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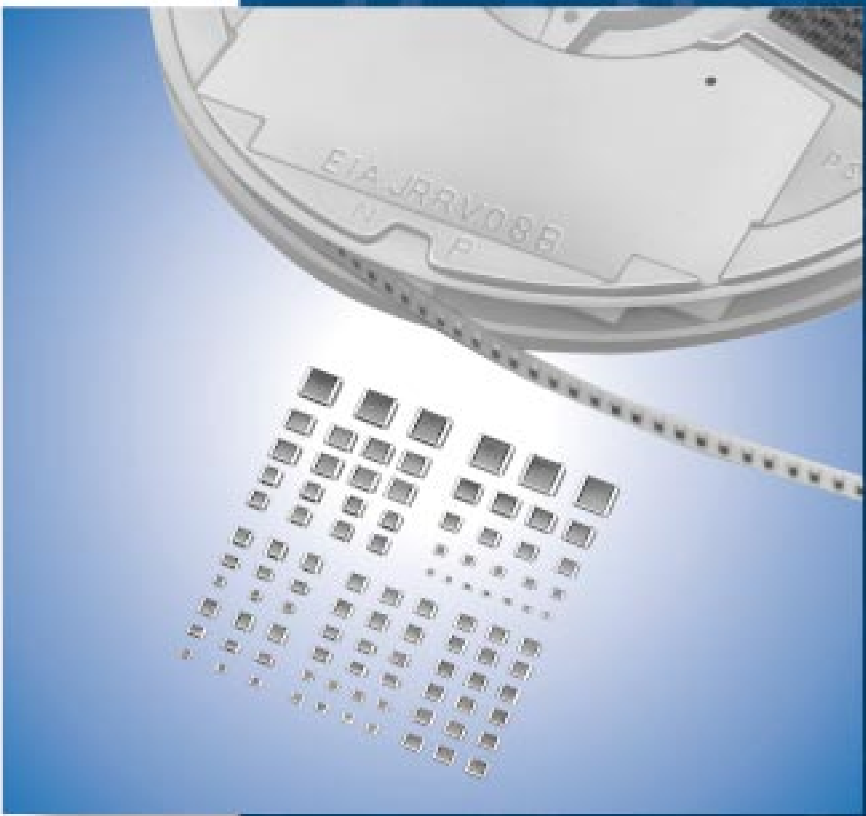
Chip Monolithic Ceramic Capacitors



muRata *Innovator in Electronics*

Murata Manufacturing Co., Ltd.

Cat.No.C02E-12

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- Please refer to "Specifications and Test Methods" at the end of each chapter of 15 – 19 .

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
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 Tin Plated 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
11	1.25×1.0mm	0504
15	1.0×0.5mm	0402
18	1.6×0.8mm	0603
1D	1.4×1.4mm	
1X	Depends on individual standards.	
21	2.0×1.25mm	0805
22	2.8×2.8mm	1111
31	3.2×1.6mm	1206
32	3.2×2.5mm	1210
3X	Depends on individual standards.	
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
R	1.8mm
S	2.8mm
Q	1.5mm
X	Depends on individual standards.

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

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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 85°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
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+100/-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 Murata Temperature Characteristic Code.
*4 Apply DC350V bias.
*5 No DC bias.

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

Ex.)

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

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❽Capacitance Tolerance

Code	Capacitance Tolerance	TC	Series	Capacitance Step	
B	±0.1pF	CΔ	**GRM/GJM**	≦5pF	E24 Series,1pF
C	±0.25pF	CΔ–SL	**GRM/ERB/GQM**	≦5pF	* 1pF
		CΔ	**GJM**	<10pF	E24 Series,1pF
D	±0.5pF	CΔ–SL	**GRM**	6.0 to 9.0pF	* 1pF
		CΔ	**ERB/GQM/GJM**	5.1 to 9.1pF	E24 Series
F	±1%	CΔ	**GRM03/15, GJM03/15**	5.0 to 9.9pF	0.1pF
G	±2%	CΔ	**GJM**	≧10pF	E12 Series
		CΔ	**GQM**	≧10pF	E24 Series
		CΔ	**GRM03/15, GJM03/15**	2.0 to 9.9pF	0.1pF
J	±5%	CΔ–SL	**GRM/GA3**	≧10pF	E12 Series
		CΔ	**ERB/GQM/GJM**	≧10pF	E24 Series
		CΔ	**GRM03/15, GJM03/15**	1.0 to 4.9pF	0.1pF
K	±10%	B, R, X7R, X5R, ZLM	**GRM/GR7/GA3**	E6 Series	
			GR4	E12 Series	
		CΔ	**GRM03/15, GJM03/15**	0.2 to 1.9pF	0.1pF
M	±20%	Z5U	**GRM**	E3 Series	
		B, R, X7R, X7S	**GRM/GMA/LLL/LLA/LLM**	E6 Series	
		X7R	**GA2**	E3 Series	
		CΔ	**GRM03/15, GJM03/15**	0.1 to 0.9pF	0.1pF
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	ø178mm Embossed Taping
D	ø178mm Paper Taping
K	ø330mm Embossed Taping
J	ø330mm Paper Taping
E	ø178mm Special Packaging
F	ø330mm Special Packaging
B	Bulk
C	Bulk Case
T	Bulk Tray

Selection Guide of Chip Monolithic Ceramic Capacitors

Start

Function	Type	Series
Decoupling, Smoothing	High Capacitance	GRM (X5R, X7R, Y5V, etc.) 220pF–100µF
	Array (2 or 4 Elements)	GNM 10pF–2.2µF
Frequency Control/Tuning, Impedance Matching	Class1 TC's;	GRM (C0G) 0.1pF–0.1µF
		GRM (U2J)
High Speed Decoupling	Low Inductance (Reverse Geometory)	LLL 22000pF–10µF
	Low Inductance (Multi Termination)	LLA/LLM (From 1GHz) 10000pF–4.5µF
High Frequency	Low ESR (50V to 500V)	ERB (1MHz to 1GHz) 0.5pF–1000pF
	Low ESR, Ultra Small	GJM (500MHz to 10GHz) 0.1pF–20pF
	Lowest ESR	GQM (500MHz to 10GHz) 0.5pF–100pF
Optical Communications	Wire-Die-Bonding	GMA 100pF–10000pF
Medium Voltage High Frequency Snubber	250V/630V/1kV/2kV/3.15kV Low Dissipation	GRM (SL, U2J) 5pF–10000pF
Medium Voltage LCD Back Lighting Inverters	3.15kV Low Dissipation	GRM (C0G) 5pF–47pF
Medium Voltage Decoupling, Smoothing	250V/630V/1kV High Capacitance	GRM 220pF–1µF
Medium Voltage Only for Camera Frash Circuit	350V High Capacitance	GR7 10000pF–47000pF
Medium Voltage Only for Telecommunication Devices	2kV High Capacitance	GR4 100pF–4700pF
	Safety Standard Recognized	Type GD 10pF–4700pF Type GF 10pF–4700pF
AC Lines Noise Removal	Safety Standard Recognized	Type GC 100pF–330pF Type GF 470pF–4700pF Type GB 10000pF–33000pF
	AC250V which meet Japanese Law	GA2 470pF–0.1µF
Automotive (Power-train, Safety Equipment)	High Capacitance	GCM (X7R, X8L, X8G etc.) 0.5µF–10µF
	Class1 TC's;	GCM (C0G, CHA etc.) 220pF–10µF
	Low Inductance	LLC 2200pF–2.2µF

Chip Monolithic Ceramic Capacitors

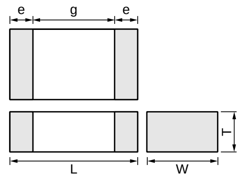
for Flow/Reflow Soldering GRM15/18/21/31 Series

■ Features

1. Terminations are made of metal highly resistant to migration.
2. The GRM series is a complete line of chip ceramic capacitors in 6.3V, 10V, 16V, 25V, 50V, 100V, 200V and 500V ratings. These capacitors have temperature characteristics ranging from C0G to Y5V.
3. A wide selection of sizes is available, from the miniature LxWxT: 1.0x0.5x0.5mm to LxWxT: 3.2x1.6x1.6mm.
   GRM18, 21 and GRM31 types are suited to flow and reflow soldering.
   GRM15 type is applied to only reflow soldering.

