			GRM18	GRM21
L x W [EIA]		1.0x0.5 [0402]			1.6x0.8 [0603]	2.0x1.25 [0805]
Rated Volt.		50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	25 (**1E**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7T (**D7**)	X7R (**R7**)
Capacitance, Capacitance Tolerance and T Dimension						
220pF(**221**)	**K**	0.25(**X**)				
330pF(**331**)	**K**	0.25(**X**)				
470pF(**471**)	**K**	0.25(**X**)				
680pF(**681**)	**K**	0.25(**X**)				
1000pF(**102**)	**K**	0.25(**X**)				
1500pF(**152**)	**K**	0.25(**X**)				
2200pF(**222**)	**K**		0.25(**X**)			
3300pF(**332**)	**K**			0.25(**X**)		
4700pF(**472**)	**K**			0.25(**X**)		
6800pF(**682**)	**K**			0.25(**X**)		
10000pF(**103**)	**K**			0.25(**X**)		
1.0µF(**105**)	**K**				0.5*(**5**)	0.85(**9**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GRM Series Specifications and Test Methods (2) (P.29).

GRM Series Specifications and Test Methods (1)

Below GRM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GRM Series Specifications and Test Methods (2) (P.29).

No.	Item	Specifications		Test Method
		Temperature Compensating Type	High Dielectric Type	
1	Operating Temperature Range	−55 to +125℃	B1, B3, F1: −25 to +85℃ R1, R7: −55 to +125℃ R6: −55 to +85℃ C8: −55 to +105℃ E4: +10 to +85℃ F5: −30 to +85℃	Reference temperature: 25℃ (2Δ, 3Δ, 4Δ, B1, B3, F1, R1: 20℃)
2	Rated Voltage	See the previous pages.		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.
3	Appearance	No defects or abnormalities		Visual inspection
4	Dimensions	Within the specified dimensions		Using calipers (GRM02 size is based on Microscope)
5	Dielectric Strength	No defects or abnormalities		No failure should be observed when 300%* of the rated voltage (temperature compensating type) or 250% of the rated voltage (high dielectric constant type) is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA. *200% for 500V
6	Insulation Resistance	C≦0.047μF: More than 10,000MΩ C>0.047μF: More than 500Ω · F C: Nominal Capacitance		The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 20/25℃ and 75%RH max. and within 2 minutes of charging, provided the charge/discharge current is less than 50mA.
7	Capacitance	Within the specified tolerance		The capacitance/Q/D.F. should be measured at 20/25℃ at the frequency and voltage shown in the table.
8	Q/ Dissipation Factor (D.F.)	30pF and over: Q≧1000 30pF and below: Q≧400+20C C: Nominal Capacitance (pF)	[R6, R7, C8] W.V.: 100V : 0.025 max. (C<0.068μF) : 0.05 max. (C≧0.068μF) W.V.: 50/25V: : 0.025 max. (C<10μF) : 0.035 max. (C≧10μF) W.V.: 16/10V: 0.035 max. W.V.: 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [E4] W.V.: 25Vmin: 0.025 max. [F1, F5] W.V.: 25V min. : 0.05 max. (C<0.1μF) : 0.09 max. (C≧0.1μF) W.V.: 16/10V: 0.125 max. W.V.: 6.3V: 0.15 max.	(see table below)

Char. / Item	ΔC to 7U, 1X (1000pF and below)	ΔC to 7U, 1X (more than 1000pF) R6, R7, C8, F5, B1, B3, F1	R6, R7, F5 (C>10μF)	E4
Frequency	1±0.1MHz	1±0.1kHz	120±24kHz	1±0.1kHz
Voltage	0.5 to 5Vrms	1±0.2Vrms	0.5±0.1Vrms	0.5±0.05Vrms

Continued on the following page.

GRM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below GRM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GRM Series Specifications and Test Methods (2) (P.29).

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
9	Capacitance Temperature Characteristics	No bias	Within the specified tolerance (Table A-1)	B1, B3: Within ±10% (−25 to +85℃) R1, R7: Within ±15% (−55 to +125℃) R6: Within ±15% (−55 to +85℃) E4: Within +22/−56% (+10 to +85℃) F1: Within +30/−80% (−25 to +85℃) F5: Within +22/−82% (−30 to +85℃) C8: Within ±22% (−55 to +105℃)	The capacitance change should be measured after 5 min. at each specified temp. 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 step 1 through 5 (5C: +25 to +125℃/ΔC: +20 to +125℃: other temp. coeffs.: +25 to +85℃/+20 to +85℃) the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A-1. The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the step 1, 3 and 5 by the cap. value in step 3. (see Table 9-1)
		50% of the Rated Voltage		B1: Within +10/–30% R1: Within +15/–40% F1: Within +30/–95%	
		Capacitance Drift	Within ±0.2% or ±0.05pF (Whichever is larger.) *Do not apply to 1X/25V	*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.	(2) High Dielectric Constant Type The ranges of capacitance change compared with the 20℃ value over the temperature ranges shown in the table should be within the specified ranges.* In case of applying voltage, the capacitance change should be measured after 1 more min. with applying voltage in equilibration of each temp. stage. (see Table 9-2)
10	Adhesive Strength of Termination		No removal of the terminations or other defect should occur. (see Fig. 1a)		Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1a using an eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1 sec. 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. *1N (GRM02), 2N (GRM03), 5N (GRM15, GRM18) (see Table 10-1)

Table 9-1 (Test Method, item 9 (1)):

Step	Temperature (℃)
1	Reference Temperature ±2
2	−55±3 (for ΔC to 7U/1X/R6/R7/C8) −30±3 (for F5), 10±3 (for E4) −25±3 (for other TC)
3	Reference Temperature ±2
4	125±3 (for ΔC/R7), 105±3 (for C8) 85±3 (for other TC)
5	Reference Temperature ±2

Table 9-2 (Test Method, item 9 (2)):

Step	Temperature (°C)	Applying Voltage (V)
1	Reference Temperature ±2	No bias
2	–55±3 (for R1, R7, R6) –25±3 (for B1, B3, F1) –30±3 (for F5)/10±3 (for E4)	
3	Reference Temperature ±2	
4	125±3 (for R1, R7)/ 85±3 (for B1, B3, R6 F1, F5, E4)	
5	Reference Temperature ±2	50% of the rated voltage
6	–55±3 (for R1)/ –25±3 (for B1, F1)	
7	Reference Temperature ±2	
8	125±3 (for R1)/ 85±3 (for B1, F1)	

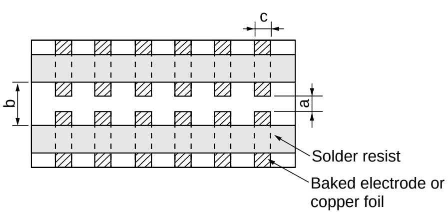


Fig. 1a

Table 10-1 (Test Method, item 10):

(in mm)

Type	a	b	c
GRM02	0.2	0.56	0.23
GRM03	0.3	0.9	0.3
GRM15	0.4	1.5	0.5
GRM18	1.0	3.0	1.2
GRM21	1.2	4.0	1.65
GRM31	2.2	5.0	2.0
GRM32	2.2	5.0	2.9
GRM43	3.5	7.0	3.7
GRM55	4.5	8.0	5.6

Continued on the following page.

GRM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below GRM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GRM Series Specifications and Test Methods (2) (P.29).

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
11	Vibration Resistance	Appearance	No defects or abnormalities		Solder the capacitor on 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).
		Capacitance	Within the specified tolerance		
		Q/D.F.	30pF and over: Q≧1000 30pF and below: Q≧400+20C C: Nominal Capacitance (pF)	[B1, B3, R6, R7, C8] W.V.: 100V : 0.025 max. (C<0.068μF) : 0.05 max. (C≧0.068μF) W.V.: 50/25V: : 0.025 max. (C<10μF) : 0.035 max. (C≧10μF) W.V.: 16/10V: 0.035 max. W.V.: 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [E4] W.V.: 25Vmin: 0.025 max. [F1, F5] W.V.: 25V min. : 0.05 max. (C<0.1μF) : 0.09 max. (C≧0.1μF) W.V.: 16/10V: 0.125 max. W.V.: 6.3V: 0.15 max.	
12	Deflection		No crack or marked defect should occur.		Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2a using an eutectic solder. Then apply a force in the direction shown in Fig. 3a for 5±1 sec. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
13	Solderability of Termination		75% of the terminations are to be soldered evenly and continuously.		Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion) . Preheat at 80 to 120℃ for 10 to 30 seconds. After preheating, immerse in an eutectic solder solution for 2±0.5 seconds at 230±5℃ or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.

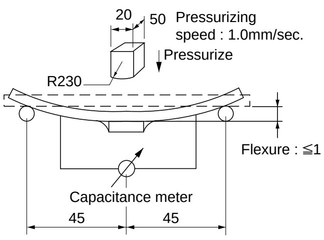


Fig. 3a

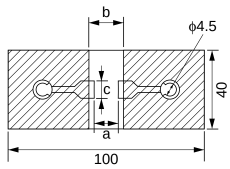


Fig. 2a

t: 1.6mm (GRM02/03/15: t: 0.8mm)

Type	a	b	c
GRM02	0.2	0.56	0.23
GRM03	0.3	0.9	0.3
GRM15	0.4	1.5	0.5
GRM18	1.0	3.0	1.2
GRM21	1.2	4.0	1.65
GRM31	2.2	5.0	2.0
GRM32	2.2	5.0	2.9
GRM43	3.5	7.0	3.7
GRM55	4.5	8.0	5.6

(in mm)

Continued on the following page.

GRM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below GRM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GRM Series Specifications and Test Methods (2) (P.29).

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
14	Resistance to Soldering Heat		The measured and observed characteristics should satisfy the specifications in the following table.		Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in an eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5℃ for 10±0.5 seconds. Set at room temperature for 24±2 hours, then measure. •Initial measurement for high dielectric constant type Perform a heat treatment at 150+0/−10℃ for one hour and then set at room temperature for 24±2 hours. Perform the initial measurement. •Preheating for GRM32/43/55 (see table below)
		Appearance	No defects or abnormalities		
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	B1, B3, R1, R6, R7, C8 : Within ±7.5% F1, F5, E4: Within ±20%	
		Q/D.F.	30pF and over: Q≧1000 30pF and below: Q≧400+20C C: Nominal Capacitance (pF)	[B1, B3, R6, R7, C8] W.V.: 100V : 0.025 max. (C<0.068μF) : 0.05 max. (C≧0.068μF) W.V.: 50/25V: : 0.025 max. (C<10μF) : 0.035 max. (C≧10μF) W.V.: 16/10V: 0.035 max. W.V.: 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [E4] W.V.: 25Vmin: 0.025 max. [F1, F5] W.V.: 25V min. : 0.05 max. (C<0.1μF) : 0.09 max. (C≧0.1μF) W.V.: 16/10V: 0.125 max. W.V.: 6.3V: 0.15 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)		
		Dielectric Strength	No defects		
15	Temperature Cycle		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 (10). Perform the five cycles according to the four heat treatments shown in the following table. Set for 24±2 hours at room temperature, then measure. (see table below) •Initial measurement for high dielectric constant type Perform a heat treatment at 150+0/−10℃ for one hour and then set at room temperature for 24±2 hours. Perform the initial measurement.
		Appearance	No defects or abnormalities		
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	B1, B3, R1, R6, R7, C8 : Within ±7.5% F1, F5, E4: Within ±20%	
		Q/D.F.	30pF and over: Q≧1000 30pF and below: Q≧400+20C C: Nominal Capacitance (pF)	[B1, B3, R6, R7, C8] W.V.: 100V : 0.025 max. (C<0.068μF) : 0.05 max. (C≧0.068μF) W.V.: 50/25V: : 0.025 max. (C<10μF) : 0.035 max. (C≧10μF) W.V.: 16/10V: 0.035 max. W.V.: 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [E4] W.V.: 25Vmin: 0.05 max. [F1, F5] W.V.: 25V min. : 0.05 max. (C<0.1μF) : 0.09 max. (C≧0.1μF) W.V.: 16/10V: 0.125 max. W.V.: 6.3V: 0.15 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)		
		Dielectric Strength	No defects		

Preheating for GRM32/43/55 (No. 14 Test Method):

Step	Temperature	Time
1	100 to 120℃	1 min.
2	170 to 200℃	1 min.

Heat treatments (No. 15 Test Method):

Step	1	2	3	4
Temp. (℃)	Min. Operating Temp. +0/−3	Room Temp.	Max. Operating Temp. +3/−0	Room Temp.
Time (min.)	30±3	2 to 3	30±3	2 to 3

Continued on the following page.

GRM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below GRM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GRM Series Specifications and Test Methods (2) (P.29).

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
16	Humidity (Steady State)		The measured and observed characteristics should satisfy the specifications in the following table.		Set the capacitor at 40±2℃ and in 90 to 95% humidity for 500±12 hours. Remove and set for 24±2 hours at room temperature, then measure.
		Appearance	No defects or abnormalities		
		Capacitance Change	Within ±5% or ±0.5pF (Whichever is larger)	B1, B3, R1, R6, R7, C8 : Within ±12.5% F1, F5, E4: Within ±30%	
		Q/D.F.	30pF and over: Q≧350 10pF and over 30pF and below: Q≧275+2.5C 10pF and below: Q≧200+10C C: Nominal Capacitance (pF)	[R6, R7, C8] W.V.: 100V : 0.05 max. (C<0.068μF) : 0.075 max. (C≧0.068μF) W.V.: 50/25/16/10V : 0.05 max. W.V.: 6.3/4V : 0.075 max. (C<3.3μF) : 0.125 max. (C≧3.3μF) [E4] W.V.: 25Vmin: 0.05 max. [F1, F5] W.V.: 25V min. : 0.075 max. (C<0.1μF) : 0.125 max. (C≧0.1μF) W.V.: 16/10V: 0.15 max. W.V.: 6.3V: 0.2 max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)		
17	Humidity Load		The measured and observed characteristics should satisfy the specifications in the following table.		Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and set for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA. •Initial measurement for F1, F5/10V max. Apply the rated DC voltage for 1 hour at 40±2℃. Remove and set for 24±2 hours at room temperature. Perform initial measurement.
		Appearance	No defects or abnormalities		
		Capacitance Change	Within ±7.5% or ±0.75pF (Whichever is larger)	B1, B3, R1, R6, R7, C8 : Within ±12.5% F1, F5, E4: Within ±30% [W.V.: 10V max.] F1, F5: Within +30/−40%	
		Q/D.F.	30pF and over: Q≧200 30pF and below: Q≧100+10C/3 C: Nominal Capacitance (pF)	[B1, B3, R6, R7, C8] W.V.: 100V : 0.05 max. (C<0.068μF) : 0.075 max. (C≧0.068μF) W.V.: 50/25/16/10V : 0.05 max. W.V.: 6.3/4V : 0.075 max. (C<3.3μF) : 0.125 max. (C≧3.3μF) [E4] W.V.: 25Vmin: 0.05 max. [F1, F5] W.V.: 25V min. : 0.075 max. (C<0.1μF) : 0.125 max. (C≧0.1μF) W.V.: 16/10V: 0.15 max. W.V.: 6.3V: 0.2 max.	
		I.R.	More than 500MΩ or 25Ω · F (Whichever is smaller)		

Continued on the following page.

GRM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below GRM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GRM Series Specifications and Test Methods (2) (P.29).

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
18	High Temperature Load		The measured and observed characteristics should satisfy the specifications in the following table.		Apply 200% (GRM21BR71H105, GRM21BR72A474, GRM31CR71H475: 150% of the rated voltage) of the rated voltage at the maximum operating temperature ±3℃ for 1000±12 hours. Set 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 at the maximum operating temperature ±3℃ for one hour. Remove and set for 24±2 hours at room temperature. Perform initial measurement.
		Appearance	No defects or abnormalities		
		Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	B1, B3, R1, R6, R7, C8 : Within ±12.5% F1, F5, E4: Within ±30% [Except 10V max. and. C≧1.0μF] F1, F5: Within +30/−40% [10V max. and C≧1.0μF]	
		Q/D.F.	30pF and over: Q≧350 10pF and over 30pF and below: Q≧275+2.5C 10pF and below: Q≧200+10C C: Nominal Capacitance (pF)	[B1, B3, R6, R7, C8] W.V.: 100V : 0.05 max. (C<0.068μF) : 0.075 max. (C≧0.068μF) W.V.: 50/25/16/10V : 0.05 max. W.V.: 6.3/4V : 0.075 max. (C<3.3μF) : 0.125 max. (C≧3.3μF) [E4] W.V.: 25Vmin: 0.05 max. [F1, F5] W.V.: 25V min. : 0.075 max.(C<0.1μF) : 0.125 max.(C≧0.1μF) W.V.: 16/10V: 0.15 max. W.V.: 6.3V: 0.2 max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)		

Table A-1

(1)

Char.	Nominal Values (ppm/℃)*1	Capacitance Change from 25℃ (%)					
		−55		−30		−10	
		Max.	Min.	Max.	Min.	Max.	Min.
5C	0± 30	0.58	−0.24	0.40	−0.17	0.25	−0.11
6C	0± 60	0.87	−0.48	0.59	−0.33	0.38	−0.21
6P	−150± 60	2.33	0.72	1.61	0.50	1.02	0.32
6R	−220± 60	3.02	1.28	2.08	0.88	1.32	0.56
6S	−330± 60	4.09	2.16	2.81	1.49	1.79	0.95
6T	−470± 60	5.46	3.28	3.75	2.26	2.39	1.44
7U	−750±120	8.78	5.04	6.04	3.47	3.84	2.21
1X	+350 to −1000	−	−	−	−	−	−

*1: Nominal values denote the temperature coefficient within a range of 25℃ to 125℃ (for ΔC)/85℃ (for other TC).

(2)

Char.	Nominal Values (ppm/℃)*2	Capacitance Change from 20℃ (%)					
		−55		−25		−10	
		Max.	Min.	Max.	Min.	Max.	Min.
2C	0± 60	0.82	−0.45	0.49	−0.27	0.33	−0.18
3C	0±120	1.37	−0.90	0.82	−0.54	0.55	−0.36
4C	0±250	2.56	−1.88	1.54	−1.13	1.02	−0.75
2P	−150± 60	−	−	1.32	0.41	0.88	0.27
3P	−150±120	−	−	1.65	0.14	1.10	0.09
4P	−150±250	−	−	2.36	−0.45	1.57	−0.30
2R	−220± 60	−	−	1.70	0.72	1.13	0.48
3R	−220±120	−	−	2.03	0.45	1.35	0.30
4R	−220±250	−	−	2.74	−0.14	1.83	−0.09
2S	−330± 60	−	−	2.30	1.22	1.54	0.81
3S	−330±120	−	−	2.63	0.95	1.76	0.63
4S	−330±250	−	−	3.35	0.36	2.23	0.24
2T	−470± 60	−	−	3.07	1.85	2.05	1.23
3T	−470±120	−	−	3.40	1.58	2.27	1.05
4T	−470±250	−	−	4.12	0.99	2.74	0.66
3U	−750±120	−	−	4.94	2.84	3.29	1.89
4U	−750±250	−	−	5.65	2.25	3.77	1.50

*2: Nominal values denote the temperature coefficient within a range of 20℃ to 125℃ (for ΔC)/85℃ (for other TC).

GRM Series Specifications and Test Methods (2)

Below GRM Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GRM Series Specifications and Test Methods (1) (P.23).

<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>B1, B3, F1: −25 to +85℃
R1, R7, C7, D7, E7: -55 to +125℃
C6, R6: −55 to +85℃
F5: −30 to +85℃
C8, D8: −55 to +105℃,</td><td>Reference temperature: 25℃
(B1, B3, R1, F1: 20℃)</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td>Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when 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</td><td>More than 50Ω · F</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at reference temperature and 75%RH max. and within 1 minutes of charging, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</td><td>Within the specified tolerance

*Table 1<table>
<tr><td>GRM155</td><td>B3/R6</td><td>1A</td><td>124 to 105</td></tr>
<tr><td>GRM185</td><td>B3/R6</td><td>1C/1A</td><td>105</td></tr>
<tr><td>GRM185</td><td>C8/D7</td><td>1A</td><td>105</td></tr>
<tr><td>GRM188</td><td>B3/R6</td><td>1C/1A</td><td>225</td></tr>
<tr><td>GRM188</td><td>R7/C8</td><td>1A</td><td>225</td></tr>
<tr><td>GRM188</td><td>B3/R6</td><td>1A</td><td>335</td></tr>
<tr><td>GRM219</td><td>B3/R6</td><td>1C/1A</td><td>475, 106</td></tr>
<tr><td>GRM219</td><td>C8</td><td>1A</td><td>475</td></tr>
<tr><td>GRM21B</td><td>B3/R6</td><td>1C/1A</td><td>106</td></tr>
<tr><td>GRM21B</td><td>R7/C8</td><td>1A</td><td>106</td></tr>
<tr><td>GRM319</td><td>B3/R6</td><td>1C/1A</td><td>106</td></tr>
</table></td><td rowspan="2">The capacitance/D.F. should be measured at reference temperature at the frequency and voltage shown in the table.<table>
<tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr>
<tr><td>C≦10μF (10V min.)*1</td><td>1±0.1kHz</td><td>1.0±0.2Vrms</td></tr>
<tr><td>C≦10μF (6.3V max.)</td><td>1±0.1kHz</td><td>0.5±0.1Vrms</td></tr>
<tr><td>C>10μF</td><td>120±24Hz</td><td>0.5±0.1Vrms</td></tr>
</table>*1 However the voltage is 0.5±0.1Vrms about Table 1 items on the left side.</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>B1, B3, R6*2, R7*3, C7, C8, D8*2: 0.1 max.
F1, F5: 0.2 max.</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Capacitance Temperature Characteristics</td><td>No bias</td><td>B1, B3 : Within ±10% (−25 to +85℃)
F1 : Within +30/−80% (−25 to +85℃)
R6 : Within ±15% (−55 to +85℃)
R1, R7 : Within ±15% (−55 to +125℃)
F5 : Within +22/−82% (−30 to +85℃)
C6 : Within ±22% (-55 to +85℃)
C7 : Within ±22% (−55 to +125℃)
C8 : Within ±22% (−55 to +105℃)
D7 : Within +22/-33% (-55 to +125℃)
E7 : Within +22/-56% (-55 to +125℃)
D8 : Within +22/-33% (-55 to +105℃)</td><td rowspan="2">The capacitance change should be measured after 5 min. at each specified temp. stage.
The ranges of capacitance change compared with the reference temperature value over the temperature ranges shown in the table should be within the specified ranges.*
In case of applying voltage, the capacitance change should be measured after 1 more min. with applying voltage in equilibration of each temp. stage.

*GRM43 B1/R6 0J/1A 336/476 only: 1.0±0.2Vrms<table>
<tr><th>Step</th><th>Temperature (°C)</th><th>Applying Voltage (V)</th></tr>
<tr><td>1</td><td>25±2 (for R6, R7, C6, C7, C8, D7, D8, E7, F5)
20±2 (for B1, B3, F1, R1)</td><td rowspan="4">No bias</td></tr>
<tr><td>2</td><td>–55±3 (for R1, R6, R7, C6, C7, C8, D7, D8, E7)
–30±3 (for F5)
–25±3 (for B1, B3, F1)</td></tr>
<tr><td>3</td><td>25±2 (for R6, R7, C6, C7, C8, D7, D8, E7, F5)
20±2 (for B1, B3, F1, R1)</td></tr>
<tr><td>4</td><td>125±3 (for R1, R7, C7, D7, E7)
105±3 (for C8, D8)
85±3 (for B1, B3, F1, F5, R6, C6)</td></tr>
<tr><td>5</td><td>20±2 (for B1, F1, R1)</td><td rowspan="4">50% of the rated voltage</td></tr>
<tr><td>6</td><td>–55±3 (for R1)
–25±3 (for B1, F1)</td></tr>
<tr><td>7</td><td>20±2 (for B1, F1, R1)</td></tr>
<tr><td>8</td><td>125±3 (for R1)
85±3 (for B1, F1)</td></tr>
</table>•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>50% of the Rated Voltage</td><td>B1: Within +10/−30%
R1: Within +15/−40%
F1: Within +30/−95%</td></tr>
</table>

*2: GRM31CR60J107, GRM31CD80G107: 0.15 max.
*3: GRM31CR71E106: 0.125 max.

Continued on the following page.

GRM Series Specifications and Test Methods (2)

Continued from the preceding page.

Below GRM Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GRM Series Specifications and Test Methods (1) (P.23).

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defects should occur.

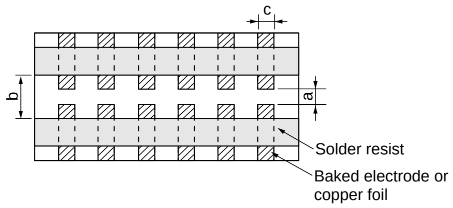



Fig. 1a</td><td>Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 1a using an eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1sec.
The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*1N: GRM02, 2N: GRM03, 5N: GRM15/GRM18
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>**GRM02**</td><td>0.2</td><td>0.56</td><td>0.23</td></tr><tr><td>**GRM03**</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>**GRM15**</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>**GRM18**</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>**GRM21**</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>**GRM31**</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>**GRM32**</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>**GRM43**</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>**GRM55**</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table></td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor on 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>B1, B3, R1, R6*2, R7*3, C7, C8, E7, D7, D8*2: 0.1 max.
C6: 0.125 max.
F1, F5: 0.2 max.</td></tr>
<tr><td>12</td><td colspan="2">Deflection</td><td>No cracking or marking defects should occur.

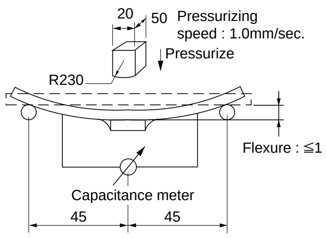
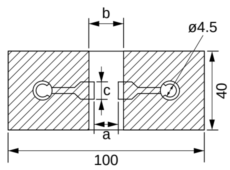



Fig.3a</td><td>Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2a using an eutectic solder. Then apply a force in the direction shown in Fig. 3a for 5±1 sec. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

t: 1.6mm
Fig. 2a
(GRM02/03/15: t: 0.8mm)
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>**GRM02**</td><td>0.2</td><td>0.56</td><td>0.23</td></tr><tr><td>**GRM03**</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>**GRM15**</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>**GRM18**</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>**GRM21**</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>**GRM31**</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>**GRM32**</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>**GRM43**</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>**GRM55**</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table>(in mm)</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td>75% of the terminations is 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 an eutectic solder solution for 2±0.5 seconds at 230±5℃ or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.</td></tr>
</table>

*2: GRM31CR60J107, GRM31CD80G107: 0.15 max.
*3: GRM31CR71E106: 0.125 max.

Continued on the following page.

GRM Series Specifications and Test Methods (2)

Continued from the preceding page.

Below GRM Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GRM Series Specifications and Test Methods (1) (P.23).

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></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 an eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5℃ for 10±0.5 seconds. Set at room temperature for 24±2 hours, then measure.
*Do not apply to GRM02.

•Initial measurement for high dielectric constant type
Perform a heat treatment at 150+0/−10℃ for one hour and then set at room temperature for 24±2 hours.
Perform the initial measurement.

*Preheating for GRM32/43/55
<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100 to 120℃</td><td>1 min.</td></tr><tr><td>2</td><td>170 to 200℃</td><td>1 min.</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td>B1, B3, R1, R6*4, R7, C6, C7, C8, E7, D7, D8: Within ±7.5%
F1, F5: Within ±20%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6*2, R7*3, C7, C8, E7, D7, D8*2: 0.1 max.
C6: 0.125 max.
F1, F5: 0.2 max.</td></tr>
<tr><td>I.R.</td><td>More than 50Ω · F</td></tr>
<tr><td>Dielectric Strength</td><td>No defects</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Temperature Sudden Change</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 shown in the following table.
Set 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. (℃)</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 for high dielectric constant type
Perform a heat treatment at 150+0/−10℃ for one hour and then set at room temperature for 24±2 hours.
Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>B1, B3, R1, R6, R7, C6, C7, C8, D7, D8: Within ±7.5%
E7: Within ±30%
F1, F5: Within ±20%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6*2, R7*3, C7, C8, E7, D7, D8*2: 0.1 max.
C6: 0.125 max.
F1, F5: 0.2 max.</td></tr>
<tr><td>I.R.</td><td>More than 50Ω · F</td></tr>
<tr><td>Dielectric Strength</td><td>No defects</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">High Temperature High Humidity (Steady)</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="4">Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. The charge/discharge current is less than 50mA.

•Initial measurement
Perform a heat treatment at 150+0/−10℃ for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.

•Measurement after test
Perform a heat treatment at 150+0/−10℃ for one hour and then let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>B1, B3, R1, R6, R7, C6, C7, C8, E7, D7, D8: Within ±12.5%
F1, F5: Within ±30%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6, R7, C6, C7, C8, E7, D7, D8: 0.2 max.
F1, F5: 0.4 max.</td></tr>
<tr><td>I.R.</td><td>More than 12.5Ω · F</td></tr>
<tr><td rowspan="4">17</td><td rowspan="4">Durability</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="4">Apply 150% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3℃. Let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.

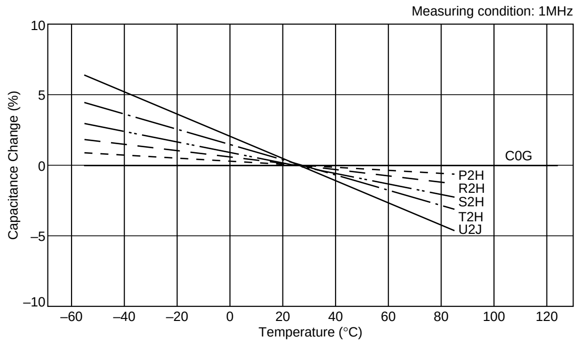
•Initial measurement
Perform a heat treatment at 150+0/−10℃ for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.

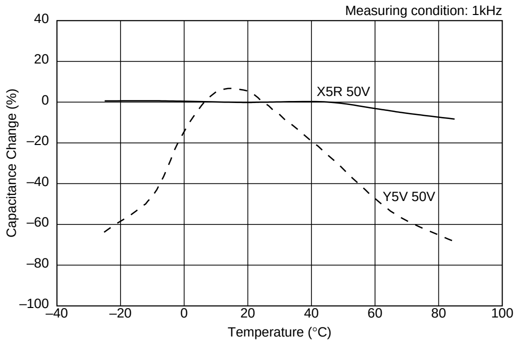
•Measurement after test
Perform a heat treatment at 150+0/−10℃ for one hour and then let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>B1, B3, R1, R6, R7, C6, C7, C8, E7, D7, D8: Within ±12.5%
F1, F5: Within ±30%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R1, R6, R7, C6, C7, C8, E7, D7, D8: 0.2 max.
F1, F5: 0.4 max.</td></tr>
<tr><td>I.R.</td><td>More than 25Ω · F</td></tr>
</table>

*2: GRM31CR60J107, GRM31CD80G107: 0.15 max.
*3: GRM31CR71E106: 0.125 max.
*4: GRM153R60G105, GRM188R60J106: Within ±12.5%

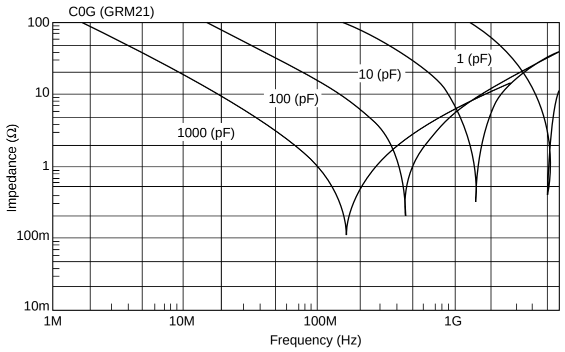
GRM Series Data

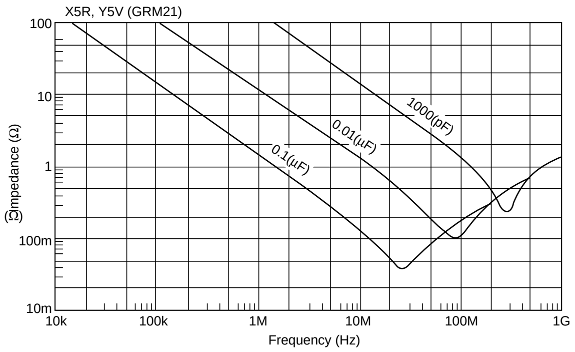
■ Capacitance - Temperature Characteristics



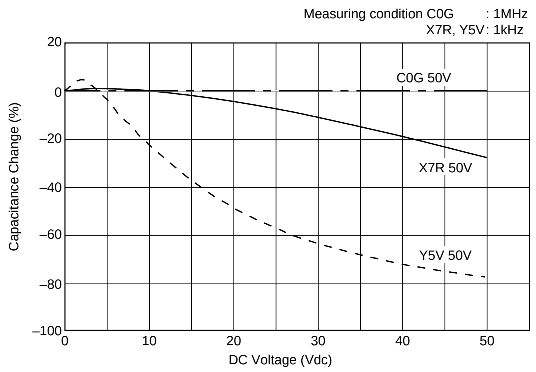


■ Impedance - Frequency Characteristics

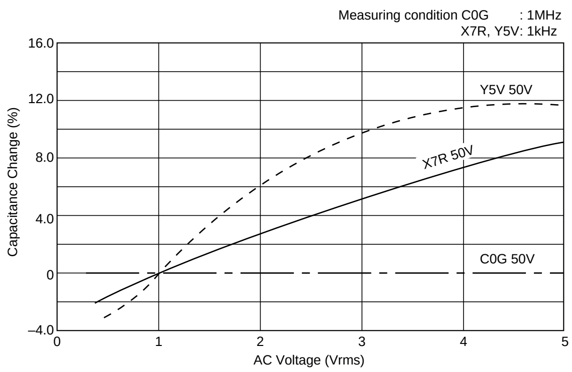




■ Capacitance - DC Voltage Characteristics



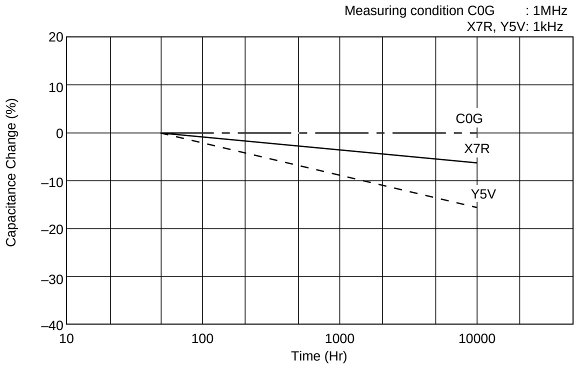
■ Capacitance - AC Voltage Characteristics



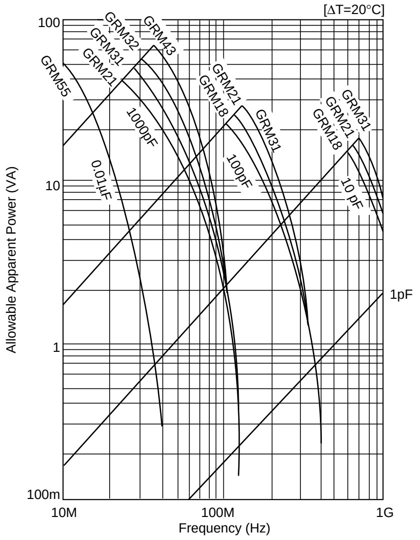
Continued on the following page. ↗

Continued from the preceding page.

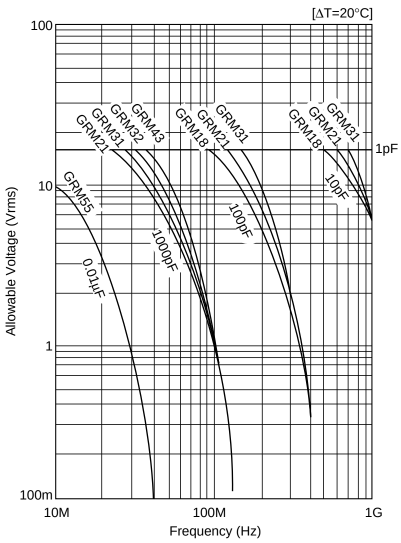
■ Capacitance Change - Aging



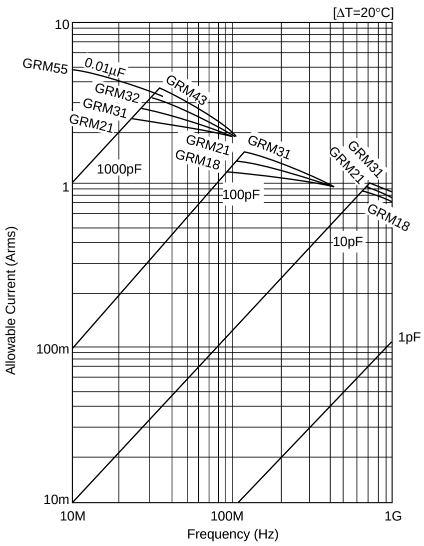
■ Allowable Apparent Power - Frequency



■ Allowable Voltage - Frequency



■ Allowable Current - Frequency



Chip Monolithic Ceramic Capacitors

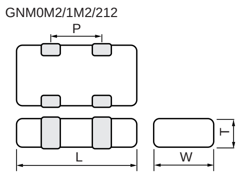
Capacitor Array GNM Series

■ Features

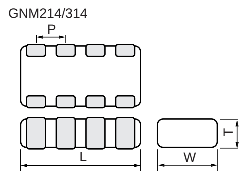
1. High density mounting due to mounting space saving
2. Mounting cost saving

■ Applications

General electronic equipment



Part Number	Dimensions (mm) L	W	T	P
GNM0M2	0.9 ±0.05	0.6 ±0.05	0.45 ±0.05	0.45 ±0.05
GNM1M2	1.37 ±0.15	1.0 ±0.15	0.5 +0.05/-0.10	0.64 ±0.05
			0.6 ±0.1	
			0.8 +0/-0.15	
GNM212	2.0 ±0.15	1.25 ±0.15	0.6 ±0.1	1.0 ±0.1
			0.85 ±0.1	



Part Number	Dimensions (mm) L	W	T	P
GNM214	2.0 ±0.15	1.25 ±0.15	0.6 ±0.1	0.5 ±0.05
			0.85 ±0.1	
GNM314	3.2 ±0.15	1.6 ±0.15	0.8 ±0.1	0.8 ±0.1
			0.85 ±0.1	
			1.0 ±0.1	
			1.15 ±0.1	

Temperature Compensating Type C0G(5C) Characteristics

Part Number		GNM1M	GNM21	GNM31	
L x W [EIA]		1.37x1.0 [0504]	2.0x1.25 [0805]	3.2x1.6 [1206]	
Rated Volt.		50 (**1H**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension					
10pF(**100**)	**K**	0.6(**2**)	0.6(**4**)	0.8(**4**)	0.8(**4**)
15pF(**150**)	**K**	0.6(**2**)	0.6(**4**)	0.8(**4**)	0.8(**4**)
22pF(**220**)	**K**	0.6(**2**)	0.6(**4**)	0.8(**4**)	0.8(**4**)
33pF(**330**)	**K**	0.6(**2**)	0.6(**4**)	0.8(**4**)	0.8(**4**)
47pF(**470**)	**K**	0.6(**2**)	0.6(**4**)	0.8(**4**)	0.8(**4**)
68pF(**680**)	**K**	0.6(**2**)	0.6(**4**)	0.8(**4**)	0.8(**4**)
100pF(**101**)	**K**	0.6(**2**)	0.6(**4**)	0.8(**4**)	0.8(**4**)
150pF(**151**)	**K**	0.6(**2**)	0.6(**4**)	0.8(**4**)	0.8(**4**)
220pF(**221**)	**K**	0.6(**2**)	0.6(**4**)		0.8(**4**)
330pF(**331**)	**K**				0.8(**4**)

The part numbering code is shown in each ( ). The (2) & (4) code in T (mm) means number of elements (two) & (four).
Dimensions are shown in mm and Rated Voltage in Vdc.