■ Applications

General electronic equipment



Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRM155	1.0 ±0.05	0.5 ±0.05	0.5 ±0.05	0.15 to 0.35	0.3
GRM188*	1.6 ±0.1	0.8 ±0.1	0.8 ±0.1	0.2 to 0.5	0.5
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		

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

Temperature Compensating Type GRM15 Series (1.00x0.50mm) 50/25V

Part Number	GRM15							
L x W [EIA]	1.00x0.50 [0402]							
TC	C0G (**5C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)		T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)								
0.30pF(**R30**)	0.50(**5**)							
0.40pF(**R40**)	0.50(**5**)							
0.50pF(**R50**)	0.50(**5**)							
0.60pF(**R60**)	0.50(**5**)							
0.70pF(**R70**)	0.50(**5**)							
0.75pF(**R75**)	0.50(**5**)							
0.80pF(**R80**)	0.50(**5**)							
0.90pF(**R90**)	0.50(**5**)							
1.0pF(**1R0**)	0.50(**5**)							
1.1pF(**1R1**)	0.50(**5**)							
1.2pF(**1R2**)	0.50(**5**)							
1.3pF(**1R3**)	0.50(**5**)							
1.4pF(**1R4**)	0.50(**5**)							
1.5pF(**1R5**)	0.50(**5**)							
1.6pF(**1R6**)	0.50(**5**)							
1.7pF(**1R7**)	0.50(**5**)							
1.8pF(**1R8**)	0.50(**5**)							
1.9pF(**1R9**)	0.50(**5**)							
2.0pF(**2R0**)	0.50(**5**)							
2.1pF(**2R1**)	0.50(**5**)							
2.2pF(**2R2**)	0.50(**5**)							
2.3pF(**2R3**)	0.50(**5**)							
2.4pF(**2R4**)	0.50(**5**)							
2.5pF(**2R5**)	0.50(**5**)							
2.6pF(**2R6**)	0.50(**5**)							

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Part Number	GRM15							
L x W [EIA]	1.00x0.50 [0402]							
TC	C0G (**5C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)		T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)								
2.7pF(**2R7**)	0.50(**5**)							
2.8pF(**2R8**)	0.50(**5**)							
2.9pF(**2R9**)	0.50(**5**)							
3.0pF(**3R0**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
3.1pF(**3R1**)	0.50(**5**)							
3.2pF(**3R2**)	0.50(**5**)							
3.3pF(**3R3**)	0.50(**5**)							
3.4pF(**3R4**)	0.50(**5**)							
3.5pF(**3R5**)	0.50(**5**)							
3.6pF(**3R6**)	0.50(**5**)							
3.7pF(**3R7**)	0.50(**5**)							
3.8pF(**3R8**)	0.50(**5**)							
3.9pF(**3R9**)	0.50(**5**)							
4.0pF(**4R0**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
4.1pF(**4R1**)	0.50(**5**)							
4.2pF(**4R2**)	0.50(**5**)							
4.3pF(**4R3**)	0.50(**5**)							
4.4pF(**4R4**)	0.50(**5**)							
4.5pF(**4R5**)	0.50(**5**)							
4.6pF(**4R6**)	0.50(**5**)							
4.7pF(**4R7**)	0.50(**5**)							
4.8pF(**4R8**)	0.50(**5**)							
4.9pF(**4R9**)	0.50(**5**)							
5.0pF(**5R0**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
5.1pF(**5R1**)	0.50(**5**)							
5.2pF(**5R2**)	0.50(**5**)							
5.3pF(**5R3**)	0.50(**5**)							
5.4pF(**5R4**)	0.50(**5**)							
5.5pF(**5R5**)	0.50(**5**)							
5.6pF(**5R6**)	0.50(**5**)							
5.7pF(**5R7**)	0.50(**5**)							
5.8pF(**5R8**)	0.50(**5**)							
5.9pF(**5R9**)	0.50(**5**)							
6.0pF(**6R0**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
6.1pF(**6R1**)	0.50(**5**)							
6.2pF(**6R2**)	0.50(**5**)							
6.3pF(**6R3**)	0.50(**5**)							
6.4pF(**6R4**)	0.50(**5**)							
6.5pF(**6R5**)	0.50(**5**)							
6.6pF(**6R6**)	0.50(**5**)							
6.7pF(**6R7**)	0.50(**5**)							
6.8pF(**6R8**)	0.50(**5**)							
6.9pF(**6R9**)	0.50(**5**)							
7.0pF(**7R0**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
7.1pF(**7R1**)	0.50(**5**)							
7.2pF(**7R2**)	0.50(**5**)							
7.3pF(**7R3**)	0.50(**5**)							
7.4pF(**7R4**)	0.50(**5**)							
7.5pF(**7R5**)	0.50(**5**)							
7.6pF(**7R6**)	0.50(**5**)							
7.7pF(**7R7**)	0.50(**5**)							
7.8pF(**7R8**)	0.50(**5**)							

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Part Number	**GRM15**							
L x W [EIA]	1.00x0.50 [0402]							
TC	C0G (**5C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)		T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)								
7.9pF(**7R9**)	0.50(**5**)							
8.0pF(**8R0**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
8.1pF(**8R1**)	0.50(**5**)							
8.2pF(**8R2**)	0.50(**5**)							
8.3pF(**8R3**)	0.50(**5**)							
8.4pF(**8R4**)	0.50(**5**)							
8.5pF(**8R5**)	0.50(**5**)							
8.6pF(**8R6**)	0.50(**5**)							
8.7pF(**8R7**)	0.50(**5**)							
8.8pF(**8R8**)	0.50(**5**)							
8.9pF(**8R9**)	0.50(**5**)							
9.0pF(**9R0**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
9.1pF(**9R1**)	0.50(**5**)							
9.2pF(**9R2**)	0.50(**5**)							
9.3pF(**9R3**)	0.50(**5**)							
9.4pF(**9R4**)	0.50(**5**)							
9.5pF(**9R5**)	0.50(**5**)							
9.6pF(**9R6**)	0.50(**5**)							
9.7pF(**9R7**)	0.50(**5**)							
9.8pF(**9R8**)	0.50(**5**)							
9.9pF(**9R9**)	0.50(**5**)							
10pF(**100**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
12pF(**120**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
15pF(**150**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
18pF(**180**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
22pF(**220**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
27pF(**270**)	0.50(**5**)	0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
33pF(**330**)	0.50(**5**)		0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
39pF(**390**)	0.50(**5**)			0.50(**5**)			0.50(**5**)	0.50(**5**)
47pF(**470**)	0.50(**5**)				0.50(**5**)		0.50(**5**)	0.50(**5**)
56pF(**560**)	0.50(**5**)				0.50(**5**)		0.50(**5**)	0.50(**5**)
68pF(**680**)	0.50(**5**)				0.50(**5**)		0.50(**5**)	0.50(**5**)
82pF(**820**)	0.50(**5**)				0.50(**5**)		0.50(**5**)	0.50(**5**)
100pF(**101**)	0.50(**5**)				0.50(**5**)		0.50(**5**)	0.50(**5**)
120pF(**121**)	0.50(**5**)				0.50(**5**)			0.50(**5**)
150pF(**151**)	0.50(**5**)				0.50(**5**)			0.50(**5**)
180pF(**181**)	0.50(**5**)				0.50(**5**)			0.50(**5**)
220pF(**221**)	0.50(**5**)					0.50(**5**)		
270pF(**271**)	0.50(**5**)					0.50(**5**)		
330pF(**331**)	0.50(**5**)					0.50(**5**)		
390pF(**391**)	0.50(**5**)					0.50(**5**)		
470pF(**471**)	0.50(**5**)							
560pF(**561**)	0.50(**5**)							
680pF(**681**)	0.50(**5**)							
820pF(**821**)	0.50(**5**)							
1000pF(**102**)	0.50(**5**)							