High Dielectric Constant Type X5R(R6) Characteristics

Part Number		GNM0M			GNM1M					GNM21			GNM31	
L x W [EIA]		0.9x0.6 [0302]			1.37x1.0 [0504]					2.0x1.25 [0805]			3.2x1.6 [1206]	
Rated Volt.		16 (**1C**)	10 (**1A**)	6.3 (**0J**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	16 (**1C**)	10 (**1A**)
TC		X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)	X5R (**R6**)
Capacitance, Capacitance Tolerance and T Dimension														
1000pF(**102**)	**M**				0.6(**2**)									
2200pF(**222**)	**M**					0.6(**2**)								
4700pF(**472**)	**M**					0.6(**2**)								
10000pF(**103**)	**M**	0.45*(**2**)	0.45*(**2**)	0.45*(**2**)		0.6(**2**)								
22000pF(**223**)	**M**	0.45*(**2**)	0.45*(**2**)	0.45*(**2**)			0.6(**2**)	0.6(**2**)						
47000pF(**473**)	**M**	0.45*(**2**)	0.45*(**2**)	0.45*(**2**)			0.6(**2**)	0.6(**2**)						
0.10µF(**104**)	**M**	0.45*(**2**)	0.45*(**2**)	0.45*(**2**)				0.6(**2**)						
0.22µF(**224**)	**M**						0.8*(**2**)							
0.47µF(**474**)	**M**									0.85(**2**)				
1.0µF(**105**)	**M**						0.8*(**2**)	0.5*(**2**)	0.8*(**2**)	0.85(**2**)	0.85*(**4**)	0.85*(**4**)	0.85(**4**)	0.85(**4**)
2.2µF(**225**)	**M**							0.8*(**2**)	0.8*(**2**)		0.85*(**2**)	0.85*(**2**)		

The part numbering code is shown in each ( ). The (2) & (4) code in T (mm) means number of elements (two) & (four).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GNM Series Specifications and Test Methods (2)(P.40)

High Dielectric Constant Type X7R/7S(R7/C7) Characteristics

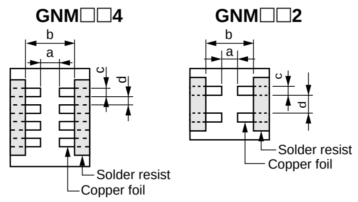
Part Number		GNM1M					GNM21			GNM31			
L x W [EIA]		1.37x1.0 [0504]					2.0x1.25 [0805]			3.2x1.6 [1206]			
Rated Volt.		50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)		50 (**1H**)	25 (**1E**)	16 (**1C**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	6.3 (**0J**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)
Capacitance, Capacitance Tolerance and T Dimension													
470pF(**471**)	**M**						0.6(**4**)						
1000pF(**102**)	**M**	0.6(**2**)					0.6(**4**)						
2200pF(**222**)	**M**		0.6(**2**)					0.6(**4**)					
4700pF(**472**)	**M**		0.6(**2**)					0.6(**4**)					
10000pF(**103**)	**M**		0.6(**2**)					0.6(**4**)					
22000pF(**223**)	**M**			0.6(**2**)	0.6(**2**)				0.85(**4**)				
47000pF(**473**)	**M**			0.6(**2**)	0.6(**2**)				0.85(**4**)	0.85(**4**)		1.0(**4**)	
0.10µF(**104**)	**M**			0.6(**2**)		0.6(**2**)			0.85(**4**)	0.85(**4**)	0.85(**4**)	1.0(**4**)	
1.0µF(**105**)	**M**												1.15(**4**)

The part numbering code is shown in each ( ). The (2) & (4) code in T (mm) means number of elements (two) & (four).
Dimensions are shown in mm and Rated Voltage in Vdc.

GNM Series Specifications and Test Methods (1)

Below GNM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GNM Series Specifications and Test Methods (2) (P.40).

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specifications</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>5C: –55 to +125°C</td><td>R7, C7: –55 to +125°C
R6: –55 to +85°C</td><td></td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td colspan="2">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 colspan="2">No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td colspan="2">Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td colspan="2">No defects or abnormalities</td><td>No failure should be observed when 300% of the rated voltage (5C) or 250% of the rated voltage (R7) 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</td><td colspan="2">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°C and 75%RH max. and within 2 minutes of charging.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</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>Item \ Char.</th><th>5C</th><th>R7</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±0.2Vrms</td></tr>
</table></td></tr>
<tr><td>8</td><td colspan="2">Q/
Dissipation Factor
(D.F.)</td><td>30pF min.: Q≧1000
30pF max.:
Q≧400+20C

C: Nominal Capacitance (pF)</td><td>
<table>
<tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr>
<tr><td>R7, R6, C7</td><td>0.025 max.</td><td>0.035 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr>
</table></td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Capacitance Temperature Characteristics</td><td>Capacitance Change</td><td>Within the specified tolerance
(Table A)</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°C to +125°C</td><td rowspan="3">25°C</td><td rowspan="2">Within ±15%</td></tr>
<tr><td>R6</td><td>–55°C to +85°C</td></tr>
<tr><td>C7</td><td>–55°C to +125°C</td><td>Within ±22%</td></tr>
</table></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, the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A.
The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the steps 1, 3 and 5 by the cap. 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 5C/R7/C7), –30±3 (for F5)</td></tr>
<tr><td>3</td><td>25±2</td></tr>
<tr><td>4</td><td>125±3 (for 5C/R7/C7), 85±3 (for F5)</td></tr>
<tr><td>5</td><td>20±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.</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 ±0.05pF
(Whichever is larger.)</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td colspan="2">No removal of the terminations or other defect should occur.

</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply 5N force in parallel with the test jig for 10±1 sec.
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><th>d</th></tr>
<tr><td>GNM1M2</td><td>0.5</td><td>1.6</td><td>0.32</td><td>0.32</td></tr>
<tr><td>GNM212</td><td>0.6</td><td>1.8</td><td>0.5</td><td>0.5</td></tr>
<tr><td>GNM214</td><td>0.6</td><td>2.0</td><td>0.25</td><td>0.25</td></tr>
<tr><td>GNM314</td><td>0.8</td><td>2.5</td><td>0.4</td><td>0.4</td></tr>
</table>
(in mm)
Fig. 1</td></tr>
</table>

Continued on the following page.

GNM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below GNM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GNM Series Specifications and Test Methods (2) (P.40).

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specifications</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td colspan="2">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 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>Char. / 25V min. / 16V / 10V / 6.3V
R7, R6, C7 / 0.025 max. / 0.035 max. / 0.035 max. / 0.05 max.</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2" colspan="2">Deflection</td><td colspan="2">No cracking or marking defects should occur.</td><td rowspan="2">Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2 using a eutectic solder.
Then apply a force in the direction shown in Fig. 3 for 5±1 sec. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

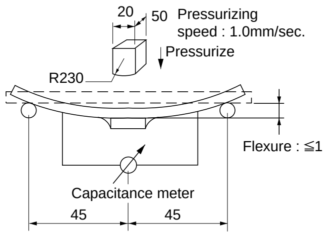
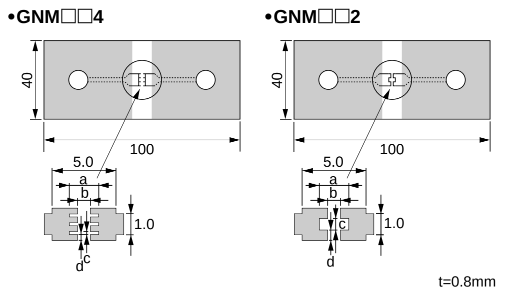



Fig. 3</td></tr>
<tr><td colspan="2">•GNM□□4 •GNM□□2

Type / a / b / c / d
GNM1M2 / 2.0±0.05 / 0.5±0.05 / 0.32±0.05 / 0.32±0.05
GNM212 / 2.0±0.05 / 0.6±0.05 / 0.5±0.05 / 0.5±0.05
GNM214 / 2.0±0.05 / 0.7±0.05 / 0.3±0.05 / 0.2±0.05
GNM314 / 2.5±0.05 / 0.8±0.05 / 0.4±0.05 / 0.4±0.05
(in mm)
Fig. 2</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td colspan="2">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°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.</td></tr>
<tr><td rowspan="6">14</td><td colspan="2">Resistance to Soldering Heat</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="6">Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in a eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5°C for 10±0.5 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.</td></tr>
<tr><td rowspan="5"></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>R7, R6, C7: Within ±7.5%</td></tr>
<tr><td>Q/D.F.</td><td>30pF min.: Q≧1000
30pF max.: Q≧400+20C
C: Nominal Capacitance (pF)</td><td>Char. / 25V min. / 16V / 10V / 6.3V
R7, R6, C7 / 0.025 max. / 0.035 max. / 0.035 max. / 0.05 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>Dielectric Strength</td><td colspan="2">No failure</td></tr>
</table>

Continued on the following page.

GNM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below GNM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GNM Series Specifications and Test Methods (2) (P.40).

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
15	Temperature Cycle		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 (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. Step | 1 | 2 | 3 | 4 Temp. (°C) | Min. Operating Temp. +0/–3 | Room Temp. | Max. Operating Temp. +3/–0 | Room Temp. Time (min.) | 30±3 | 2 to 3 | 30±3 | 2 to 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)	R7, R6, C7: Within ±7.5%	
		Q/D.F.	30pF min.: Q≧1000 30pF max.: Q≧400+20C C:Nominal Capacitance (pF)	Char. | 25V min. | 16V | 10V | 6.3V R7, R6, C7 | 0.025 max. | 0.035 max. | 0.035 max. | 0.05 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)		
		Dielectric Strength	No failure		
16	Humidity Steady State		The measured and observed characteristics should satisfy the specifications in the following table.		Sit the capacitor at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure.
		Appearance	No marking defects		
		Capacitance Change	Within ±5% or ±0.5pF (Whichever is larger)	R7, R6, C7: Within ±12.5%	
		Q/D.F.	30pF and over: Q≧350 10pF and over, 30pF and below: Q≧275+5C/2 10pF and below: Q≧200+10C C: Nominal Capacitance (pF)	Char. | 25V min. | 16V | 10V/6.3V R7, R6, C7 | 0.05 max. | 0.05 max. | 0.05 max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)		
17	Humidity Load		The measured and observed characteristics should satisfy the specifications in the following table.		Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects		
		Capacitance Change	Within ±7.5% or ±0.75pF (Whichever is larger)	R7, R6, C7: Within ±12.5%	
		Q/D.F.	30pF and over: Q≧200 30pF and below: Q≧100+10C/3 C: Nominal Capacitance (pF)	Char. | 25V min. | 16V | 10V/6.3V R7, R6, C7 | 0.05 max. | 0.05 max. | 0.05 max.	
		I.R.	More than 500MΩ or 25Ω · F (Whichever is smaller)		

Continued on the following page.

GNM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below GNM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GNM Series Specifications and Test Methods (2) (P.40).

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
18	High Temperature Load		The measured and observed characteristics should satisfy the specifications in the following table.		Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±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 24±2 hours at room temperature. Perform initial measurement.
		Appearance	No marking defects		
		Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	R7, R6, C7: Within ±12.5%	
		Q/D.F.	30pF and over: Q≧350 10pF and over, 30pF and below: Q≧275+5C/2 10pF and below: Q≧200+10C C: Nominal Capacitance (pF)	Char. / 25V min. / 16V / 10V/6.3V R7, R6, C7 / 0.04 max. / 0.05 max. / 0.05 max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)		

Table A

Char.	Nominal Values (ppm/℃) Note 1	Capacitance Change from 25℃ (%)					
		−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 to 125℃.

GNM Series Specifications and Test Methods (2)

Below GNM Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GNM Series Specifications and Test Methods (1) (P.36).

No.	Item	Specifications	Test Method
1	Operating Temperature Range	R6: −55°C to +85°C	
2	Rated Voltage	See the previous pages.	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, VP-P or VO-P, whichever is larger, should be maintained within the rated voltage range.
3	Appearance	No defects or abnormalities	Visual inspection
4	Dimensions	Within the specified dimension	Using calipers
5	Dielectric Strength	No defects or abnormalities	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.
6	Insulation Resistance	50Ω · F min.	The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25°C and 75%RH max. and within 1 minute of charging.
7	Capacitance	Within the specified tolerance	(see Test Method for 7 and 8 below)
8	Dissipation Factor (D.F.)	0.1 max.*3 (see Table 3 below)	

7, 8 – Specifications (8. Dissipation Factor (D.F.))

0.1 max.*3

Table 3

GNM0M2	**R6**	**103/223/473/104**	
GNM1M2	**R6**	**0J**	**105/225**
GNM1M2	**R6**	**1A**	**225**
GNM212	**R6**	**0J**	**225**
GNM212	**R6**	**1A**	**225**

*3 However 0.125 max. about Table 3 items on the left side.

7, 8 – Test Method

The capacitance/D.F. should be measured at 25°C at the frequency and voltage shown in the table.

Capacitance	Frequency	Voltage
C≦10μF *1 (10V min.)	1±0.1kHz	1.0±0.2Vrms
C≦10μF *2 (6.3V max.)	1±0.1kHz	0.5±0.1Vrms

Table 1

GNM0M2	**R6**	**1A**	**104**
GNM0M2	**R6**	**1C**	**104**
GNM1M2	**R6**	**1A**	**105/225**
GNM1M2	**R6**	**1C**	**224/105**

Table 2

GNM0M2	**R6**	**0J**	**103/223/473**
GNM212	**R6**	**0J**	**225**
GNM214	**R6**	**0J**	**105**

*1 However the voltage is 0.5±0.1Vrms about Table 1 items on the left side.
*2 However the voltage is 1.0±0.2Vrms about Table 2 items on the left side.

9 – Capacitance Temperature Characteristics

Specifications:

Char.	Temp. Range	Reference Temp.	Cap. Change
R6	−55 to +85°C	25°C	Within ±15%

Test Method:

The capacitance change should be measured affter 5 min.at each specified temperature stage.

Step	Temperature (℃)
1	25±2
2	−55±3
3	25±2
4	85±3
5	25±2

The ranges of capacitance change compared with the 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.

10 – Adhesive Strength of Termination

Specifications:

No removal of the terminations or other defects should occur.

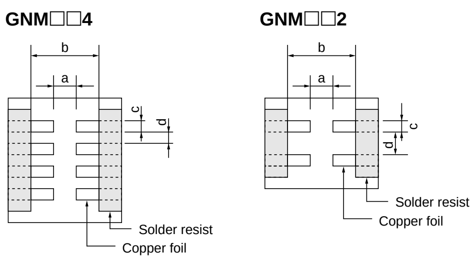


Fig. 1

Test Method:

Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder.
Then apply 5N (GNM0M2: 2N) force in parallel with the test jig for 10±1 sec. 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.

Type	a	b	c	d
GNM0M2	0.2	0.96	0.25	0.2
GNM1M2	0.5	1.6	0.32	0.32
GNM212	0.6	1.8	0.5	0.5
GNM214	0.6	2.0	0.25	0.25
GNM314	0.8	2.5	0.4	0.4

(in mm)

11 – Vibration

No.	Item		Specifications
11	Vibration	Appearance	No defects or abnormalities
		Capacitance	Within the specified tolerance
		D.F.	0.1 max.*3 *3 However 0.125 max. about Table 3 items on the left side.

Test Method:

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).

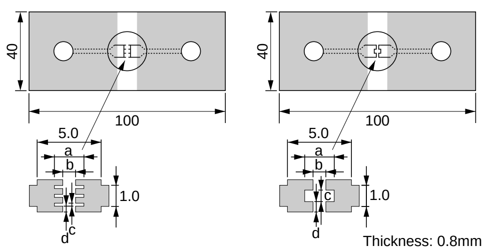
Continued on the following page.

muRata

GNM Series Specifications and Test Methods (2)

Continued from the preceding page.

Below GNM Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GNM Series Specifications and Test Methods (1) (P.36).

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>12</td><td colspan="2">Deflection</td><td>No cracking or marking defects should occur.
•GNM□□4 •GNM□□2


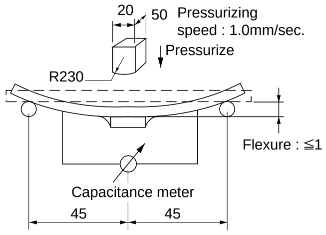
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>GNM0M2</td><td>2.0±0.05</td><td>0.2±0.05</td><td>0.2±0.05</td><td>0.25±0.05</td></tr><tr><td>GNM1M2</td><td>2.0±0.05</td><td>0.5±0.05</td><td>0.32±0.05</td><td>0.32±0.05</td></tr><tr><td>GNM212</td><td>2.0±0.05</td><td>0.6±0.05</td><td>0.5±0.05</td><td>0.5±0.05</td></tr><tr><td>GNM214</td><td>2.0±0.05</td><td>0.7±0.05</td><td>0.3±0.05</td><td>0.2±0.05</td></tr><tr><td>GNM314</td><td>2.5±0.05</td><td>0.8±0.05</td><td>0.4±0.05</td><td>0.4±0.05</td></tr></table>(in mm)
Fig. 2</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.


Fig. 3</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°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.</td></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in a eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5°C for 10±0.5 seconds.
Let sit at room temperature for 24±2 hours, then measure.
• Initial measurement
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>Capacitance Change</td><td>R6: Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>0.1 max. *3
*3 However 0.125 max. about Table 3 items on the left side.</td></tr>
<tr><td>I.R.</td><td>50Ω · F min.</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 marking defects</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 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. (℃)</td><td>Min. Operating Temp.</td><td>Room Temp.</td><td>Max. Operating Temp.</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 °C for one hour and then let sit for 24±2 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>R6: Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>0.1 max. *3
*3 However 0.125 max. about Table 3 items on the left side.</td></tr>
<tr><td>I.R.</td><td>50Ω · F min.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">High Temperature High Humidity (Steady)</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. The charge/discharge current is less than 50mA.
• Initial measurement
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.
• Measurement after test
Perform a heat treatment at 150 +0/-10°C for one hour and then let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>R6: Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>0.2 max.</td></tr>
<tr><td>I.R.</td><td>12.5Ω · F min.</td></tr>
<tr><td rowspan="4">17</td><td rowspan="4">Durability</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply 150% (GNM1M2R61A225/1C105: 125% of the rated voltage) of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.
• Initial measurement
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.
• Measurement after test
Perform a heat treatment at 150 +0/-10°C for one hour and then let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>R6: Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>0.2 max.</td></tr>
<tr><td>I.R.</td><td>25Ω · F min.</td></tr>
</table>

Chip Monolithic Ceramic Capacitors

muRata

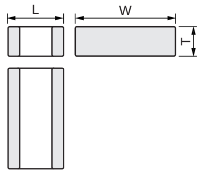
Low ESL LLL/LLA/LLM Series

■ Features (Reversed Geometry Low ESL Type)

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
LLL153	0.5 ±0.05	1.0 ±0.05	0.3 ±0.05
LLL185	0.8 ±0.1	1.6 ±0.1	0.6 max.
LLL215	1.25 ±0.1	2.0 ±0.1	0.5 +0/-0.15
LLL216			0.6 ±0.1
LLL219			0.85 ±0.1
LLL315	1.6 ±0.15	3.2 ±0.15	0.5 +0/-0.15
LLL317			0.7 ±0.1
LLL31M			1.15 ±0.1

Reversed Geometry Low ESL Type

Part Number		LLL15	LLL18					LLL21						LLL31					
L x W [EIA]		0.5x1.0 [0204]	0.8x1.6 [0306]					1.25x2.0 [0508]						1.6x3.2 [0612]					
Rated Volt.		6.3 (**0J**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	4 (**0G**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	
TC		X6S (**C8**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X5R (**R6**)
Capacitance, Capacitance Tolerance and T Dimension																			
2200pF (**222**)	**M**		0.5 (**5**)																
4700pF (**472**)	**M**		0.5 (**5**)																
10000pF (**103**)	**M**			0.5 (**5**)				0.6 (**6**)						0.7 (**7**)					
22000pF (**223**)	**M**			0.5 (**5**)				0.6 (**6**)						0.7 (**7**)					
47000pF (**473**)	**M**				0.5 (**5**)				0.6 (**6**)					0.7 (**7**)					
0.10µF (**104**)	**M**	0.3* (**3**)				0.5 (**5**)			0.6 (**6**)					1.15 (**M**)	0.7 (**7**)				
0.22µF (**224**)	**M**	0.3* (**3**)				0.5 (**5**)				0.85 (**9**)	0.6 (**6**)				1.15 (**M**)	0.7 (**7**)			
0.47µF (**474**)	**M**						0.5 (**5**)				0.85 (**9**)				1.15 (**M**)	0.7 (**7**)			
1.0µF (**105**)	**M**						0.5* (**5**)					0.85 (**9**)				1.15 (**M**)	0.7 (**7**)		
2.2µF (**225**)	**M**						0.5* (**5**)						0.85 (**9**)				1.15 (**M**)	0.7 (**7**)	
4.7µF (**475**)	**M**																	1.15 (**M**)	
10µF (**106**)	**M**																		1.15* (**M**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*:Please refer to LLL/LLA/LLM Series Specifications and Test Method (2)(P.47).

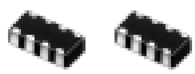
Reversed Geometry Low ESL Type Low Profile

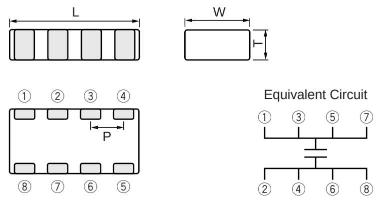
Part Number		LLL18				LLL21						LLL31			
L x W [EIA]		0.8x1.6 [0306]				1.25x2.0 [0508]						1.6x3.2 [0612]			
Rated Volt.		25 (**1E**)	16 (**1C**)	10 (**1A**)	4 (**0G**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)
Capacitance, Capacitance Tolerance and T Dimension															
10000pF(**103**)	**M**	0.5(**5**)				0.5(**5**)						0.5(**5**)			
22000pF(**223**)	**M**		0.5(**5**)				0.5(**5**)					0.5(**5**)			
47000pF(**473**)	**M**		0.5(**5**)					0.5(**5**)					0.5(**5**)		
0.10µF(**104**)	**M**			0.5(**5**)				0.5(**5**)					0.5(**5**)		
0.22µF(**224**)	**M**				0.5(**5**)				0.5(**5**)					0.5(**5**)	
0.47µF(**474**)	**M**									0.5(**5**)					0.5(**5**)
1.0µF(**105**)	**M**										0.5(**5**)				

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

■ Features (Eight Terminals Low ESL Type)
1. Low ESL (100pH) , suitable to decoupling capacitor for 1GHz clock speed IC.
2. Small, large cap

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





Part Number	Dimensions (mm)			
	L	W	T	P
LLA185	1.6 ±0.1	0.8 ±0.1	0.5 +0.05/-0.1	0.4 ±0.1
LLA215	2.0 ±0.1	1.25 ±0.1	0.5 +0.05/-0.1	0.5 ±0.05
LLA219	2.0 ±0.1	1.25 ±0.1	0.85 ±0.1	0.5 ±0.05
LLA315	3.2 ±0.15	1.6 ±0.15	0.5 +0.05/-0.1	0.8 ±0.1
LLA319	3.2 ±0.15	1.6 ±0.15	0.85 ±0.1	0.8 ±0.1
LLA31M	3.2 ±0.15	1.6 ±0.15	1.15 ±0.1	0.8 ±0.1

Eight Terminals Low ESL Type

Part Number		LLA18	LLA21					LLA31		
L x W [EIA]		1.6x0.8 [0603]	2.0x1.25 [0805]					3.2x1.6 [1206]		
Rated Volt.		4 (**0G**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	4 (**0G**)
TC		X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)
Capacitance, Capacitance Tolerance and T Dimension										
10000pF(**103**)	**M**		0.85(**9**)							
22000pF(**223**)	**M**		0.85(**9**)							
47000pF(**473**)	**M**		0.85(**9**)							
0.10µF(**104**)	**M**	0.5(**5**)		0.85(**9**)				0.85(**9**)		
0.22µF(**224**)	**M**	0.5(**5**)		0.85(**9**)				0.85(**9**)		
0.47µF(**474**)	**M**	0.5(**5**)			0.85(**9**)			0.85(**9**)		
1.0µF(**105**)	**M**	0.5*(**5**)				0.85(**9**)		1.15(**M**)	0.85(**9**)	
2.2µF(**225**)	**M**	0.5*(**5**)					0.85(**9**)		1.15(**M**)	0.85(**9**)
4.7µF(**475**)	**M**						0.85*(**9**)			

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*:Please refer to LLL/LLA/LLM Series Specifications and Test Method (2)(P.47).

4

Eight Terminals Low ESL Type Low Profile

Part Number		LLA21					LLA31		
L x W [EIA]		2.0x1.25 [0805]					3.2x1.6 [1206]		
Rated Volt.		25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)
Capacitance, Capacitance Tolerance and T Dimension									
10000pF(**103**)	**M**	0.5(**5**)							
22000pF(**223**)	**M**	0.5(**5**)							
47000pF(**473**)	**M**		0.5(**5**)						
0.10µF(**104**)	**M**		0.5(**5**)						
0.22µF(**224**)	**M**			0.5(**5**)			0.5(**5**)		
0.47µF(**474**)	**M**				0.5(**5**)			0.5(**5**)	
1.0µF(**105**)	**M**					0.5(**5**)			0.5(**5**)
2.2µF(**225**)	**M**					0.5*(**5**)			0.5(**5**)
4.7µF(**475**)	**M**					0.5*(**5**)			

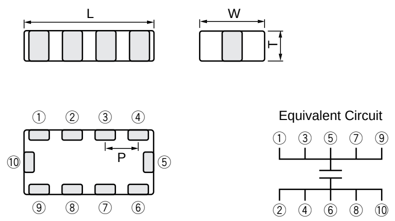
The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*:Please refer to LLL/LLA/LLM Series Specifications and Test Method (2)(P.47).

■ Features (Ten Terminals Low ESL Type)

1. Low ESL (45pH), suitable to decoupling capacitor for 2GHz clock speed IC.
2. Small, large cap

■ Applications

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



Part Number	Dimensions (mm)			
	L	W	T	P
LLM215	2.0 ±0.1	1.25 ±0.1	0.5 +0.05/-0.1	0.5 ±0.05
LLM315	3.2 ±0.15	1.6 ±0.15	0.5 +0.05/-0.1	0.8 ±0.1

Ten Terminals Low ESL Type Low Profile

Part Number		LLM21				LLM31		
L x W [EIA]		2.0x1.25 [0805]				3.2x1.6 [1206]		
Rated Volt.		25 (**1E**)	16 (**1C**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7S (**C7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)
Capacitance, Capacitance Tolerance and T Dimension								
10000pF(**103**)	**M**	0.5(**5**)						
22000pF(**223**)	**M**	0.5(**5**)						
47000pF(**473**)	**M**		0.5(**5**)					
0.10µF(**104**)	**M**		0.5(**5**)			0.5(**5**)		
0.22µF(**224**)	**M**			0.5(**5**)		0.5(**5**)		
0.47µF(**474**)	**M**			0.5(**5**)			0.5(**5**)	
1.0µF(**105**)	**M**				0.5(**5**)			
2.2µF(**225**)	**M**				0.5*(**5**)			0.5(**5**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*:Please refer to LLL/LLA/LLM Series Specifications and Test Method (2)(P.47).

LLL/LLA/LLM Series Specifications and Test Methods (1)

Below LLL/LLA/LLM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to LLL/LLA/LLM Series Specifications and Test Methods (2) (P.47).

<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, C7: −55 to +125°C</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</td><td>C≦0.047μF: More than 10,000MΩ
C>0.047μF: More than 500Ω · F
C: Normal Capacitance</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25°C 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°C at the frequency and voltage shown in the table.
Frequency: 1±0.1kHz
Voltage: 1±0.2Vrms
✻However the voltage is 0.5±0.1Vrms about LLA185C70G474.</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>W.V.: 25V min.; 0.025 max.
W.V.: 16V/10V max.; 0.035 max.
W.V.: 6.3V max.; 0.05 max.</td></tr>
<tr><td>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td><table><tr><th>Char.</th><th>Temp. Range (°C)</th><th>Reference Temp.</th><th>Cap.Change</th></tr><tr><td>R7</td><td>−55 to +125</td><td>25°C</td><td>Within ±15%</td></tr><tr><td>C7</td><td>−55 to +125</td><td>25°C</td><td>Within ±22%</td></tr></table></td><td>The capacitance change should be measured after 5 min. at each specified temperature stage.
<table><tr><th>Step</th><th>Temperature (°C)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>−55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table>The ranges of capacitance change compared with the 25°C value over the temperature ranges shown in the table should be within the specified ranges.</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the test jig (glass epoxy board) using a eutectic solder. Then apply 10N✻ force in parallel with the test jig for 10±1 sec. 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. ✻LLL18 and LLA/LLM Series: 5N</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>W.V.: 25V min.; 0.025 max.
W.V.: 16V/10V max.; 0.035 max.
W.V.: 6.3V max.; 0.05 max.</td></tr>
<tr><td>12</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°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C, or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.</td></tr>
<tr><td rowspan="5">13</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in a eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5°C for 10±0.5 seconds. Let sit at room temperature for 24±2 hours, then measure.

• Initial measurement.
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>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>W.V.: 25V min.; 0.025 max.
W.V.: 16V/10V max.; 0.035 max.
W.V.: 6.3V max.; 0.05 max.</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>
</table>

Continued on the following page. ↗

muRata

LLL/LLA/LLM Series Specifications and Test Methods (1)

Continued from the preceding page.

Below LLL/LLA/LLM Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to LLL/LLA/LLM Series Specifications and Test Methods (2) (P.47).

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td>No marking defects</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 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>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$^{+0}_{-10}$°C for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>W.V.: 25V min.; 0.025 max.
W.V.: 16V/10V max.; 0.035 max.
W.V.: 6.3V max.; 0.05 max.</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">15</td><td rowspan="4">Humidity (Steady State)</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Sit the capacitor at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>W.V.: 10V min.; 0.05 max.
W.V.: 6.3V max.; 0.075 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">Humidity Load</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>W.V.: 10V min.; 0.05 max.
W.V.: 6.3V max.; 0.075 max.</td></tr>
<tr><td>I.R.</td><td>More than 500MΩ or 25Ω · F
(Whichever is smaller)</td></tr>
<tr><td rowspan="4">17</td><td rowspan="4">High Temperature Load</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 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°C. Remove and let sit for 24±2 hours at room temperature.
Perform initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>W.V.: 10V min.; 0.05 max.
W.V.: 6.3V max.; 0.075 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 50Ω · F
(Whichever is smaller)</td></tr>
</table>

muRata

LLL/LLA/LLM Series Specifications and Test Methods (2)

Below LLL/LLA/LLM Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to LLL/LLA/LLM Series Specifications and Test Methods (1) (P.45).

No.	Item		Specifications	Test Method
1	Operating Temperature Range		R6: −55 to +85°C R7, C7: −55 to +125°C C8: −55 to +105°C	
2	Rated Voltage		See the previous pages.	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.
3	Appearance		No defects or abnormalities	Visual inspection
4	Dimensions		Within the specified dimension	Using calipers
5	Dielectric Strength		No defects or abnormalities	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.
6	Insulation Resistance		50Ω · F min.	The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25°C and 75%RH max. and within 1 minute of charging.
7	Capacitance		Within the specified tolerance	The capacitance/D.F. should be measured at 25°C at the frequency and voltage shown in the table. Capacitance / Frequency / Voltage: C≦10μF (10V min.) / 1±0.1kHz / 1.0±0.2Vrms C≦10μF (6.3V max.) / 1±0.1kHz / 0.5±0.1Vrms C>10μF / 120±24Hz / 0.5±0.1Vrms
8	Dissipation Factor (D.F.)		R6, R7, C7, C8: 0.120 max.	
9	Capacitance Temperature Characteristics		Char. / Temp. Range (°C) / Reference Temp. / Cap.Change: R6 / −55 to +85 / 25°C / Within ±15% R7 / −55 to +125 / 25°C / Within ±15% C7 / −55 to +125 / 25°C / Within ±22% C8 / −55 to +105 / 25°C / Within ±22%	The capacitance change should be measured after 5 min. at each specified temperature stage. The ranges of capacitance change compared with the 25°C value over the temperature ranges shown in the table should be within the specified ranges.
10	Adhesive Strength of Termination		No removal of the terminations or other defect should occur.	Solder the capacitor to the test jig (glass epoxy board) using a eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1 sec. 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. *5N (LLL15, LLL18, LLA,LLM Series)
11	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 (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).
		Capacitance	Within the specified tolerance	
		D.F.	R6, R7, C7, C8: 0.120 max.	
12	Solderability of Termination		75% of the terminations are to be soldered evenly and continuously.	Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C, or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.
13	Resistance to Soldering Heat	Appearance	No marking defects	Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in a eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5°C for 10±0.5 seconds. Let sit at room temperature for 24±2 hours, then measure. • Initial measurement. 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.
		Capacitance Change	R6, R7, C7, C8: Within ±7.5%	
		D.F.	R6, R7, C7, C8: 0.120 max.	
		I.R.	50Ω · F min.	
		Dielectric Strength	No failure	

Continued on the following page.

LLL/LLA/LLM Series Specifications and Test Methods (2)

Continued from the preceding page.

Below LLL/LLA/LLM Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to LLL/LLA/LLM Series Specifications and Test Methods (1) (P.45).

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Temperature Sudden Change</td><td>Appearance</td><td>No marking defects</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 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>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$^{+0}_{-10}$°C for one hour and then let sit for 24±2 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>R6, R7, C7, C8: Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>R6, R7, C7, C8: 0.120 max.</td></tr>
<tr><td>I.R.</td><td>50Ω · F min.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">High Temperatue High Humidity (Steady State)</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours.
The charge/discharge current is less than 50mA.
Apply the rated DC voltage.

•Initial measurement
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.

•Measurement after test
Perform a heat treatment at 150$^{+0}_{-10}$°C for one hour and then let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>R6, R7, C7, C8: Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>R6, R7, C7, C8: 0.2 max.</td></tr>
<tr><td>I.R.</td><td>12.5Ω · F min.</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">Durability</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply 150% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C.
The charge/discharge current is less than 50mA.

•Initial measurement
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.

•Measurement after test
Perform a heat treatment at 150$^{+0}_{-10}$°C for one hour and then let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>R6, R7, C7, C8: Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>R6, R7, C7, C8: 0.2 max.</td></tr>
<tr><td>I.R.</td><td>25Ω · F min.</td></tr>
</table>

muRata

Chip Monolithic Ceramic Capacitors

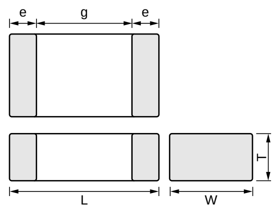
High-Q Type GJM Series

■ Features

1. Mobile Telecommunication and RF module, mainly
2. Quality improvement of telephone call, Low power Consumption, yield ratio improvement

■ Applications

VCO, PA, Mobile Telecommunication



Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GJM03	0.6 ±0.03	0.3 ±0.03	0.3 ±0.03	0.1 to 0.2	0.2
GJM15	1.0 ±0.05	0.5 ±0.05	0.5 ±0.05	0.15 to 0.3	0.4

Part Number		**GJM03**			**GJM15**
L x W [EIA]		0.6x0.3 [0201]			1.0x0.5 [0402]
Rated Volt.		25 (**1E**)		6.3 (**0J**)	50 (**1H**)
TC		C0G (**5C**)	C0H (**6C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension					
0.10pF(**R10**)	**W, B**				0.5(**5**)
0.20pF(**R20**)	**W, B**	0.3(**3**)			0.5(**5**)
0.30pF(**R30**)	**W, B**	0.3(**3**)			0.5(**5**)
0.40pF(**R40**)	**W, B**	0.3(**3**)			0.5(**5**)
0.50pF(**R50**)	**W, B**	0.3(**3**)			0.5(**5**)
0.60pF(**R60**)	**W, B**	0.3(**3**)			0.5(**5**)
0.70pF(**R70**)	**W, B**	0.3(**3**)			0.5(**5**)
0.80pF(**R80**)	**W, B**	0.3(**3**)			0.5(**5**)
0.90pF(**R90**)	**W, B**	0.3(**3**)			0.5(**5**)
1.0pF(**1R0**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.1pF(**1R1**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.2pF(**1R2**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.3pF(**1R3**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.4pF(**1R4**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.5pF(**1R5**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.6pF(**1R6**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.7pF(**1R7**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.8pF(**1R8**)	**W, B, C**	0.3(**3**)			0.5(**5**)
1.9pF(**1R9**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.0pF(**2R0**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.1pF(**2R1**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.2pF(**2R2**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.3pF(**2R3**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.4pF(**2R4**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.5pF(**2R5**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.6pF(**2R6**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.7pF(**2R7**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.8pF(**2R8**)	**W, B, C**	0.3(**3**)			0.5(**5**)
2.9pF(**2R9**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.0pF(**3R0**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.1pF(**3R1**)	**W, B, C**	0.3(**3**)			0.5(**5**)

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

Continued on the following page. ↗

Continued from the preceding page.

Part Number		GJM03			GJM15
L x W [EIA]		0.6x0.3 [0201]			1.0x0.5 [0402]
Rated Volt.		25 (**1E**)		6.3 (**0J**)	50 (**1H**)
TC		C0G (**5C**)	C0H (**6C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension					
3.2pF(**3R2**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.3pF(**3R3**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.4pF(**3R4**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.5pF(**3R5**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.6pF(**3R6**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.7pF(**3R7**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.8pF(**3R8**)	**W, B, C**	0.3(**3**)			0.5(**5**)
3.9pF(**3R9**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.0pF(**4R0**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.1pF(**4R1**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.2pF(**4R2**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.3pF(**4R3**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.4pF(**4R4**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.5pF(**4R5**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.6pF(**4R6**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.7pF(**4R7**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.8pF(**4R8**)	**W, B, C**	0.3(**3**)			0.5(**5**)
4.9pF(**4R9**)	**W, B, C**	0.3(**3**)			0.5(**5**)
5.0pF(**5R0**)	**W, B, C**	0.3(**3**)			0.5(**5**)
5.1pF(**5R1**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
5.2pF(**5R2**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
5.3pF(**5R3**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
5.4pF(**5R4**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
5.5pF(**5R5**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
5.6pF(**5R6**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
5.7pF(**5R7**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
5.8pF(**5R8**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
5.9pF(**5R9**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.0pF(**6R0**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.1pF(**6R1**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.2pF(**6R2**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.3pF(**6R3**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.4pF(**6R4**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.5pF(**6R5**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.6pF(**6R6**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.7pF(**6R7**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.8pF(**6R8**)	**W, B, C, D**	0.3(**3**)			0.5(**5**)
6.9pF(**6R9**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.0pF(**7R0**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.1pF(**7R1**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.2pF(**7R2**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.3pF(**7R3**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.4pF(**7R4**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.5pF(**7R5**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.6pF(**7R6**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.7pF(**7R7**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.8pF(**7R8**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
7.9pF(**7R9**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
8.0pF(**8R0**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)
8.1pF(**8R1**)	**W, B, C, D**		0.3(**3**)		0.5(**5**)

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

Continued on the following page.

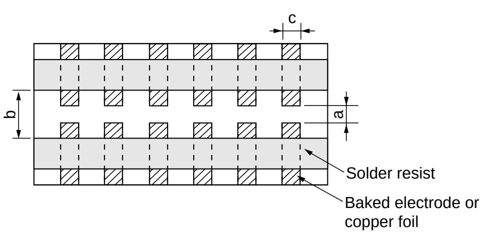
Continued from the preceding page.

Part Number		GJM03			GJM15
L x W [EIA]		0.6x0.3 [0201]			1.0x0.5 [0402]
Rated Volt.		25 (**1E**)		6.3 (**0J**)	50 (**1H**)
TC		C0G (**5C**)	C0H (**6C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension					
8.2pF(**8R2**)	W, B, C, D		0.3(**3**)		0.5(**5**)
8.3pF(**8R3**)	W, B, C, D		0.3(**3**)		0.5(**5**)
8.4pF(**8R4**)	W, B, C, D		0.3(**3**)		0.5(**5**)
8.5pF(**8R5**)	W, B, C, D		0.3(**3**)		0.5(**5**)
8.6pF(**8R6**)	W, B, C, D		0.3(**3**)		0.5(**5**)
8.7pF(**8R7**)	W, B, C, D		0.3(**3**)		0.5(**5**)
8.8pF(**8R8**)	W, B, C, D		0.3(**3**)		0.5(**5**)
8.9pF(**8R9**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.0pF(**9R0**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.1pF(**9R1**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.2pF(**9R2**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.3pF(**9R3**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.4pF(**9R4**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.5pF(**9R5**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.6pF(**9R6**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.7pF(**9R7**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.8pF(**9R8**)	W, B, C, D		0.3(**3**)		0.5(**5**)
9.9pF(**9R9**)	W, B, C, D		0.3(**3**)		0.5(**5**)
10pF(**100**)	**G, J**		0.3(**3**)		0.5(**5**)
11pF(**110**)	**G, J**		0.3(**3**)		0.5(**5**)
12pF(**120**)	**G, J**		0.3(**3**)		0.5(**5**)
13pF(**130**)	**G, J**		0.3(**3**)		0.5(**5**)
15pF(**150**)	**G, J**		0.3(**3**)		0.5(**5**)
16pF(**160**)	**G, J**		0.3(**3**)		0.5(**5**)
18pF(**180**)	**G, J**		0.3(**3**)		0.5(**5**)
20pF(**200**)	**G, J**		0.3(**3**)		0.5(**5**)
22pF(**220**)	**G, J**			0.3(**3**)	
24pF(**240**)	**G, J**			0.3(**3**)	
27pF(**270**)	**G, J**			0.3(**3**)	
30pF(**300**)	**G, J**			0.3(**3**)	
33pF(**330**)	**G, J**			0.3(**3**)	

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

5

GJM Series Specifications and Test Methods(1)

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th>Specifications</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>−55 to +125℃</td><td>Reference Temperature: 25℃
(2C, 3C, 4C: 20℃)</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td>Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when 300% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>10,000MΩ min. or 500Ω · F min. (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/Q should be measured at 25℃ at the frequency and voltage shown in the table.
<table><tr><td>Frequency</td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vrms</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Q</td><td>30pF and over: Q≧1000
30pF and below: Q≧400+20C
C: Nominal Capacitance (pF)</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Capacitance Temperature Characteristics</td><td>Temperature Coefficient</td><td>Within the specified tolerance (Table A)</td><td rowspan="2">The capacitance change should be measured after 5 min. at each specified temperature stage.
Temperature Compensating Type
The temperature coefficient is determined using the capacitance measured in step 3 as a reference.
When cycling the temperature sequentially from step 1 through 5, (5C: +25 to 125℃: other temp. coeffs.: +20 to 125℃) the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as 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 (℃)</th></tr><tr><td>1</td><td>Reference Temp. ±2</td></tr><tr><td>2</td><td>−55±3</td></tr><tr><td>3</td><td>Reference Temp. ±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>Reference Temp. ±2</td></tr></table></td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF
(Whichever is larger.)</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply a 5N* force in parallel with the test jig for 10±1 sec. 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 (GJM03)


<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GJM03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GJM15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr></table>(in mm)
Fig. 1</td></tr>
</table>

Continued on the following page. ↗

muRata

GJM Series Specifications and Test Methods(1)

Continued from the preceding page.

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th>Specifications</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th></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>Q</td><td>30pF and over: Q≧1000
30pF and below: Q≧400+20C
C: Nominal Capacitance (pF)</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2" colspan="2">Deflection</td><td>No cracking or marking defects 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 by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

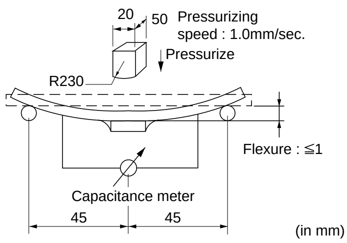
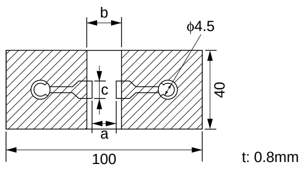



Fig. 3</td></tr>
<tr><td>

Type	a	b	c
GJM03	0.3	0.9	0.3
GJM15	0.4	1.5	0.5

(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℃ or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.</td></tr>
<tr><td rowspan="6">14</td><td rowspan="6">Resistance to Soldering Heat</td><td></td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="6">Preheat the capacitor at 120 to 150℃ for 1 minute.
Immerse the capacitor in a eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5℃ for 10±0.5 seconds.
Let sit at room temperature for 24±2 hours.</td></tr>
<tr><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>30pF and over: Q≧1000
30pF and below: Q≧400+20C
C: Nominal Capacitance (pF)</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="6">15</td><td rowspan="6">Temperature Cycle</td><td></td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="6">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 24±2 hours at room temperature, then measure.

Step	1	2	3	4
Temp. (℃)	Min. Operating Temp. $^{+0}_{-3}$	Room Temp.	Max. Operating Temp. $^{+3}_{-0}$	Room Temp.
Time (min.)	30±3	2 to 3	30±3	2 to 3

</td></tr>
<tr><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>30pF and over: Q≧1000
30pF and below: Q≧400+20C
C: Nominal Capacitance (pF)</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">16</td><td rowspan="5">Humidity, Steady State</td><td></td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Let the capacitor sit at 40±2℃ and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 24±2 hours (temperature compensating type) at room temperature, then measure.</td></tr>
<tr><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>30pF and below: Q≧350
10pF and over, 30pF and below: $Q \geqq 275+\frac{5}{2}C$
10pF and below: Q≧200+10C
C: Nominal Capacitance (pF)</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
</table>

Continued on the following page.

GJM Series Specifications and Test Methods(1)

Continued from the preceding page.

No.	Item		Specifications: Temperature Compensating Type	Test Method
17	Humidity Load		The measured and observed characteristics should satisfy the specifications in the following table.	Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects	
		Capacitance Change	Within ±7.5% or ±0.75pF (Whichever is larger)	
		Q	30pF and over: Q≧200 30pF and below: Q≧100+$\frac{10}{3}$C C: Nominal Capacitance (pF)	
		I.R.	More than 500MΩ or 25Ω · F (Whichever is smaller)	
18	High Temperature Load		The measured and observed characteristics should satisfy the specifications in the following table.	Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3℃. Let sit for 24±2 hours (temperature compensating type) at room temperature, then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects	
		Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	
		Q	30pF and over: Q≧350 10pF and over, 30pF and below: Q≧275+$\frac{5}{2}$C 10pF and below: Q≧200+10C C: Nominal Capacitance (pF)	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)	
19	ESR		0.1pF≦C≦1pF: 350mΩ · pF below 1pF<C≦5pF: 300mΩ below 5pF<C≦10pF: 250mΩ below	The ESR should be measured at room temperature, and frequency 1±0.2GHz with the equivalent of BOONTON Model 34A.
			10pF<C≦33pF: 400mΩ below	The ESR should be measured at room temperature, and frequency 500±50MHz with the equivalent of HP8753B.

Table A

(1)

Char. Code	Temp. Coeff. (ppm/℃) ∗1	Capacitance Change from 25℃ Value (%)					
		−55℃		−30℃		−10℃	
		Max.	Min.	Max.	Min.	Max.	Min.
5C	0±30	0.58	−0.24	0.40	−0.17	0.25	−0.11
6C	0±60	0.87	−0.48	0.60	−0.33	0.38	−0.21

∗1: Nominal values denote the temperature coefficient within a range of 25 to 125℃.

(2)

Char.	Nominal Values (ppm/℃) ∗2	Capacitance Change from 20℃ Value (%)					
		−55℃		−25℃		−10℃	
		Max.	Min.	Max.	Min.	Max.	Min.
2C	0±60	0.82	−0.45	0.49	−0.27	0.33	−0.18
3C	0±120	1.37	−0.90	0.82	−0.54	0.55	−0.36
4C	0±250	2.56	−1.88	1.54	−1.13	1.02	−0.75

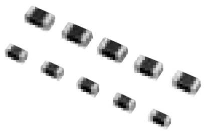
∗2: Nominal values denote the temperature coefficient within a range of 20 to 125℃.

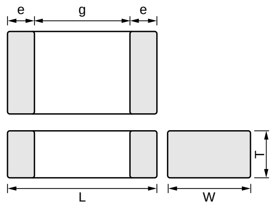
Chip Monolithic Ceramic Capacitors

High Frequency GQM Series

■ Features

1. HiQ and low ESR at VHF, UHF, Microwave
2. Feature improvement, low power consumption for mobile telecommunication. (Base station, terminal, etc.)





■ Applicatons

High frequency circuit (Mobile telecommunication, etc.)

Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GQM187	1.6 ±0.15	0.8 ±0.15	0.7 ±0.1	0.2 to 0.5	0.5
GQM188	1.6 ±0.1	0.8 ±0.1	0.8 ±0.1	0.2 to 0.5	0.5
GQM219	2.0 ±0.1	1.25 ±0.1	0.85 ±0.1	0.2 to 0.7	0.7

Part Number		**GQM18**			**GQM21**	
L x W [EIA]		1.6x0.8 [0603]			2.0x1.25 [0805]	
Rated Volt.		250 (**2E**)	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension						
0.10pF(**R10**)	**B**	0.7(**7**)				
0.20pF(**R20**)	**B**	0.7(**7**)				
0.30pF(**R30**)	**B, C**	0.7(**7**)				
0.40pF(**R40**)	**B, C**	0.7(**7**)				
0.50pF(**R50**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
0.75pF(**R75**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
1.0pF(**1R0**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
1.1pF(**1R1**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
1.2pF(**1R2**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
1.3pF(**1R3**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
1.5pF(**1R5**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
1.6pF(**1R6**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
1.8pF(**1R8**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
2.0pF(**2R0**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
2.2pF(**2R2**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
2.4pF(**2R4**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
2.7pF(**2R7**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
3.0pF(**3R0**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
3.3pF(**3R3**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
3.6pF(**3R6**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
3.9pF(**3R9**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
4.0pF(**4R0**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
4.3pF(**4R3**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
4.7pF(**4R7**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
5.0pF(**5R0**)	**B, C**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
5.1pF(**5R1**)	**C, D**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
5.6pF(**5R6**)	**C, D**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
6.0pF(**6R0**)	**C, D**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
6.2pF(**6R2**)	**C, D**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
6.8pF(**6R8**)	**C, D**	0.7(**7**)	0.8(**8**)		0.85(**9**)	
7.0pF(**7R0**)	**C, D**	0.7(**7**)		0.8(**8**)	0.85(**9**)	

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

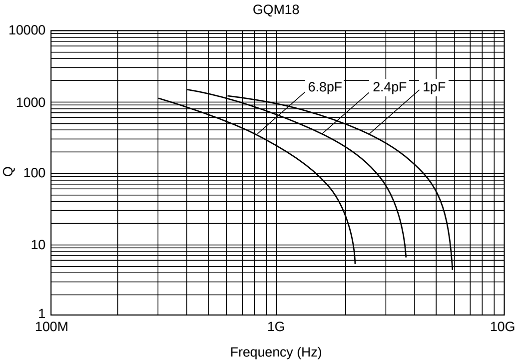
Continued on the following page. ↗

Continued from the preceding page.

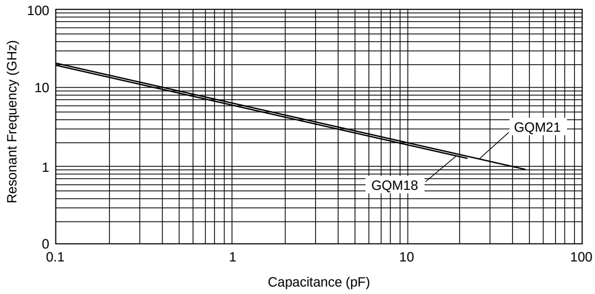
Part Number		**GQM18**			**GQM21**	
L x W [EIA]		1.6x0.8 [0603]			2.0x1.25 [0805]	
Rated Volt.		250 (**2E**)	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension						
7.5pF(**7R5**)	**C, D**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
8.0pF(**8R0**)	**C, D**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
8.2pF(**8R2**)	**C, D**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
9.0pF(**9R0**)	**C, D**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
9.1pF(**9R1**)	**C, D**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
10pF(**100**)	**G, J**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
11pF(**110**)	**G, J**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
12pF(**120**)	**G, J**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
13pF(**130**)	**G, J**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
15pF(**150**)	**G, J**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
16pF(**160**)	**G, J**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
18pF(**180**)	**G, J**	0.7(**7**)		0.8(**8**)	0.85(**9**)	
20pF(**200**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
22pF(**220**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
24pF(**240**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
27pF(**270**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
30pF(**300**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
33pF(**330**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
36pF(**360**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
39pF(**390**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
43pF(**430**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
47pF(**470**)	**G, J**	0.7(**7**)		0.8(**8**)		0.85(**9**)
51pF(**510**)	**G, J**			0.8(**8**)		0.85(**9**)
56pF(**560**)	**G, J**			0.8(**8**)		0.85(**9**)
62pF(**620**)	**G, J**			0.8(**8**)		0.85(**9**)
68pF(**680**)	**G, J**			0.8(**8**)		0.85(**9**)
75pF(**750**)	**G, J**			0.8(**8**)		0.85(**9**)
82pF(**820**)	**G, J**			0.8(**8**)		0.85(**9**)
91pF(**910**)	**G, J**			0.8(**8**)		0.85(**9**)
100pF(**101**)	**G, J**			0.8(**8**)		0.85(**9**)

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

■ Q - Frequency Characteristics

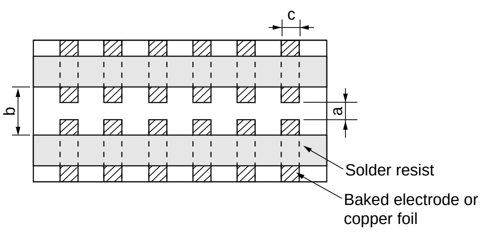


■ Resonant Frequency - Capacitance



GQM Series Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature</td><td>−55 to 125℃</td><td>Reference Temperature: 25℃</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous page.</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">Dimension</td><td>Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when 300%* of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
*250V only 250%</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance</td><td>More than 10,000MΩ
(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/Q should be measured at 25℃ at the frequency and voltage shown in the table.<table><tr><td>Frequency</td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vrms</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Q</td><td>30pF min.: Q≧1400
30pF max.: Q≧800+20C

C: Nominal Capacitance (pF)</td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Capacitance Temperature Characteristics</td><td>Capacitance Change</td><td>Within the specified tolerance (Table A)</td><td rowspan="3">The temperature coefficient is determined using the capacitance measured in step 3 as a reference.
When cycling the temperature sequentially from step 1 through 5 the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as in Table A.
The capacitance drift is calculated 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 (℃)</th></tr><tr><td>1</td><td>Reference Temp. ±2</td></tr><tr><td>2</td><td>−55±3</td></tr><tr><td>3</td><td>Reference Temp. ±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>Reference Temp. ±2</td></tr></table></td></tr>
<tr><td>Temperature Coefficient</td><td>Within the specified tolerance (Table A)</td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF
(Whichever is larger)</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.
</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1 sec.
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.
*5N (GQM188)<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GQM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GQM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr></table>(in mm)
Fig. 1</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10).
The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute.
This motion should be applied for a period of 2 hours in each of 3 mutually perpendicular directions (total of 6 hours).</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>Q</td><td>30pF min.: Q≧1400
30pF max.: Q≧800+20C

C: Nominal Capacitance (pF)</td></tr>
</table>

Continued on the following page.

GQM Series Specifications and Test Methods

Continued from the preceding page.

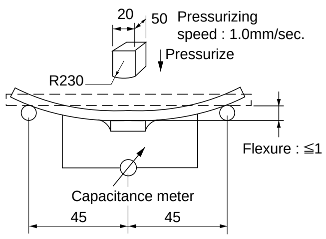
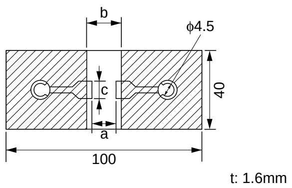
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="2">12</td><td rowspan="2" colspan="2">Deflection</td><td>No crack or marked defect should occur.</td><td rowspan="2">Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2 using a eutectic solder.
Then apply a force in the direction shown in Fig. 3.
The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.


Fig. 3</td></tr>
<tr><td>

<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GQM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GQM21</td><td>1.2</td><td>4.0</td><td>1.65</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℃ or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.</td></tr>
<tr><td rowspan="6">14</td><td rowspan="6">Resistance to Soldering Heat</td><td></td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="6">Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 24±2 hours.</td></tr>
<tr><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25 pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>30pF min.: Q≧1400
30pF max.: Q≧800+20C

C: Nominal Capacitance (pF)</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="6">15</td><td rowspan="6">Temperature Cycle</td><td></td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="6">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 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. (℃)</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></td></tr>
<tr><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>30pF min.: Q≧1400
30pF max.: Q≧800+20C

C: Nominal Capacitance (pF)</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Humidity Steady State</td><td></td><td>The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Let the capacitor sit at 40±2℃ and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 24±2 hours (temperature compensating type) at room temperature, then measure.</td></tr>
<tr><td>Appearance</td><td>No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>30pF min.: Q≧350
10pF and over, 30pF and below: Q≧275+5C/2
10pF max.: Q≧200+10C

C: Nominal Capacitance (pF)</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
</table>

Continued on the following page.

GQM Series Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specifications	Test Method
17	Humidity Load		The measured and observed characteristics should satisfy the specifications in the following table.	Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects	
		Capacitance Change	Within ±7.5% or ±0.75pF (Whichever is larger)	
		Q	30pF min.: Q≧200 30pF max.: Q≧100+10C/3 C: Nominal Capacitance (pF)	
		I.R.	More than 500MΩ	
18	High Temperature Load		The measured and observed characteristics should satisfy the specifications in the following table.	Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3℃. Let sit for 24±2 hours (temperature compensating type) at room temperature, then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects	
		Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	
		Q	30pF min.: Q≧350 10pF and over, 30pF and below: Q≧275+5C/2 10pF max.: Q≧200+10C C: Nominal Capacitance (pF)	
		I.R.	More than 1,000MΩ	

Table A

Char.	Nominal Values (ppm/℃) ∗1	Capacitance Change from 25℃ (%)					
		−55℃		−30℃		−10℃	
		Max.	Min.	Max.	Min.	Max.	Min.
5C	0±30	0.58	−0.24	0.40	−0.17	0.25	−0.11

∗1: Nominal values denote the temperature coefficient within a range of 25 to 125℃.

Chip Monolithic Ceramic Capacitors

muRata

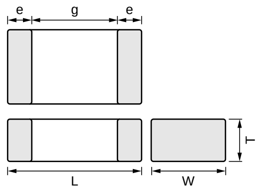
High Frequency Type ERB Series

■ Features (ERB Series)

1. Negligible inductance is achieved by its monolithic structure so the series can be used at frequencies above 1GHz.
2. Nickel barriered terminations of ERB series improve solderability and decrease solder leaching.
3. ERB18/21 series are designed for both flow and reflow soldering and ERB32 series are designed for reflow soldering.

■ Applications

High frequency and high-power circuits



Part Number	Dimensions (mm)				
	L	W	T max.	e min.	g min.
ERB188	1.6±0.1	0.8±0.1	0.9	0.2	0.5
ERB21B	2.0±0.3	1.25±0.3	1.35	0.25	0.7
ERB32Q	3.2±0.3	2.5±0.3	1.7	0.3	1.0

Part Number		**ERB18**	**ERB21**			**ERB32**				
L x W [EIA]		1.6x0.8 [0603]	2.0x1.25 [0805]			3.2x2.5 [1210]				
Rated Volt.		250 (**2E**)	250 (**2E**)	100 (**2A**)	50 (**1H**)	500 (**2H**)	300 (**YD**)	250 (**2E**)	100 (**2A**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension										
0.50pF(**R50**)	**B, C**	0.9(**8**)	1.35(**B**)							
0.75pF(**R75**)	**B, C**	0.9(**8**)	1.35(**B**)							
1.0pF(**1R0**)	**B, C**	0.9(**8**)	1.35(**B**)							
1.1pF(**1R1**)	**B, C**	0.9(**8**)	1.35(**B**)							
1.2pF(**1R2**)	**B, C**	0.9(**8**)	1.35(**B**)							
1.3pF(**1R3**)	**B, C**	0.9(**8**)	1.35(**B**)							
1.5pF(**1R5**)	**B, C**	0.9(**8**)	1.35(**B**)							
1.6pF(**1R6**)	**B, C**	0.9(**8**)	1.35(**B**)							
1.8pF(**1R8**)	**B, C**	0.9(**8**)	1.35(**B**)							
2.0pF(**2R0**)	**B, C**	0.9(**8**)	1.35(**B**)							
2.2pF(**2R2**)	**B, C**	0.9(**8**)	1.35(**B**)							
2.4pF(**2R4**)	**B, C**	0.9(**8**)	1.35(**B**)							
2.7pF(**2R7**)	**B, C**	0.9(**8**)	1.35(**B**)							
3.0pF(**3R0**)	**B, C**	0.9(**8**)	1.35(**B**)							
3.3pF(**3R3**)	**B, C**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
3.6pF(**3R6**)	**B, C**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
3.9pF(**3R9**)	**B, C**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
4.0pF(**4R0**)	**B, C**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
4.3pF(**4R3**)	**B, C**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
4.7pF(**4R7**)	**B, C**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
5.0pF(**5R0**)	**B, C**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
5.1pF(**5R1**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
5.6pF(**5R6**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
6.0pF(**6R0**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
6.2pF(**6R2**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
6.8pF(**6R8**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
7.0pF(**7R0**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
7.5pF(**7R5**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
8.0pF(**8R0**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
8.2pF(**8R2**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				

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

Continued on the following page. ↗

Continued from the preceding page.

Part Number		**ERB18**	**ERB21**			**ERB32**				
L x W [EIA]		1.6x0.8 [0603]	2.0x1.25 [0805]			3.2x2.5 [1210]				
Rated Volt.		250 (**2E**)	250 (**2E**)	100 (**2A**)	50 (**1H**)	500 (**2H**)	300 (**YD**)	250 (**2E**)	100 (**2A**)	50 (**1H**)
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	C0G (**5C**)
Capacitance, Capacitance Tolerance and T Dimension										
9.0pF(**9R0**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
9.1pF(**9R1**)	**B, C, D**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
10pF(**100**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
11pF(**110**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
12pF(**120**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
13pF(**130**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
15pF(**150**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
16pF(**160**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
18pF(**180**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
20pF(**200**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
22pF(**220**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
24pF(**240**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
27pF(**270**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
30pF(**300**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
33pF(**330**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
36pF(**360**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
39pF(**390**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
43pF(**430**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
47pF(**470**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
51pF(**510**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
56pF(**560**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
62pF(**620**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
68pF(**680**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
75pF(**750**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
82pF(**820**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
91pF(**910**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
100pF(**101**)	**G, J**	0.9(**8**)	1.35(**B**)			1.7(**Q**)				
110pF(**111**)	**G, J**			1.35(**B**)		1.7(**Q**)				
120pF(**121**)	**G, J**			1.35(**B**)		1.7(**Q**)				
130pF(**131**)	**G, J**			1.35(**B**)			1.7(**Q**)			
150pF(**151**)	**G, J**				1.35(**B**)		1.7(**Q**)			
160pF(**161**)	**G, J**				1.35(**B**)			1.7(**Q**)		
180pF(**181**)	**G, J**							1.7(**Q**)		
200pF(**201**)	**G, J**							1.7(**Q**)		
220pF(**221**)	**G, J**							1.7(**Q**)		
240pF(**241**)	**G, J**								1.7(**Q**)	
270pF(**271**)	**G, J**								1.7(**Q**)	
300pF(**301**)	**G, J**								1.7(**Q**)	
330pF(**331**)	**G, J**								1.7(**Q**)	
360pF(**361**)	**G, J**								1.7(**Q**)	
390pF(**391**)	**G, J**								1.7(**Q**)	
430pF(**431**)	**G, J**								1.7(**Q**)	
470pF(**471**)	**G, J**								1.7(**Q**)	
510pF(**511**)	**G, J**									1.7(**Q**)
560pF(**561**)	**G, J**									1.7(**Q**)
620pF(**621**)	**G, J**									1.7(**Q**)
680pF(**681**)	**G, J**									1.7(**Q**)
750pF(**751**)	**G, J**									1.7(**Q**)
820pF(**821**)	**G, J**									1.7(**Q**)
910pF(**911**)	**G, J**									1.7(**Q**)
1000pF(**102**)	**G, J**									1.7(**Q**)

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

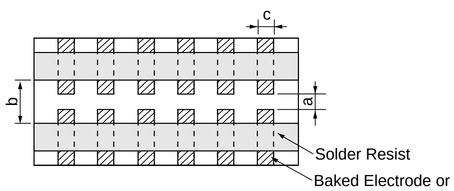
muRata

ERB Series 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>−55 to +125℃</td><td>Reference Temperature: 25°C</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td>Within the specified 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 300%(*) of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
(*) 300V: 250%, 500V: 200%</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>1,000,000MΩ min. (C≦470pF)
100,000MΩ min. (C>470pF)</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25℃ and standard humidity 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/Q should be measured at 25℃ at the frequency and voltage shown in the table.

Frequency: 1±0.1MHz
Voltage: 1±0.2Vrms</td></tr>
<tr><td>8</td><td colspan="2">Q</td><td>C≦ 220pF : Q≧10,000
220pF<C≦ 470pF : Q≧ 5,000
470pF<C≦1,000pF : Q≧ 3,000
C: Nominal Capacitance (pF)</td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Capacitance Temperature Characteristics</td><td>Capacitance Change</td><td>Within the specified tolerance (Table A-6)</td><td rowspan="3">The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step 1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A.
The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3.

Step / Temperature (℃)
1: 25±2
2: −55±3
3: 25±2
4: 125±3
5: 25±2</td></tr>
<tr><td>Temperature Coefficent</td><td>Within the specified tolerance (Table A-6)</td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF
(Whichever is larger)</td></tr>
<tr><td rowspan="2">10</td><td colspan="2" rowspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defects should occur.</td><td rowspan="2">Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 1 using an eutectic solder.
Then apply 10N* force in parallel with the test jig for 10±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.

Type / a / b / c
ERB18: 1.0 / 3.0 / 1.2
ERB21: 1.2 / 4.0 / 1.65
ERB32: 2.2 / 5.0 / 2.9
(in mm)
*5N (ERB188)</td></tr>
<tr><td>
Fig.1</td></tr>
</table>

Continued on the following page.

ERB Series Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specifications	Test Method
11	Vibration Resistance	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 (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).
		Capacitance	Within the specified tolerance	
		Q	Satisfies the initial value. C≦ 220pF : Q≧10,000 220pF<C≦ 470pF : Q≧ 5,000 470pF<C≦1,000pF : Q≧ 3,000 C: Nominal Capacitance (pF)	
12	Deflection		No crack or marked defect should occur.	Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2a using an eutectic solder. Then apply a force in the direction shown in Fig. 3a. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
13	Solderability of Termination		95% of the terminations are to be soldered evenly and continuously.	Immerse the capacitor in a solution of isopropyl alcohol and rosin (25% rosin in weight proportion). Preheat at 80 to 120℃ for 10 to 30 seconds. After preheating, immerse in an eutectic solder or Sn-3.0Ag-0.5Cu solder solution for 5±0.5 seconds at 245±5℃.

12 Deflection

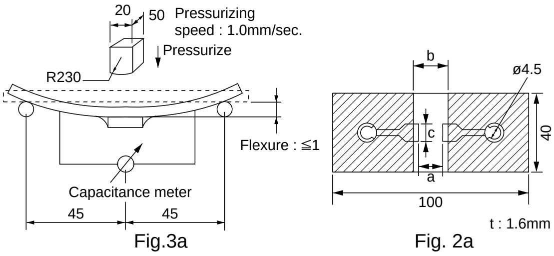


Fig.3a　Fig. 2a

Type	a	b	c
ERB18	1.0	3.0	1.2
ERB21	1.2	4.0	1.65
ERB32	2.2	5.0	2.9

(in mm)

14 Resistance to Soldering Heat

Specifications: The measured and observed characteristics should satisfy the specifications in the following table.

Item	Specifications
Appearance	No marked defect
Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)
Q	C≦ 220pF : Q≧10,000 220pF<C≦ 470pF : Q≧ 5,000 470pF<C≦1,000pF : Q≧ 3,000
Dielectric Strength	No failure

C: Nominal Capacitance (pF)

Test Method: Preheat according to the conditions listed in the table below. Immerse the capacitor in an eutectic solder or Sn-3.0Ag-0.5Cu solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 24±2 hours.

Chip Size	Preheat Condition
2.0×1.25mm max.	1minute at 120 to 150℃
3.2×2.5mm	Each 1 minute at 100 to 120℃ and then 170 to 200℃

15 Temperature Cycle

Specifications: The measured and observed characteristics should satisfy the specifications in the following table.

Item	Specifications
Appearance	No marked defect
Capacitance Change	Within ±5% or ±0.5pF (Whichever is larger)
Q	C≧30pF : Q≧350 10pF≦C<30pF : Q≧275+ $\frac{5}{2}$ C C<10pF : Q≧200+10C
I.R.	1,000MΩ min.
Dielectric Strength	No failure

C: Nominal Capacitance (pF)

Test Method: 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 24±2 hours at room temperature, then measure.

Step	1	2	3	4
Temp. (℃)	Min. Operating Temp. +0/−3	Room Temp.	Max. Operating Temp. +3/−0	Room Temp.
Time (min.)	30±3	5 max.	30±3	5 max.

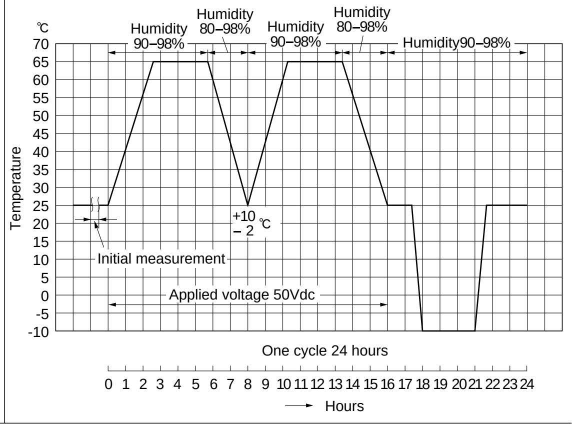
16 Humidity

Specifications: The measured and observed characteristics should satisfy the specifications in the following table.

Item	Specifications
Appearance	No marked defect
Capacitance Change	Within ±5% or ±0.5pF (Whichever is larger)
Q	C≧30pF : Q≧350 10pF≦C<30pF : Q≧275+ $\frac{5}{2}$ C C<10pF : Q≧200+10C
I.R.	1,000MΩ min.

C: Nominal Capacitance (pF)

Test Method: Apply the 24-hour heat (−10 to +65℃) and humidity (80 to 100%) treatment shown below, 10 consecutive times. Remove, let sit for 24±2 hours at room temperature, and measure.



Continued on the following page.

ERB Series Specifications and Test Methods

Continued from the preceding page.

No.	Item	Specifications	Test Method
17	High Temperature Load	The measured and observed characteristics should satisfy the specifications in the following table. Item / Specifications: Appearance: No marked defect Capacitance Change: Within ±3% or ±0.3pF (Whichever is larger) Q: C≧30pF : Q≧350; 10pF≦C<30pF : Q≧275+ 5/2 C; C<10pF : Q≧200+10C I.R.: 1,000MΩ min. C: Nominal Capacitance (pF)	Apply 200% (500V only 150%) of the rated voltage for 1,000±12 hours at 125±3℃. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.

Table A-6

Char.	Nominal Values (ppm/℃) Note 1	Capacitance Change from 25℃ (%)					
		−55		−30		−10	
		Max.	Min.	Max.	Min.	Max.	Min.
5C	0±30	0.58	−0.24	0.40	−0.17	0.25	−0.11

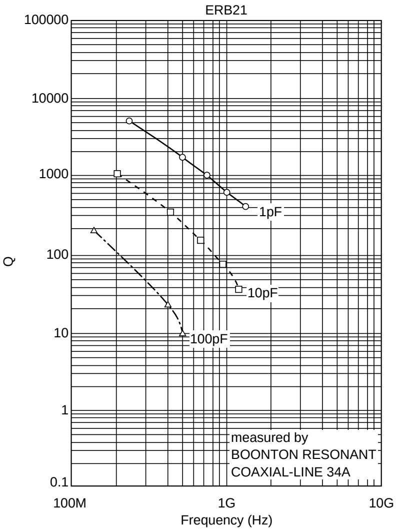
Note 1: Nominal values denote the temperature coefficient within a range of 25 to 125℃ (for 5C)

7

ERB Series Data

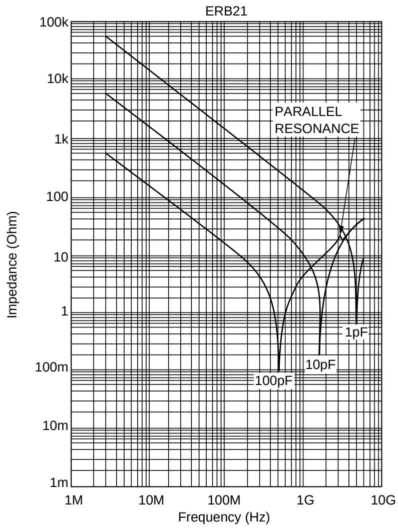
■ Q - Frequency Characteristics

ERB Series



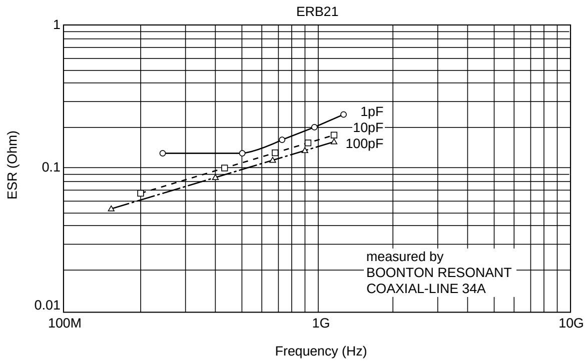
■ Impedance - Frequency Characteristics

ERB Series



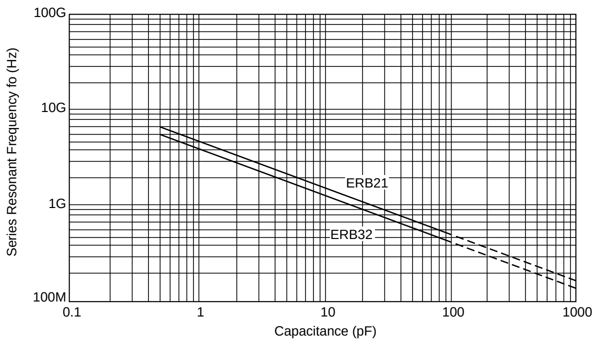
■ ESR - Frequency Characteristics

ERB Series

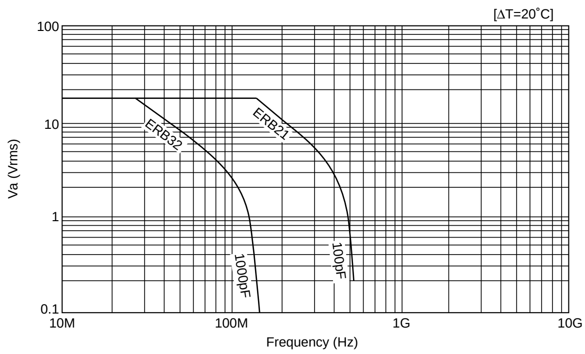


■ Resonant Frequency - Capacitance

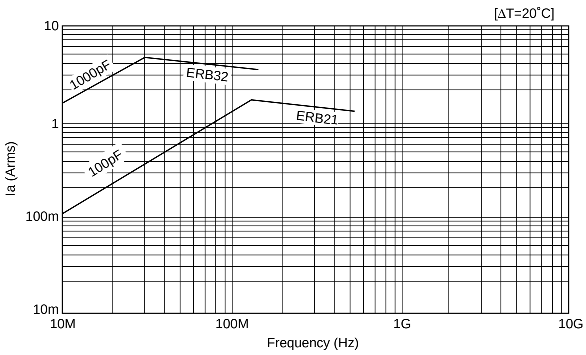
ERB Series



■ Allowable Voltage - Frequency



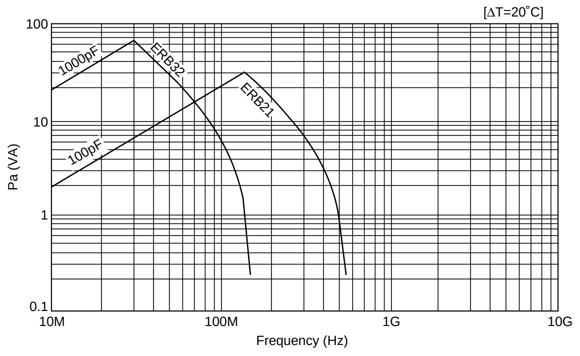
■ Allowable Current - Frequency



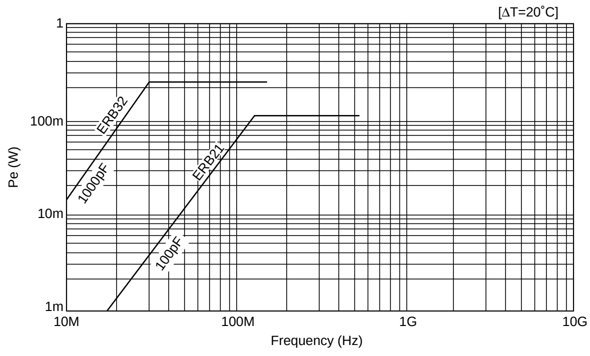
Continued on the following page. ↗

Continued from the preceding page.

■ Allowable Apparent Power - Frequency



■ Allowable Effective Power - Frequency



Chip Monolithic Ceramic Capacitors

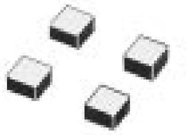
Monolithic Microchip GMA Series

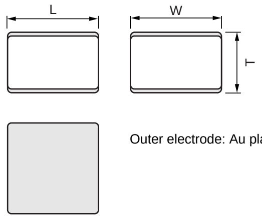
■ Features

1. Better micro wave characteristics
2. Suitable for by-passing
3. High density mounting

■ Applications

1. Optical device for telecommunication
2. IC, IC packaging built-in
3. Measuring equipment





Part Number	Dimensions (mm)		
	L	W	T
GMA0D3	0.38 ±0.05	0.38 ±0.05	0.3 ±0.05
GMA05X	0.5 ±0.05	0.5 ±0.05	0.35 ±0.05
GMA085	0.8 ±0.05	0.8 ±0.05	0.5 ±0.1

Part Number		**GMA0D**	**GMA05**				**GMA08**			
L x W [EIA]		0.38x0.38 [015015]	0.5x0.5 [0202]				0.8x0.8 [0303]			
Rated Volt.		10 (**1A**)	100 (**2A**)	25 (**1E**)	10 (**1A**)	6.3 (**0J**)	100 (**2A**)	25 (**1E**)	10 (**1A**)	6.3 (**0J**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X5R (**R6**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X5R (**R6**)
Capacitance, Capacitance Tolerance and T Dimension										
100pF(**101**)	**M**		0.35(**X**)							
150pF(**151**)	**M**		0.35(**X**)							
220pF(**221**)	**M**		0.35(**X**)							
330pF(**331**)	**M**		0.35(**X**)							
470pF(**471**)	**M**		0.35(**X**)							
680pF(**681**)	**M**		0.35(**X**)							
1000pF(**102**)	**M**		0.35(**X**)							
1500pF(**152**)	**M**			0.35(**X**)			0.5(**5**)			
2200pF(**222**)	**M**			0.35(**X**)			0.5(**5**)			
3300pF(**332**)	**M**			0.35(**X**)			0.5(**5**)			
4700pF(**472**)	**M**			0.35(**X**)			0.5(**5**)			
6800pF(**682**)	**M**				0.35(**X**)		0.5(**5**)			
10000pF(**103**)	**M**	0.3(**3**)			0.35(**X**)			0.5(**5**)		
15000pF(**153**)	**M**				0.35(**X**)			0.5(**5**)		
22000pF(**223**)	**M**				0.35(**X**)			0.5(**5**)		
33000pF(**333**)	**M**								0.5(**5**)	
47000pF(**473**)	**M**								0.5(**5**)	
68000pF(**683**)	**M**								0.5(**5**)	
0.10µF(**104**)	**M**					0.35*(**X**)			0.5(**5**)	
0.47µF(**474**)	**M**									0.5*(**5**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GMA Series Specification and Test Methods(2)(P.71)

GMA Series Specifications and Test Methods(1)

Below GMA Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GMA Series Specifications and Test Methods (2) (P.71).