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

Temperature Compensating Type GRM18 Series (1.60x0.80mm) 200/100/50/25V

Part Number	**GRM18**										
L x W [EIA]	1.60x0.80 [0603]										
TC	C0G (**5C**)			P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)			T2H (**6T**)	U2J (**7U**)
Rated Volt.	200 (**2D**)	100 (**2A**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	200 (**2D**)	100 (**2A**)	50 (**1H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)											
0.50pF(**R50**)	0.80(**8**)	0.80(**8**)	0.80(**8**)								
0.75pF(**R75**)	0.80(**8**)	0.80(**8**)	0.80(**8**)								
1.0pF(**1R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)								
2.0pF(**2R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)								
3.0pF(**3R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)				0.80(**8**)	0.80(**8**)
4.0pF(**4R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)				0.80(**8**)	0.80(**8**)
5.0pF(**5R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)				0.80(**8**)	0.80(**8**)
6.0pF(**6R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)				0.80(**8**)	0.80(**8**)
7.0pF(**7R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)				0.80(**8**)	0.80(**8**)
8.0pF(**8R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)				0.80(**8**)	0.80(**8**)
9.0pF(**9R0**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)				0.80(**8**)	0.80(**8**)
10pF(**100**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)				0.80(**8**)	0.80(**8**)
12pF(**120**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
15pF(**150**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
18pF(**180**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
22pF(**220**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
27pF(**270**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
33pF(**330**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
39pF(**390**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
47pF(**470**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
56pF(**560**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)			0.80(**8**)	0.80(**8**)
68pF(**680**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)		0.80(**8**)	0.80(**8**)	0.80(**8**)
82pF(**820**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)		0.80(**8**)	0.80(**8**)	0.80(**8**)
100pF(**101**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)		0.80(**8**)	0.80(**8**)	0.80(**8**)
120pF(**121**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
150pF(**151**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
180pF(**181**)		0.80(**8**)	0.80(**8**)		0.80(**8**)	0.80(**8**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
220pF(**221**)		0.80(**8**)	0.80(**8**)			0.80(**8**)		0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
270pF(**271**)		0.80(**8**)	0.80(**8**)					0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
330pF(**331**)		0.80(**8**)	0.80(**8**)					0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
390pF(**391**)		0.80(**8**)	0.80(**8**)					0.80(**8**)	0.80(**8**)	0.80(**8**)	0.80(**8**)
470pF(**471**)		0.80(**8**)	0.80(**8**)						0.80(**8**)	0.80(**8**)	0.80(**8**)
560pF(**561**)		0.80(**8**)	0.80(**8**)						0.80(**8**)		0.80(**8**)
680pF(**681**)		0.80(**8**)	0.80(**8**)						0.80(**8**)		0.80(**8**)
820pF(**821**)		0.80(**8**)	0.80(**8**)								
1000pF(**102**)		0.80(**8**)	0.80(**8**)						0.80(**8**)		0.80(**8**)
1200pF(**122**)			0.80(**8**)						0.80(**8**)		0.80(**8**)
1500pF(**152**)			0.80(**8**)						0.80(**8**)		0.80(**8**)
1800pF(**182**)			0.80(**8**)						0.80(**8**)		0.80(**8**)
2200pF(**222**)			0.80(**8**)						0.80(**8**)		0.80(**8**)
2700pF(**272**)			0.80(**8**)						0.80(**8**)		0.80(**8**)
3300pF(**332**)									0.80(**8**)		0.80(**8**)
3900pF(**392**)									0.80(**8**)		0.80(**8**)
4700pF(**472**)									0.80(**8**)		0.80(**8**)
5600pF(**562**)									0.80(**8**)		0.80(**8**)
6800pF(**682**)									0.80(**8**)		0.80(**8**)
8200pF(**822**)									0.80(**8**)		0.80(**8**)
10000pF(**103**)									0.80(**8**)		0.80(**8**)

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

muRata

Temperature Compensating Type GRM21 Series (2.00x1.25mm) 200/100/50/25V

Part Number	**GRM21**										
L x W [EIA]	2.00x1.25 [0805]										
TC	C0G (**5C**)			P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)			T2H (**6T**)	U2J (**7U**)
Rated Volt.	200 (**2D**)	100 (**2A**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	200 (**2D**)	100 (**2A**)	50 (**1H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)											
12pF(**120**)	0.85(**9**)	0.85(**9**)									
15pF(**150**)	0.85(**9**)	0.85(**9**)									
18pF(**180**)	0.85(**9**)	0.85(**9**)									
22pF(**220**)	0.85(**9**)	0.85(**9**)									
27pF(**270**)	0.85(**9**)	0.85(**9**)									
33pF(**330**)	0.85(**9**)	0.85(**9**)									
39pF(**390**)	0.85(**9**)	0.85(**9**)									
47pF(**470**)	0.85(**9**)	0.85(**9**)									
56pF(**560**)	0.85(**9**)	0.85(**9**)									
68pF(**680**)	1.25(**B**)										
82pF(**820**)	1.25(**B**)										
100pF(**101**)	1.25(**B**)										
120pF(**121**)	1.25(**B**)						0.85(**9**)				
150pF(**151**)	1.25(**B**)						1.25(**B**)				
180pF(**181**)	1.25(**B**)			0.85(**9**)			1.25(**B**)				
220pF(**221**)	1.25(**B**)			0.85(**9**)	0.85(**9**)		1.25(**B**)				
270pF(**271**)				0.85(**9**)	0.85(**9**)	0.85(**9**)	1.25(**B**)				
330pF(**331**)				0.85(**9**)	0.85(**9**)	0.85(**9**)	1.25(**B**)				
390pF(**391**)				1.25(**B**)	0.85(**9**)	0.85(**9**)	1.25(**B**)				
470pF(**471**)				1.25(**B**)	0.85(**9**)	0.85(**9**)	1.25(**B**)	0.85(**9**)			
560pF(**561**)				1.25(**B**)	1.25(**B**)	1.25(**B**)		0.85(**9**)		1.25(**B**)	
680pF(**681**)		0.85(**9**)			1.25(**B**)	1.25(**B**)		0.85(**9**)		1.25(**B**)	
820pF(**821**)		0.85(**9**)				1.25(**B**)		1.25(**B**)	0.60(**6**)	1.25(**B**)	0.60(**6**)
1000pF(**102**)		0.85(**9**)						1.25(**B**)	0.60(**6**)	1.25(**B**)	0.60(**6**)
1200pF(**122**)		0.85(**9**)	0.60(**6**)					1.25(**B**)	0.60(**6**)	1.25(**B**)	0.60(**6**)
1500pF(**152**)		0.85(**9**)	0.60(**6**)					1.25(**B**)	0.85(**9**)	1.25(**B**)	0.85(**9**)
1800pF(**182**)			0.60(**6**)					1.25(**B**)	0.85(**9**)	1.25(**B**)	0.85(**9**)
2200pF(**222**)			0.60(**6**)						0.85(**9**)		0.85(**9**)
2700pF(**272**)			0.60(**6**)						1.25(**B**)		1.25(**B**)
3300pF(**332**)			0.60(**6**)						1.25(**B**)		1.25(**B**)
3900pF(**392**)			0.60(**6**)								
4700pF(**472**)			0.60(**6**)								
5600pF(**562**)			0.85(**9**)								
6800pF(**682**)			0.85(**9**)								
8200pF(**822**)			0.85(**9**)								
10000pF(**103**)			0.85(**9**)						0.60(**6**)		0.60(**6**)
12000pF(**123**)			0.85(**9**)						0.60(**6**)		0.60(**6**)
15000pF(**153**)			0.85(**9**)						0.60(**6**)		0.60(**6**)
18000pF(**183**)			1.25(**B**)						0.60(**6**)		0.60(**6**)
22000pF(**223**)			1.25(**B**)						0.85(**9**)		0.85(**9**)
27000pF(**273**)									0.85(**9**)		0.85(**9**)
33000pF(**333**)									1.00(**A**)		1.00(**A**)
39000pF(**393**)									1.25(**B**)		1.25(**B**)
47000pF(**473**)									1.25(**B**)		1.25(**B**)

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

Temperature Compensating Type GRM31 Series (3.20x1.60mm) 500/200/100/50/25V

Part Number	GRM31													
L x W [EIA]	3.20x1.60 [1206]													
TC	C0G (**5C**)					C0H (**6C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)			T2H (**6T**)	U2J (**7U**)
Rated Volt.	500 (**2H**)	200 (**2D**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	200 (**2D**)	100 (**2A**)	50 (**1H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)														
1.0pF(**1R0**)	1.15(**M**)													
2.0pF(**2R0**)	1.15(**M**)													
3.0pF(**3R0**)	1.15(**M**)													
4.0pF(**4R0**)	1.15(**M**)													
5.0pF(**5R0**)	1.15(**M**)													
6.0pF(**6R0**)	1.15(**M**)													
7.0pF(**7R0**)	1.15(**M**)													
8.0pF(**8R0**)	1.15(**M**)													
9.0pF(**9R0**)	1.15(**M**)													
10pF(**100**)	1.15(**M**)													
12pF(**120**)	1.15(**M**)													
15pF(**150**)	1.15(**M**)													
18pF(**180**)	1.15(**M**)													
22pF(**220**)	1.15(**M**)													
27pF(**270**)	1.15(**M**)													
33pF(**330**)	1.15(**M**)													
39pF(**390**)	1.15(**M**)													
47pF(**470**)	1.15(**M**)													
56pF(**560**)	1.15(**M**)													
68pF(**680**)	1.15(**M**)													
82pF(**820**)	1.15(**M**)													
270pF(**271**)		1.15(**M**)												
330pF(**331**)		1.15(**M**)												
390pF(**391**)		1.15(**M**)												
470pF(**471**)		1.15(**M**)									0.85(**9**)			
560pF(**561**)										1.15(**M**)	0.85(**9**)			
680pF(**681**)							0.85(**9**)			1.15(**M**)	0.85(**9**)			
820pF(**821**)			0.85(**9**)				0.85(**9**)	0.85(**9**)		1.15(**M**)	0.85(**9**)			
1000pF(**102**)			0.85(**9**)				1.15(**M**)	1.15(**M**)	0.85(**9**)	1.15(**M**)	0.85(**9**)			
1200pF(**122**)			0.85(**9**)				1.15(**M**)	1.15(**M**)	1.15(**M**)	1.15(**M**)	0.85(**9**)			
1500pF(**152**)			0.85(**9**)				1.15(**M**)	1.15(**M**)	1.15(**M**)		0.85(**9**)			
1800pF(**182**)			0.85(**9**)						1.15(**M**)		0.85(**9**)			
2200pF(**222**)			0.85(**9**)								1.15(**M**)		1.15(**M**)	
2700pF(**272**)			0.85(**9**)								1.15(**M**)		1.15(**M**)	
3300pF(**332**)			0.85(**9**)	0.85(**9**)							1.15(**M**)		1.15(**M**)	
3900pF(**392**)			0.85(**9**)	0.85(**9**)							1.15(**M**)	0.85(**9**)	1.15(**M**)	0.85(**9**)
4700pF(**472**)			0.85(**9**)	0.85(**9**)							1.15(**M**)	0.85(**9**)		0.85(**9**)
5600pF(**562**)			0.85(**9**)	0.85(**9**)								0.85(**9**)		0.85(**9**)
6800pF(**682**)				0.85(**9**)	0.85(**9**)	0.85(**9**)						1.15(**M**)		1.15(**M**)
8200pF(**822**)				0.85(**9**)	1.15(**M**)	1.15(**M**)						1.15(**M**)		1.15(**M**)
10000pF(**103**)				0.85(**9**)	0.85(**9**)									
12000pF(**123**)				0.85(**9**)										
15000pF(**153**)				0.85(**9**)										
18000pF(**183**)				0.85(**9**)										
22000pF(**223**)				0.85(**9**)										
27000pF(**273**)				0.85(**9**)										
33000pF(**333**)				0.85(**9**)										
39000pF(**393**)				1.15(**M**)										
47000pF(**473**)				1.15(**M**)										

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Part Number	GRM31													
L x W [EIA]	3.20x1.60 [1206]													
TC	C0G (**5C**)					C0H (**6C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)			T2H (**6T**)	U2J (**7U**)
Rated Volt.	500 (**2H**)	200 (**2D**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	200 (**2D**)	100 (**2A**)	50 (**1H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)														
56000pF(**563**)				1.60(**C**)								0.85(**9**)		0.85(**9**)
68000pF(**683**)				1.60(**C**)								1.15(**M**)		1.15(**M**)
82000pF(**823**)				1.60(**C**)								1.15(**M**)		1.15(**M**)
0.10µF(**104**)					1.60(**C**)							1.15(**M**)		1.15(**M**)

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

High Dielectric Constant Type X5R (R6) Characteristics

TC	X5R (**R6**)									
Part Number	GRM15		GRM18			GRM21		GRM31		
L x W [EIA]	1.00x0.50 [0402]		1.60x0.80 [0603]			2.00x1.25 [0805]		3.20x1.60 [1206]		
Rated Volt.	16 (**1C**)	10 (**1A**)	25 (**1E**)	10 (**1A**)	6.3 (**0J**)	10 (**1A**)	6.3 (**0J**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)										
68000pF(**683**)		0.50(**5**)								
0.10µF(**104**)	0.50(**5**)	0.50(**5**)								
0.22µF(**224**)			0.80(**8**)							
0.33µF(**334**)				0.80(**8**)		0.60(**6**)				
0.47µF(**474**)				0.80(**8**)						
0.68µF(**684**)				0.80(**8**)						
1.0µF(**105**)				0.80(**8**)	0.80(**8**)	0.85(**9**)			0.85(**9**)	
1.5µF(**155**)							0.85(**9**)			
2.2µF(**225**)						1.25(**B**)	1.25(**B**)		0.85(**9**)	
3.3µF(**335**)							1.25(**B**)		1.30(**X**)	
4.7µF(**475**)							1.25(**B**)	1.60(**C**)	1.60(**C**)	1.15(**M**)
10µF(**106**)									1.60(**C**)	1.60(**C**)

The part numbering code is shown in each ( ).
3.3µF and 4.7µF, 6.3V rated are GRM21 series of L: 2±0.15, W: 1.25±0.15, T: 1.25±0.15.
T: 1.15±0.1mm is also available for GRM31 1.0µF for 16V.
L: 3.2±0.2, W: 1.6±0.2 for GRM31 16V 1.0µF type. Also L: 3.2±0.2, W: 1.6±0.2, T: 1.15±0.15 for GRM31 16V 1.5µF and 2.2µF type.
Dimensions are shown in mm and Rated Voltage in Vdc.