No.	Item		Specifications	Test Method
1	Operating Temperature Range		R7: −55 to +125℃	Reference Temperature: 25℃
2	Rated Voltage		See the previous pages.	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.
3	Appearance		No defects or abnormalities	Visual inspection
4	Dimensions		Within the specified dimersions	Using calipers
5	Dielectric Strength		No defects or abnormalities	No failure should be observed when a voltage of 250% of the rated voltage is applied between the both terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance		More than 10,000MΩ or 500ΩF (Whichever is smaller)	The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at normal temperature and humidity and within 2 minutes of charging.
7	Capacitance		Within the specified tolerance	The capacitance/D.F. should be measured at reference temperature at the frequency and voltage shown in the table. Frequency: 1±0.1kHz Voltage: 1±0.2Vrms
8	Dissipation Factor (D.F.)		R7: W.V.: 25V min.; 0.025 max. W.V.: 16V/10V; 0.035 max.	
9	Capacitance Temperature Characteristics	No bias	R7: Within +/–15% (–55 to +125°C)	The capacitance change should be measured after 5min. at each specified temp. stage. •The ranges of capacitance change compared with the Reference Temperature value over the temperature ranges shown in the table should be within the specified ranges.* Step / Temperature (°C): 1: 25±2 2: –55±3 3: 25±2 4: 125±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.
10	Mechanical Strength	Bond Strength	Pull force: 0.03N min.	MIL-STD-883 Method 2011 Condition D Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20) and bond a 25μm (0.001 inch) gold wire to the capacitor terminal using an ultrasonic ball bond. Then, pull wire.
10	Mechanical Strength	Die Shear Strength	Die Shear force: 2N min.	MIL-STD-883 Method 2019 Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20). Apply the force parallel to the substrate.
11	Vibration Resistance	Appearance	No defects or abnormalities	Ramp frequency from 10 to 55Hz then return to 10Hz all within 1 minute. Amplitude: 1.5 mm (0.06 inch) max. total excursion. Apply this motion for a period of 2 hours in each of 3 mutually perpendicular directions (total 6 hours).
		Capacitance	Within the specified tolerance	
		D.F.	R7: W.V.: 25V min.; 0.025 max. W.V.: 16V/10V; 0.035 max.	
12	Temperature Cycle	Appearance	No defects or abnormalities	The capacitor should be set for 24±2 hours at room temperature after one hour heat of treatment at 150+0/−10℃, then measure for the initial measurement. Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11) and conduct the five cycles according to the temperatures and time shown in the following table. Set it for 24±2 hours at room temperature, then measure. Step 1: Temp. (℃) Min. Operating Temp. +0/−3; Time (min.) 30±3 Step 2: Temp. (℃) Room Temp.; Time (min.) 2 to 3 Step 3: Temp. (℃) Max. Operating Temp. +3/−0; Time (min.) 30±3 Step 4: Temp. (℃) Room Temp.; Time (min.) 2 to 3
		Capacitance Change	R7: Within ±7.5%	
		D.F.	R7: W.V.: 25V min.; 0.025 max. W.V.: 16V/10V; 0.035 max.	
		I.R.	More than 10,000MΩ or 500ΩF (Whichever is smaller)	
		Dielectric Strength	No defects	

Mounting for testing: The capacitors should be mounted on the substrate as shown below using die bonding and wire bonding when tests No.11 to 15 are performed.

Continued on the following page.

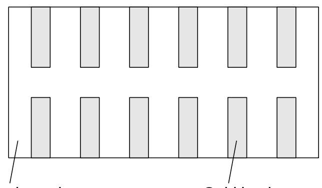
GMA Series Specifications and Test Methods(1)

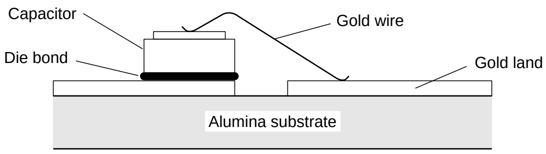
Continued from the preceding page.

Below GMA Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GMA Series Specifications and Test Methods (2) (P.71).

No.	Item		Specifications	Test Method
13	Humidity (Steady State)	Appearance	No defects or abnormalities	Set the capacitor for 500±12 hours at 40±20℃, in 90 to 95% humidity. Take it out and set it for 24±2 hours at room temperature, then measure.
		Capacitance Change	R7: Within ±12.5%	
		D.F.	R7: W.V.: 10V min.; 0.05 max.	
		I.R.	More than 1,000MΩ or 50ΩF (Whichever is smaller)	
14	Humidity Load	Appearance	No defects or abnormalities	Apply the rated voltage for 500±12 hours at 40±2℃, in 90 to 95% humidity and set it for 24±2 hours at room temperature,then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	R7: Within ±12.5%	
		D.F.	R7: W.V.: 10V min.; 0.05 max.	
		I.R.	More than 500MΩ or 25ΩF (Whichever is smaller)	
15	High Temperature Load	Appearance	No defects or abnormalities	A voltage treatment should be given to the capacitor, in which a DC voltage of 200% the rated voltage is applied for one hour at the maximum operating temperature ±3℃ then it should be set for 24±2 hours at room temperature and the initial measurement should be conducted. Then apply the above mentioned voltage continuously for 1000±12 hours at the same temperature, remove it from the bath, and set it for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	R7: Within ±12.5%	
		D.F.	R7: W.V.: 10V min.; 0.05 max.	
		I.R.	More than 1,000MΩ or 50ΩF (Whichever is smaller)	

Mounting for testing: The capacitors should be mounted on the substrate as shown below using die bonding and wire bonding when tests No.11 to 15 are performed.





8

GMA Series Specifications and Test Methods(2)

Below GMA Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GMA Series Specifications and Test Methods (1) (P.69).

<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>R6 : –55°C to 85°C</td><td>Reference Temperature : 25°C</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td>No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td>Within the specified dimensions.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities.</td><td>No failure should be observed when 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</td><td>More than 50Ω · F</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at normal temperature and humidity and within 1 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 reference temperature at the frequency and voltage shown in the table.<table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>C≦10μF (6.3Vmax.)</td><td>1±0.1kHz</td><td>0.5±0.1Vrms</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>R6 : 0.1 max.</td></tr>
<tr><td>9</td><td>Capacitance Temperature Characteristics</td><td>No bias</td><td>R6 : Within ±15% (–55°C to +85°C)</td><td>The capacitance change should be measured after 5min. at each specified temp. stage.

The ranges of capacitance change compared with the 25°C value over the temperature ranges shown in the table should be within the specified ranges.*<table><tr><th>Step</th><th>Temperature (°C)</th></tr><tr><td>1</td><td>Reference temperature ±2</td></tr><tr><td>2</td><td>–55±3</td></tr><tr><td>3</td><td>Reference temperature ±2</td></tr><tr><td>4</td><td>85±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 24±2 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Mechanical Strength</td><td>Bond Strength</td><td>Pull force : 0.03N min.</td><td>MIL-STD-883 Method 2011 Condition D
Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20) and bond a 25μm (0.001 inch) gold wire to the capacitor terminal using an ultrasonic ball bond. Then, pull wire.</td></tr>
<tr><td>Die Shear Strength</td><td>Die Shear force : 2N min.</td><td>MIL-STD-883 Method 2019
Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20). Apply the force parallel to the substrate.</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">Ramp frequency from 10 to 55Hz then return to 10Hz all within 1 minute. Amplitude : 1.5 mm (0.06 inch) max. total excursion. Apply this motion for a period of 2 hours in each of 3 mutually perpendicular directions (total 6 hours).</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance.</td></tr>
<tr><td>D.F.</td><td>R6 : 0.1 max.</td></tr>
<tr><td rowspan="5">12</td><td rowspan="5">Temperature Sudden Change</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="5">The capacitor should be set for 24±2 hours at room temperature after one hour heat of treatment at 150+0/−10℃, then measure for the initial measurement. Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11) and conduct the five cycles according to the temperatures and time shown in the following table. Set it 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. (°C)</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></td></tr>
<tr><td>Capacitance Change</td><td>R6 : Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>R6 : 0.1 max.</td></tr>
<tr><td>I.R.</td><td>More than 50Ω · F</td></tr>
<tr><td>Dielectric Strength</td><td>No defects</td></tr>
</table>

Mounting for testing : The capacitors should be mounted on the substrate as shown below using die bonding and wire bonding when tests No.11 to 14 are performed.

Continued on the following page. ↗

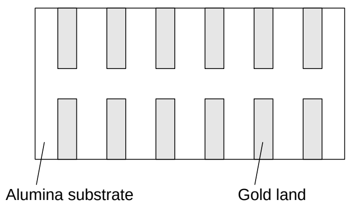
GMA Series Specifications and Test Methods(2)

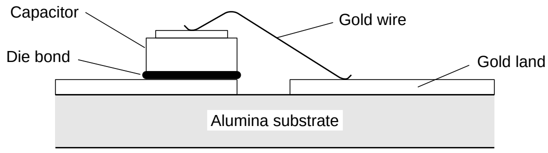
Continued from the preceding page.

Below GMA Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GMA Series Specifications and Test Methods (1) (P.69).

No.	Item		Specifications	Test Method
13	High Temperature High Humidity (Steady)	Appearance	No defects or abnormalities.	Apply the rated voltage for 500±12 hours at 40±2°C, in 90 to 95% humidity and set it for 24±2 hours at room temprature, then muasure. The charge/discharge current is less than 50mA. • Initial measurement 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. • Measurement after test Perform a heat treatment at 150+0/–10°C for one hour and then let sit for 24±2 hours at room temperature, then measure.
		Capacitance Change	R6 : Within ±12.5%	
		D.F.	R6 : 0.2 max.	
		I.R.	More than 12.5Ω · F	
14	Durability	Appearance	No defects or abnormalities.	Apply 150% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 hours at room temperature, then measure. The charge/ discharge current is less than 50mA. • Initial measurement 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. • Measurement after test Perform a heat treatment at 150+0/–10°C for one hour and then let sit for 24±2 hours at room temperature, then measure.
		Capacitance Change	R6 : Within ±12.5%	
		D.F.	R6 : 0.2 max.	
		I.R.	More than 25Ω · F	

Mounting for testing : The capacitors should be mounted on the substrate as shown below using die bonding and wire bonding when tests No.11 to 14 are performed.





8

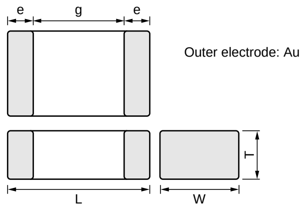
murata

Chip Monolithic Ceramic Capacitors

for Bonding GMD Series

■ Features

1. Small chip size (LxWxT: 0.6x0.3x0.3, 1.0x0.5x0.5mm)
2. Available for Wire/Die bonding due to Gold termination.
3. Suitable for Optical device for telecommunication, IC packaging built-in.



■ Applcation

1. Optical device for telecommunication
2. IC, IC packaging built-in

Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GMD033	0.6±0.03	0.3±0.03	0.3±0.03	0.12 to 0.22	0.16
GMD155	1.0±0.05	0.5±0.05	0.5±0.05	0.15 to 0.35	0.3

High Dielectric Constant Type X5R(R6) Characteristics

Part Number		**GMD03**	**GMD15**	
L x W [EIA]		0.6x0.3 [0201]	1.0x0.5 [0402]	
Rated Volt.		6.3 (**0J**)	10 (**1A**)	6.3 (**0J**)
TC		X5R (**R6**)	X5R (**R6**)	X5R (**R6**)
Capacitance, Capacitance Tolerance and T Dimension				
56000pF(**563**)	**K**	0.3*(**3**)		
68000pF(**683**)	**K**	0.3*(**3**)		
82000pF(**823**)	**K**	0.3*(**3**)		
0.10µF(**104**)	**K**	0.3*(**3**)		
0.12µF(**124**)	**K**		0.5*(**5**)	
0.15µF(**154**)	**K**		0.5*(**5**)	
0.18µF(**184**)	**K**		0.5*(**5**)	
0.22µF(**224**)	**K**		0.5*(**5**)	
0.27µF(**274**)	**K**		0.5*(**5**)	
0.33µF(**334**)	**K**		0.5*(**5**)	
0.39µF(**394**)	**K**		0.5*(**5**)	
0.47µF(**474**)	**K**		0.5*(**5**)	
1.0µF(**105**)	**K**			0.5*(**5**)

The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.
*: Please refer to GMD Series Specifications and Test Method (2)(P.77).

High Dielectric Constant Type X7R(R7) Characteristics

Part Number		**GMD03**			**GMD15**		
L x W [EIA]		0.6x0.3 [0201]			1.0x0.5 [0402]		
Rated Volt.		25 (**1E**)	16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)
Capacitance, Capacitance Tolerance and T Dimension							
100pF(**101**)	**K**	0.3(**3**)					
120pF(**121**)	**K**	0.3(**3**)					

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

Continued on the following page. ↗

Continued from the preceding page.

Part Number		GMD03			GMD15		
L x W [EIA]		0.6x0.3 [0201]			1.0x0.5 [0402]		
Rated Volt.		25 (**1E**)	16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)
TC		X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)	X7R (**R7**)
Capacitance, Capacitance Tolerance and T Dimension							
150pF(**151**)	**K**	0.3(**3**)					
180pF(**181**)	**K**	0.3(**3**)					
220pF(**221**)	**K**	0.3(**3**)			0.5(**5**)		
270pF(**271**)	**K**	0.3(**3**)			0.5(**5**)		
330pF(**331**)	**K**	0.3(**3**)			0.5(**5**)		
390pF(**391**)	**K**	0.3(**3**)			0.5(**5**)		
470pF(**471**)	**K**	0.3(**3**)			0.5(**5**)		
560pF(**561**)	**K**	0.3(**3**)			0.5(**5**)		
680pF(**681**)	**K**	0.3(**3**)			0.5(**5**)		
820pF(**821**)	**K**	0.3(**3**)			0.5(**5**)		
1000pF(**102**)	**K**	0.3(**3**)			0.5(**5**)		
1200pF(**122**)	**K**	0.3(**3**)			0.5(**5**)		
1500pF(**152**)	**K**	0.3(**3**)			0.5(**5**)		
1800pF(**182**)	**K**		0.3(**3**)		0.5(**5**)		
2200pF(**222**)	**K**		0.3(**3**)		0.5(**5**)		
2700pF(**272**)	**K**		0.3(**3**)		0.5(**5**)		
3300pF(**332**)	**K**		0.3(**3**)		0.5(**5**)		
3900pF(**392**)	**K**			0.3(**3**)	0.5(**5**)		
4700pF(**472**)	**K**			0.3(**3**)	0.5(**5**)		
5600pF(**562**)	**K**			0.3(**3**)		0.5(**5**)	
6800pF(**682**)	**K**			0.3(**3**)		0.5(**5**)	
8200pF(**822**)	**K**			0.3(**3**)		0.5(**5**)	
10000pF(**103**)	**K**			0.3(**3**)		0.5(**5**)	
12000pF(**123**)	**K**					0.5(**5**)	
15000pF(**153**)	**K**					0.5(**5**)	
18000pF(**183**)	**K**					0.5(**5**)	
22000pF(**223**)	**K**					0.5(**5**)	
27000pF(**273**)	**K**					0.5(**5**)	
33000pF(**333**)	**K**					0.5(**5**)	
39000pF(**393**)	**K**					0.5(**5**)	
47000pF(**473**)	**K**					0.5(**5**)	
56000pF(**563**)	**K**						0.5(**5**)
68000pF(**683**)	**K**						0.5(**5**)
82000pF(**823**)	**K**						0.5(**5**)
0.10μF(**104**)	**K**						0.5(**5**)

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

GMD Series Specifications and Test Methods (1)

Below GMD Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GMD Series Specifications and Test Methods (2) (P.77).

No.	Item		Specifications	Test Method
1	Operating Temperature Range		R7 : –55°C to 125°C	Reference Temperature : 25°C
2	Rated Voltage		See the previous pages.	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.
3	Appearance		No defects or abnormalities.	Visual inspection.
4	Dimensions		Within the specified dimensions.	Using calipers.
5	Dielectric Strength		No defects or abnormality.	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.
6	Insulation Resistance		More than 10,000MΩ or 500Ω · F (Whichever is smaller)	The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at normal temperature and humidity and within 2 minutes of charging.
7	Capacitance		Within the specified tolerance.	The capacitance/D.F. should be measured at reference temperature at the frequency and voltage shown in the table. Frequency: 1±0.1kHz Voltage: 1±0.2Vrms
8	Dissipation Factor (D.F.)		R7 : W.V. 25Vmin. : 0.025 max. W.V. 16/10V : 0.035 max.	
9	Capacitance Temperature Characteristics	No bias	R7 : Within ±15% (–55°C to +125°C)	The capacitance change should be measured after 5min. at each specified temp. stage. The ranges of capacitance change compared with the 25°C value over the temperature ranges shown in the table should be within the specified ranges.* Step 1: Reference temperature ±2 Step 2: –55±3 Step 3: Reference temperature ±2 Step 4: 125±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.
10	Mechanical Strength	Bond Strength	Pull force : 0.03N min.	MIL-STD-883 Method 2011 Condition D Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20) and bond a 25μm (0.001 inch) gold wire to the capacitor terminal using an ultrasonic ball bond. Then, pull wire.
		Die Shear Strength	Die Shear force : 2N min.	MIL-STD-883 Method 2019 Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20). Apply the force parallel to the substrate.
11	Vibration Resistance	Appearance	No defects or abnormalities.	Ramp frequency from 10 to 55Hz then return to 10Hz all within 1 minute. Amplitude : 1.5 mm (0.06 inch) max. total excursion. Apply this motion for a period of 2 hours in each of 3 mutually perpendicular directions (total 6 hours).
		Capacitance	Within the specified tolerance.	
		D.F.	R7 : W.V. 25Vmin. : 0.025 max. W.V. 16/10V : 0.035 max.	
12	Temperature Cycle	Appearance	No defects or abnormalities.	The capacitor should be set for 24±2 hours at room temperature after one hour heat of treatment at 150+0/−10℃, then measure for the initial measurement. Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11) and conduct the five cycles according to the temperatures and time shown in the following table. Set it for 24±2 hours at room temperature, then measure.
		Capacitance Change	R7 : Within ±7.5%	
		D.F.	R7 : W.V. 25Vmin. : 0.025 max. W.V. 16/10V : 0.035 max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)	
		Dielectric Strength	No defects	

Step	1	2	3	4
Temp. (°C)	Min. Operating Temp.+0/–3	Room Temp.	Max. Operating Temp.+3/–0	Room Temp.
Time (min.)	30+/–3	2 to 3	30+/–3	2 to 3

Mounting for testing : The capacitors should be mounted on the substrate as shown below using die bonding. when tests No.11 to 15 are performed.

Continued on the following page.

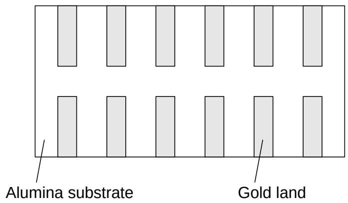
GMD Series Specifications and Test Methods (1)

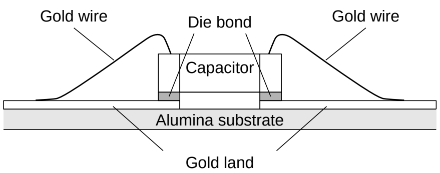
Continued from the preceding page.

Below GMD Series Specifications and Test Methods (1) are applied to Non "*" PNs in capacitance table.
In case "*" is added in capacitance table, please refer to GMD Series Specifications and Test Methods (2) (P.77).

No.	Item		Specifications	Test Method
13	Humidity (Steady State)	Appearance	No defects or abnormalities.	Set the capacitor for 500±12 hours at 40±2℃, in 90 to 95% humidity. Take it out and set it for 24±2 hours at room temperature, then measure.
		Capacitance Change	R7 : Within ±12.5%	
		D.F.	R7 : W.V. 25Vmin. : 0.05 max. W.V. 16/10V : 0.05 max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)	
14	Humidity Load	Appearance	No defects or abnormalities.	Apply the rated voltage for 500±12 hours at 40±2℃, in 90 to 95% humidity and set it for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	R7 : Within ±12.5%	
		D.F.	R7 : W.V. 25Vmin. : 0.05 max. W.V. 16/10V : 0.05 max.	
		I.R.	More than 500MΩ or 25Ω · F (Whichever is smaller)	
15	High Temperature Load	Appearance	No defects or abnormalities.	A voltage treatment should be given to the capacitor, in which a DC voltage of 200% the rated voltage is applied for one hour at the maximum operating temperature ±3℃ then it should be set for 24±2 hours at room temperature and the initial measurement should be conducted. Then apply the above mentioned voltage continuously for 1000±12 hours at the same temperature, remove it from the bath, and set it for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	R7 : Within ±12.5%	
		D.F.	R7 : W.V. 25Vmin. : 0.05 max. W.V. 16/10V : 0.05 max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)	

Mounting for testing : The capacitors should be mounted on the substrate as shown below using die bonding. when tests No.11 to 15 are performed.





9

GMD Series Specifications and Test Methods (2)

Below GMD Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GMD Series Specifications and Test Methods (1) (P.75).

<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>R6 : –55°C to 85°C</td><td>Reference Temperature : 25°C</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td>No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td>Within the specified dimensions.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities.</td><td>No failure should be observed when 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</td><td>More than 50Ω · F</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at normal temperature and humidity and within 1 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 reference temperature at the frequency and voltage shown in the table.
<table>
<tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr>
<tr><td>C≦10μF (10Vmin.)*1</td><td>1±0.1kHz</td><td>1.0±0.2Vrms</td></tr>
<tr><td>C≦10μF (6.3Vmax.)</td><td>1±0.1kHz</td><td>0.5±0.1Vrms</td></tr>
</table>
*1 GMD155 R6 1A 124 to 224 are applied to 0.5±0.1 Vrms.</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>R6 : 0.1 max.</td></tr>
<tr><td>9</td><td>Capacitance Temperature Characteristics</td><td>No bias</td><td>R6 : Within ±15% (–55°C to +85°C)</td><td>The capacitance change should be measured after 5min. at each specified temp. stage.

The ranges of capacitance change compared with the 25°C value over the temperature ranges shown in the table should be within the specified ranges.*
<table>
<tr><th>Step</th><th>Temperature (°C)</th></tr>
<tr><td>1</td><td>Reference temperature ±2</td></tr>
<tr><td>2</td><td>–55±3</td></tr>
<tr><td>3</td><td>Reference temperature ±2</td></tr>
<tr><td>4</td><td>85±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 24±2 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Mechanical Strength</td><td>Bond Strength</td><td>Pull force : 0.03N min.</td><td>MIL-STD-883 Method 2011 Condition D
Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20) and bond a 25μm (0.001 inch) gold wire to the capacitor terminal using an ultrasonic ball bond. Then, pull wire.</td></tr>
<tr><td>Die Shear Strength</td><td>Die Shear force : 2N min.</td><td>MIL-STD-883 Method 2019
Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20). Apply the force parallel to the substrate.</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">Ramp frequency from 10 to 55Hz then return to 10Hz all within 1 minute. Amplitude : 1.5 mm (0.06 inch) max. total excursion. Apply this motion for a period of 2 hours in each of 3 mutually perpendicular directions (total 6 hours).</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance.</td></tr>
<tr><td>D.F.</td><td>R6 : 0.1 max.</td></tr>
<tr><td rowspan="5">12</td><td rowspan="5">Temperature Sudden Change</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="5">The capacitor should be set for 24±2 hours at room temperature after one hour heat of treatment at 150+0/−10℃, then measure for the initial measurement. Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11) and conduct the five cycles according to the temperatures and time shown in the following table. Set it 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>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></td></tr>
<tr><td>Capacitance Change</td><td>R6 : Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>R6 : 0.1 max.</td></tr>
<tr><td>I.R.</td><td>More than 50Ω · F</td></tr>
<tr><td>Dielectric Strength</td><td>No defects</td></tr>
</table>

Mounting for testing : The capacitors should be mounted on the substrate as shown below using die bonding. when tests No.11 to 14 are performed.

Continued on the following page.

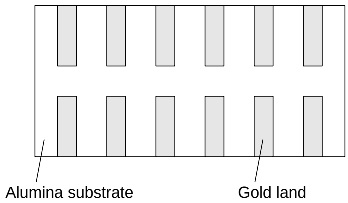
GMD Series Specifications and Test Methods (2)

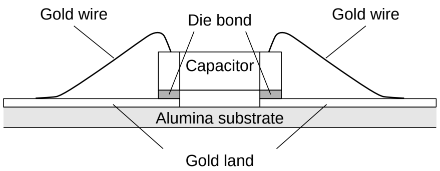
Continued from the preceding page.

Below GMD Series Specifications and Test Methods (2) are applied to "*" PNs in capacitance table.
In case "*" is not added in capacitance table, please refer to GMD Series Specifications and Test Methods (1) (P.75).

No.	Item		Specifications	Test Method
13	High Temperature High Humidity (Steady)	Appearance	No defects or abnormalities.	Apply the rated voltage for 500±12 hours at 40±2°C, in 90 to 95% humidity and set it for 24±2 hours at room temprature, then muasure. The charge/discharge current is less than 50mA. • Initial measurement 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. • Measurement after test Perform a heat treatment at 150+0/–10°C for one hour and then let sit for 24±2 hours at room temperature, then measure.
		Capacitance Change	R6 : Within ±12.5%	
		D.F.	R6 : 0.2 max.	
		I.R.	More than 12.5Ω · F	
14	Durability	Appearance	No defects or abnormalities.	Apply 150%*2 of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 24±2 hours at room temperature, then measure. The charge/ discharge current is less than 50mA. *2 GMD155 R6 1A 274 to 474 are applied to 120%. • Initial measurement 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. • Measurement after test Perform a heat treatment at 150+0/–10°C for one hour and then let sit for 24±2 hours at room temperature, then measure.
		Capacitance Change	R6 : Within ±12.5%	
		D.F.	R6 : 0.2 max.	
		I.R.	More than 25Ω · F	

Mounting for testing : The capacitors should be mounted on the substrate as shown below using die bonding. when tests No.11 to 14 are performed.





Chip Monolithic Ceramic Capacitors

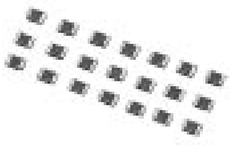
for Ultrasonic Sensors GRM Series

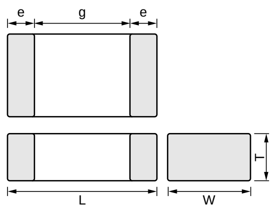
■ Features

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

■ Applications

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





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

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

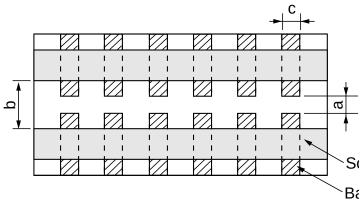
for Ultrasonic Sensors GRM Series Specifications and Test Methods

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

Item 9 step table:

Step	Temperature (℃)
1	20±2
2	−25±3
3	20±2
4	85±3
5	20±2

Item 10:



Type	a	b	c
GRM21	1.2	4.0	1.65

(in mm)

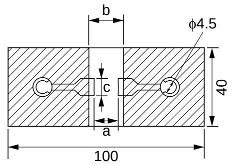
Fig. 1

Continued on the following page.

for Ultrasonic Sensors GRM Series Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specifications	Test Method
12	Deflection		No cracking or marking defects should occur.	Solder the capacitor to the test jig (glass epoxy boards) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.



t: 1.6mm

Type	a	b	c
GRM21	1.2	4.0	1.65

(in mm)

Fig. 2

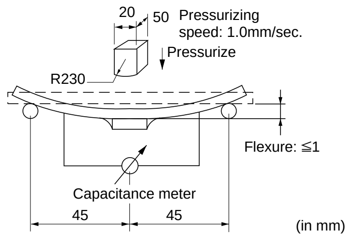


Fig.3

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

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

10

Package

■ Minimum Quantity Guide

Part Number		Dimensions (mm)			Quantity (pcs.)					
					ø180mm Reel		ø330mm Reel		Bulk Case	Bulk Bag
		L	W	T	Paper Tape	Embossed Tape	Paper Tape	Embossed Tape		
Packaging Code					D	L	J	K	C	Bulk : B Tray : T
For General Purpose	GRM02	0.4	0.2	0.2	20,000 [1]	40,000 [1]	-	-	-	1,000
	GRM03	0.6	0.3	0.3	15,000	-	50,000	-	-	1,000
	GRM15	1.0	0.5	0.25	10,000	-	50,000	-	-	1,000
				0.5	10,000	-	50,000	-	50,000	1,000
	GRM18	1.6	0.8	0.5	4,000	-	10,000	-	-	1,000
				0.8	4,000	-	10,000	-	15,000 [2]	1,000
	GRM21	2.0	1.25	0.6	4,000	-	10,000	-	10,000	1,000
				0.85	4,000	-	10,000	-	-	1,000
				1.0/1.25	-	3,000	-	10,000	5,000 [3]	1,000
	GRM31	3.2	1.6	0.6/0.85	4,000	-	10,000	-	-	1,000
				1.15	-	3,000	-	10,000	-	1,000
				1.6	-	2,000	-	6,000	-	1,000
	GRM32	3.2	2.5	0.85	4,000	-	10,000	-	-	1,000
				1.15	-	3,000	-	10,000	-	1,000
				1.35	-	2,000	-	8,000	-	1,000
				1.6	-	2,000	-	6,000	-	1,000
				1.8/2.0 2.5	-	1,000	-	4,000	-	1,000
	GRM43	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
				2.5	-	500	-	2,000	-	1,000
				2.8	-	500	-	1,500	-	500
	GRM55	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
High Power Type	GJM03	0.6	0.3	0.3	15,000	-	50,000	-	-	1,000
	GJM15	1.0	0.5	0.5	10,000	-	50,000	-	50,000	1,000
High Frequency	GQM18	1.6	0.8	0.7/0.8	4,000	-	10,000	-	-	1,000
	GQM21	2.0	1.25	0.85	4,000	-	10,000	-	-	1,000
	ERB18	1.6	0.8	0.9 max.	4,000	-	10,000	-	-	1,000
	ERB21	2.0	1.25	1.35 max.	-	3,000	-	10,000	-	1,000
	ERB32	3.2	2.5	1.7 max.	-	2,000	-	8,000	-	1,000
For Ultrasonic	GRM21	2.0	1.25	0.85	4,000	-	10,000	-	-	1,000
Microchip	GMA0D	0.38	0.38	0.3	-	-	-	-	-	400 [4]
	GMA05	0.5	0.5	0.35	-	-	-	-	-	400 [4]
	GMA08	0.8	0.8	0.5	-	-	-	-	-	400 [4]
	GMD03	0.6	0.3	0.3	15,000	-	50,000	-	-	1,000
	GMD15	1.0	0.5	0.5	10,000	-	50,000	-	-	1,000
Array	GNM0M	0.9	0.6	0.45	10,000	-	50,000	-	-	1,000
	GNM1M	1.37	1.0	0.5/0.6/0.8	4,000	-	10,000	-	-	1,000
	GNM21	2.0	1.25	0.6/0.85	4,000	-	10,000	-	-	1,000
	GNM31	3.2	1.6	0.8/0.85	4,000	-	10,000	-	-	1,000
				1.0/1.15	-	3,000	-	10,000	-	1,000
Low ESL	LLL15	0.5	1.0	0.3	10,000 [5]	-	50,000 [5]	-	-	1,000
	LLL18	0.8	1.6	0.5	-	4,000	-	10,000	-	1,000
	LLL21	1.25	2.0	0.5/0.6	-	4,000	-	10,000	-	1,000
				0.85	-	3,000	-	10,000	-	1,000
	LLL31	1.6	3.2	0.5/0.7	-	4,000	-	10,000	-	1,000
				1.15	-	3,000	-	10,000	-	1,000
	LLA18	1.6	0.8	0.5	-	4,000	-	10,000	-	1,000
	LLA21	2.0	1.25	0.5	-	4,000	-	10,000	-	1,000
				0.85	-	3,000	-	10,000	-	1,000
	LLA31	3.2	1.6	0.5	-	4,000	-	10,000	-	1,000
				0.85	-	3,000	-	10,000	-	1,000
				1.15	-	3,000	-	10,000	-	1,000
	LLM21	2.0	1.25	0.5	-	4,000	-	10,000	-	1,000
	LLM31	3.2	1.6	0.5	-	4,000	-	10,000	-	1,000

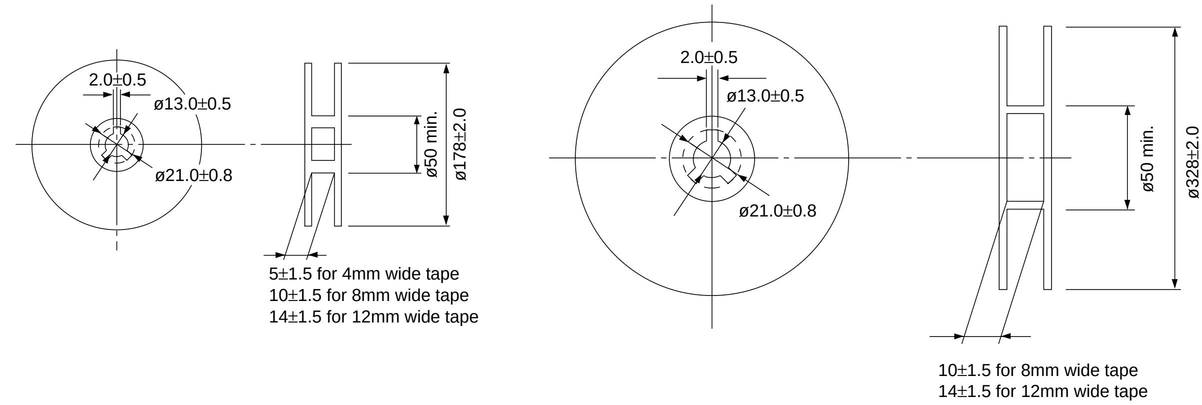
1) 8mm width 2mm pitch Paper Taping. 4mm width 1mm pitch Embossed Taping.
2) There are parts number without bulk case.
3) Dimension tolerance ±0.15mm rated are not available by bulk case.
4) Tray
5) LLL15: ø180mm Reel Paper Taping Packaging Code: E, ø330mm Reel Paper Taping Packaging Code: F

Continued on the following page. ↗

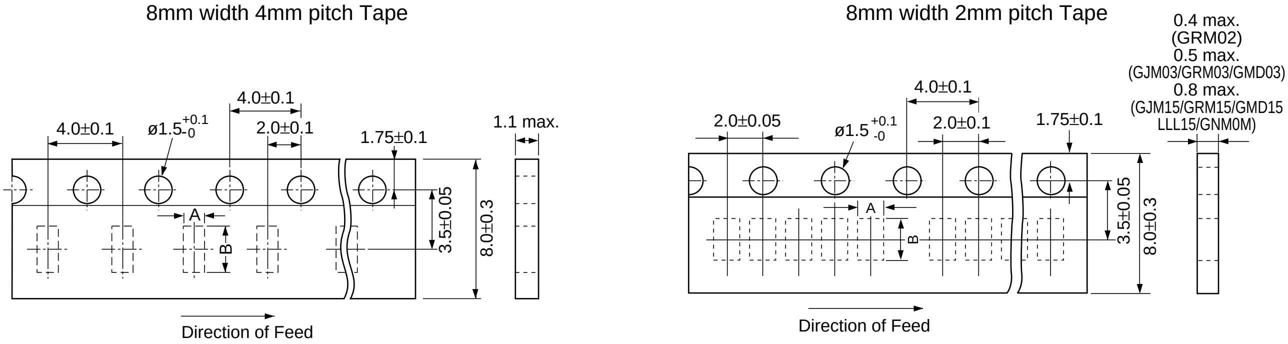
Continued from the preceding page.

■ Tape Carrier Packaging

(1) Dimensions of Reel



(2) Dimensions of Paper Tape



Part Number	A	B
GRM18 **GQM18** **ERB18**	1.05±0.1	1.85±0.1
GNM1M	1.17±0.05	1.55±0.05
GRM21 (T≦0.85mm) **GQM21** **GNM21**	1.55±0.15	2.3±0.15
GRM31 (T≦0.85mm) **GNM31** (T≦0.8mm)	2.0±0.2	3.6±0.2
GRM32 (T≦0.85mm)	2.8±0.2	3.6±0.2

Part Number	A*	B*
GRM02	0.25	0.45
GJM03 **GRM03** **GMD03**	0.37	0.67
GJM15 **GRM15** **GMD15** **LLL15**	0.65	1.15
GNM0M	0.72	1.02

*Nominal Value

(in mm)

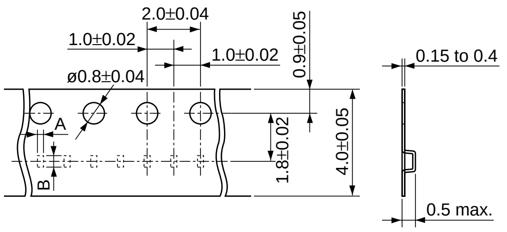
Continued on the following page.

Package

Continued from the preceding page.

(3) Dimensions of Embossed Tape

4mm width 1mm pitch Tape

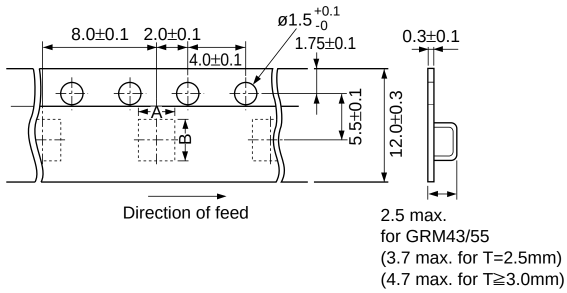


Part Number	A*	B*
GRM02	0.23	0.43

*Nominal Value

✻GRM03 is also available by 4mm width 1mm pitch Tape.

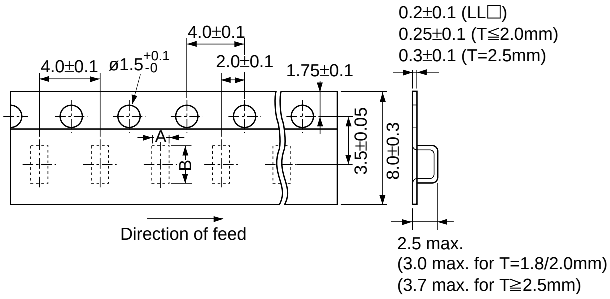
12mm width 8mm pitch Tape



Part Number	A*	B*
GRM43	3.6	4.9
GRM55	5.2	6.1

*Nominal Value

8mm width 4mm pitch Tape



Part Number	A	B
LLL18, LLA18	1.05±0.1	1.85±0.1
GRM21 (T≧1.0mm) **LLL21** **LLA21, LLM21**	1.45±0.2	2.25±0.2
ERB21	1.55±0.2	2.3±0.2
GRM31 (T≧1.15mm) **LLL31** **LLA31, LLM31** **GNM31** (T≧1.0mm)	1.9±0.2	3.5±0.2
GRM32, ERB32 (T≧1.0mm)	2.8±0.2	3.5±0.2

(in mm)

(4) Taping Method

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

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

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

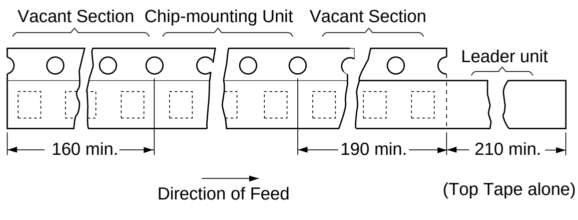
④ Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.