High Dielectric Constant Type X7R (R7) Characteristics

TC	X7R (**R7**)																			
Part Number	GRM15				GRM18					GRM21						GRM31				
L x W [EIA]	1.00x0.50 [0402]				1.60x0.80 [0603]					2.00x1.25 [0805]						3.20x1.60 [1206]				
Rated Volt.	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)																				
220pF (**221**)	0.50 (**5**)				0.80 (**8**)	0.80 (**8**)														
330pF (**331**)	0.50 (**5**)				0.80 (**8**)	0.80 (**8**)														
470pF (**471**)	0.50 (**5**)				0.80 (**8**)	0.80 (**8**)														
680pF (**681**)	0.50 (**5**)				0.80 (**8**)	0.80 (**8**)														

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TC	X7R (**R7**)																			
Part Number	**GRM15**				**GRM18**					**GRM21**						**GRM31**				
L x W [EIA]	1.00x0.50 [0402]				1.60x0.80 [0603]					2.00x1.25 [0805]						3.20x1.60 [1206]				
Rated Volt.	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)																				
1000pF (**102**)	0.50 (**5**)				0.80 (**8**)	0.80 (**8**)														
1500pF (**152**)	0.50 (**5**)				0.80 (**8**)	0.80 (**8**)														
2200pF (**222**)	0.50 (**5**)				0.80 (**8**)	0.80 (**8**)														
3300pF (**332**)	0.50 (**5**)				0.80 (**8**)	0.80 (**8**)														
4700pF (**472**)	0.50 (**5**)					0.80 (**8**)				0.85 (**9**)										
6800pF (**682**)		0.50 (**5**)				0.80 (**8**)				0.85 (**9**)										
10000pF (**103**)		0.50 (**5**)				0.80 (**8**)				1.25 (**B**)										
15000pF (**153**)		0.50 (**5**)	0.50 (**5**)			0.80 (**8**)				1.25 (**B**)										
22000pF (**223**)		0.50 (**5**)	0.50 (**5**)			0.80 (**8**)				1.25 (**B**)										
33000pF (**333**)		0.50 (**5**)	0.50 (**5**)	0.50 (**5**)		0.80 (**8**)	0.80 (**8**)			1.25 (**B**)	0.85 (**9**)					1.15 (**M**)				
47000pF (**473**)		0.50 (**5**)		0.50 (**5**)		0.80 (**8**)	0.80 (**8**)			1.25 (**B**)	1.25 (**B**)					1.15 (**M**)				
68000pF (**683**)			0.50 (**5**)			0.80 (**8**)	0.80 (**8**)				1.25 (**B**)					1.15 (**M**)				
0.10µF (**104**)			0.50 (**5**)	0.50 (**5**)		0.80 (**8**)	0.80 (**8**)	0.80 (**8**)			1.25 (**B**)	1.25 (**B**)								
0.15µF (**154**)							0.80 (**8**)	0.80 (**8**)	0.80 (**8**)		1.25 (**B**)	1.25 (**B**)								
0.22µF (**224**)							0.80 (**8**)	0.80 (**8**)	0.80 (**8**)		1.25 (**B**)	0.85 (**9**)								
0.33µF (**334**)								0.80 (**8**)			0.85 (**9**)	1.25 (**B**)		0.60 (**6**)			0.85 (**9**)			
0.47µF (**474**)								0.80 (**8**)			1.25 (**B**)	0.85 (**9**)	0.85 (**9**)				1.15 (**M**)		0.85 (**9**)	
0.68µF (**684**)													0.85 (**9**)					0.85 (**9**)		
1.0µF (**105**)												1.25 (**B**)	1.25 (**B**)				1.15 (**M**)	1.15 (**M**)	0.85 (**9**)	0.85 (**9**)
1.5µF (**155**)												1.25 (**B**)					1.60 (**C**)		1.15 (**M**)	
2.2µF (**225**)														1.25 (**B**)	1.25 (**B**)		1.60 (**C**)	1.15 (**M**)	1.15 (**M**)	1.15 (**M**)
3.3µF (**335**)																		1.60 (**C**)	1.60 (**C**)	
4.7µF (**475**)																		1.60 (**C**)	1.60 (**C**)	1.60 (**C**)
10µF (**106**)																				1.60 (**C**)

The part numbering code is shown in each ( ).
The tolerance will be changed to L: 3.2±0.2, W: 1.6±0.2 for GRM31 16V 1.0µF type. Also L: 3.2±0.2, W: 1.6±0.2, T: 1.15±0.15 for GRM31 16V 1.5µF and 2.2µF type.
Dimensions are shown in mm and Rated Voltage in Vdc.

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High Dielectric Constant Type Y5V (F5) Characteristics

TC	Y5V (**F5**)																	
Part Number	**GRM15**				**GRM18**					**GRM21**				**GRM31**				
L x W [EIA]	1.00x0.50 [0402]				1.60x0.80 [0603]					2.00x1.25 [0805]				3.20x1.60 [1206]				
Rated Volt.	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	100 (**2A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)																		
2200pF (**222**)	0.50 (**5**)																	
4700pF (**472**)	0.50 (**5**)				0.80 (**8**)													
10000pF (**103**)	0.50 (**5**)					0.80 (**8**)												
22000pF (**223**)		0.50 (**5**)				0.80 (**8**)												
47000pF (**473**)		0.50 (**5**)	0.50 (**5**)			0.80 (**8**)												
0.10µF (**104**)		0.50 (**5**)	0.50 (**5**)			0.80 (**8**)	0.80 (**8**)			0.85 (**9**)								
0.22µF (**224**)			0.50 (**5**)			0.80 (**8**)		0.80 (**8**)		1.25 (**B**)	0.85 (**9**)							
0.47µF (**474**)			0.50 (**5**)	0.50 (**5**)			0.80 (**8**)	0.80 (**8**)	0.80 (**8**)	0.85 (**9**)	1.25 (**B**)			1.15 (**M**)				
1.0µF (**105**)								0.80 (**8**)	0.80 (**8**)	0.85 (**9**)	0.85 (**9**)	0.85 (**9**)	0.85 (**9**)		1.15 (**M**)	0.85 (**9**)		
2.2µF (**225**)											1.25 (**B**)	1.25 (**B**)	1.25 (**B**)			1.15 (**M**)	0.85 (**9**)	
4.7µF (**475**)													1.25 (**B**)	1.60 (**C**)	1.15 (**M**)	1.15 (**M**)	1.15 (**M**)	
10µF (**106**)															1.60 (**C**)		1.15 (**M**)	1.15 (**M**)

The part numbering code is shown in each ( ).
T: 1.25±0.1mm is also available for GRM21 25V or 16V 1.0µF type.
Dimensions are shown in mm and Rated Voltage in Vdc.

Chip Monolithic Ceramic Capacitors

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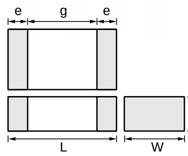
for Reflow Soldering GRM32/43/55 Series

Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GRM329			0.85 ±0.1		
GRM32M			1.15 ±0.1		
GRM32N	3.2 ±0.3	2.5 ±0.2	1.35 ±0.15	0.3	1.0
GRM32R			1.8 ±0.2		
GRM32E			2.5 ±0.2		
GRM43M			1.15 ±0.1		
GRM43N			1.35 ±0.15		
GRM43R	4.5 ±0.4	3.2 ±0.3	1.8 ±0.2	0.3	2.0
GRM43D			2.0 ±0.2		
GRM43E			2.5 ±0.2		
GRM55M			1.15 ±0.1		
GRM55N			1.35 ±0.15		
GRM55C	5.7 ±0.4	5.0 ±0.4	1.6 ±0.2	0.3	2.0
GRM55R			1.8 ±0.2		
GRM55D			2.0 ±0.2		
GRM55E			2.5 ±0.2		



■ Features

1. Terminations are made of metal highly resistant to migration.
2. The GRM series is a complete line of chip ceramic capacitors in 10V, 16V, 25V, 50V, 100V and 200V ratings. These capacitors have temperature characteristics ranging from C0G to Y5V.
3. This series consists of type LxWxT: 3.2x2.5x0.85mm to LxWxT: 5.7x5.0x2.5mm. These are suited to only reflow soldering.