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

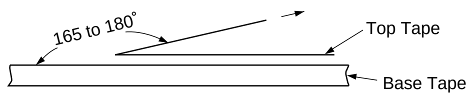
⑥ Cumulative tolerance of sprocket holes, 10 pitches: ±0.3mm.

⑦ Peeling off force: 0.1 to 0.6N* in the direction shown below.

*GRM02, GRM03, GJM03, GMD03 : 0.05 to 0.5N



(in mm)

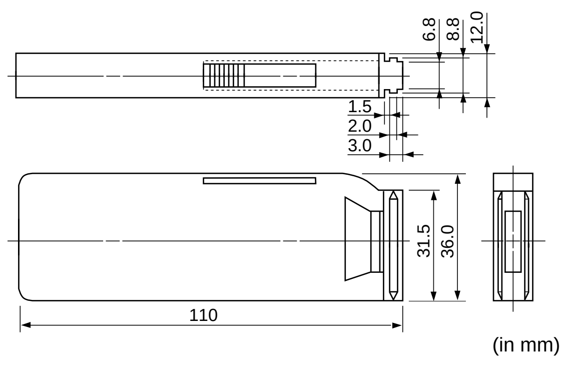


Continued on the following page.

Continued from the preceding page.

■ Dimensions of Bulk Case Packaging

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



⚠Caution

■ ⚠Caution (storage and operation condition)

Chip monolithic ceramic capacitors (chips) can experience degradation of termination solderability when subjected to high temperature or humidity, or if exposed to sulfur or chlorine gases.
Storage environment must be at an ambient temperature of 5-40 degree C and an ambient humidity of 20-70%RH.
Use chip within 6 months. If 6 months or more have elapsed, check solderability before use.
Insulation Resistance should be deteriorated on specific condition of high humidity or incorrosion gas such as hydrogen sulfide, sulfurous acid gas, chlorine.
Those condition are not suitable for use.

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

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

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

■ Handling

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

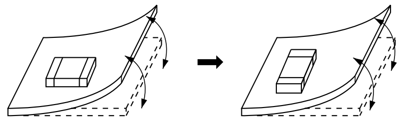
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCTS IS USED.

■ ⚠Caution (Soldering and Mounting)

1. Mounting Position

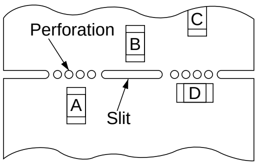
Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[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

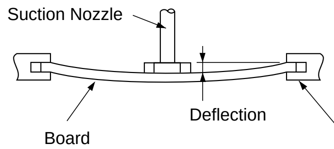
(Reference Data 2. Board bending strength for solder fillet height)
(Reference Data 3. Temperature cycling for solder fillet height)
(Reference Data 4. Board bending strength for board material)

2. Chip Placing

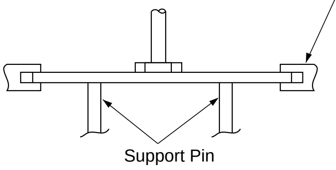
- An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips. So adjust the suction nozzle's bottom dead point by correcting warp in the board. Normally, the suction nozzle's bottom dead point must be set on the upper surface of the 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.

(Reference Data 5. Break strength)

[Incorrect]



[Correct]



Continued on the following page. ↗

⚠Caution

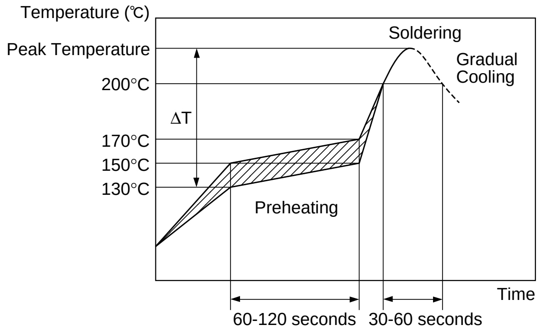
Continued from the preceding page.

3. Reflow Soldering

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

[Standard Conditions for Reflow Soldering]

Infrared Reflow



Vapor Reflow

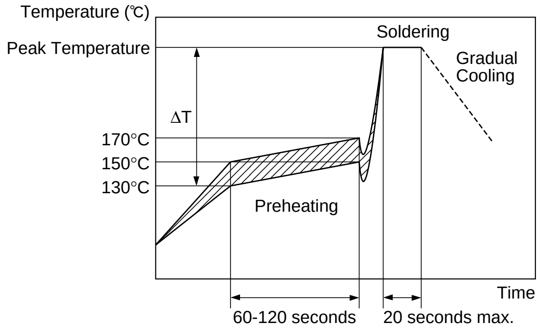
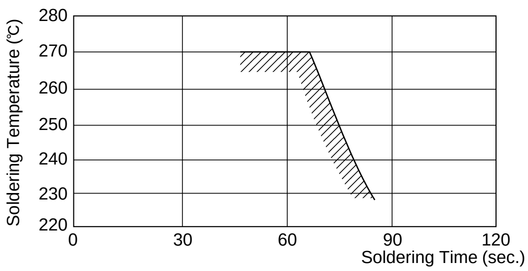


Table 1

Part Number	Temperature Differential
GRM02/03/15/18/21/31	ΔT≦190℃
GJM03/15	
LLL15/18/21/31	
ERB18/21	
GQM18/21	
GRM32/43/55	ΔT≦130℃
LLA18/21/31	
LLM21/31	
GNM	
ERB32	

[Allowable Soldering Temperature and Time]



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

Recommended Conditions

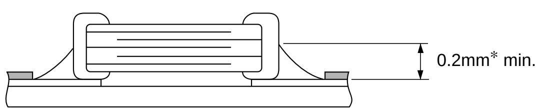
	Pb-Sn Solder		Lead Free Solder
	Infrared Reflow	Vapor Reflow	
Peak Temperature	230-250°C	230-240°C	240-260°C
Atmosphere	Air	Air	Air or N_2

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

● Optimum Solder Amount for Reflow Soldering

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

[Optimum Solder Amount for Reflow Soldering]



* GRM02/03: 1/3 of Chip Thickness min.

Inverting the PCB

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

Continued on the following page.

muRata

Continued from the preceding page.

4. Leaded Component Insertion

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

5. Flow Soldering

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

Table 2

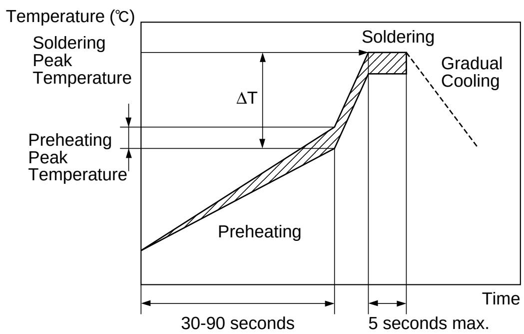
Part Number	Temperature Differential
GRM18/21/31	ΔT≦150℃
LLL21/31	
ERB18/21	
GQM18/21	

Recommended Conditions

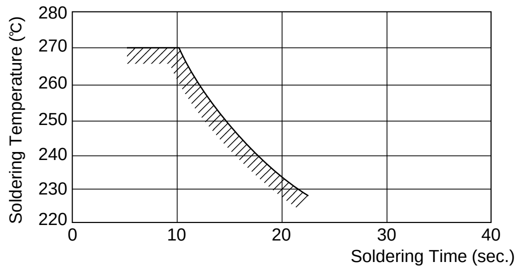
	Pb-Sn Solder	Lead Free Solder
Preheating Peak Temperature	90-110°C	100-120°C
Soldering Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N_2

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

[Standard Conditions for Flow Soldering]

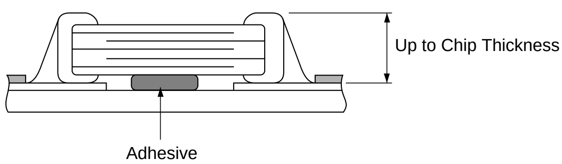


[Allowable Soldering Temperature and Time]



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

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



Continued on the following page.

⚠Caution

Continued from the preceding page.

6. Correction with a Soldering Iron

(1) For Chip Type Capacitors

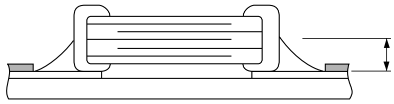
● When sudden heat is applied to the components by soldering iron, the mechanical strength of the components should go down because remarkable temperature change causes deformity inside components. In order to prevent mechanical damage in the components, preheating should be required for both of the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

Table 3

Part Number	Temperature Differential	Peak Temperature	Atmosphere
GRM03/15/18/21/31 **GJM03/15** **LLL15/18/21/31** **GQM18/21** **ERB18/21**	ΔT≦190℃	300°C max. 3 seconds max. / termination	Air
GRM32/43/55 **GNM** **LLA18/21/31** **LLM21/31** **ERB32**	ΔT≦130℃	270°C max. 3 seconds max. / termination	Air

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

● Optimum Solder Amount when Corrections Are Made Using a Soldering Iron
The top of the solder fillet should be lower than the thickness of components. If the solder amount is excessively big, the risk of cracking is higher during board bending or under any other stressful conditions. Soldering iron ø3mm or smaller should be required. And it is necessary to keep a distance between the soldering iron and the components without direct touch. Thread solder with ø0.5mm or smaller is required for soldering.



7. Washing

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

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

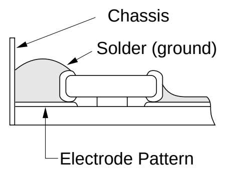
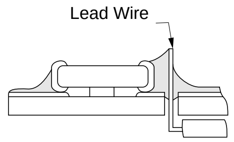
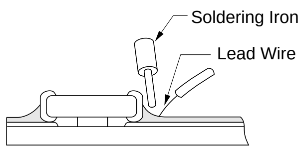
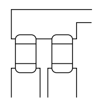
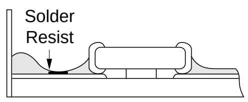
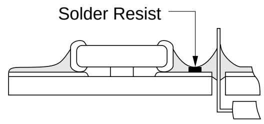
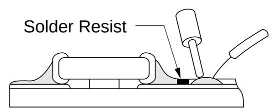
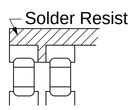
■ Notice (Soldering and Mounting)

1. PCB Design

(1) Notice for Pattern Forms

Unlike leaded components, chip components are susceptible to flexing stresses since they are mounted directly on the substrate.
They are also more sensitive to mechanical and thermal stresses than leaded components.
Excess solder fillet height can multiply these stresses and cause chip cracking. When designing substrates, take land patterns and dimensions into consideration to eliminate the possibility of excess solder fillet height.
It has a possibility to happen the chip crack by the expansion and shrinkage of metal board. Please contact us 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
Prohibited				
Correct				

Continued on the following page.

Notice

Continued from the preceding page.

(2) Land Dimensions

- Chip capacitor could be cracked due to the stress of PCB bending / etc if the land area is larger having excess amount of solder.
  Please refer to land dimension of table 1 for flow soldering, table 2 for reflow soldering, table 3 for GNM & LLA, and table 4 for LLM.

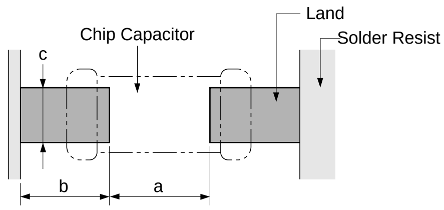


Table 1 Flow Soldering Method

Part Number \ Dimensions	Chip (L×W)	a	b	c
GRM18 **GQM18**	1.6×0.8	0.6–1.0	0.8–0.9	0.6–0.8
GRM21 **GQM21**	2.0×1.25	1.0–1.2	0.9–1.0	0.8–1.1
GRM31	3.2×1.6	2.2–2.6	1.0–1.1	1.0–1.4
LLL21	1.25×2.0	0.4–0.7	0.5–0.7	1.4–1.8
LLL31	1.6×3.2	0.6–1.0	0.8–0.9	2.6–2.8
ERB18	1.6×0.8	0.6–1.0	0.8–0.9	0.6–0.8
ERB21	2.0×1.25	1.0–1.2	0.9–1.0	0.8–1.1

(in mm)

Table 2 Reflow Soldering Method

Part Number \ Dimensions	Chip (L×W)	a	b	c
GRM02	0.4×0.2	0.16–0.2	0.12–0.18	0.2–0.23
GRM03 **GJM03**	0.6×0.3	0.2–0.3	0.2–0.35	0.2–0.4
GRM15 **GJM15**	1.0×0.5	0.3–0.5	0.35–0.45	0.4–0.6
GRM18 **GQM18**	1.6×0.8	0.6–0.8	0.6–0.7	0.6–0.8
GRM21 **GQM21**	2.0×1.25	1.0–1.2	0.6–0.7	0.8–1.1
GRM31	3.2×1.6	2.2–2.4	0.8–0.9	1.0–1.4
GRM32	3.2×2.5	2.0–2.4	1.0–1.2	1.8–2.3
GRM43	4.5×3.2	3.0–3.5	1.2–1.4	2.3–3.0
GRM55	5.7×5.0	4.0–4.6	1.4–1.6	3.5–4.8
LLL15	0.5×1.0	0.15–0.2	0.2–0.3	0.7–1.0
LLL18	0.8×1.6	0.2–0.3	0.3–0.4	1.4–1.6
LLL21	1.25×2.0	0.4–0.6	0.4–0.5	1.4–1.8
LLL31	1.6×3.2	0.6–0.8	0.6–0.7	2.6–2.8
ERB18	1.6×0.8	0.6–0.8	0.6–0.7	0.6–0.8
ERB21	2.0×1.25	1.0–1.2	0.6–0.7	0.8–1.1
ERB32	3.2×2.5	2.0–2.4	1.0–1.2	1.8–2.3

(in mm)

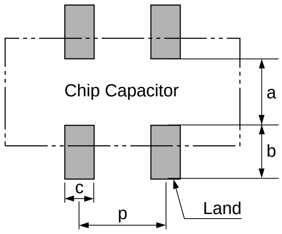
Continued on the following page.

Notice

Continued from the preceding page.

● GNM, LLA Series for Reflow Soldering Method

GNM□□2



GNM□□4
LLA

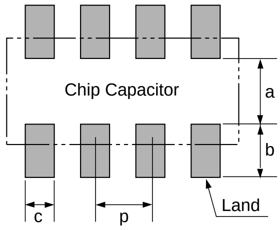


Table 3 GNM, LLA Series for Reflow Soldering Land Dimensions

Part Number	Dimensions (mm)					
	L	W	a	b	c	p
GNM0M2	0.9	0.6	0.12 to 0.20*	0.35 to 0.40*	0.3	0.45
GNM1M2	1.37	1.0	0.4 to 0.5	0.35 to 0.45	0.3 to 0.35	0.64
GNM212	2.0	1.25	0.6 to 0.7	0.5 to 0.7	0.4 to 0.5	1.0
GNM214	2.0	1.25	0.6 to 0.7	0.5 to 0.7	0.25 to 0.35	0.5
GNM314	3.2	1.6	0.8 to 1.0	0.7 to 0.9	0.3 to 0.4	0.8
LLA18	1.6	0.8	0.3 to 0.4	0.25 to 0.35	0.15 to 0.25	0.4
LLA21	2.0	1.25	0.5 to 0.7	0.35 to 0.6	0.2 to 0.3	0.5
LLA31	3.2	1.6	0.7 to 0.9	0.4 to 0.7	0.3 to 0.4	0.8

* $0.82 \leqq a+2b \leqq 1.00$

● LLM Series for Reflow Soldering Method

LLM

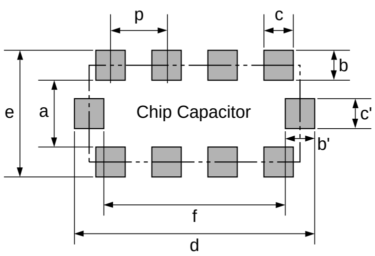


Table 4 LLM Series for Reflow Soldering Land Dimensions

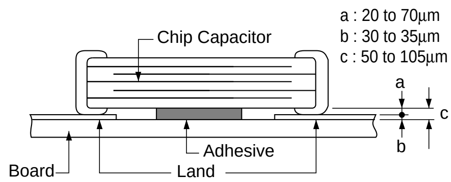
Part Number	Dimensions (mm)						
	a	b, b'	c, c'	d	e	f	p
LLM21	0.6 to 0.8	(0.3 to 0.5)	0.3	2.0 to 2.6	1.3 to 1.8	1.4 to 1.6	0.5
LLM31	1.0	(0.3 to 0.5)	0.4	3.2 to 3.6	1.6 to 2.0	2.6	0.8

b=(c-e)/2, b'=(d-f)/2

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 at right 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℃)



● Adhesive Coverage*

Part Number	Adhesive Coverage*
GRM18, GQM18	0.05mg min.
GRM21, LLL21, GQM21	0.1mg min.
GRM31, LLL31	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.

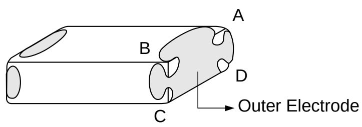
4. Flux Application

- 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 percentage of halide may cause corrosion of the outer electrodes unless sufficient cleaning. Use flux with a halide content of 0.2% max.
- Do not use strong acidic flux.
- Do not use water-soluble flux.
  (*Water-soluble flux can be defined as non resin type flux including wash-type flux and non-wash-type flux.)

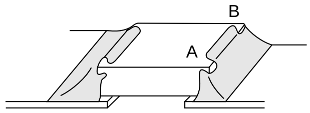
5. Flow Soldering

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

[As a Single Chip]



[As Mounted on Substrate]



(Reference Data 6. Thermal shock)
(Reference Data 7. Solder heat resistance)

Die Bonding/Wire Bonding (GMA or GMD Series)

1. Die Bonding of Capacitors
- Use the following materials Brazing alloy:
  Au-Sn (80/20) 300 to 320 degree C in N2 atmosphere
- Mounting
  (1) Control the temperature of the substrate so that it matches the temperature of the brazing alloy.
  (2) Place brazing alloy on substrate and place the capacitor on the alloy. Hold the capacitor and gently apply the load. Be sure to complete the operation in 1 minute.

2. Wire Bonding
- Wire
  Gold wire: 25 micro m (0.001 inch) diameter
- Bonding
  (1) Thermocompression, ultrasonic ball bonding.
  (2) Required stage temperature : 150 to 200 degree C
  (3) Required wedge or capillary weight : 0.2N to 0.5N
  (4) Bond the capacitor and base substrate or other devices with gold wire.

Continued on the following page.

Notice

Continued from the preceding page.

■ Others

1. Resin Coating
   When selecting resin materials, select those with low contraction.
2. Circuit Design
   GRM, GCM, GMA/D, LLL/A/M, ERB, GQM, GJM, GNM Series capacitors in 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 values, not guaranteed ratings.

Reference Data

1. Solderability

(1) Test Method

Subject the chip capacitor to the following conditions.
Then apply flux (an ethanol solution of 25% rosin) to the chip and dip it in 230℃ eutectic solder for 2 seconds.
Conditions:
Expose prepared at room temperature (for 6 months and 12 months, respectively)
Prepared at high temperature (for 100 hours at 85℃)
Prepared left at high humidity (for 100 hours under 90%RH to 95%RH at 40℃)

(2) Test Samples

GRM21 : Products for flow/reflow soldering.

(3) Acceptance Criteria

With a 60-power optical microscope, measure the surface area of the outer electrode that is covered with solder.

(4) Results

Refer to Table 1.

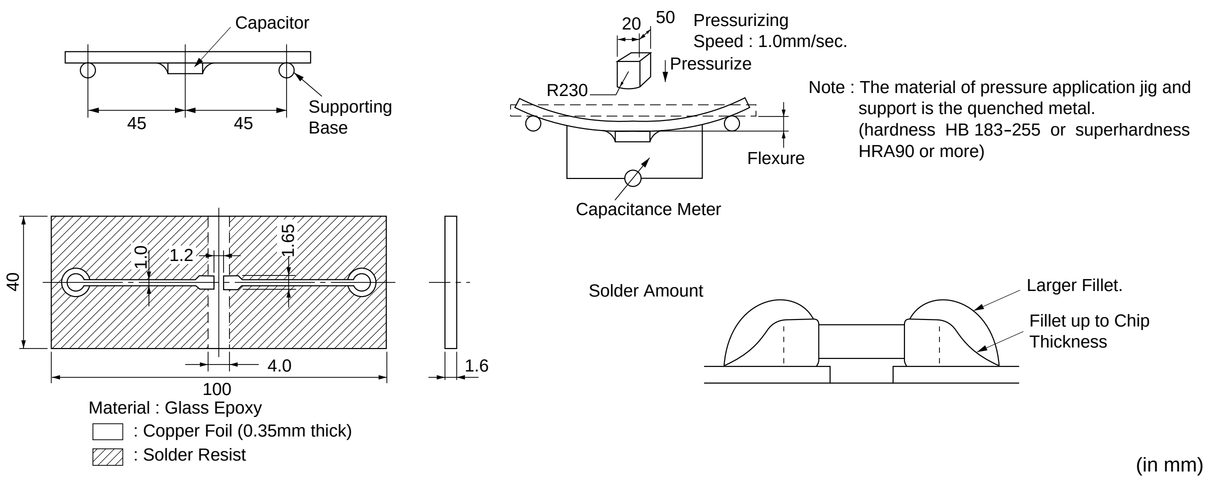
Table 1

Sample	Initial State	Prepared at Room Temperature		Prepared at High Temperature for 100 Hours at 85℃	Prepared at High Humidity for 100 Hours at 90 to 95% RH and 40℃
		6 months	12 months		
GRM21 for flow/reflow soldering	95 to 100%	95 to 100%	95%	90 to 95%	95%

2. Board Bending Strength for Solder Fillet Height

(1) Test Method

Solder the chip capacitor to the test PCB with the amount of solder paste necessary to achieve the fillet heights. Then bend the PCB using the method illustrated and measure capacitance.



(2) Test Samples

GRM21: 5C/R7/F5 Characteristics T=0.6mm

(3) Acceptance Criteria

Products should be determined to be defective if the change in capacitance has exceeded the values specified in Table 2.

Table 2

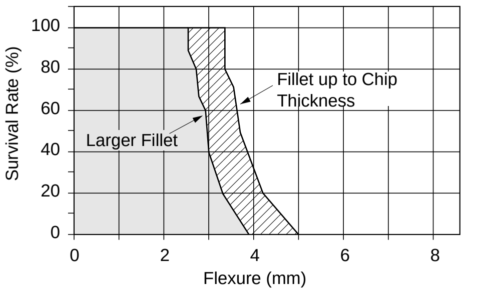
Characteristics	Change in Capacitance
5C	Within ±5% or ±0.5pF, whichever is greater
R7	Within ±12.5%
F5	Within ±20%

Continued on the following page.

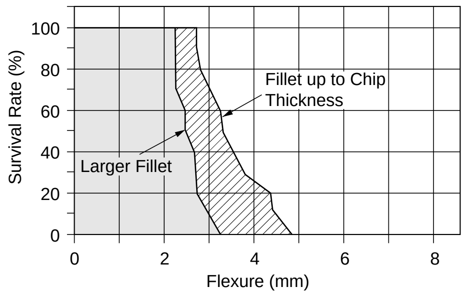
Continued from the preceding page.

(4) Results

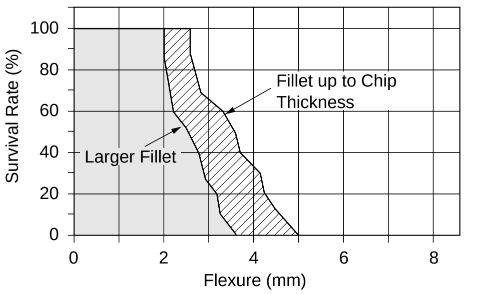
GRM21 5C (T=0.6)



GRM21 R7 (T=0.6)



GRM21 F5 (T=0.6)

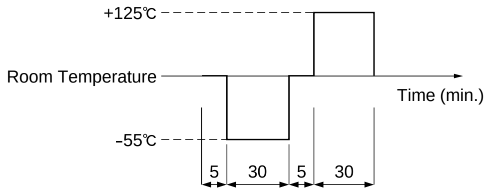


3. Temperature Cycling for Solder Fillet Height

(1) Test Method

Solder the chips to the substrate of various test fixtures using sufficient amounts of solder to achieve the required fillet height. Then subject the fixtures to the cycle illustrated below 200 times.

[Temperature Cycling]



① Solder Amount

Alumina substrates are typically designed for reflow soldering.

Glass epoxy or paper phenol substrates are typically used for flow soldering.

② Material

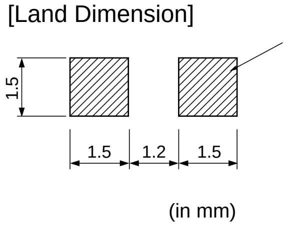
Alumina	(Thickness: 0.64mm)
Glass epoxy	(Thickness: 1.64mm)
Paper phenol	(Thickness: 1.64mm)

[Solder Amount]

Substrate		Alumina	Glass Epoxy or Paper Phenol
Solder Amount	❶	0.5T	T
	❷	0.7T	1.3T
	❸	T	1.6T
Solder to be used		6×4 Eutectic solder	

③ Land Dimension

[Land Dimension]



Alumina Substrate	Ag/Pd=72/28 Thickness: 10 to 12μm
Glass Epoxy Substrate	Cu Thickness: 35μm
Paper Phenol Substrate	

Continued on the following page.

Reference Data

Continued from the preceding page.

(2) Test Samples

GRM21 5C/R7/F5 Characteristics T=0.6mm

(3) Acceptance Criteria

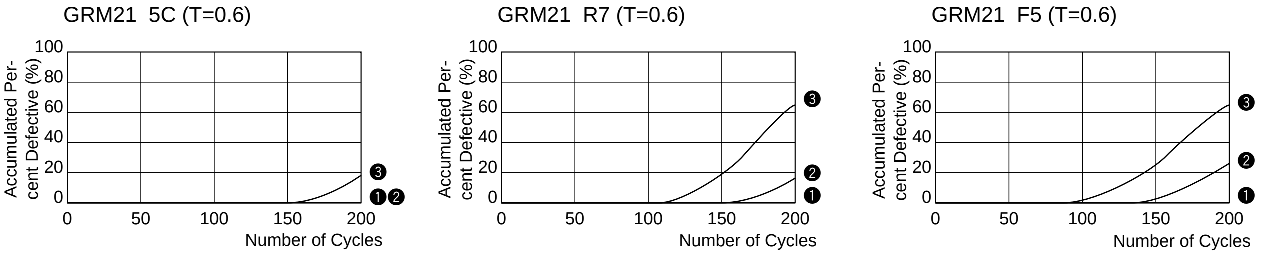
Products are determined to be defective if the change in capacitance has exceeded the values specified in Table 3.

Table 3

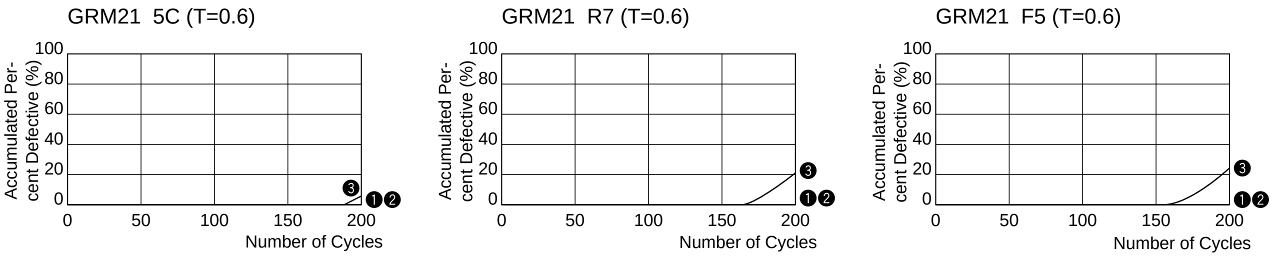
Characteristics	Change in Capacitance
5C	Within ±2.5% or ±0.25pF, whichever is greater
R7	Within ±7.5%
F5	Within ±20%

(4) Results

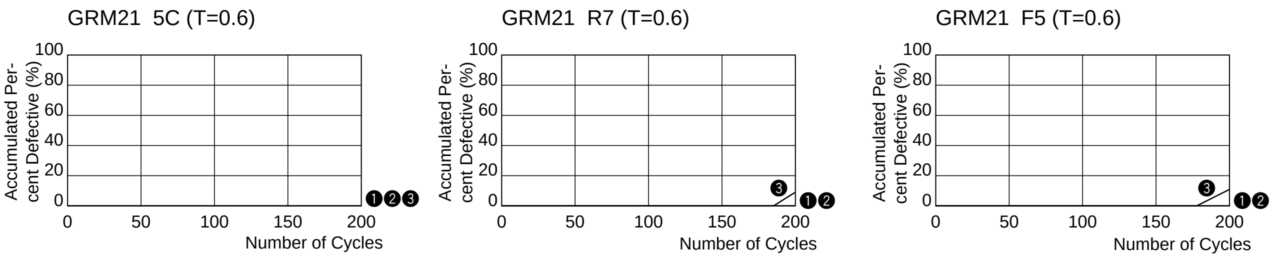
Alumina Substrate (Thickness 0.64mm)



Glass Epoxy Substrate (Thickness 1.6mm)



Paper Phenol Substrate (Thickness 1.6mm)



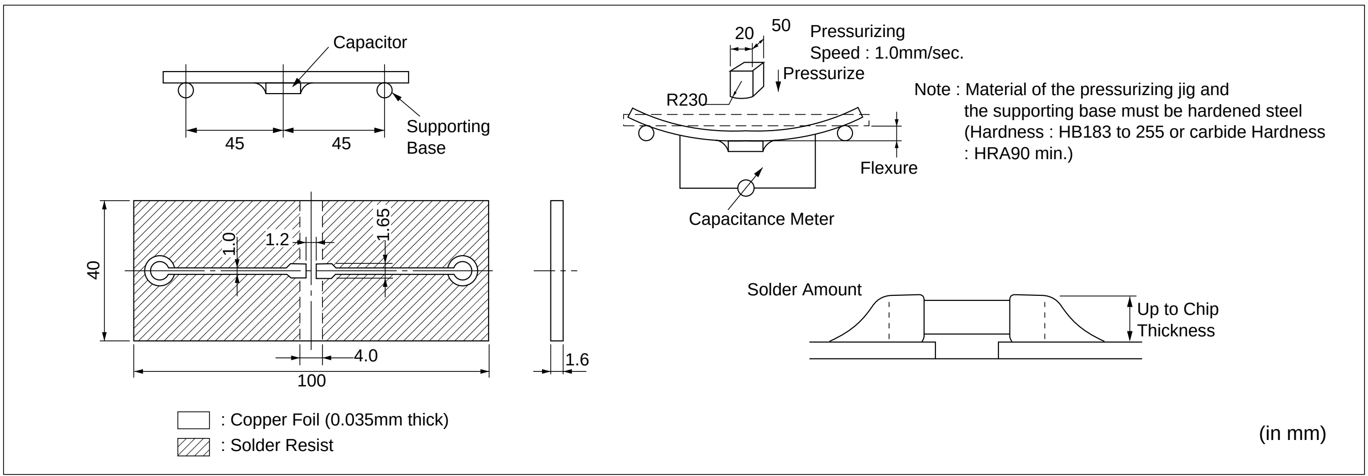
Continued on the following page.

Continued from the preceding page.

4. Board Bending Strength for Board Material

(1) Test Method

Solder the chip to the test board. Then bend the board using the method illustrated below, to measure capacitance.



(2) Test Samples

GRM21 5C/R7/F5 Characteristics T=0.6mm typical

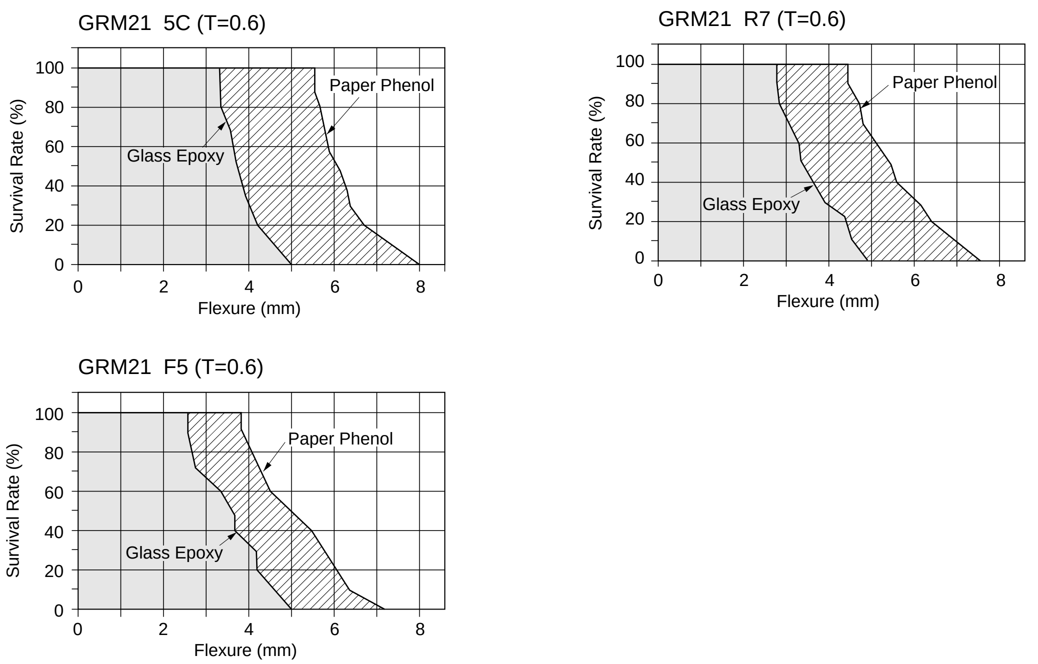
(3) Acceptance Criteria

Products should be determined to be defective if the change in capacitance has exceeded the values specified in Table 4.

Table 4

Characteristics	Change in Capacitance
5C	Within ±5% or ±0.5pF, whichever is greater
R7	Within ±12.5%
F5	Within ±20%

(4) Results



Continued on the following page.

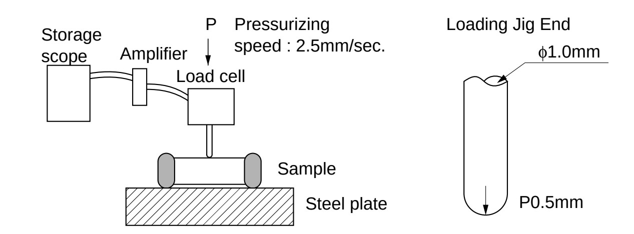
Reference Data

Continued from the preceding page.

5. Break Strength

(1) Test Method

Place the chip on a steel plate as illustrated on the right. Increase load applied to a point near the center of the test sample.

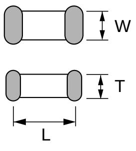


(2) Test Samples

GRM21 5C/R7/F5 Characteristics
GRM31 5C/R7/F5 Characteristics

(3) Acceptance Criteria

Define the load that has caused the chip to break or crack, as the bending force.



Chip Size	L	W	γ 5C Charac-teristics	γ R7 Charac-teristics	γ F5 Charac-teristics
GRM21	1.5	1.2	300	180	160
GRM31	2.7	1.5			

(in mm)

(4) Explanation

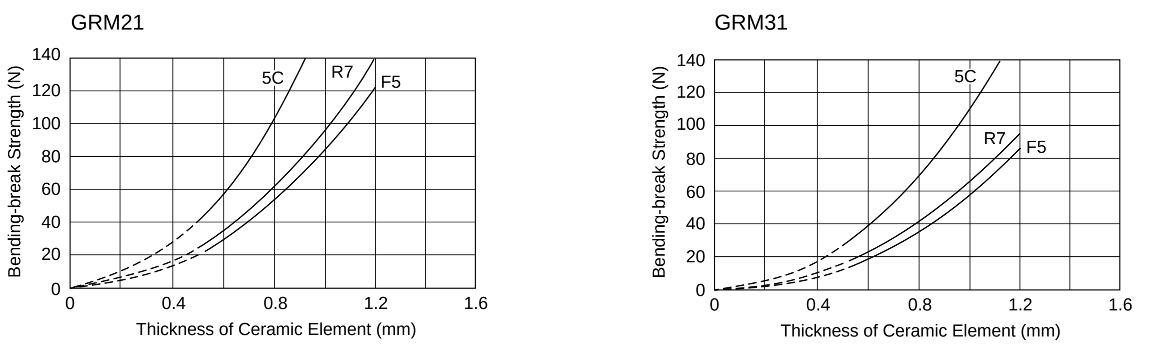
Break strength, P, is proportionate to the square of the thickness of the ceramic element and is expressed as a curve of secondary degree.

The formula is:

$$P = \frac{2\gamma W T^2}{3L} \quad (N)$$

W : Width of ceramic element (mm)
T : Thickness of element (mm)
L : Distance between fulcrums (mm)
γ : Bending stress (N/mm^2)

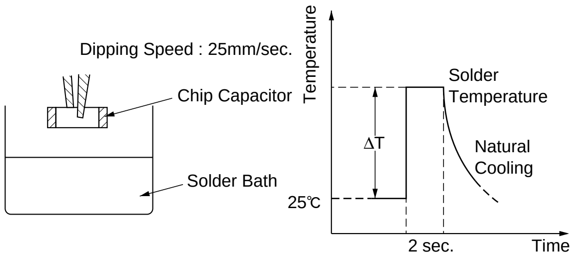
(5) Results



6. Thermal Shock

(1) Test method

After applying flux (an ethanol solution of 25% rosin), dip the chip in a solder bath (6✕4 eutectic solder) in accordance with the following conditions:



(2) Test samples

GRM21 5C/R7/F5 Characteristics T=0.6mm typical

(3) Acceptance criteria

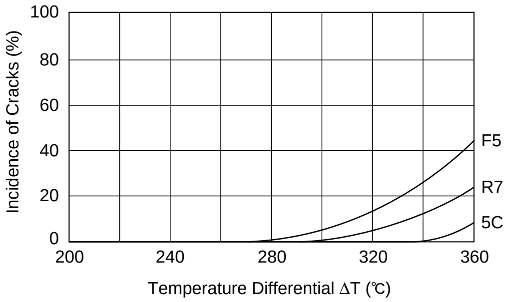
Visually inspect the test sample with a 60-power optical microscope. Chips exhibiting breaks or cracks should be determined to be defective.

Continued on the following page.

Reference Data

Continued from the preceding page.

(4) Results



7. Solder Heat Resistance

(1) Test Method

① Reflow soldering:
Apply about 300 μm of solder paste over the alumina substrate. After reflow soldering, remove the chip and check for leaching that may have occurred on the outer electrode.

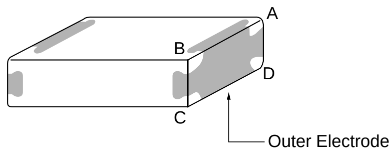
② Flow soldering:
After dipping the test sample with a pair of tweezers in wave solder (eutectic solder), check for leaching that may have occurred on the outer electrode.

③ Dip soldering:
After dipping the test sample with a pair of tweezers in static solder (eutectic solder), check for leaching that may have occurred on the outer electrode.

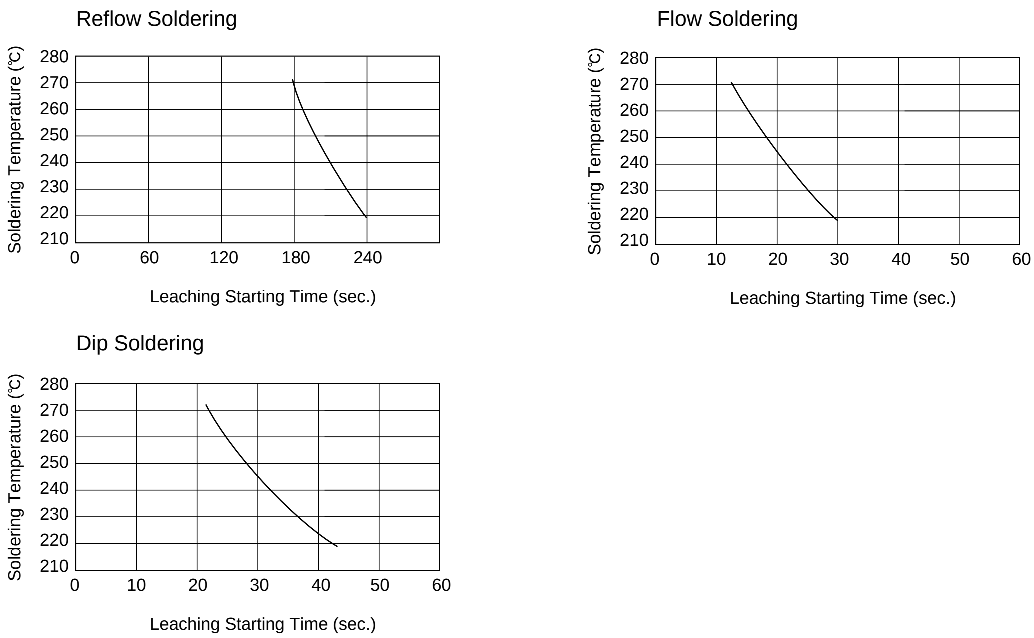
④ Flux to be used: An ethanol solution of 25% rosin.

(2) Test samples
GRM21: For flow/reflow soldering T=0.6mm

(3) Acceptance criteria
The starting time of leaching should be defined as the time when the outer electrode has lost 25% of the total edge length of A-B-C-D as illustrated:



(4) Results



Continued on the following page.

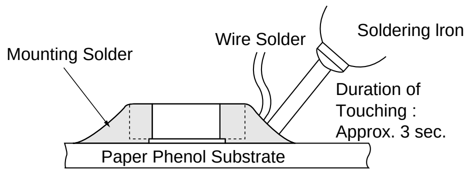
Reference Data

Continued from the preceding page.

8. Thermal Shock when Making Corrections with a Soldering Iron

(1) Test Method

Apply a soldering iron meeting the conditions below to the soldered joint of a chip that has been soldered to a paper phenol board, while supplying wire solder. (Note: the soldering iron tip should not directly touch the ceramic element of the chip.)



Soldering Iron	Tip diameter
Ceramic heater 20W	ϕ3mm

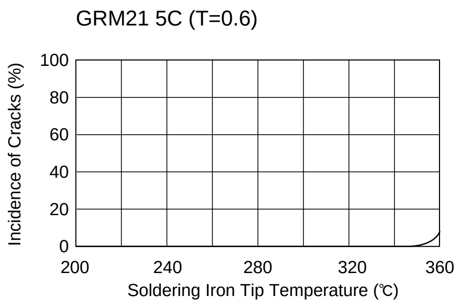
(2) Test Samples

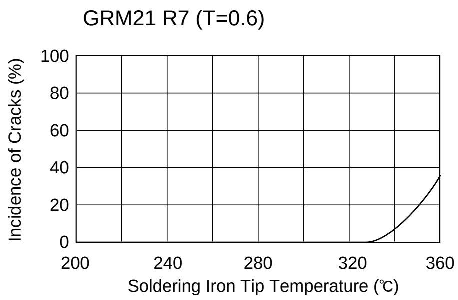
GRM21 5C/R7/F5 Characteristics T=0.6mm

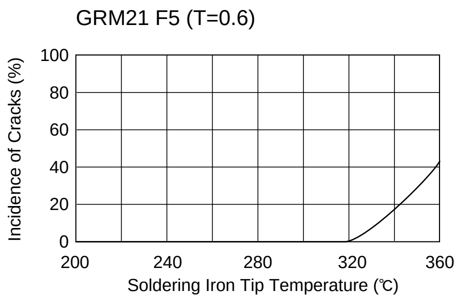
(3) Acceptance Criteria for Defects

Observe the appearance of the test sample with a 60-power optical microscope. Those units displaying any breaks or cracks are determined to be defective.

(4) Results



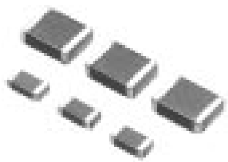


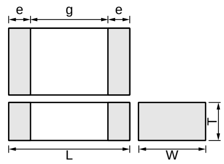


Chip Monolithic Ceramic Capacitors

muRata

Medium Voltage Low Dissipation Factor





Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GRM21A	2.0 ±0.2	1.25 ±0.2	1.0 +0,-0.3	0.3	0.7
GRM31A	3.2 ±0.2	1.6 ±0.2	1.0 +0,-0.3	0.3	1.5*
GRM31B	3.2 ±0.2	1.6 ±0.2	1.25 +0,-0.3	0.3	1.5*
GRM32A	3.2 ±0.2	2.5 ±0.2	1.0 +0,-0.3	0.3	1.5*
GRM32B	3.2 ±0.2	2.5 ±0.2	1.25 +0,-0.3	0.3	1.5*
GRM42A	4.5 ±0.3	2.0 ±0.2	1.0 +0,-0.3	0.3	2.9

* GRM31A7U3D, GRM32A7U3D, GRM32B7U3D : 1.8mm min.

■ Features

1. Low-loss and suitable for high frequency circuits
2. Murata's original internal electrode structure realizes high flash-over voltage.
3. A new monolithic structure for small, surface-mountable devices capable of operating at high voltage levels
4. Sn-plated external electrodes realize good solderability.
5. Use the GRM21/31 type with flow or reflow soldering, and other types with reflow soldering only.

■ Applications

Ideal for use on high frequency pulse circuits such as snubber circuits for switching power supplies, DC-DC converters, ballasts (inverter fluorescent lamps), etc.

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GRM21A7U2E101JW31D	DC250	U2J (EIA)	100 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM21A7U2E151JW31D	DC250	U2J (EIA)	150 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM21A7U2E221JW31D	DC250	U2J (EIA)	220 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM21A7U2E331JW31D	DC250	U2J (EIA)	330 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM21A7U2E471JW31D	DC250	U2J (EIA)	470 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM21A7U2E681JW31D	DC250	U2J (EIA)	680 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM21A7U2E102JW31D	DC250	U2J (EIA)	1000 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM21A7U2E152JW31D	DC250	U2J (EIA)	1500 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM21A7U2E222JW31D	DC250	U2J (EIA)	2200 ±5%	2.0	1.25	1.0	0.7	0.3 min.
GRM31A7U2E332JW31D	DC250	U2J (EIA)	3300 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2E472JW31D	DC250	U2J (EIA)	4700 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31B7U2E682JW31L	DC250	U2J (EIA)	6800 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GRM31B7U2E103JW31L	DC250	U2J (EIA)	10000 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GRM31A7U2J100JW31D	DC630	U2J (EIA)	10 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J150JW31D	DC630	U2J (EIA)	15 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J220JW31D	DC630	U2J (EIA)	22 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J330JW31D	DC630	U2J (EIA)	33 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J470JW31D	DC630	U2J (EIA)	47 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J680JW31D	DC630	U2J (EIA)	68 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J101JW31D	DC630	U2J (EIA)	100 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J151JW31D	DC630	U2J (EIA)	150 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J221JW31D	DC630	U2J (EIA)	220 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J331JW31D	DC630	U2J (EIA)	330 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J471JW31D	DC630	U2J (EIA)	470 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J681JW31D	DC630	U2J (EIA)	680 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U2J102JW31D	DC630	U2J (EIA)	1000 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM32A7U2J152JW31D	DC630	U2J (EIA)	1500 ±5%	3.2	2.5	1.0	1.5	0.3 min.
GRM32A7U2J222JW31D	DC630	U2J (EIA)	2200 ±5%	3.2	2.5	1.0	1.5	0.3 min.
GRM31A7U3A100JW31D	DC1000	U2J (EIA)	10 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U3A150JW31D	DC1000	U2J (EIA)	15 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U3A220JW31D	DC1000	U2J (EIA)	22 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U3A330JW31D	DC1000	U2J (EIA)	33 ±5%	3.2	1.6	1.0	1.5	0.3 min.

Continued on the following page. ↗

Continued from the preceding page.

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GRM31A7U3A470JW31D	DC1000	U2J (EIA)	47 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U3A680JW31D	DC1000	U2J (EIA)	68 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U3A101JW31D	DC1000	U2J (EIA)	100 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U3A151JW31D	DC1000	U2J (EIA)	150 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U3A221JW31D	DC1000	U2J (EIA)	220 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31A7U3A331JW31D	DC1000	U2J (EIA)	330 ±5%	3.2	1.6	1.0	1.5	0.3 min.
GRM31B7U3A471JW31L	DC1000	U2J (EIA)	470 ±5%	3.2	1.6	1.25	1.5	0.3 min.
GRM31A7U3D100JW31D	DC2000	U2J (EIA)	10 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D120JW31D	DC2000	U2J (EIA)	12 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D150JW31D	DC2000	U2J (EIA)	15 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D180JW31D	DC2000	U2J (EIA)	18 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D220JW31D	DC2000	U2J (EIA)	22 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D270JW31D	DC2000	U2J (EIA)	27 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D330JW31D	DC2000	U2J (EIA)	33 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D390JW31D	DC2000	U2J (EIA)	39 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D470JW31D	DC2000	U2J (EIA)	47 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D560JW31D	DC2000	U2J (EIA)	56 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM31A7U3D680JW31D	DC2000	U2J (EIA)	68 ±5%	3.2	1.6	1.0	1.8	0.3 min.
GRM32A7U3D820JW31D	DC2000	U2J (EIA)	82 ±5%	3.2	2.5	1.0	1.8	0.3 min.
GRM32A7U3D101JW31D	DC2000	U2J (EIA)	100 ±5%	3.2	2.5	1.0	1.8	0.3 min.
GRM32A7U3D121JW31D	DC2000	U2J (EIA)	120 ±5%	3.2	2.5	1.0	1.8	0.3 min.
GRM32A7U3D151JW31D	DC2000	U2J (EIA)	150 ±5%	3.2	2.5	1.0	1.8	0.3 min.
GRM32B7U3D181JW31L	DC2000	U2J (EIA)	180 ±5%	3.2	2.5	1.25	1.8	0.3 min.
GRM32B7U3D221JW31L	DC2000	U2J (EIA)	220 ±5%	3.2	2.5	1.25	1.8	0.3 min.
GRM42A7U3F270JW31L	DC3150	U2J (EIA)	27 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A7U3F330JW31L	DC3150	U2J (EIA)	33 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A7U3F390JW31L	DC3150	U2J (EIA)	39 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A7U3F470JW31L	DC3150	U2J (EIA)	47 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A7U3F560JW31L	DC3150	U2J (EIA)	56 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A7U3F680JW31L	DC3150	U2J (EIA)	68 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A7U3F820JW31L	DC3150	U2J (EIA)	82 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A7U3F101JW31L	DC3150	U2J (EIA)	100 ±5%	4.5	2.0	1.0	2.9	0.3 min.

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>−55 to +125℃</td><td>−</td></tr>
<tr><td>2</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>3</td><td colspan="2">Dimensions</td><td>Within the specified dimension</td><td>Using calipers</td></tr>
<tr><td>4</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when voltage in Table is applied between the terminations for 1 to 5 sec., provided the charge/discharge current is less than 50mA.
<table>
<tr><th>Rated Voltage</th><th>Test Voltage</th></tr>
<tr><td>DC250V</td><td>200% of the rated voltage</td></tr>
<tr><td>DC630V</td><td>150% of the rated voltage</td></tr>
<tr><td>DC1kV, DC2kV</td><td>120% of the rated voltage</td></tr>
<tr><td>DC3.15kV</td><td>DC4095V</td></tr>
</table></td></tr>
<tr><td>5</td><td colspan="2">Insulation Resistance (I.R.)</td><td>More than 10,000MΩ</td><td>The insulation resistance should be measured with DC500±50V (DC250±25V in case of rated voltage: DC250V) and within 60±5 sec. of charging.</td></tr>
<tr><td>6</td><td colspan="2">Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/Q should be measured at the frequency and voltage shown as follows.
<table>
<tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr>
<tr><td>C<1,000pF</td><td>1±0.2MHz</td><td>AC0.5 to 5V(r.m.s.)</td></tr>
<tr><td>C≧1,000pF</td><td>1±0.2kHz</td><td>AC1±0.2V(r.m.s.)</td></tr>
</table></td></tr>
<tr><td>7</td><td colspan="2">Q</td><td>1,000 min.</td></tr>
<tr><td>8</td><td colspan="2">Capacitance Temperature Characteristics</td><td>Temp. Coefficient
−750±120 ppm/℃ (Temp. Range : +25 to +125℃)
−750+120, −347 ppm/℃ (Temp. Range : −55 to +25℃)</td><td>The capacitance measurement should be made at each step specified in Table.
<table>
<tr><th>Step</th><th>Temperature (℃)</th></tr>
<tr><td>1</td><td>25±2</td></tr>
<tr><td>2</td><td>Min. Operating Temp.±3</td></tr>
<tr><td>3</td><td>25±2</td></tr>
<tr><td>4</td><td>Max. Operating Temp.±2</td></tr>
<tr><td>5</td><td>25±2</td></tr>
</table></td></tr>
<tr><td>9</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1.
Then apply 10N force in the direction of the arrow.
The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

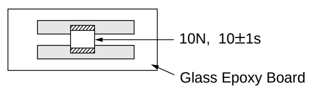
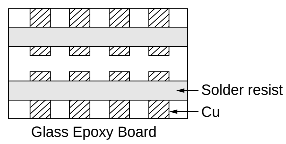



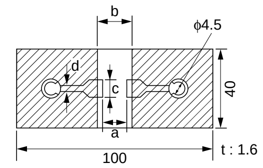
Fig. 1</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board).
The capacitor should be subjected to a simple harmonic motion having a total amplitude 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 min. This motion should be applied for a period of 2 hrs. in each of 3 mutually perpendicular directions (total of 6 hrs.).
</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>Q</td><td>1,000 min.</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

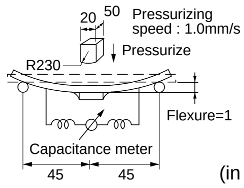
Continued from the preceding page.

No.	Item		Specifications	Test Method
11	Deflection		No cracking or marking defects should occur.	Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2. Then apply a force in the direction shown in Fig. 3. The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.



L×W (mm)	Dimension (mm) a	b	c	d
2.0×1.25	1.2	4.0	1.65	1.0
3.2×1.6	2.2	5.0	2.0	
3.2×2.5	2.2	5.0	2.9	
4.5×2.0	3.5	7.0	2.4	

Fig. 2



(in mm)

Fig. 3

No.	Item		Specifications	Test Method
12	Solderability of Termination		75% of the terminations are to be soldered evenly and continuously.	Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in solder solution for 2±0.5 sec. Immersing speed: 25±2.5mm/s Temp. of solder: 245±5°C Lead Free Solder (Sn-3.0Ag-0.5Cu) 235±5°C H60A or H63A Eutectic Solder
13	Resistance to Soldering Heat	Appearance	No marking defects	Preheat the capacitor at 120 to 150℃* for 1 min. Immerse the capacitor in solder solution at 260±5℃ for 10±1 sec. Let sit at room condition* for 24±2 hrs., then measure. •Immersing speed: 25±2.5mm/s *Preheating for more than 3.2×2.5mm
		Capacitance Change	Within ±2.5%	
		Q	1,000 min.	
		I.R.	More than 10,000MΩ	
		Dielectric Strength	In accordance with item No.4	

Step	Temperature	Time
1	100 to 120℃	1 min.
2	170 to 200℃	1 min.

No.	Item		Specifications	Test Method
14	Temperature Cycle	Appearance	No marking defects	Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4. Perform the 5 cycles according to the 4 heat treatments listed in the following table. Let sit for 24±2 hrs. at room condition*, then measure.
		Capacitance Change	Within ±2.5%	
		Q	500 min.	
		I.R.	More than 10,000MΩ	
		Dielectric Strength	In accordance with item No.4	

Step	Temperature (℃)	Time (min.)
1	Min. Operating Temp.±3	30±3
2	Room Temp.	2 to 3
3	Max. Operating Temp.±2	30±3
4	Room Temp.	2 to 3

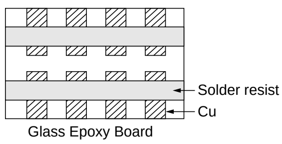


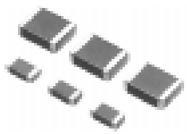
Fig. 4

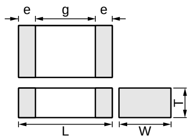
No.	Item		Specifications	Test Method
15	Humidity (Steady State)	Appearance	No marking defects	Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500^{+24}_{-0} hrs. Remove and let sit for 24±2 hrs. at room condition*, then measure.
		Capacitance Change	Within ±5.0%	
		Q	350 min.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	
16	Life	Appearance	No marking defects	Apply 120% of the rated voltage for $1{,}000^{+48}_{-0}$ hrs. at maximum operating temperature ±3℃. Remove and let sit for 24±2 hrs. at room condition*, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	Within ±3.0%	
		Q	350 min.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Chip Monolithic Ceramic Capacitors

Medium Voltage High Capacitance for General Use





Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRM188	1.6 ±0.1	0.8 ±0.1	0.8 ±0.1	0.2 to 0.5	0.4
GRM21A	2.0 ±0.2	1.25 ±0.2	1.0 +0,-0.3	0.3 min.	0.7
GRM21B			1.25 ±0.2		
GRM31B	3.2 ±0.2	1.6 ±0.2	1.25 +0,-0.3		1.2
GRM31C			1.6 ±0.2		
GRM32Q	3.2 ±0.3	2.5 ±0.2	1.5 +0,-0.3		
GRM32D			2.0 +0,-0.3		
GRM43Q	4.5 ±0.4	3.2 ±0.3	1.5 +0,-0.3		2.2
GRM43D			2.0 +0,-0.3		
GRM55D	5.7 ±0.4	5.0 ±0.4	2.0 +0,-0.3		3.2

■ Features

1. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
2. Sn-plated external electrodes realizes good solderability.
3. Use the GRM18/21/31 types with flow or reflow soldering, and other types with reflow soldering only.

■ Applications

1. Ideal for use on diode-snubber circuits for switching power supplies.
2. Ideal for use as primary-secondary coupling for DC-DC converter.
3. Ideal for use on line filters and ringer detectors for telephones, facsimiles and modems.

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GRM188R72E221KW07D	DC250	X7R (EIA)	220pF ±10%	1.6	0.8	0.8	0.4	0.2 to 0.5
GRM188R72E331KW07D	DC250	X7R (EIA)	330pF ±10%	1.6	0.8	0.8	0.4	0.2 to 0.5
GRM188R72E471KW07D	DC250	X7R (EIA)	470pF ±10%	1.6	0.8	0.8	0.4	0.2 to 0.5
GRM188R72E681KW07D	DC250	X7R (EIA)	680pF ±10%	1.6	0.8	0.8	0.4	0.2 to 0.5
GRM188R72E102KW07D	DC250	X7R (EIA)	1000pF ±10%	1.6	0.8	0.8	0.4	0.2 to 0.5
GRM21AR72E102KW01D	DC250	X7R (EIA)	1000pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GRM188R72E152KW07D	DC250	X7R (EIA)	1500pF ±10%	1.6	0.8	0.8	0.4	0.2 to 0.5
GRM21AR72E152KW01D	DC250	X7R (EIA)	1500pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GRM188R72E222KW07D	DC250	X7R (EIA)	2200pF ±10%	1.6	0.8	0.8	0.4	0.2 to 0.5
GRM21AR72E222KW01D	DC250	X7R (EIA)	2200pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GRM21AR72E332KW01D	DC250	X7R (EIA)	3300pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GRM21AR72E472KW01D	DC250	X7R (EIA)	4700pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GRM21AR72E682KW01D	DC250	X7R (EIA)	6800pF ±10%	2.0	1.25	1.0	0.7	0.3 min.
GRM21BR72E103KW03L	DC250	X7R (EIA)	10000pF ±10%	2.0	1.25	1.25	0.7	0.3 min.
GRM31BR72E153KW01L	DC250	X7R (EIA)	15000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR72E223KW01L	DC250	X7R (EIA)	22000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31CR72E333KW03L	DC250	X7R (EIA)	33000pF ±10%	3.2	1.6	1.6	1.2	0.3 min.
GRM31CR72E473KW03L	DC250	X7R (EIA)	47000pF ±10%	3.2	1.6	1.6	1.2	0.3 min.
GRM31BR72E683KW01L	DC250	X7R (EIA)	68000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM32QR72E683KW01L	DC250	X7R (EIA)	68000pF ±10%	3.2	2.5	1.5	1.2	0.3 min.
GRM31CR72E104KW03L	DC250	X7R (EIA)	0.10μF ±10%	3.2	1.6	1.6	1.2	0.3 min.
GRM32DR72E104KW01L	DC250	X7R (EIA)	0.10μF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GRM43QR72E154KW01L	DC250	X7R (EIA)	0.15μF ±10%	4.5	3.2	1.5	2.2	0.3 min.
GRM32DR72E224KW01L	DC250	X7R (EIA)	0.22μF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GRM43DR72E224KW01L	DC250	X7R (EIA)	0.22μF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GRM43DR72E334KW01L	DC250	X7R (EIA)	0.33μF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GRM55DR72E334KW01L	DC250	X7R (EIA)	0.33μF ±10%	5.7	5.0	2.0	3.2	0.3 min.
GRM43DR72E474KW01L	DC250	X7R (EIA)	0.47μF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GRM55DR72E474KW01L	DC250	X7R (EIA)	0.47μF ±10%	5.7	5.0	2.0	3.2	0.3 min.
GRM55DR72E105KW01L	DC250	X7R (EIA)	1.0μF ±10%	5.7	5.0	2.0	3.2	0.3 min.
GRM31BR72J102KW01L	DC630	X7R (EIA)	1000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR72J152KW01L	DC630	X7R (EIA)	1500pF ±10%	3.2	1.6	1.25	1.2	0.3 min.

Continued on the following page.

Continued from the preceding page.

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GRM31BR72J222KW01L	DC630	X7R (EIA)	2200pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR72J332KW01L	DC630	X7R (EIA)	3300pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR72J472KW01L	DC630	X7R (EIA)	4700pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR72J682KW01L	DC630	X7R (EIA)	6800pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR72J103KW01L	DC630	X7R (EIA)	10000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31CR72J153KW03L	DC630	X7R (EIA)	15000pF ±10%	3.2	1.6	1.6	1.2	0.3 min.
GRM32QR72J223KW01L	DC630	X7R (EIA)	22000pF ±10%	3.2	2.5	1.5	1.2	0.3 min.
GRM32DR72J333KW01L	DC630	X7R (EIA)	33000pF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GRM32DR72J473KW01L	DC630	X7R (EIA)	47000pF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GRM43QR72J683KW01L	DC630	X7R (EIA)	68000pF ±10%	4.5	3.2	1.5	2.2	0.3 min.
GRM43DR72J104KW01L	DC630	X7R (EIA)	0.10µF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GRM55DR72J154KW01L	DC630	X7R (EIA)	0.15µF ±10%	5.7	5.0	2.0	3.2	0.3 min.
GRM55DR72J224KW01L	DC630	X7R (EIA)	0.22µF ±10%	5.7	5.0	2.0	3.2	0.3 min.
GRM31BR73A471KW01L	DC1000	X7R (EIA)	470pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR73A102KW01L	DC1000	X7R (EIA)	1000pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR73A152KW01L	DC1000	X7R (EIA)	1500pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR73A222KW01L	DC1000	X7R (EIA)	2200pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR73A332KW01L	DC1000	X7R (EIA)	3300pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR73A472KW01L	DC1000	X7R (EIA)	4700pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM32QR73A682KW01L	DC1000	X7R (EIA)	6800pF ±10%	3.2	2.5	1.5	1.2	0.3 min.
GRM32QR73A103KW01L	DC1000	X7R (EIA)	10000pF ±10%	3.2	2.5	1.5	1.2	0.3 min.
GRM32DR73A153KW01L	DC1000	X7R (EIA)	15000pF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GRM32DR73A223KW01L	DC1000	X7R (EIA)	22000pF ±10%	3.2	2.5	2.0	1.2	0.3 min.
GRM43DR73A333KW01L	DC1000	X7R (EIA)	33000pF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GRM43DR73A473KW01L	DC1000	X7R (EIA)	47000pF ±10%	4.5	3.2	2.0	2.2	0.3 min.
GRM55DR73A104KW01L	DC1000	X7R (EIA)	0.10µF ±10%	5.7	5.0	2.0	3.2	0.3 min.

Specifications and Test Methods

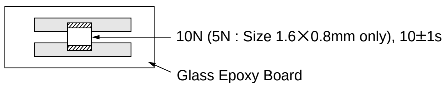
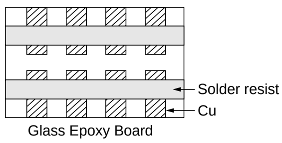
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>−55 to +125℃</td><td>−</td></tr>
<tr><td>2</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>3</td><td colspan="2">Dimensions</td><td>Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>4</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when 150% of the rated voltage (200% of the rated voltage in case of rated voltage: DC250V, 120% of the rated voltage in case of rated voltage: DC1kV) is applied between the terminations for 1 to 5 sec., provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>5</td><td colspan="2">Insulation Resistance (I.R.)</td><td>C≧0.01μF: More than 100MΩ • μF
C<0.01μF: More than 10,000MΩ</td><td>The insulation resistance should be measured with DC500±50V (DC250±25V in case of rated voltage: DC250V) and within 60±5 sec. of charging.</td></tr>
<tr><td>6</td><td colspan="2">Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/D.F. should be measured at a frequency of 1±0.2kHz and a voltage of AC1±0.2V(r.m.s.)</td></tr>
<tr><td>7</td><td colspan="2">Dissipation Factor (D.F.)</td><td>0.025 max.</td></tr>
<tr><td>8</td><td colspan="2">Capacitance Temperature Characteristics</td><td>Cap. Change
Within ±15%
(Temp. Range: −55 to +125℃)</td><td>The capacitance measurement should be made at each step specified in Table.
<table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>Min. Operating Temp.±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>Max. Operating Temp.±2</td></tr><tr><td>5</td><td>25±2</td></tr></table>•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.</td></tr>
<tr><td>9</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1.
Then apply 10N force in the direction of the arrow.
The soldering should be done 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. 1</td></tr>
<tr><td rowspan="3">10</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).
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 min. This motion should be applied for a period of 2 hrs. in each of 3 mutually perpendicular directions (total of 6 hrs.).

</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
</table>

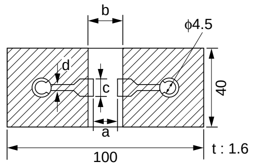
* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Continued on the following page. ↗

Specifications and Test Methods

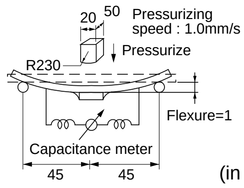
Continued from the preceding page.

No.	Item		Specifications	Test Method
11	Deflection		No cracking or marking defects should occur. (see Fig. 2)	Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2. Then apply a force in the direction shown in Fig. 3. The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock. (see Fig. 3)
12	Solderability of Termination		75% of the terminations are to be soldered evenly and continuously.	Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in solder solution for 2±0.5 sec. Immersing speed: 25±2.5mm/s Temp. of solder: 245±5°C Lead Free Solder (Sn-3.0Ag-0.5Cu) 235±5°C H60A or H63A Eutectic Solder
13	Resistance to Soldering Heat	Appearance	No marking defects	Preheat the capacitor at 120 to 150℃* for 1 min. Immerse the capacitor in solder solution at 260±5℃ for 10±1 sec. Let sit at room condition* for 24±2 hrs., then measure. •Immersing speed: 25±2.5mm/s •Pretreatment Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*. ✻Preheating for more than 3.2×2.5mm (see table below)
		Capacitance Change	Within ±10%	
		D.F.	0.025 max.	
		I.R.	C≧0.01μF: More than 100MΩ • μF C<0.01μF: More than 10,000MΩ	
		Dielectric Strength	In accordance with item No.4	
14	Temperature Cycle	Appearance	No marking defects	Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4. Perform the 5 cycles according to the 4 heat treatments listed in the following table. Let sit for 24±2 hrs. at room condition*, then measure. (see table below) •Pretreatment Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*. (see Fig. 4)
		Capacitance Change	Within ±7.5%	
		D.F.	0.025 max.	
		I.R.	C≧0.01μF: More than 100MΩ • μF C<0.01μF: More than 10,000MΩ	
		Dielectric Strength	In accordance with item No.4	
15	Humidity (Steady State)	Appearance	No marking defects	Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500^{+24}_{-0} hrs. Remove and let sit for 24±2 hrs. at room condition*, then measure. •Pretreatment Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	C≧0.01μF: More than 10MΩ • μF C<0.01μF: More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	



L×W (mm)	Dimension (mm) a	b	c	d
1.6×0.8	1.0	3.0	1.2	1.0
2.0×1.25	1.2	4.0	1.65	
3.2×1.6	2.2	5.0	2.0	
3.2×2.5	2.2	5.0	2.9	
4.5×3.2	3.5	7.0	3.7	
5.7×5.0	4.5	8.0	5.6	

Fig. 2



(in mm)

Fig. 3

✻Preheating for more than 3.2×2.5mm

Step	Temperature	Time
1	100 to 120℃	1 min.
2	170 to 200℃	1 min.

Step	Temperature (℃)	Time (min.)
1	Min. Operating Temp.±3	30±3
2	Room Temp.	2 to 3
3	Max. Operating Temp.±2	30±3
4	Room Temp.	2 to 3

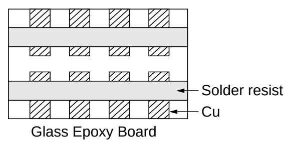


Fig. 4

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Continued on the following page.

Specifications and Test Methods

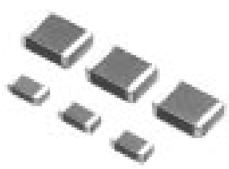
Continued from the preceding page.

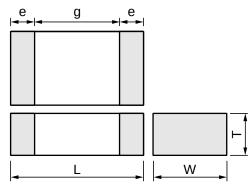
No.	Item		Specifications	Test Method
16	Life	Appearance	No marking defects	Apply 120% of the rated voltage (150% of the rated voltage in case of rated voltage: DC250V, 110% of the rated voltage in case of rated voltage: DC1kV) for $1,000^{+48}_{-0}$ hrs. at maximum operating temperature ±3℃. Remove and let sit for 24 ±2 hrs. at room condition*, then measure. The charge/discharge current is less than 50mA. •Pretreatment Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±15% (rated voltage: DC250V, DC630V) Within ±20% (rated voltage: DC1kV)	
		D.F.	0.05 max.	
		I.R.	C≧0.01μF: More than 10MΩ • μF C<0.01μF: More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	
17	Humidity Loading (Application: DC250V, DC630V item)	Appearance	No marking defects	Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95% for 500^{+24}_{-0} hrs. Remove and let sit for 24±2 hrs. at room condition*, then measure. •Pretreatment Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	C≧0.01μF: More than 10MΩ • μF C<0.01μF: More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Chip Monolithic Ceramic Capacitors

Only for LCD Backlight Inverter Circuit





Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GRM42A	4.5 ±0.3	2.0 ±0.2	1.0 +0, - 0.3	0.3	2.9

■ Features

1. Low-loss and suitable for high frequency circuits
2. Murata's original internal electrode structure realizes high flash-over voltage.
3. A new monolithic structure for small, surface-mountable devices capable of operating at high voltage levels.
4. Sn-plated external electrodes realize good solderability.
5. Only for reflow soldering
6. The capacitors less than 22pF can be applied maximum 4.0kV peak to peak at 100kHz or less only for the ballast or the resonance usage in the LCD backlight inverter circuit.

■ Applications

Ideal for use as the ballast in LCD backlight inverter.

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GRM42A5C3F050DW01L	DC3150	C0G (EIA)	5.0 ±0.5pF	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F100JW01L	DC3150	C0G (EIA)	10 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F120JW01L	DC3150	C0G (EIA)	12 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F150JW01L	DC3150	C0G (EIA)	15 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F180JW01L	DC3150	C0G (EIA)	18 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F220JW01L	DC3150	C0G (EIA)	22 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F270JW01L	DC3150	C0G (EIA)	27 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F330JW01L	DC3150	C0G (EIA)	33 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F390JW01L	DC3150	C0G (EIA)	39 ±5%	4.5	2.0	1.0	2.9	0.3 min.
GRM42A5C3F470JW01L	DC3150	C0G (EIA)	47 ±5%	4.5	2.0	1.0	2.9	0.3 min.

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>−55 to +125℃</td><td>−</td></tr>
<tr><td>2</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>3</td><td colspan="2">Dimensions</td><td>Within the specified dimension</td><td>Using calipers</td></tr>
<tr><td>4</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when DC4095V is applied between the terminations for 1 to 5 sec., provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>5</td><td colspan="2">Insulation Resistance (I.R.)</td><td>More than 10,000MΩ</td><td>The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.</td></tr>
<tr><td>6</td><td colspan="2">Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/Q should be measured at a frequency of 1±0.2MHz and a voltage of AC0.5 to 5V(r.m.s.)</td></tr>
<tr><td>7</td><td colspan="2">Q</td><td>1,000 min.</td></tr>
<tr><td>8</td><td colspan="2">Capacitance Temperature Characteristics</td><td>Temp. Coefficient
0±30 ppm/℃ (Temp. Range: +25 to +125℃)
0+30, −72 ppm/℃ (Temp. Range: −55 to +25℃)</td><td>The capacitance measurement should be made at each step specified in Table.
<table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>Min. Operating Temp.±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>Max. Operating Temp.±2</td></tr><tr><td>5</td><td>25±2</td></tr></table></td></tr>
<tr><td>9</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1.
Then apply 10N force in the direction of the arrow.
The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

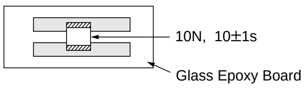
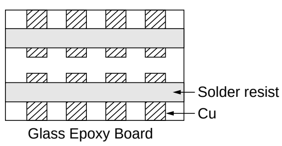
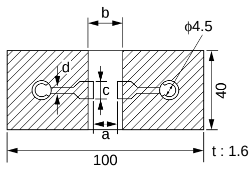
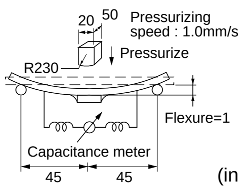



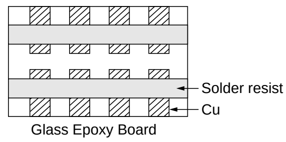
Fig. 1</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board).
The capacitor should be subjected to a simple harmonic motion having a total amplitude 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 min. This motion should be applied for a period of 2 hrs. in each of 3 mutually perpendicular directions (total of 6 hrs.).
</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>Q</td><td>1,000 min.</td></tr>
<tr><td>11</td><td colspan="2">Deflection</td><td>No cracking or marking defects should occur.

<table><tr><th rowspan="2">L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td><td>1.0</td></tr></table>
Fig. 2</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2.
Then apply a force in the direction shown in Fig. 3.
The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

(in mm)
Fig. 3</td></tr>
</table>

Continued on the following page. ↗

Specifications and Test Methods

Continued from the preceding page.

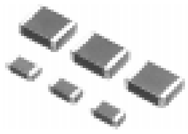
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>12</td><td colspan="2">Solderability of Termination</td><td>75% of the terminations are to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in solder solution for 2±0.5 sec.
Immersing speed: 25±2.5mm/s
Temp. of solder: 245±5°C Lead Free Solder (Sn-3.0Ag-0.5Cu)
235±5°C H60A or H63A Eutectic Solder</td></tr>
<tr><td rowspan="5">13</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Preheat the capacitor as table.
Immerse the capacitor in solder solution at 260±5℃ for 10±1 sec.
Let sit at room condition* for 24±2 hrs., then measure.
•Immersing speed: 25±2.5mm/s

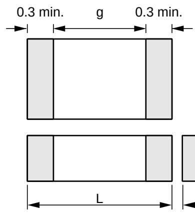
*Preheating<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100 to 120℃</td><td>1 min.</td></tr><tr><td>2</td><td>170 to 200℃</td><td>1 min.</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5%</td></tr>
<tr><td>Q</td><td>1,000 min.</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4.
Perform the 5 cycles according to the 4 heat treatments listed in the following table.
Let sit for 24±2 hrs. at room condition*, then measure.<table><tr><th>Step</th><th>Temperature (℃)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table>Fig. 4</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5%</td></tr>
<tr><td>Q</td><td>1,000 min.</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Humidity (Steady State)</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500^{+24}_{-0} hrs.
Remove and let sit for 24±2 hrs. at room condition*, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0%</td></tr>
<tr><td>Q</td><td>350 min.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Life</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Apply 120% of the rated voltage for $1{,}000^{+48}_{-0}$ hrs. at maximum operating temperature ±3℃.
Remove and let sit for 24±2 hrs. at room condition*, then measure.
The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3.0%</td></tr>
<tr><td>Q</td><td>350 min.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
</table>

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Chip Monolithic Ceramic Capacitors

Only for Information Devices/Tip & Ring





Part Number	Dimensions (mm)			
	L	W	T	g min.
GR442Q	4.5 ±0.3	2.0 ±0.2	1.5 +0, -0.3	2.5
GR443D	4.5 ±0.4	3.2 ±0.3	2.0 +0, -0.3	
GR443Q			1.5 +0, -0.3	
GR455D	5.7 ±0.4	5.0 ±0.4	2.0 +0, -0.3	3.2

■ Features

1. These items are designed specifically for telecommunications devices (IEEE802.3) in Ethernet LAN and primary-secondary coupling for DC-DC converter.
2. A new monolithic structure for small, high capacitance capable of operating at high voltage levels
3. Sn-plated external electrodes realizes good solderability.
4. Only for reflow soldering
5. The low-profile type (thickness: 1.5mm max.) is available. Fit for use on thinner type equipment.

■ Applications

1. Ideal for use on telecommunications devices in Ethernet LAN
2. Ideal for use as primary-secondary coupling for DC-DC converter

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GR442QR73D101KW01L	DC2000	X7R (EIA)	100 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D121KW01L	DC2000	X7R (EIA)	120 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D151KW01L	DC2000	X7R (EIA)	150 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D181KW01L	DC2000	X7R (EIA)	180 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D221KW01L	DC2000	X7R (EIA)	220 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D271KW01L	DC2000	X7R (EIA)	270 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D331KW01L	DC2000	X7R (EIA)	330 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D391KW01L	DC2000	X7R (EIA)	390 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D471KW01L	DC2000	X7R (EIA)	470 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D561KW01L	DC2000	X7R (EIA)	560 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D681KW01L	DC2000	X7R (EIA)	680 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D821KW01L	DC2000	X7R (EIA)	820 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D102KW01L	DC2000	X7R (EIA)	1000 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D122KW01L	DC2000	X7R (EIA)	1200 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR442QR73D152KW01L	DC2000	X7R (EIA)	1500 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GR443QR73D182KW01L	DC2000	X7R (EIA)	1800 ±10%	4.5	3.2	1.5	2.5	0.3 min.
GR443QR73D222KW01L	DC2000	X7R (EIA)	2200 ±10%	4.5	3.2	1.5	2.5	0.3 min.
GR443QR73D272KW01L	DC2000	X7R (EIA)	2700 ±10%	4.5	3.2	1.5	2.5	0.3 min.
GR443QR73D332KW01L	DC2000	X7R (EIA)	3300 ±10%	4.5	3.2	1.5	2.5	0.3 min.
GR443QR73D392KW01L	DC2000	X7R (EIA)	3900 ±10%	4.5	3.2	1.5	2.5	0.3 min.
GR443DR73D472KW01L	DC2000	X7R (EIA)	4700 ±10%	4.5	3.2	2.0	2.5	0.3 min.
GR455DR73D103KW01L	DC2000	X7R (EIA)	10000 ±10%	5.7	5.0	2.0	3.2	0.3 min.