■ Applications

General electronic equipment

Temperature Compensating Type GRM32/43/55 Series

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM32N5C2D561JV01	C0G (EIA)	200	560 ±5%	3.20	2.50	1.35
GRM32N5C2D681JY21	C0G (EIA)	200	680 ±5%	3.20	2.50	1.35
GRM32N5C2D821JY21	C0G (EIA)	200	820 ±5%	3.20	2.50	1.35
GRM32N5C2D102JY21	C0G (EIA)	200	1000 ±5%	3.20	2.50	1.35
GRM43R5C2D122JV01	C0G (EIA)	200	1200 ±5%	4.50	3.20	1.80
GRM43R5C2D152JV01	C0G (EIA)	200	1500 ±5%	4.50	3.20	1.80
GRM43R5C2D182JY21	C0G (EIA)	200	1800 ±5%	4.50	3.20	1.80
GRM43R5C2D222JY21	C0G (EIA)	200	2200 ±5%	4.50	3.20	1.80
GRM43R5C2D272JY21	C0G (EIA)	200	2700 ±5%	4.50	3.20	1.80
GRM55N5C2D332JY21	C0G (EIA)	200	3300 ±5%	5.70	5.00	1.35
GRM55R5C2D392JY21	C0G (EIA)	200	3900 ±5%	5.70	5.00	1.80
GRM55R5C2D472JY21	C0G (EIA)	200	4700 ±5%	5.70	5.00	1.80
GRM55R5C2D562JY21	C0G (EIA)	200	5600 ±5%	5.70	5.00	1.80
GRM32N1X2D152JV01	SL (JIS)	200	1500 ±5%	3.20	2.50	1.35
GRM43N1X2D182JV01	SL (JIS)	200	1800 ±5%	4.50	3.20	1.35
GRM43N1X2D222JV01	SL (JIS)	200	2200 ±5%	4.50	3.20	1.35
GRM43R1X2D272JV01	SL (JIS)	200	2700 ±5%	4.50	3.20	1.80
GRM43R1X2D332JV01	SL (JIS)	200	3300 ±5%	4.50	3.20	1.80
GRM43R1X2D392JV01	SL (JIS)	200	3900 ±5%	4.50	3.20	1.80
GRM55N1X2D472JV01	SL (JIS)	200	4700 ±5%	5.70	5.00	1.35
GRM55R1X2D562JV01	SL (JIS)	200	5600 ±5%	5.70	5.00	1.80
GRM55R1X2D682JV01	SL (JIS)	200	6800 ±5%	5.70	5.00	1.80
GRM55R1X2D822JV01	SL (JIS)	200	8200 ±5%	5.70	5.00	1.80
GRM32N1X2A562JZ01	SL (JIS)	100	5600 ±5%	3.20	2.50	1.35
GRM32N1X2A682JZ01	SL (JIS)	100	6800 ±5%	3.20	2.50	1.35
GRM43N1X2A822JZ01	SL (JIS)	100	8200 ±5%	4.50	3.20	1.35
GRM43R1X2A103JZ01	SL (JIS)	100	10000 ±5%	4.50	3.20	1.80
GRM43R1X2A123JZ01	SL (JIS)	100	12000 ±5%	4.50	3.20	1.80
GRM43R1X2A153JZ01	SL (JIS)	100	15000 ±5%	4.50	3.20	1.80
GRM55M1X2A183JZ01	SL (JIS)	100	18000 ±5%	5.70	5.00	1.15
GRM55N1X2A223JZ01	SL (JIS)	100	22000 ±5%	5.70	5.00	1.35
GRM55R1X2A273JZ01	SL (JIS)	100	27000 ±5%	5.70	5.00	1.80
GRM55R1X2A333JZ01	SL (JIS)	100	33000 ±5%	5.70	5.00	1.80
GRM55R1X2A393JZ01	SL (JIS)	100	39000 ±5%	5.70	5.00	1.80

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Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM32N1X1H103JZ01	SL (JIS)	50	10000 ±5%	3.20	2.50	1.35
GRM32N1X1H123JZ01	SL (JIS)	50	12000 ±5%	3.20	2.50	1.35
GRM43R1X1H153JZ01	SL (JIS)	50	15000 ±5%	4.50	3.20	1.80
GRM55M1X1H183JZ01	SL (JIS)	50	18000 ±5%	5.70	5.00	1.15
GRM55N1X1H223JZ01	SL (JIS)	50	22000 ±5%	5.70	5.00	1.35
GRM55R1X1H273JZ01	SL (JIS)	50	27000 ±5%	5.70	5.00	1.80
GRM55R1X1H333JZ01	SL (JIS)	50	33000 ±5%	5.70	5.00	1.80
GRM55R1X1H393JZ01	SL (JIS)	50	39000 ±5%	5.70	5.00	1.80

High Dielectric Constant Type Type GRM32 Series (3.20x2.50mm)

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM32ER61A106KA01	X5R (EIA)	10	10μF ±10%	3.20	2.50	2.50
GRM32NR72A683KA01	X7R (EIA)	100	68000pF ±10%	3.20	2.50	1.35
GRM32NR72A104KA01	X7R (EIA)	100	0.10μF ±10%	3.20	2.50	1.35
GRM32CR72A684KA01	X7R (EIA)	100	0.68μF ±10%	3.20	2.50	1.60
GRM32CR72A105KA35	X7R (EIA)	100	1.0μF ±10%	3.20	2.50	1.60
GRM32ER72A105KA01	X7R (EIA)	100	1.0μF ±10%	3.20	2.50	2.50
GRM32DR72A155KA35	X7R (EIA)	100	1.5μF ±10%	3.20	2.50	2.00
GRM32ER72A225KA35	X7R (EIA)	100	2.2μF ±10%	3.20	2.50	2.50
GRM32NR71H684KA01	X7R (EIA)	50	0.68μF ±10%	3.20	2.50	1.35
GRM32DR71H335KA88	X7R (EIA)	50	3.3μF ±10%	3.20	2.50	2.00
GRM32ER71H475KA88	X7R (EIA)	50	4.7μF ±10%	3.20	2.50	2.50
GRM32NR71E155KA01	X7R (EIA)	25	1.5μF ±10%	3.20	2.50	1.35
GRM32RR71E225KA01	X7R (EIA)	25	2.2μF ±10%	3.20	2.50	1.80
GRM32DR71E335KA01	X7R (EIA)	25	3.3μF ±10%	3.20	2.50	2.00
GRM32DR71E475KA61	X7R (EIA)	25	4.7μF ±10%	3.20	2.50	2.00
GRM32MR71C225KA01	X7R (EIA)	16	2.2μF ±10%	3.20	2.50	1.15
GRM32NR71C335KA01	X7R (EIA)	16	3.3μF ±10%	3.20	2.50	1.35
GRM32RR71C475KA01	X7R (EIA)	16	4.7μF ±10%	3.20	2.50	1.80
GRM32DR71C106KA01	X7R (EIA)	16	10μF ±10%	3.20	2.50	2.00
GRM32NF52A104ZA01	Y5V (EIA)	100	0.10μF +80/-20%	3.20	2.50	1.35
GRM32RF51H105ZA01	Y5V (EIA)	50	1.0μF +80/-20%	3.20	2.50	1.80
GRM32DF51H106ZA01	Y5V (EIA)	50	10μF +80/-20%	3.20	2.50	2.00
GRM329F51E475ZA01	Y5V (EIA)	25	4.7μF +80/-20%	3.20	2.50	0.85
GRM32NF51E106ZA01	Y5V (EIA)	25	10μF +80/-20%	3.20	2.50	1.35
GRM32NF51C106ZA01	Y5V (EIA)	16	10μF +80/-20%	3.20	2.50	1.35

High Dielectric Constant Type Type GRM43 Series (4.50x3.20mm)

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance (μF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM43RR72A154KA01	X7R (EIA)	100	0.15 ±10%	4.50	3.20	1.80
GRM43RR72A224KA01	X7R (EIA)	100	0.22 ±10%	4.50	3.20	1.80
GRM43DR72A474KA01	X7R (EIA)	100	0.47 ±10%	4.50	3.20	2.00
GRM43DR72A155KA01	X7R (EIA)	100	1.5 ±10%	4.50	3.20	2.00
GRM43ER72A225KA01	X7R (EIA)	100	2.2 ±10%	4.50	3.20	2.50
GRM43DR71H155KA01	X7R (EIA)	50	1.5 ±10%	4.50	3.20	2.00
GRM43ER71H225KA01	X7R (EIA)	50	2.2 ±10%	4.50	3.20	2.50
GRM43ER71E475KA01	X7R (EIA)	25	4.7 ±10%	4.50	3.20	2.50
GRM43RF52A224ZD01	Y5V (EIA)	100	0.22 +80/-20%	4.50	3.20	1.80

High Dielectric Constant Type Type GRM55 Series (5.70x5.00mm)

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance (μF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM55DR61H106KA88	X5R (EIA)	50	10 ±10%	5.70	5.00	2.00
GRM55DR72A105KA01	X7R (EIA)	100	1.0 ±10%	5.70	5.00	2.00
GRM55ER72A475KA01	X7R (EIA)	100	4.7 ±10%	5.70	5.00	2.50
GRM55RR71H105KA01	X7R (EIA)	50	1.0 ±10%	5.70	5.00	1.80
GRM55RR71H155KA01	X7R (EIA)	50	1.5 ±10%	5.70	5.00	1.80
GRM55ER11H475KA01	X7R (EIA)	50	4.7 ±10%	5.70	5.00	2.50
GRM55ER71H475KA01	X7R (EIA)	50	4.7 ±10%	5.70	5.00	2.50
GRM55RF52A474ZA01	Y5V (EIA)	100	0.47 +80/-20%	5.70	5.00	1.80

Chip Monolithic Ceramic Capacitors

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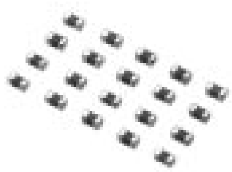
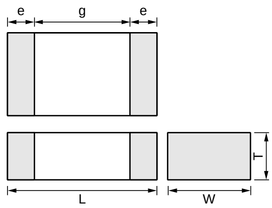
Ultra-small GRM02/03 Series

■ Features

1. Small chip size (LxWxT: 0.4x0.2x0.2, 0.6x0.3x0.3 mm)
2. Terminations are made of metal highly resistant to migration.
3. GRM02, GRM03 series is suited to only reflow soldering.
4. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placement on PCBs.
5. GRM02, GRM03 series are suited to miniature micro wave module, portable equipment and high frequency circuits.





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

■ Applications

1. Miniature micro wave module
2. Portable equipment
3. High frequency circuit

Part Number	**GRM02**	**GRM03**											
L x W	0.4x0.2 [01005]	0.6x0.3 [0201]											
TC	C0G (**5C**)	C0G (**5C**)	R2H (**6R**)	S2H (**6S**)	T2H (**6T**)	U2J (**7U**)		X5R (**R6**)	X7R (**R7**)				Y5V (**F5**)
Rated Volt.	16 (**1C**)	25 (**1E**)	25 (**1E**)	25 (**1E**)	25 (**1E**)	50 (**1H**)	25 (**1E**)	10 (**1A**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)													
0.30pF(**R30**)		0.3(**3**)											
0.40pF(**R40**)		0.3(**3**)											
0.50pF(**R50**)		0.3(**3**)											
0.60pF(**R60**)		0.3(**3**)											
0.70pF(**R70**)		0.3(**3**)											
0.75pF(**R75**)		0.3(**3**)											
0.80pF(**R80**)		0.3(**3**)											
0.90pF(**R90**)		0.3(**3**)											
1.0pF(**1R0**)	0.2(**2**)	0.3(**3**)											
1.1pF(**1R1**)		0.3(**3**)											
1.2pF(**1R2**)		0.3(**3**)											
1.3pF(**1R3**)		0.3(**3**)											
1.4pF(**1R4**)		0.3(**3**)											
1.5pF(**1R5**)		0.3(**3**)											
1.6pF(**1R6**)		0.3(**3**)											
1.7pF(**1R7**)		0.3(**3**)											
1.8pF(**1R8**)		0.3(**3**)											
1.9pF(**1R9**)		0.3(**3**)											
2.0pF(**2R0**)	0.2(**2**)	0.3(**3**)											
2.1pF(**2R1**)		0.3(**3**)											
2.2pF(**2R2**)		0.3(**3**)											
2.3pF(**2R3**)		0.3(**3**)											
2.4pF(**2R4**)		0.3(**3**)											
2.5pF(**2R5**)		0.3(**3**)											
2.6pF(**2R6**)		0.3(**3**)											
2.7pF(**2R7**)		0.3(**3**)											

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Part Number	GRM02	GRM03											
L x W	0.4x0.2 [01005]	0.6x0.3 [0201]											
TC	C0G (**5C**)	C0G (**5C**)	R2H (**6R**)	S2H (**6S**)	T2H (**6T**)	U2J (**7U**)		X5R (**R6**)	X7R (**R7**)				Y5V (**F5**)
Rated Volt.	16 (**1C**)	25 (**1E**)	25 (**1E**)	25 (**1E**)	25 (**1E**)	50 (**1H**)	25 (**1E**)	10 (**1A**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)													
2.8pF(**2R8**)		0.3(**3**)											
2.9pF(**2R9**)		0.3(**3**)											
3.0pF(**3R0**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
3.1pF(**3R1**)		0.3(**3**)											
3.2pF(**3R2**)		0.3(**3**)											
3.3pF(**3R3**)		0.3(**3**)											
3.4pF(**3R4**)		0.3(**3**)											
3.5pF(**3R5**)		0.3(**3**)											
3.6pF(**3R6**)		0.3(**3**)											
3.7pF(**3R7**)		0.3(**3**)											
3.8pF(**3R8**)		0.3(**3**)											
3.9pF(**3R9**)		0.3(**3**)											
4.0pF(**4R0**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
4.1pF(**4R1**)		0.3(**3**)											
4.2pF(**4R2**)		0.3(**3**)											
4.3pF(**4R3**)		0.3(**3**)											
4.4pF(**4R4**)		0.3(**3**)											
4.5pF(**4R5**)		0.3(**3**)											
4.6pF(**4R6**)		0.3(**3**)											
4.7pF(**4R7**)		0.3(**3**)											
4.8pF(**4R8**)		0.3(**3**)											
4.9pF(**4R9**)		0.3(**3**)											
5.0pF(**5R0**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
5.1pF(**5R1**)		0.3(**3**)											
5.2pF(**5R2**)		0.3(**3**)											
5.3pF(**5R3**)		0.3(**3**)											
5.4pF(**5R4**)		0.3(**3**)											
5.5pF(**5R5**)		0.3(**3**)											
5.6pF(**5R6**)		0.3(**3**)											
5.7pF(**5R7**)		0.3(**3**)											
5.8pF(**5R8**)		0.3(**3**)											
5.9pF(**5R9**)		0.3(**3**)											
6.0pF(**6R0**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
6.1pF(**6R1**)		0.3(**3**)											
6.2pF(**6R2**)		0.3(**3**)											
6.3pF(**6R3**)		0.3(**3**)											
6.4pF(**6R4**)		0.3(**3**)											
6.5pF(**6R5**)		0.3(**3**)											
6.6pF(**6R6**)		0.3(**3**)											
6.7pF(**6R7**)		0.3(**3**)											
6.8pF(**6R8**)		0.3(**3**)											
6.9pF(**6R9**)		0.3(**3**)											
7.0pF(**7R0**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
7.1pF(**7R1**)		0.3(**3**)											
7.2pF(**7R2**)		0.3(**3**)											
7.3pF(**7R3**)		0.3(**3**)											
7.4pF(**7R4**)		0.3(**3**)											
7.5pF(**7R5**)		0.3(**3**)											
7.6pF(**7R6**)		0.3(**3**)											
7.7pF(**7R7**)		0.3(**3**)											
7.8pF(**7R8**)		0.3(**3**)											
7.9pF(**7R9**)		0.3(**3**)											