Specifications and Test Methods

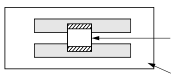
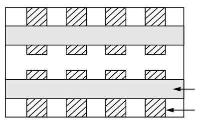
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>−55 to +125℃</td><td>—</td></tr>
<tr><td>2</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>3</td><td colspan="2">Dimensions</td><td>Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>4</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when voltage in table is applied between the terminations, provided the charge/discharge current is less than 50mA.
<table>
<tr><th>Rated Voltage</th><th>Test Voltage</th><th>Time</th></tr>
<tr><td rowspan="2">DC2kV</td><td>120% of the rated voltage</td><td>60±1 sec.</td></tr>
<tr><td>AC1500V(r.m.s.)</td><td>60±1 sec.</td></tr>
</table></td></tr>
<tr><td>5</td><td colspan="2">Pulse Voltage</td><td>No self healing breakdowns or flash-overs have taken place in the capacitor.</td><td>10 impulse of alternating polarity is subjected.
(5 impulse for each polarity)
The interval between impulse is 60 sec.
Applied Voltage: 2.5kV zero to peak</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>More than 6,000MΩ</td><td>The insulation resistance should be measured with DC500±50V and within 60±5 sec. 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 a frequency of 1±0.2kHz and a voltage of AC1±0.2V(r.m.s.)</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>0.025 max.</td></tr>
<tr><td>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td>Cap. Change
within ±15%
(Temp. Range: −55 to +125℃)</td><td>The capacitance measurement should be made at each step specified in Table.
<table>
<tr><th>Step</th><th>Temperature (℃)</th></tr>
<tr><td>1</td><td>25±2</td></tr>
<tr><td>2</td><td>Min. Operating Temp.±3</td></tr>
<tr><td>3</td><td>25±2</td></tr>
<tr><td>4</td><td>Max. Operating Temp.±2</td></tr>
<tr><td>5</td><td>25±2</td></tr>
</table>
•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1.
Then apply 10N force in the direction of the arrow.
The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.


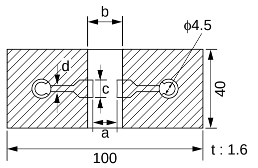
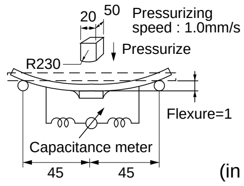
Fig. 1</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board).
The capacitor should be subjected to a simple harmonic motion having a total amplitude 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 min. This motion should be applied for a period of 2 hrs. in each of 3 mutually perpendicular directions (total of 6 hrs.).

</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
</table>

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

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>12</td><td colspan="2">Deflection</td><td>No cracking or marking defects should occur.

<table>
<tr><th>L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr>
<tr><th></th><th>a</th><th>b</th><th>c</th><th>d</th></tr>
<tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td><td rowspan="3">1.0</td></tr>
<tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr>
<tr><td>5.7×5.0</td><td>4.5</td><td>8.0</td><td>5.6</td></tr>
</table>
Fig. 2</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2.
Then apply a force in the direction shown in Fig. 3.
The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

(in mm)
Fig. 3</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).
Immerse in solder solution for 2±0.5 sec.
Immersing speed: 25±2.5mm/s
Temp. of solder: 245±5°C Lead Free Solder (Sn-3.0Ag-0.5Cu)
235±5°C H60A or H63A Eutectic Solder</td></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Preheat the capacitor as table.
Immerse the capacitor in solder solution at 260±5℃ for 10±1 sec. Let sit at room condition* for 24±2 hrs., then measure.
•Immersing speed: 25±2.5mm/s
•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.

*Preheating
<table>
<tr><th>Step</th><th>Temperature</th><th>Time</th></tr>
<tr><td>1</td><td>100 to 120℃</td><td>1 min.</td></tr>
<tr><td>2</td><td>170 to 200℃</td><td>1 min.</td></tr>
</table></td></tr>
<tr><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4.
Perform the 5 cycles according to the 4 heat treatments listed in the following table.
Let sit for 24±2 hrs. at room condition*, then measure.
<table>
<tr><th>Step</th><th>Temperature (℃)</th><th>Time (min.)</th></tr>
<tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr>
<tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr>
<tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr>
<tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr>
</table>
•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.

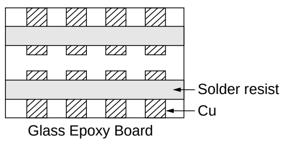



Fig. 4</td></tr>
<tr><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Humidity (Steady State)</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500^{+24}_{-0} hrs.
Remove and let sit for 24±2 hrs. at room condition*, then measure.
•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
</table>

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Continued on the following page.

Specifications and Test Methods

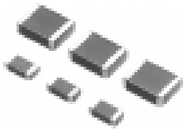
Continued from the preceding page.

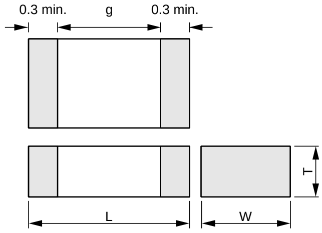
No.	Item		Specifications	Test Method
17	Life	Appearance	No marking defects	Apply 110% of the rated voltage for 1,000 $^{+48}_{-0}$ hrs. at maximum operating temperature ±3℃. Remove and let sit for 24 ±2 hrs. at room condition*, then measure. The charge/discharge current is less than 50mA. •Pretreatment Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±20%	
		D.F.	0.05 max.	
		I.R.	More than 2,000MΩ	
		Dielectric Strength	In accordance with item No.4	

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Chip Monolithic Ceramic Capacitors

Only for Camera Flash Circuit





■ Features

1. Suitable for the trigger of the flash circuit, because real capacitance is stable during operating voltage.
2. The thin type fit for thinner camera.
3. Sn-plated external electrodes realizes good solderability.
4. For flow and reflow soldering

Part Number	Dimensions (mm)			
	L	W	T	g min.
GR731A	3.2 ±0.2	1.6 ±0.2	1.0 +0, -0.3	1.2
GR731B			1.25 +0, -0.3	
GR731C			1.6 ±0.2	

■ Applications

For strobe circuit

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GR731AW0BB103KW01D	DC350	-	10000 ±10%	3.2	1.6	1.0	1.2	0.3 min.
GR731AW0BB153KW01D	DC350	-	15000 ±10%	3.2	1.6	1.0	1.2	0.3 min.
GR731BW0BB223KW01L	DC350	-	22000 ±10%	3.2	1.6	1.25	1.2	0.3 min.
GR731BW0BB333KW01L	DC350	-	33000 ±10%	3.2	1.6	1.25	1.2	0.3 min.
GR731CW0BB473KW03L	DC350	-	47000 ±10%	3.2	1.6	1.6	1.2	0.3 min.

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>−55 to +125℃</td><td>−</td></tr>
<tr><td>2</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>3</td><td colspan="2">Dimensions</td><td>Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>4</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when DC500V is applied between the terminations for 1 to 5 sec., provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>5</td><td colspan="2">Insulation Resistance (I.R.)</td><td>C≧0.01μF: More than 100MΩ • μF
C<0.01μF: More than 10,000MΩ</td><td>The insulation resistance should be measured with DC250±50V and within 60±5 sec. of charging.</td></tr>
<tr><td>6</td><td colspan="2">Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/D.F. should be measured at a frequency of 1±0.2kHz and a voltage of AC1±0.2V(r.m.s.)</td></tr>
<tr><td>7</td><td colspan="2">Dissipation Factor (D.F.)</td><td>0.025 max.</td></tr>
<tr><td>8</td><td colspan="2">Capacitance Temperature Characteristics</td><td>Cap. Change
Within ±10% (Apply DC350V bias)
Within $^{+22}_{-33}$% (No DC bias)
(Temp. Range : −55 to +125℃)</td><td>The capacitance measurement should be made at each step specified in Table.
<table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>Min. Operating Temp.±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>Max. Operating Temp.±2</td></tr><tr><td>5</td><td>25±2</td></tr></table>•Pretreatment
Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.</td></tr>
<tr><td>9</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1.
Then apply 10N force in the direction of the arrow.
The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

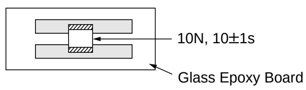
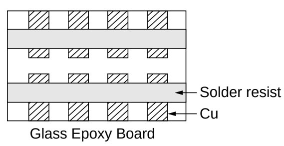



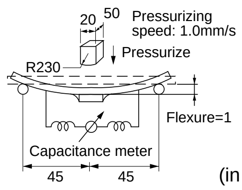
Fig. 1</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board).
The capacitor should be subjected to a simple harmonic motion having a total amplitude 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 min. This motion should be applied for a period of 2 hrs. in each of 3 mutually perpendicular directions (total of 6 hrs.).
</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
</table>

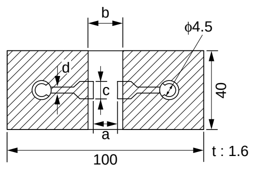
* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

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="2">11</td><td colspan="2" rowspan="2">Deflection</td><td>No cracking or marking defects should occur.</td><td rowspan="2">Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2.
Then apply a force in the direction shown in Fig. 3.
The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.


(in mm)
Fig. 3</td></tr>
<tr><td>

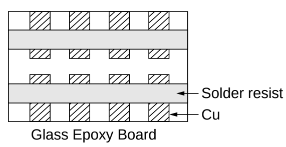
<table><tr><th>L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr><tr><th></th><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>3.2×1.6</td><td>2.2</td><td>5.0</td><td>2.0</td><td>1.0</td></tr></table>
Fig. 2</td></tr>
<tr><td>12</td><td colspan="2">Solderability of Termination</td><td>75% of the 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).
Immerse in solder solution for 2±0.5 sec.
Immersing speed: 25±2.5mm/s
Temp. of solder: 245±5°C Lead Free Solder (Sn-3.0Ag-0.5Cu)
235±5°C H60A or H63A Eutectic Solder</td></tr>
<tr><td rowspan="5">13</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Preheat the capacitor at 120 to 150℃* for 1 min.
Immerse the capacitor in solder solution at 260±5℃ for 10±1 sec. Let sit at room condition* for 24±2 hrs., then measure.
•Immersing speed: 25±2.5mm/s
•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>C≧0.01μF: More than 100MΩ • μF
C<0.01μF: More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4.
Perform the 5 cycles according to the 4 heat treatments listed in the following table.
Let sit for 24±2 hrs. at room condition*, then measure.
<table><tr><th>Step</th><th>Temperature (℃)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table>
•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.


Fig. 4</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>C≧0.01μF: More than 100MΩ • μF
C<0.01μF: More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Humidity (Steady State)</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500^{+24}_{-0} hrs.
Remove and let sit for 24±2 hrs. at room condition*, then measure.
•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>C≧0.01μF: More than 10MΩ • μF
C<0.01μF: More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
</table>

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

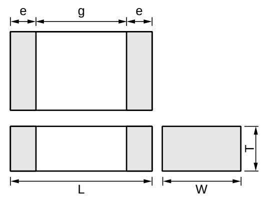
No.	Item		Specifications	Test Method
16	Life	Appearance	No marking defects	Apply DC350V for 1,000 $^{+48}_{-0}$ hrs. at maximum operating temperature ±3℃. Remove and let sit for 24 ±2 hrs. at room condition*, then measure. The charge/discharge current is less than 50mA. •Pretreatment Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	C≧0.01μF: More than 10MΩ • μF C<0.01μF: More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	
17	Humidity Loading	Appearance	No marking defects	Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95% for 500 $^{+24}_{-0}$ hrs. Remove and let sit for 24±2 hrs. at room condition*, then measure. •Pretreatment Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	C≧0.01μF: More than 10MΩ • μF C<0.01μF: More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

15

Chip Monolithic Ceramic Capacitors

AC250V (r.m.s.) Type (Which Meet Japanese Law)



Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GA242Q	4.5 ±0.3	2.0 ±0.2	1.5 +0, -0.3		
GA243D	4.5 ±0.4	3.2 ±0.3	2.0 +0, -0.3	0.3	2.5
GA243Q			1.5 +0, -0.3		
GA255D	5.7 ±0.4	5.0 ±0.4	2.0 +0, -0.3		3.2

■ Features

1. Chip monolithic ceramic capacitor for AC lines.
2. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
3. Sn-plated external electrodes realizes good solderability.
4. Only for reflow soldering
5. Capacitance 0.01 to 0.1uF for connecting lines and 470 to 4700pF for connecting lines to earth.

■ Applications

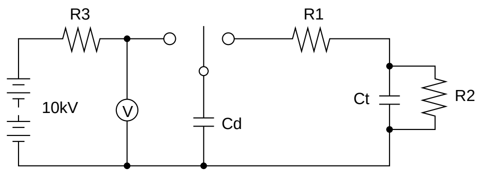
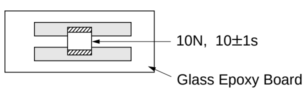
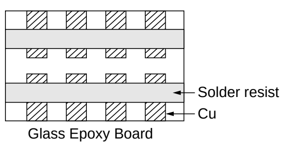
Noise suppression filters for switching power supplies, telephones, facsimiles, modems.

■ Reference standard

GA2 series obtains no safety approval.
This series is based on the standards of the electrical appliance and material safety law of Japan (separated table 4).

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GA242QR7E2471MW01L	AC250 (r.m.s.)	X7R (EIA)	470pF ±20%	4.5	2.0	1.5	2.5	0.3 min.
GA242QR7E2102MW01L	AC250 (r.m.s.)	X7R (EIA)	1000pF ±20%	4.5	2.0	1.5	2.5	0.3 min.
GA243QR7E2222MW01L	AC250 (r.m.s.)	X7R (EIA)	2200pF ±20%	4.5	3.2	1.5	2.5	0.3 min.
GA243QR7E2332MW01L	AC250 (r.m.s.)	X7R (EIA)	3300pF ±20%	4.5	3.2	1.5	2.5	0.3 min.
GA243DR7E2472MW01L	AC250 (r.m.s.)	X7R (EIA)	4700pF ±20%	4.5	3.2	2.0	2.5	0.3 min.
GA243QR7E2103MW01L	AC250 (r.m.s.)	X7R (EIA)	10000pF ±20%	4.5	3.2	1.5	2.5	0.3 min.
GA243QR7E2223MW01L	AC250 (r.m.s.)	X7R (EIA)	22000pF ±20%	4.5	3.2	1.5	2.5	0.3 min.
GA243DR7E2473MW01L	AC250 (r.m.s.)	X7R (EIA)	47000pF ±20%	4.5	3.2	2.0	2.5	0.3 min.
GA255DR7E2104MW01L	AC250 (r.m.s.)	X7R (EIA)	0.10µF ±20%	5.7	5.0	2.0	3.2	0.3 min.

Specifications and Test Methods

No.	Item		Specifications	Test Method
1	Operating Temperature Range		−55 to +125℃	−
2	Appearance		No defects or abnormalities	Visual inspection
3	Dimensions		Within the specified dimensions	Using calipers
4	Dielectric Strength		No defects or abnormalities	No failure should be observed when voltage in table is applied between the terminations for 60±1 sec., provided the charge/discharge current is less than 50mA. <table><tr><th>Nominal Capacitance</th><th>Test Voltage</th></tr><tr><td>C≧10,000pF</td><td>AC575V (r.m.s.)</td></tr><tr><td>C<10,000pF</td><td>AC1500V (r.m.s.)</td></tr></table>
5	Insulation Resistance (I.R.)		More than 2,000MΩ	The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.
6	Capacitance		Within the specified tolerance	The capacitance/D.F. should be measured at a frequency of 1±0.2kHz and a voltage of AC1±0.2V (r.m.s.)
7	Dissipation Factor (D.F.)		0.025 max.	
8	Capacitance Temperature Characteristics		Cap. Change Within ±15% (Temp. Range: −55 to +125℃)	The capacitance measurement should be made at each step specified in Table. <table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>Min. Operating Temp.±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>Max. Operating Temp.±2</td></tr><tr><td>5</td><td>25±2</td></tr></table>•Pretreatment Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.
9	Discharge Test (Application: Nominal Capacitance C<10,000pF)	Appearance	No defects or abnormalities	As in Fig., discharge is made 50 times at 5 sec. intervals from the capacitor (Cd) charged at DC voltage of specified.  Ct: Capacitor under test Cd: 0.001μF R1: 1,000Ω R2: 100MΩ R3: Surge resistance
10	Adhesive Strength of Termination		No removal of the terminations or other defects should occur.	Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1. Then apply 10N force in the direction of the arrow. The soldering should be done 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. 1
11	Vibration Resistance	Appearance	No defects or abnormalities	Solder the capacitor to the test jig (glass epoxy board). 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 min. This motion should be applied for a period of 2 hrs. in each of 3 mutually perpendicular directions (total of 6 hrs.). 
		Capacitance	Within the specified tolerance	
		D.F.	0.025 max.	

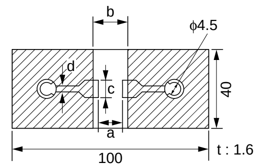
* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Continued on the following page.

Specifications and Test Methods

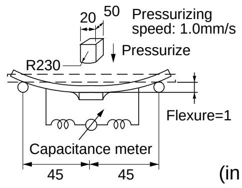
Continued from the preceding page.

No.	Item		Specifications	Test Method
12	Deflection		No cracking or marking defects should occur.	Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2. Then apply a force in the direction shown in Fig. 3. The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
13	Solderability of Termination		75% of the terminations are to be soldered evenly and continuously.	Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in solder solution for 2±0.5 sec. Immersing speed: 25±2.5mm/s Temp. of solder: 245±5°C Lead Free Solder (Sn-3.0Ag-0.5Cu) 235±5°C H60A or H63A Eutectic Solder
14	Humidity Insulation	Appearance	No marking defects	The capacitor should be subjected to 40±2℃, relative humidity of 90 to 98% for 8 hrs., and then removed in room condition* for 16 hrs. until 5 cycles.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	
15	Resistance to Soldering Heat	Appearance	No marking defects	Preheat the capacitor as table. Immerse the capacitor in solder solution at 260±5℃ for 10±1 sec. Let sit at room condition* for 24±2 hrs., then measure. •Immersing speed: 25±2.5mm/s •Pretreatment Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*. *Preheating
		Capacitance Change	Within ±10%	
		D.F.	0.025 max.	
		I.R.	More than 2,000MΩ	
		Dielectric Strength	In accordance with item No.4	
16	Temperature Cycle	Appearance	No marking defects	Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4. Perform the 5 cycles according to the 4 heat treatments listed in the following table. Let sit for 24±2 hrs. at room condition*, then measure.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 2,000MΩ	
		Dielectric Strength	In accordance with item No.4	•Pretreatment Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.



L×W (mm)	Dimension (mm) a	b	c	d
4.5×2.0	3.5	7.0	2.4	1.0
4.5×3.2	3.5	7.0	3.7	
5.7×5.0	4.5	8.0	5.6	

Fig. 2



(in mm)

Fig. 3

Step	Temperature	Time
1	100 to 120℃	1 min.
2	170 to 200℃	1 min.

Step	Temperature (℃)	Time (min.)
1	Min. Operating Temp.±3	30±3
2	Room Temp.	2 to 3
3	Max. Operating Temp.±2	30±3
4	Room Temp.	2 to 3

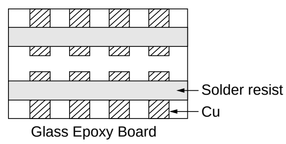


Fig. 4

* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

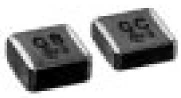
No.	Item		Specifications	Test Method
17	Humidity (Steady State)	Appearance	No marking defects	Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500$^{+24}_{\ 0}$ hrs. Remove and let sit for 24±2 hrs. at room condition*, then measure. •Pretreatment Perform a heat treatment at 150$^{\ 0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	
18	Life	Appearance	No marking defects	Apply voltage and time as Table at maximum operating temperature ±3℃. Remove and let sit for 24±2 hrs. at room condition*, then measure. The charge / discharge current is less than 50mA. Nominal Capacitance / Test Time / Test Voltage: C≧10,000pF / 1,000$^{+48}_{\ 0}$ hrs. / AC300V (r.m.s.) C<10,000pF / 1,500$^{+48}_{\ 0}$ hrs. / AC500V (r.m.s.) ✻ ✻ Except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec. •Pretreatment Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±20%	
		D.F.	0.05 max.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	
19	Humidity Loading	Appearance	No marking defects	Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95% for 500$^{+24}_{\ 0}$ hrs. Remove and let sit for 24±2 hrs. at room condition*, then measure. •Pretreatment Apply test voltage for 60±5 min. at test temperature. Remove and let sit for 24±2 hrs. at room condition*.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	

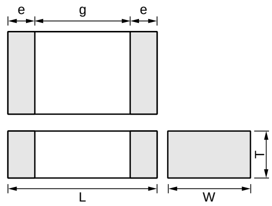
* "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

Chip Monolithic Ceramic Capacitors

muRata

Safety Standard Recognized Type GC (UL, IEC60384-14 Class X1/Y2)





Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GA355D	5.7 ±0.4	5.0 ±0.4	2.0 ±0.3	0.3	4.0

■ Features

1. Chip monolithic ceramic capacitor (certified as conforming to safety standards) for AC lines.
2. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
3. Compared to lead type capacitors, this new capacitor is greatly downsized and low-profiled to 1/10 or less in volume, and 1/4 or less in height.
4. The type GC can be used as an X1-class and Y2-class capacitor, line-by-pass capacitor of UL1414.
5. +125 degree C guaranteed
6. Only for reflow soldering

■ Applications

1. Ideal for use as Y capacitor or X capacitor for various switching power supplies
2. Ideal for modem applications

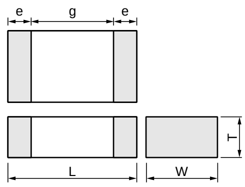
■ Standard Recognition

	Standard No.	Class	Rated Voltage
UL	UL1414	Line By-pass	AC250V (r.m.s.)
VDE	IEC 60384-14 EN 60384-14	X1, Y2	
BSI	EN 60065 (14.2) IEC 60384-14 EN 60384-14		
SEMKO	IEC 60384-14 EN 60384-14		
ESTI	EN 60065 IEC 60384-14		

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GA355DR7GC101KY02L	AC250 (r.m.s.)	X7R (EIA)	100 ±10%	5.7	5.0	2.0	4.0	0.3 min.
GA355DR7GC151KY02L	AC250 (r.m.s.)	X7R (EIA)	150 ±10%	5.7	5.0	2.0	4.0	0.3 min.
GA355DR7GC221KY02L	AC250 (r.m.s.)	X7R (EIA)	220 ±10%	5.7	5.0	2.0	4.0	0.3 min.
GA355DR7GC331KY02L	AC250 (r.m.s.)	X7R (EIA)	330 ±10%	5.7	5.0	2.0	4.0	0.3 min.

Chip Monolithic Ceramic Capacitors

Safety Standard Recognized Type GD (IEC60384-14 Class Y3)



■ Features

1. Available for equipment based on IEC/EN60950 and UL1950
2. The type GD can be used as a Y3-class capacitor.
3. A new monolithic structure for small, high capacitance capable of operating at high voltage levels
4. +125 degree C guaranteed
5. Only for reflow soldering
6. The low-profile type (thickness: 1.5mm max.) is available. Fit for use on thinner type equipment.

Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GA342A	4.5 ±0.3	2.0 ±0.2	1.0 +0, -0.3	0.3	2.5
GA342D			2.0 ±0.3		
GA342Q			1.5 +0, -0.3		
GA343D	4.5 ±0.4	3.2 ±0.3	2.0 +0, -0.3		
GA343Q			1.5 +0, -0.3		

■ Applications

1. Ideal for use on line filters and couplings for DAA modems without transformers
2. Ideal for use on line filters for information equipment

■ Standard Recognition

	Standard No.	Class	Rated Voltage
UL	UL 60950-1	Y3	AC250V(r.m.s.)
SEMKO	IEC 60384-14 EN 60384-14		

Applications

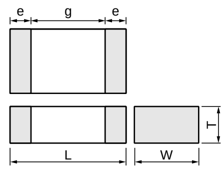
Size	Switching power supplies	Communication network devices such as a modem
4.5×3.2mm and under	–	◎

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GA342D1XGD100JY02L	AC250 (r.m.s.)	SL (JIS)	10 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD120JY02L	AC250 (r.m.s.)	SL (JIS)	12 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD150JY02L	AC250 (r.m.s.)	SL (JIS)	15 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD180JY02L	AC250 (r.m.s.)	SL (JIS)	18 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD220JY02L	AC250 (r.m.s.)	SL (JIS)	22 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342A1XGD270JW31L	AC250 (r.m.s.)	SL (JIS)	27 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGD330JW31L	AC250 (r.m.s.)	SL (JIS)	33 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGD390JW31L	AC250 (r.m.s.)	SL (JIS)	39 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGD470JW31L	AC250 (r.m.s.)	SL (JIS)	47 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGD560JW31L	AC250 (r.m.s.)	SL (JIS)	56 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGD680JW31L	AC250 (r.m.s.)	SL (JIS)	68 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGD820JW31L	AC250 (r.m.s.)	SL (JIS)	82 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342QR7GD101KW01L	AC250 (r.m.s.)	X7R (EIA)	100 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342QR7GD151KW01L	AC250 (r.m.s.)	X7R (EIA)	150 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342QR7GD221KW01L	AC250 (r.m.s.)	X7R (EIA)	220 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342QR7GD331KW01L	AC250 (r.m.s.)	X7R (EIA)	330 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342QR7GD471KW01L	AC250 (r.m.s.)	X7R (EIA)	470 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342QR7GD681KW01L	AC250 (r.m.s.)	X7R (EIA)	680 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342QR7GD102KW01L	AC250 (r.m.s.)	X7R (EIA)	1000 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342QR7GD152KW01L	AC250 (r.m.s.)	X7R (EIA)	1500 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA343QR7GD182KW01L	AC250 (r.m.s.)	X7R (EIA)	1800 ±10%	4.5	3.2	1.5	2.5	0.3 min.
GA343QR7GD222KW01L	AC250 (r.m.s.)	X7R (EIA)	2200 ±10%	4.5	3.2	1.5	2.5	0.3 min.
GA343DR7GD472KW01L	AC250 (r.m.s.)	X7R (EIA)	4700 ±10%	4.5	3.2	2.0	2.5	0.3 min.

Chip Monolithic Ceramic Capacitors

muRata

Safety Standard Recognized Type GF (IEC60384-14 Class Y2, X1/Y2)



Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GA342A	4.5 ±0.3	2.0 ±0.2	1.0 +0, -0.3	0.3	2.5
GA342D			2.0 ±0.2*		
GA342Q			1.5 +0, -0.3		
GA352Q	5.7 ±0.4	2.8 ±0.3	1.5 +0, -0.3		4.0
GA355D		5.0 ±0.4	2.0 +0, -0.3		
GA355Q			1.5 +0, -0.3		

* GA342D1X : 2.0±0.3

■ Features

1. Available for equipment based on IEC/EN60950 and UL1950. Besides, the GA352/355 types are available for equipment based on IEC/EN60065, UL1492, and UL6500
2. The type GF can be used as a Y2-class capacitor.
3. A new monolithic structure for small, high capacitance capable of operating at high voltage levels
4. +125 degree C guaranteed
5. Only for reflow soldering
6. The low-profile type (thickness: 1.5mm max.) is available. Fit for use on thinner type equipment.

■ Applications

1. Ideal for use on line filters and couplings for DAA modems without transformers
2. Ideal for use on line filters for information equipment
3. Ideal for use as Y capacitor or X capacitor for various switching power supplies (GA352/355 types only)

■ Standard Recognition

	Standard No.	Class	Status of Recognition		Rated Voltage
			Size : 4.5×2.0mm	Size : 5.7×2.8mm and over	
UL	UL1414	X1, Y2	—	◎	AC250V (r.m.s.)
	UL 60950-1	—	◎	—	
SEMKO	IEC 60384-14 EN 60384-14	Y2	◎	◎	

Applications

Size	Switching power supplies	Communication network devices such as a modem
4.5×2.0mm	—	◎
5.7×2.8mm and over	◎	◎

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GA342D1XGF100JY02L	AC250 (r.m.s.)	SL (JIS)	10 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF120JY02L	AC250 (r.m.s.)	SL (JIS)	12 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF150JY02L	AC250 (r.m.s.)	SL (JIS)	15 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF180JY02L	AC250 (r.m.s.)	SL (JIS)	18 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF220JY02L	AC250 (r.m.s.)	SL (JIS)	22 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342A1XGF270JW31L	AC250 (r.m.s.)	SL (JIS)	27 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGF330JW31L	AC250 (r.m.s.)	SL (JIS)	33 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGF390JW31L	AC250 (r.m.s.)	SL (JIS)	39 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGF470JW31L	AC250 (r.m.s.)	SL (JIS)	47 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGF560JW31L	AC250 (r.m.s.)	SL (JIS)	56 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGF680JW31L	AC250 (r.m.s.)	SL (JIS)	68 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342A1XGF820JW31L	AC250 (r.m.s.)	SL (JIS)	82 ±5%	4.5	2.0	1.0	2.5	0.3 min.
GA342QR7GF101KW01L	AC250 (r.m.s.)	X7R (EIA)	100 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342QR7GF151KW01L	AC250 (r.m.s.)	X7R (EIA)	150 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA342DR7GF221KW02L	AC250 (r.m.s.)	X7R (EIA)	220 ±10%	4.5	2.0	2.0	2.5	0.3 min.
GA342DR7GF331KW02L	AC250 (r.m.s.)	X7R (EIA)	330 ±10%	4.5	2.0	2.0	2.5	0.3 min.
GA342QR7GF471KW01L	AC250 (r.m.s.)	X7R (EIA)	470 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA352QR7GF471KW01L	AC250 (r.m.s.)	X7R (EIA)	470 ±10%	5.7	2.8	1.5	4.0	0.3 min.
GA342QR7GF681KW01L	AC250 (r.m.s.)	X7R (EIA)	680 ±10%	4.5	2.0	1.5	2.5	0.3 min.
GA352QR7GF681KW01L	AC250 (r.m.s.)	X7R (EIA)	680 ±10%	5.7	2.8	1.5	4.0	0.3 min.
GA342DR7GF102KW02L	AC250 (r.m.s.)	X7R (EIA)	1000 ±10%	4.5	2.0	2.0	2.5	0.3 min.
GA352QR7GF102KW01L	AC250 (r.m.s.)	X7R (EIA)	1000 ±10%	5.7	2.8	1.5	4.0	0.3 min.
GA352QR7GF152KW01L	AC250 (r.m.s.)	X7R (EIA)	1500 ±10%	5.7	2.8	1.5	4.0	0.3 min.

Continued on the following page. ↗

Continued from the preceding page.

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GA355QR7GF182KW01L	AC250 (r.m.s.)	X7R (EIA)	1800 ±10%	5.7	5.0	1.5	4.0	0.3 min.
GA355QR7GF222KW01L	AC250 (r.m.s.)	X7R (EIA)	2200 ±10%	5.7	5.0	1.5	4.0	0.3 min.
GA355QR7GF332KW01L	AC250 (r.m.s.)	X7R (EIA)	3300 ±10%	5.7	5.0	1.5	4.0	0.3 min.
GA355DR7GF472KW01L	AC250 (r.m.s.)	X7R (EIA)	4700 ±10%	5.7	5.0	2.0	4.0	0.3 min.

Chip Monolithic Ceramic Capacitors

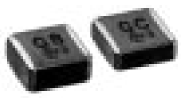
Safety Standard Recognized Type GB (IEC60384-14 Class X2)

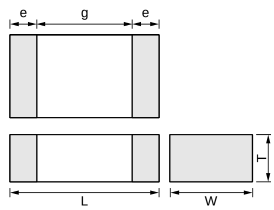
■ Features

1. The type GB can be used as an X2-class capacitor.
2. Chip monolithic ceramic capacitor (certified as conforming to safety standards) for AC lines
3. A new monolithic structure for small, high capacitance capable of operating at high voltage levels
4. Compared to lead type capacitors, this new capacitor is greatly downsized and low-profiled to 1/10 or less in volume, and 1/4 or less in height.
5. +125 degree C guaranteed
6. Only for reflow soldering

■ Applications

Ideal for use as X capacitor for various switching power supplies





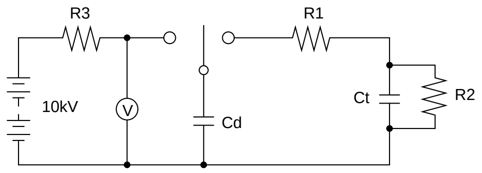
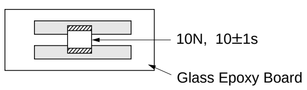
Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GA355D	5.7 ±0.4	5.0 ±0.4	2.0 ±0.3	0.3	4.0
GA355X			2.7 ±0.3		

■ Standard Recognition

	Standard No.	Class	Rated Voltage
VDE	IEC 60384-14 EN 60384-14	X2	AC250V (r.m.s.)
SEMKO			
ESTI			

Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GA355DR7GB103KY02L	AC250 (r.m.s.)	X7R (EIA)	10000 ±10%	5.7	5.0	2.0	4.0	0.3 min.
GA355DR7GB153KY02L	AC250 (r.m.s.)	X7R (EIA)	15000 ±10%	5.7	5.0	2.0	4.0	0.3 min.
GA355DR7GB223KY02L	AC250 (r.m.s.)	X7R (EIA)	22000 ±10%	5.7	5.0	2.0	4.0	0.3 min.
GA355XR7GB333KY06L	AC250 (r.m.s.)	X7R (EIA)	33000 ±10%	5.7	5.0	2.7	4.0	0.3 min.

GA3 Series Specifications and Test Methods

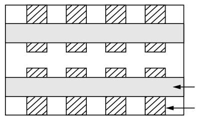
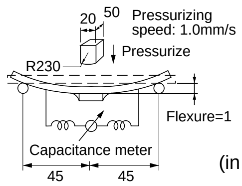
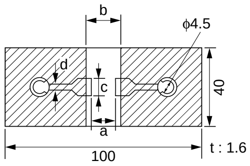
No.	Item	Specifications	Test Method
1	Operating Temperature Range	−55 to +125℃	–
2	Appearance	No defects or abnormalities	Visual inspection
3	Dimensions	Within the specified dimensions	Using calipers
4	Dielectric Strength	No defects or abnormalities	No failure should be observed when voltage in table is applied between the terminations for 60±1 sec., provided the charge/discharge current is less than 50mA. (Type / Test Voltage) Type GB: DC1075V Type GC/GD/GF: AC1500V (r.m.s.)
5	Pulse Voltage (Application: Type GD/GF)	No self healing breakdowns or flash-overs have taken place in the capacitor.	10 impulse of alternating polarity is subjected. (5 impulse for each polarity) The interval between impulse is 60 sec. Applied Voltage: 2.5kV zero to peak
6	Insulation Resistance (I.R.)	More than 6,000MΩ	The insulation resistance should be measured with DC500±50V and within 60±5 sec. of charging.
7	Capacitance	Within the specified tolerance	The capacitance/Q/D.F. should be measured at a frequency of 1±0.2kHz (SL char.: 1±0.2MHz) and a voltage of AC1±0.2V (r.m.s.)
8	Dissipation Factor (D.F.) Q	(Char. / Specification) X7R: D.F.≦0.025 SL: Q≧400+20C*2 (C<30pF) Q≧1000 (C≧30pF)	
9	Capacitance Temperature Characteristics	(Char. / Capacitance Change) X7R: Within ±15% Temperature characteristic guarantee is −55 to +125℃ (Char. / Temperature Coefficient) SL: +350 to −1000ppm/℃ Temperature characteristic guarantee is +20 to +85℃	The capacitance measurement should be made at each step specified in Table. (Step / Temperature (℃)) 1: 25±2 (20±2 for SL char.) 2: Min. Operating Temp.±3 3: 25±2 (20±2 for SL char.) 4: Max. Operating Temp.±2 5: 25±2 (20±2 for SL char.) SL char. : The capacitance should be measured at even 85℃ between step 3 and step 4. •Pretreatment for X7R char. Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*1.
10	Discharge Test (Application: Type GC) — Appearance	No defects or abnormalities	As in Fig., discharge is made 50 times at 5 sec. intervals from the capacitor (Cd) charged at DC voltage of specified.  Ct: Capacitor under test Cd: 0.001μF R1: 1,000Ω R2: 100MΩ R3: Surge resistance
	I.R.	More than 1,000MΩ	
	Dielectric Strength	In accordance with item No.4	
11	Adhesive Strength of Termination	No removal of the terminations or other defect should occur.	Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 1. Then apply 10N force in the direction of the arrow. The soldering should be done 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. 1

*1 "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa
*2 "C" expresses nominal capacitance value (pF).

Continued on the following page.

GA3 Series 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="3">12</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).
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 min. This motion should be applied for a period of 2 hrs. in each of 3 mutually perpendicular directions (total of 6 hrs.).
</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.025</td></tr><tr><td>SL</td><td>Q≧400+20C*2 (C<30pF)
Q≧1000 (C≧30pF)</td></tr></table></td></tr>
<tr><td rowspan="2">13</td><td colspan="2" rowspan="2">Deflection</td><td>No cracking or marking defects should occur.</td><td rowspan="2">Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2.
Then apply a force in the direction shown in Fig. 3. The soldering should be done using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
(in mm)
Fig. 3</td></tr>
<tr><td><table><tr><th rowspan="2">L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td><td rowspan="4">1.0</td></tr><tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>5.7×2.8</td><td>4.5</td><td>8.0</td><td>3.2</td></tr><tr><td>5.7×5.0</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table>Fig. 2</td></tr>
<tr><td>14</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).
Immerse in solder solution for 2±0.5 sec.
Immersing speed: 25±2.5mm/s
Temp. of solder: 245±5°C Lead Free Solder (Sn-3.0Ag-0.5Cu)
235±5°C H60A or H63A Eutectic Solder</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Preheat the capacitor as table. Immerse the capacitor in solder solution at 260±5℃ for 10±1 sec. Let sit at room condition*1 for 24±2 hrs., then measure.
•Immersing speed: 25±2.5mm/s
•Pretreatment for X7R char.
Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*1.

*Preheating<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100 to 120℃</td><td>1 min.</td></tr><tr><td>2</td><td>170 to 200℃</td><td>1 min.</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±10%</td></tr><tr><td>SL</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
</table>

*1 "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa
*2 "C" expresses nominal capacitance value (pF).

Continued on the following page.

GA3 Series Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specifications	Test Method

16 Temperature Cycle

Specifications

Item	Specifications
Appearance	No marking defects
I.R.	More than 3,000MΩ
Dielectric Strength	In accordance with item No.4

Capacitance Change:

Char.	Capacitance Change
X7R	Within ±15%
SL	Within ±2.5% or ±0.25pF (Whichever is larger)

D.F. / Q:

Char.	Specification
X7R	D.F.≦0.05
SL	Q≧400+20C*2 (C<30pF) Q≧1000 (C≧30pF)

Test Method

Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4.
Perform the 5 cycles according to the 4 heat treatments listed in the following table.
Let sit for 24±2 hrs. at room condition*1, then measure.

Step	Temperature (℃)	Time (min.)
1	Min. Operating Temp.±3	30±3
2	Room Temp.	2 to 3
3	Max. Operating Temp.±2	30±3
4	Room Temp.	2 to 3

•Pretreatment for X7R char.
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*1.

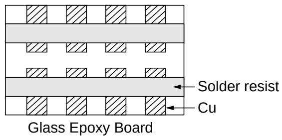


Fig. 4

17 Humidity (Steady State)

Specifications

Item	Specifications
Appearance	No marking defects
I.R.	More than 3,000MΩ
Dielectric Strength	In accordance with item No.4

Capacitance Change:

Char.	Capacitance Change
X7R	Within ±15%
SL	Within ±5.0% or ±0.5pF (Whichever is larger)

D.F. / Q:

Char.	Specification
X7R	D.F.≦0.05
SL	Q≧275+5/2C*2 (C<30pF) Q≧350 (C≧30pF)

Test Method

Before this test, the test shown in the following is performed.
·Item 11 Adhesive Strength of Termination (applied force is 5N)
·Item 13 Deflection

Let the capacitor sit at 40±2℃ and relative humidity of 90 to 95% for 500^{+24}_{-0} hrs.
Remove and let sit for 24±2 hrs. at room condition*1, then measure.
•Pretreatment for X7R char.
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*1.

18 Life

Specifications

Item	Specifications
Appearance	No marking defects
I.R.	More than 3,000MΩ
Dielectric Strength	In accordance with item No.4

Capacitance Change:

Char.	Capacitance Change
X7R	Within ±20%
SL	Within ±3.0% or ±0.3pF (Whichever is larger)

D.F. / Q:

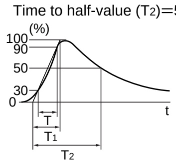
Char.	Specification
X7R	D.F.≦0.05
SL	Q≧275+5/2C*2 (C<30pF) Q≧350 (C≧30pF)

Test Method

Before this test, the test shown in the following is performed.
·Item 11 Adhesive Strength of Termination (apply force is 5N)
·Item 13 Deflection

Impulse Voltage
Each individual capacitor should be subjected to a 2.5kV (Type GC/GF: 5kV) Impulse (the voltage value means zero to peak) for three times. Then the capacitors are applied to life test.

Front time (T_1)=1.2μs=1.67T
Time to half-value (T_2)=50μs



Apply voltage as Table for 1,000 hrs. at 125^{+3}_{-0}℃, relative humidity 50% max.

Type	Applied Voltage
GB	AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.
GC **GD** **GF**	AC425V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 sec.

Let sit for 24±2 hrs. at room condition*1, then measure.
•Pretreatment for X7R char.
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*1.

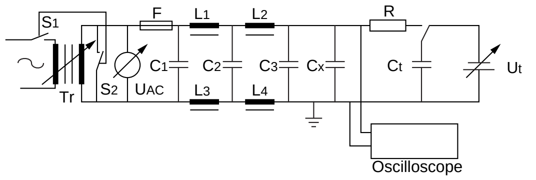
*1 "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa
*2 "C" expresses nominal capacitance value (pF).

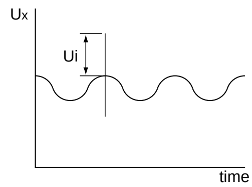
Continued on the following page.

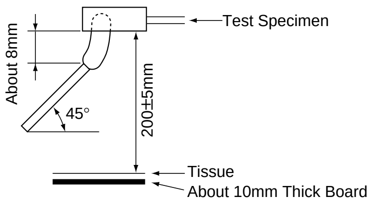
GA3 Series Specifications and Test Methods

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">19</td><td rowspan="5">Humidity Loading</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Before this test, the test shown in the following is performed.
·Item 11 Adhesive Strength of Termination (apply force is 5N)
·Item 13 Deflection

Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95% for 500 $^{+24}_{-0}$ hrs. Remove and let sit for 24±2 hrs. at room condition*1, then measure.
•Pretreatment for X7R char.
Perform a heat treatment at 150 $^{+0}_{-10}$ ℃ for 60±5 min. and then let sit for 24±2 hrs. at room condition*1.</td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>SL</td><td>Within ±5.0% or ±0.5pF
(Whichever is larger)</td></tr></table></td></tr>
<tr><td>D.F.
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.05</td></tr><tr><td>SL</td><td>Q≧275+5/2C*2 (C<30pF)
Q≧350 (C≧30pF)</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<tr><td>20</td><td colspan="2">Active Flammability</td><td>The cheesecloth should not be on fire.</td><td>The capacitor should be individually wrapped in at least one but not more than two complete layers of cheesecloth. The capacitor should be subjected to 20 discharges. The interval between successive discharges should be 5 sec. The UAC should be maintained for 2 min. after the last discharge.


C1,2 : 1μF±10%   C3 : 0.033μF±5% 10kV
L1 to 4 : 1.5mH±20% 16A Rod core choke
Ct : 3μF±5% 10kV   R : 100Ω±2%
Cx : Capacitor under test   UAC : UR±5%
F : Fuse, Rated 16A   UR : Rated Voltage
Ut : Voltage applied to Ct


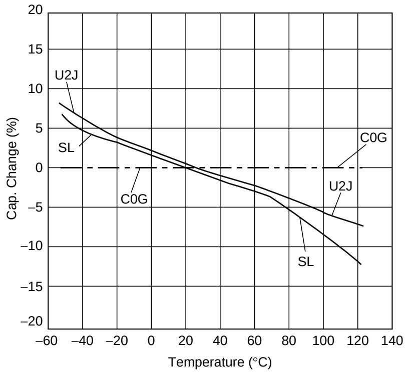
<table><tr><th>Type</th><th>Ui</th></tr><tr><td>**GB, GD**</td><td>2.5kV</td></tr><tr><td>**GC, GF**</td><td>5kV</td></tr></table></td></tr>
<tr><td>21</td><td colspan="2">Passive Flammability</td><td>The burning time should not exceed 30 sec.
The tissue paper should not ignite.</td><td>The capacitor under test should be held in the flame in the position which best promotes burning. Each specimen should only be exposed once to the flame. Time of exposure to flame: 30 sec.
Length of flame : 12±1mm
Gas burner : Length 35mm min.
Inside Dia. 0.5±0.1mm
Outside Dia. 0.9mm max.
Gas : Butane gas Purity 95% min.

</td></tr>
</table>

*1 "Room condition" Temperature: 15 to 35℃, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa
*2 "C" expresses nominal capacitance value (pF).

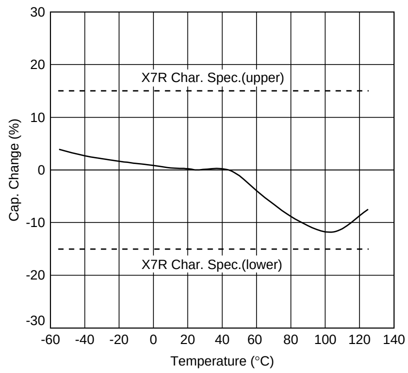
GRM/GR4/GR7/GA2/GA3 Series Data (Typical Example)

■ Capacitance - Temperature Characteristics

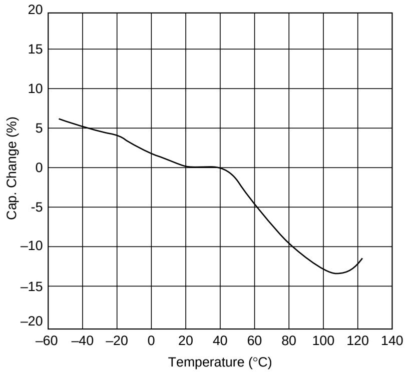
C0G/U2J/SL Characteristics



X7R Characteristics

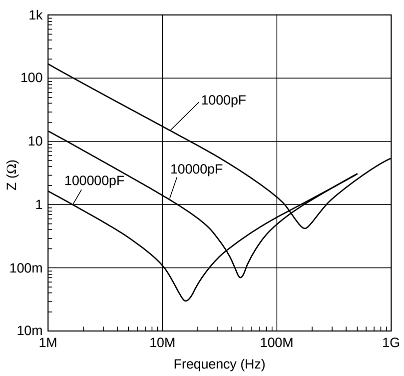


GR4 Series

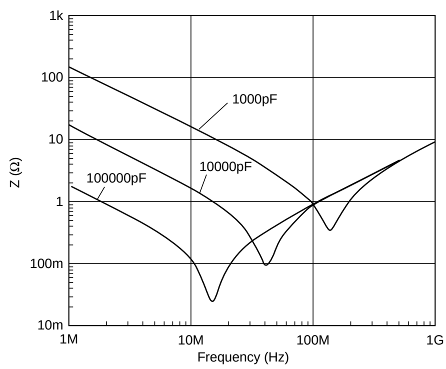


■ Impedance - Frequency Characteristics

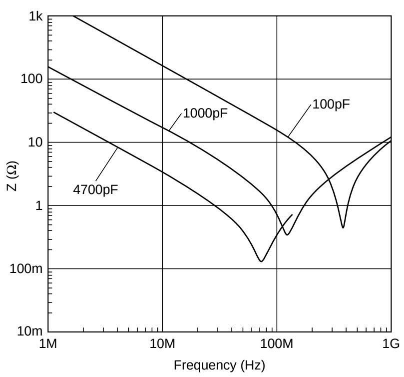
GRM Series (X7R Char. 250V)



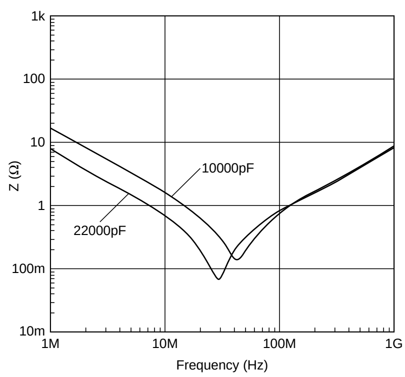
GRM Series (X7R Char. 630V)



GR4 Series



GR7 Series



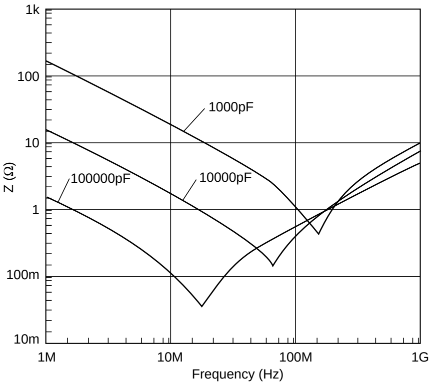
Continued on the following page. ↗

GRM/GR4/GR7/GA2/GA3 Series Data (Typical Example)

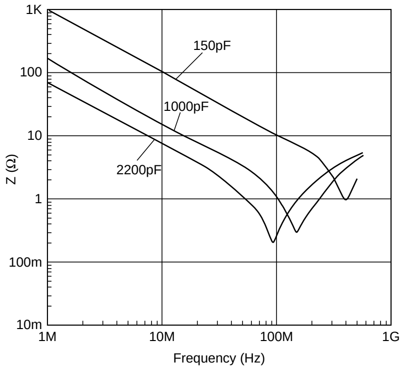
Continued from the preceding page.

■ Impedance - Frequency Characteristics

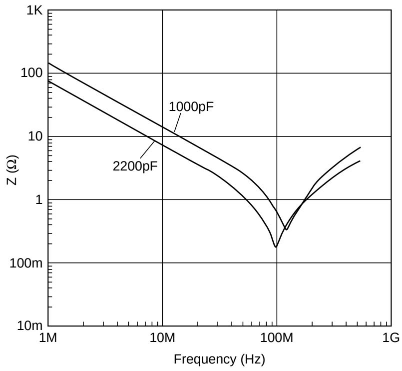
GA2 Series



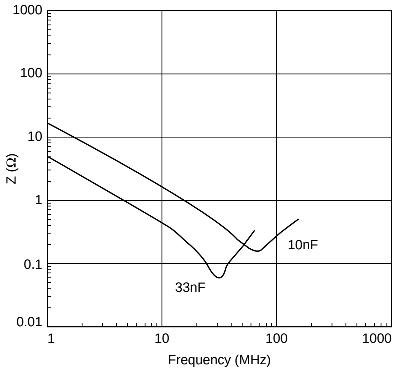
GA3 Series (Type GD)



GA3 Series (Type GF)

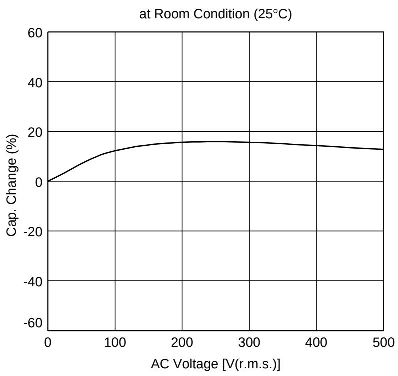


GA3 Series (Type GB)

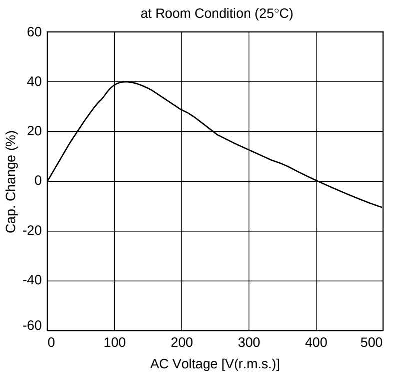


■ Capacitance - AC Voltage Characteristics

GA3 Series (Type GD/GF, X7R char.)



GA3 Series (Type GB)



Package

Taping is standard packaging method.

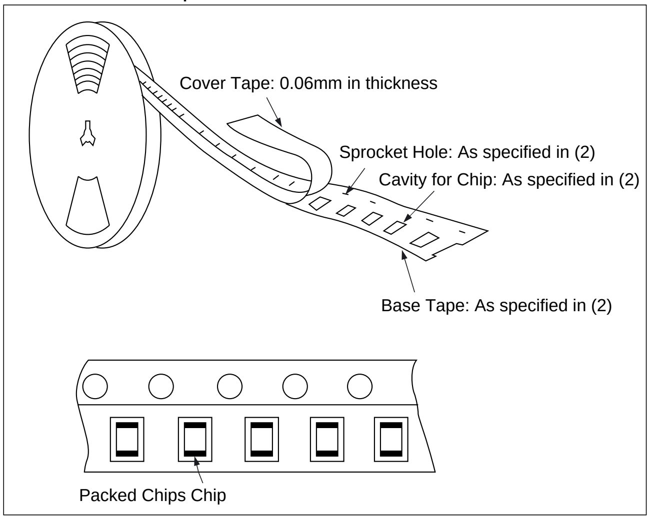
■ Minimum Quantity Guide

Part Number		Dimensions (mm)			Quantity (pcs.) ø180mm Reel	
		L	W	T	Paper Tape	Embossed Tape
Medium Voltage	GRM18	1.6	0.8	0.8	4,000	-
	GRM21	2.0	1.25	1.0	4,000	-
				1.25	-	3,000
	GRM31/GR731	3.2	1.6	1.0	4,000	-
				1.25	-	3,000
				1.6	-	2,000
	GRM32	3.2	2.5	1.0	4,000	-
				1.25	-	3,000
				1.5	-	2,000
				2.0	-	1,000
	GRM42/GR442	4.5	2.0	1.0	-	3,000
				1.5	-	2,000
				2.0	-	2,000
	GRM43/GR443	4.5	3.2	1.5	-	1,000
				2.0	-	1,000
				2.5	-	500
	GRM55/GR455	5.7	5.0	2.0	-	1,000
AC250V	GA242	4.5	2.0	1.5	-	2,000
	GA243	4.5	3.2	1.5	-	1,000
				2.0	-	1,000
	GA255	5.7	5.0	2.0	-	1,000
Safety Std. Recognition	GA342	4.5	2.0	1.0	-	3,000
				1.5	-	2,000
				2.0	-	2,000
	GA343	4.5	3.2	1.5	-	1,000
				2.0	-	1,000
	GA352	5.7	2.8	1.5	-	1,000
	GA355	5.7	5.0	1.5	-	1,000
				2.0	-	1,000
				2.7	-	500

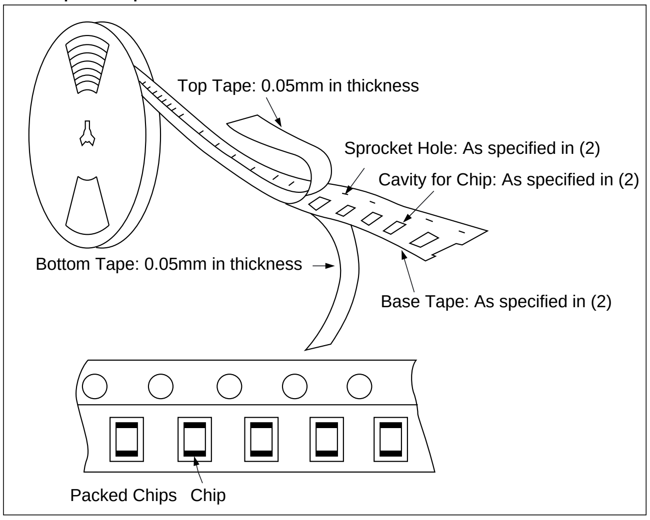
■ Tape Carrier Packaging

(1) Appearance of Taping

① Embossed Tape



② Paper Tape



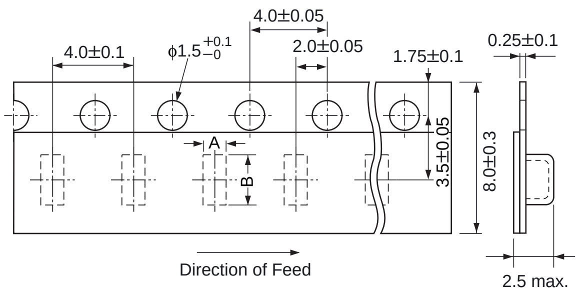
Continued on the following page.

Continued from the preceding page.

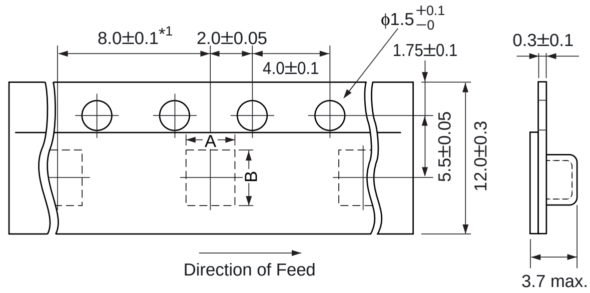
(2) Dimensions of Tape

① Embossed Tape

8mm width 4mm pitch Tape



12mm width 8mm/4mm pitch Tape



Part Number	A*	B*
GRM21 (T≧1.25mm)	1.45	2.25
GRM31/GR731 (T≧1.25mm)	2.0	3.6
GRM32 (T≧1.25mm)	2.9	3.6

*Nominal Value

Part Number	A*	B*
GRM42/GR442/GA242/GA342	2.5	5.1
GRM43/GR443/GA243/GA343	3.6	4.9
GA352	3.2	6.1
GRM55/GR455/GA255/GA355	5.4	6.1

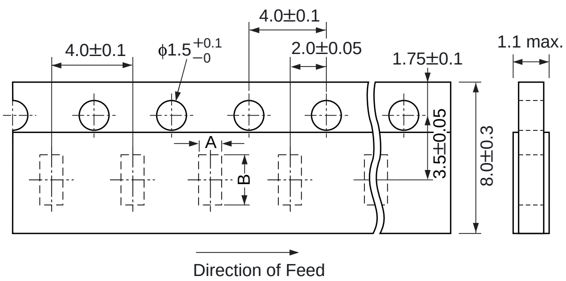
*1 4.0±0.1mm in case of GRM42/GR442/GA242/GA342

*Nominal Value

(in mm)

② Paper Tape

8mm width 4mm pitch Tape

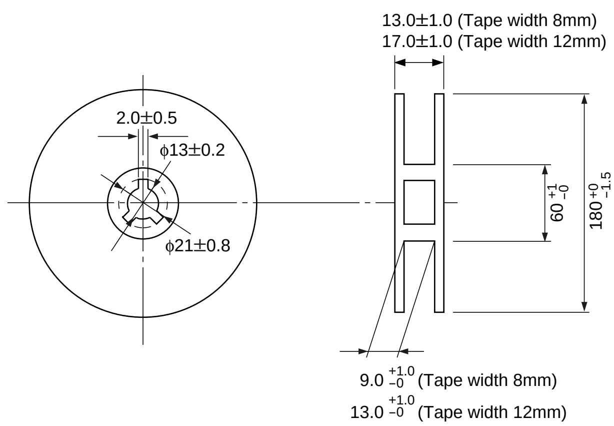


Part Number	A*	B*
GRM18	1.05	1.85
GRM21 (T=1.0mm)	1.45	2.25
GRM31/GR731 (T=1.0mm)	2.0	3.6
GRM32 (T=1.0mm)	2.9	3.6

*Nominal Value

(in mm)

(3) Dimensions of Reel



(in mm)

Continued on the following page.

Package

Continued from the preceding page.

(4) Taping Method

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

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

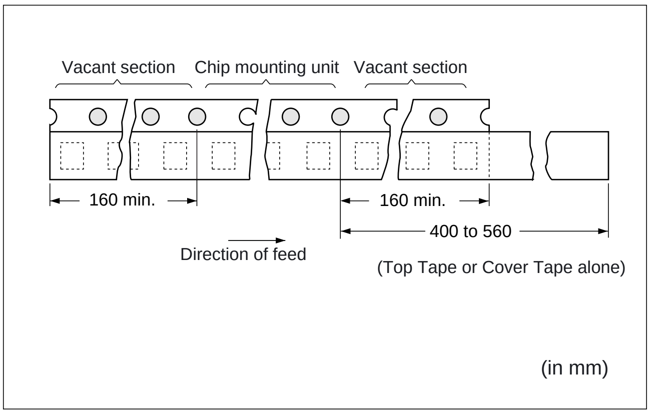
③ The top tape or cover tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

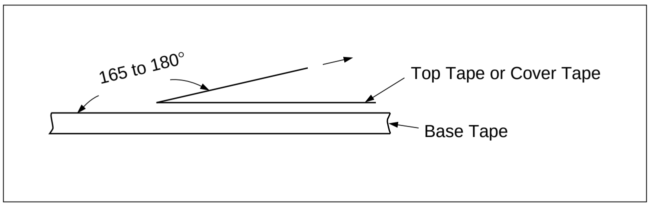
④ Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.

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

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

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





⚠Caution

■ Storage and Operating Conditions

Operating and storage environment

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

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

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

■ Handling

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

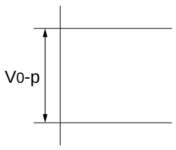
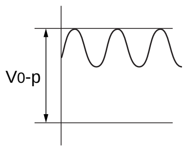
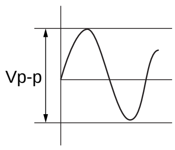
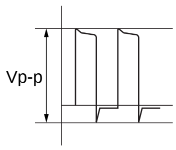
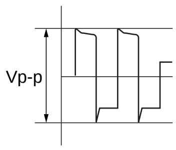
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND CAUSE FUMING OR PARTIAL DISPERSION WHEN THE PRODUCT IS USED.

⚠Caution

■ Caution (Rating)

1. Operating Voltage

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

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

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

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

(1) In case of X7R char.
Applied voltage should be the load such as self-generated heat is within 20°C on the condition of atmosphere temperature 25°C. When measuring, use a thermocouple of small thermal capacity -K of ø0.1mm in conditions where the capacitor is not affected by radiant heat from other components or surrounding ambient fluctuations. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running. Otherwise, accurate measurement cannot be ensured.)

Continued on the following page. ↗

⚠Caution

Continued from the preceding page.

(2) In case of C0G, U2J char.

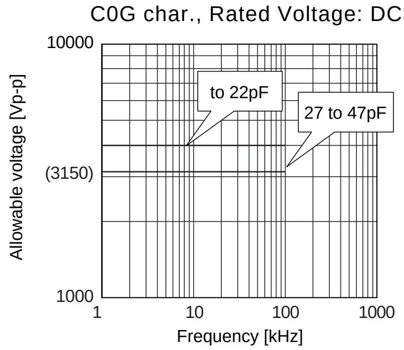
Due to the low self-heating characteristics of low-dissipation capacitors, the allowable electric power of these capacitors is generally much higher than that of X7R characteristic capacitors.

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

<C0G char.>

Therefore, in case of C0G char., the frequency of the applied sine wave voltage should be less than 100kHz. The applied voltage should be less than the value shown in figure at right. The capacitors less than 22pF can be applied maximum 4.0kV peak to peak at 100kHz or less only for the ballast or the resonance usage in the LCD backlight inverter circuit.

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



The sine-wave frequency VS allowable voltage

<U2J char.>

In case of U2J char., the frequency of the applied sine wave voltage should be less than 500kHz (less than 100kHz in case of rated voltage: DC3.15kV). The applied voltage should be less than the value shown in figure below.

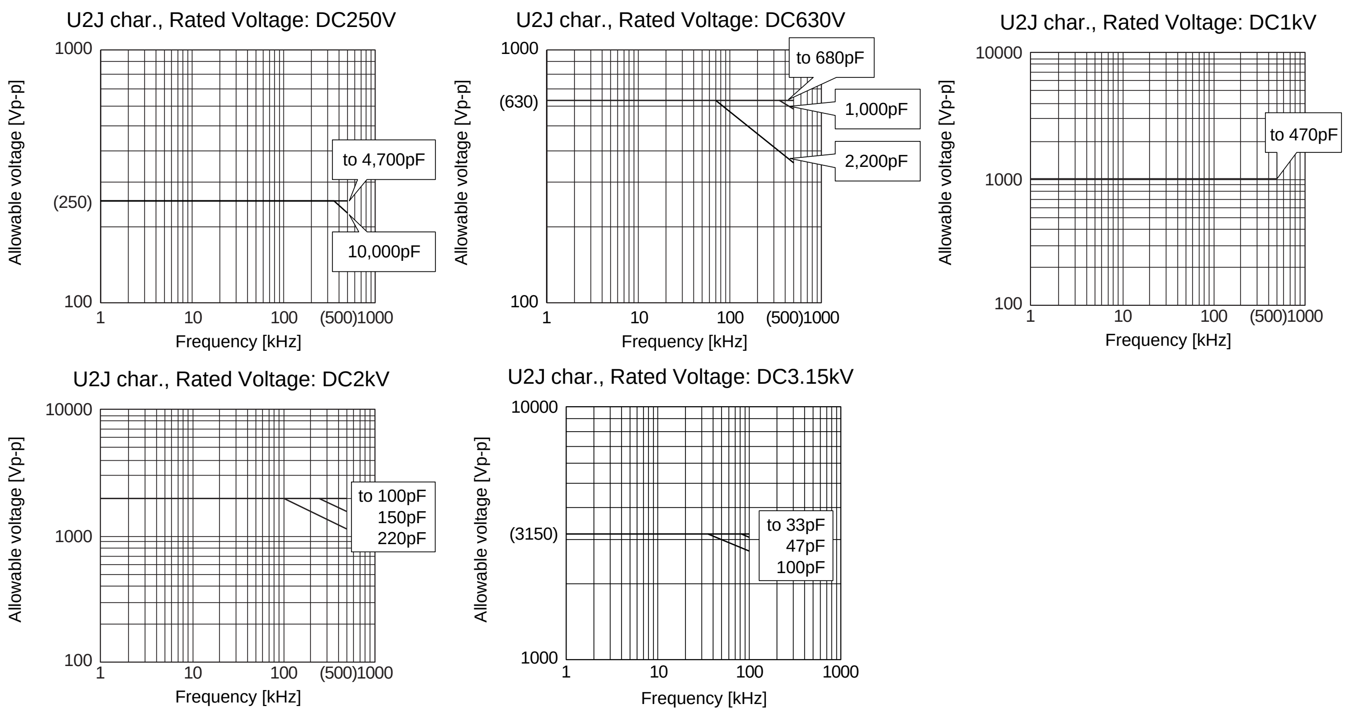
<Capacitor selection tool>

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

The software can be downloaded from Murata's Internet Website.
(http://www.murata.com/designlib/mmcsv_e.html).
By inputting capacitance values and applied voltage waveform of the specific capacitor series, this software will calculate the capacitor's power consumption and list suitable capacitors (non-sine wave is also available).

* As of Jul. 2006, subject series are below.
· Temperature Characteristics C0G, U2J

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



The sine-wave frequency VS allowable voltage

Continued on the following page.

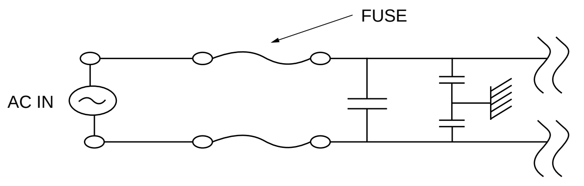
⚠Caution

Continued from the preceding page.

3. Fail-safe

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

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



4. Test Condition for AC Withstanding Voltage

(1) Test Equipment

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

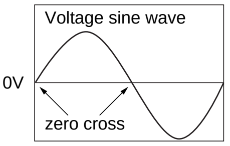
If the distorted sine wave or overload exceeding the specified voltage value is applied, a defect may be caused.

(2) Voltage Applied Method

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

*ZERO CROSS is the point where voltage sine wave pass 0V.

- See the figure at right -



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

■ Caution (Soldering and Mounting)

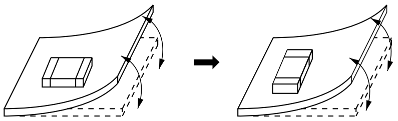
1. Vibration and Impact
   Do not expose a capacitor to excessive shock or vibration during use.

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

3. Land Layout for Cropping PC Board

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

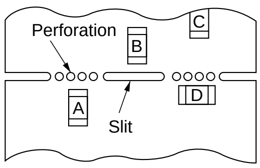
[Component Direction]



<Example to be avoided> <Examples of improvements>

Locate chip horizontal to the direction in which stress acts.

[Chip Mounting Close to Board Separation Point]



Chip arrangement
Worst A>C>B~D Best

Continued on the following page.

⚠Caution

Continued from the preceding page.

4. Reflow Soldering

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

Table 1

Part Number	Temperature Differential
G□□18/21/31	ΔT≦190℃
G□□32/42/43/52/55	ΔT≦130℃

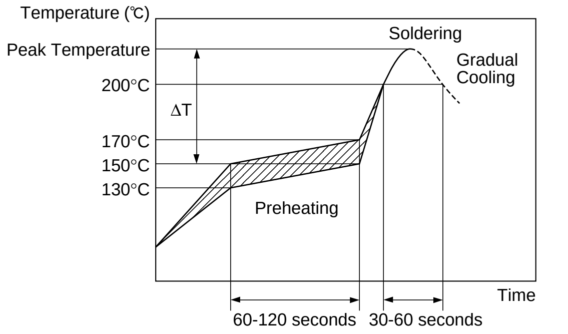
Recommended Conditions

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

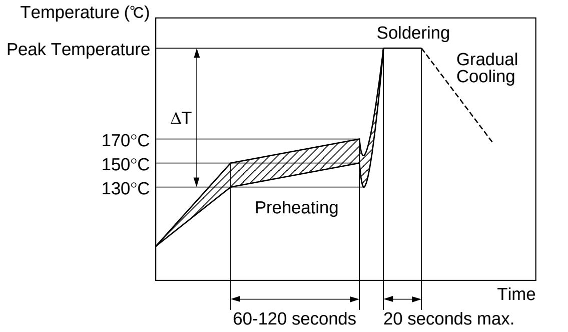
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Reflow Soldering]

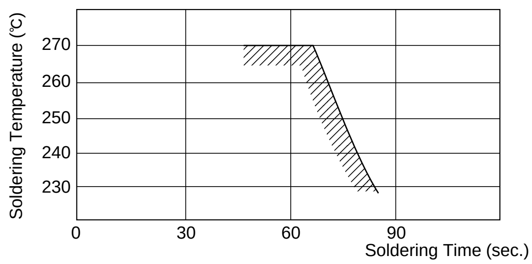
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]

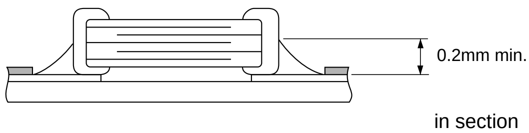


In case of repeated soldering, the accumulated soldering time must be within the range shown above.

Optimum Solder Amount for Reflow Soldering

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

[Optimum Solder Amount for Reflow Soldering]



in section

Inverting the PCB

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

Continued on the following page.

Continued from the preceding page.

5. Flow Soldering

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

Table 2

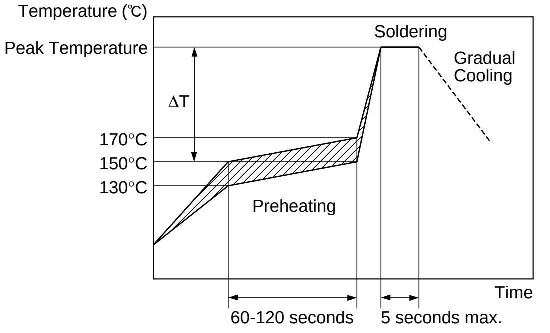
Part Number	Temperature Differential
G□□18/21/31	ΔT≦150℃

Recommended Conditions

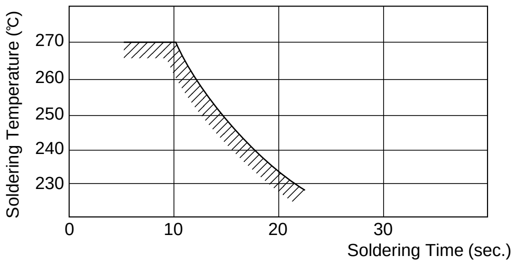
	Pb-Sn Solder	Lead Free Solder
Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N_2

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

[Standard Conditions for Flow Soldering]

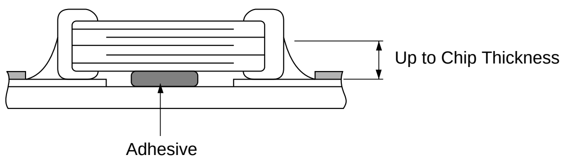


[Allowable Soldering Temperature and Time]



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

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



in section

Continued on the following page.

⚠Caution

Continued from the preceding page.

6. Correction with a Soldering Iron

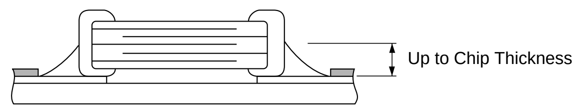
- When sudden heat is applied to the components by soldering iron, the mechanical strength of the components should go down because remarkable temperature change causes deformity of components inside. In order to prevent mechanical damage in the components, preheating should be required for both of the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

Table 3

Part Number	Temperature Differential	Peak Temperature	Atmosphere
G□□18/21/31	ΔT≦190℃	300°C max. 3 sec. max. / termination (both sides total 6 sec. max.)	Air
G□□32/42/43/ 52/55	ΔT≦130℃	270°C max. 3 sec. max. / termination (both sides total 6 sec. max.)	Air

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

- Optimum Solder Amount when Corrections Are Made Using a Soldering Iron
  The top of the solder fillet should be lower than the thickness of components. If the solder amount is excessively big, the risk of cracking is higher during board bending or under any other stressful conditions. Soldering iron ø3mm or smaller should be required. And it is necessary to keep a distance between the soldering iron and the components without direct touch. Thread solder with ø0.5mm or smaller is required for soldering.



7. Washing

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

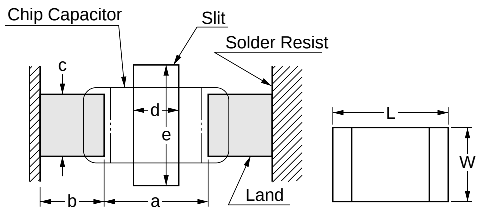
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCT IS USED.

■ Notice (Soldering and Mounting)

1. Construction of Board Pattern

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

Construction and Dimensions of Pattern (Example)



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

Flow Soldering

L×W	a	b	c
1.6×0.8	0.6-1.0	0.8-0.9	0.6-0.8
2.0×1.25	1.0-1.2	0.9-1.0	0.8-1.1
3.2×1.6	2.2-2.6	1.0-1.1	1.0-1.4

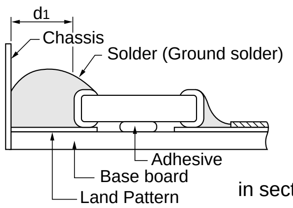
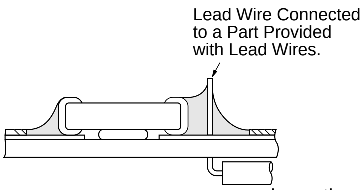
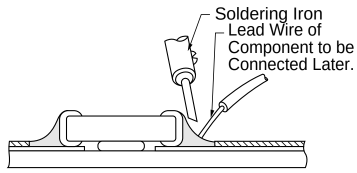
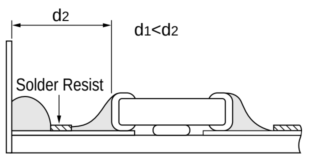
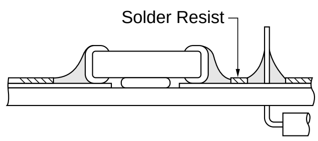
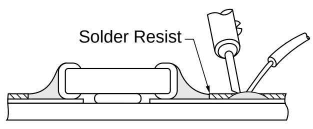
Flow soldering : 3.2×1.6 or less available.

Reflow Soldering

L×W	a	b	c	d	e
1.6×0.8	0.6-0.8	0.6-0.7	0.6-0.8	-	-
2.0×1.25	1.0-1.2	0.9-1.0	0.8-1.1	-	-
3.2×1.6	2.2-2.4	0.8-0.9	1.0-1.4	1.0-2.0	3.2-3.7
3.2×2.5	2.0-2.4	1.0-1.2	1.8-2.3	1.0-2.0	4.1-4.6
4.5×2.0	2.8-3.4	1.2-1.4	1.4-1.8	1.0-2.8	3.6-4.1
4.5×3.2	2.8-3.4	1.2-1.4	2.3-3.0	1.0-2.8	4.8-5.3
5.7×2.8	4.0-4.6	1.4-1.6	2.1-2.6	1.0-4.0	4.4-4.9
5.7×5.0	4.0-4.6	1.4-1.6	3.5-4.8	1.0-4.0	6.6-7.1

(in mm)

Land Layout to Prevent Excessive Solder

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

Continued on the following page.

Notice

Continued from the preceding page.

2. Mounting of Chips

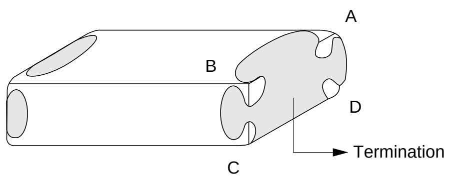
● Thickness of adhesives applied
Keep thickness of adhesives applied (50-105μm or more) to reinforce the adhesive contact considering the thickness of the termination or capacitor (20-70μm) and the land pattern (30-35μm).

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

3. Soldering

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

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



(2) Flux Application

- An excessive amount of flux generates a large quantity of flux gas, causing deteriorated solderability. So apply flux thinly and evenly throughout. (A foaming system is generally used for flow soldering.)
- Flux containing too high percentage of halide may cause corrosion of the outer electrodes unless sufficient cleaning. Use flux with a halide content of 0.2% max.
- Do not use strong acidic flux.
- Do not use water-soluble flux*.
(*Water-soluble flux can be defined as non resin type flux including wash-type flux and non-wash-type flux.)

Continued on the following page.

Notice

Continued from the preceding page.

4. Cleaning

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

5. Resin Coating

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

■ Rating

1. Capacitance change of capacitor

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

(2) In case of any char. except X7R
Capacitance might change a little depending on the surrounding temperature or an applied voltage.
Please contact us if you intend to use this product in a strict time constant circuit.

2. Performance check by equipment

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

ISO 9001 Certifications

■ Qualified Standards

The products listed here have been produced by ISO 9001 certified factory.

Plant
Fukui Murata Mfg. Co., Ltd.
Izumo Murata Mfg. Co., Ltd.
Okayama Murata Mfg. Co., Ltd.
Murata Electronics Singapore (Pte.) Ltd.
Murata Amazonia Industria E Comercio Ltda.
Suzhou Murata Electronics Co., Ltd.
Beijing Murata Electronics Co., Ltd.

⚠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 July 2008. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.
4. Please read rating and ⚠CAUTION (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.
5. This catalog has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.
6. Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.
7. No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.

muRata Murata Manufacturing Co., Ltd.

http://www.murata.com/

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

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