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Part Number	GRM02	GRM03											
L x W	0.4x0.2 [01005]	0.6x0.3 [0201]											
TC	C0G (**5C**)	C0G (**5C**)	R2H (**6R**)	S2H (**6S**)	T2H (**6T**)	U2J (**7U**)		X5R (**R6**)	X7R (**R7**)				Y5V (**F5**)
Rated Volt.	16 (**1C**)	25 (**1E**)	25 (**1E**)	25 (**1E**)	25 (**1E**)	50 (**1H**)	25 (**1E**)	10 (**1A**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)													
8.0pF(**8R0**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
8.1pF(**8R1**)		0.3(**3**)											
8.2pF(**8R2**)		0.3(**3**)											
8.3pF(**8R3**)		0.3(**3**)											
8.4pF(**8R4**)		0.3(**3**)											
8.5pF(**8R5**)		0.3(**3**)											
8.6pF(**8R6**)		0.3(**3**)											
8.7pF(**8R7**)		0.3(**3**)											
8.8pF(**8R8**)		0.3(**3**)											
8.9pF(**8R9**)		0.3(**3**)											
9.0pF(**9R0**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
9.1pF(**9R1**)		0.3(**3**)											
9.2pF(**9R2**)		0.3(**3**)											
9.3pF(**9R3**)		0.3(**3**)											
9.4pF(**9R4**)		0.3(**3**)											
9.5pF(**9R5**)		0.3(**3**)											
9.6pF(**9R6**)		0.3(**3**)											
9.7pF(**9R7**)		0.3(**3**)											
9.8pF(**9R8**)		0.3(**3**)											
9.9pF(**9R9**)		0.3(**3**)											
10pF(**100**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
12pF(**120**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
15pF(**150**)	0.2(**2**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)							
18pF(**180**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
22pF(**220**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
27pF(**270**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
33pF(**330**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
39pF(**390**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
47pF(**470**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
56pF(**560**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
68pF(**680**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
82pF(**820**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)						
100pF(**101**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)		0.3(**3**)		0.3(**3**)	0.3(**3**)			
150pF(**151**)									0.3(**3**)	0.3(**3**)			
220pF(**221**)									0.3(**3**)	0.3(**3**)			
330pF(**331**)									0.3(**3**)	0.3(**3**)			
470pF(**471**)									0.3(**3**)	0.3(**3**)			
680pF(**681**)									0.3(**3**)	0.3(**3**)			
1000pF(**102**)									0.3(**3**)	0.3(**3**)			
1500pF(**152**)								0.3(**3**)	0.3(**3**)			0.3(**3**)	
2200pF(**222**)								0.3(**3**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	0.3(**3**)
3300pF(**332**)								0.3(**3**)		0.3(**3**)	0.3(**3**)	0.3(**3**)	
4700pF(**472**)								0.3(**3**)			0.3(**3**)	0.3(**3**)	0.3(**3**)
6800pF(**682**)								0.3(**3**)			0.3(**3**)	0.3(**3**)	
10000pF(**103**)								0.3(**3**)			0.3(**3**)	0.3(**3**)	0.3(**3**)

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

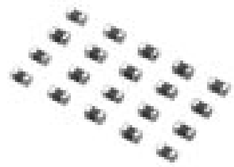
Chip Monolithic Ceramic Capacitors

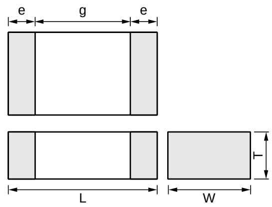
muRata

Tight Tolerance GRM03/15 Series

■ Features

1. Terminations are made of metal highly resistant to migration.
2. A wide selection of sizes is available, from the miniature LxWxT: 0.6x0.3x0.3mm or LxWxT: 1.0x0.5x0.5mm.
3. The GRM03 type is a complete line of chip ceramic capacitors in 25V ratings, The GRM15 type is a complete line of chip ceramic capacitors in 50V ratings.
4. These capacitors have temperature characteristics ranging C0G.
5. GRM03 and GRM15 type are applied to only reflow soldering.
6. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placement on PCBs.
7. The GRM series is available in paper tape and reel packaging for automatic placement.





Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRM033	0.6±0.03	0.3±0.03	0.3±0.03	0.1 to 0.2	0.2
GRM155	1.0±0.05	0.5±0.05	0.5±0.05	0.15 to 0.3	0.4

■ Applications

General electronic equipment

Temperature Compensating Type GRM03/15 Series

Part Number		**GRM03**	**GRM15**
L x W [EIA]		0.60x0.30 [0201]	1.00x0.50 [0402]
TC		C0G (**5C**)	C0G (**5C**)
Rated Volt.		25 (**1E**)	50 (**1H**)
Capacitance, Capacitance Tolerance and T Dimension			
0.10pF(**R10**)	**M, N**	0.30(**3**)	0.50(**5**)
0.20pF(**R20**)	**K, M**	0.30(**3**)	0.50(**5**)
0.30pF(**R30**)	**K, M**	0.30(**3**)	0.50(**5**)
0.40pF(**R40**)	**K, M**	0.30(**3**)	0.50(**5**)
0.50pF(**R50**)	**K, M**	0.30(**3**)	0.50(**5**)
0.60pF(**R60**)	**K, M**	0.30(**3**)	0.50(**5**)
0.70pF(**R70**)	**K, M**	0.30(**3**)	0.50(**5**)
0.80pF(**R80**)	**K, M**	0.30(**3**)	0.50(**5**)
0.90pF(**R90**)	**K, M**	0.30(**3**)	0.50(**5**)
1.0pF(**1R0**)	**J, K**	0.30(**3**)	0.50(**5**)
1.1pF(**1R1**)	**J, K**	0.30(**3**)	0.50(**5**)
1.2pF(**1R2**)	**J, K**	0.30(**3**)	0.50(**5**)
1.3pF(**1R3**)	**J, K**	0.30(**3**)	0.50(**5**)
1.4pF(**1R4**)	**J, K**	0.30(**3**)	0.50(**5**)
1.5pF(**1R5**)	**J, K**	0.30(**3**)	0.50(**5**)
1.6pF(**1R6**)	**J, K**	0.30(**3**)	0.50(**5**)
1.7pF(**1R7**)	**J, K**	0.30(**3**)	0.50(**5**)
1.8pF(**1R8**)	**J, K**	0.30(**3**)	0.50(**5**)
1.9pF(**1R9**)	**J, K**	0.30(**3**)	0.50(**5**)

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

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Part Number		GRM03	GRM15
L x W [EIA]		0.60x0.30 [0201]	1.00x0.50 [0402]
TC		C0G (**5C**)	C0G (**5C**)
Rated Volt.		25 (**1E**)	50 (**1H**)
Capacitance, Capacitance Tolerance and T Dimension			
2.0pF(**2R0**)	**G, J**	0.30(**3**)	0.50(**5**)
2.1pF(**2R1**)	**G, J**	0.30(**3**)	0.50(**5**)
2.2pF(**2R2**)	**G, J**	0.30(**3**)	0.50(**5**)
2.3pF(**2R3**)	**G, J**	0.30(**3**)	0.50(**5**)
2.4pF(**2R4**)	**G, J**	0.30(**3**)	0.50(**5**)
2.5pF(**2R5**)	**G, J**	0.30(**3**)	0.50(**5**)
2.6pF(**2R6**)	**G, J**	0.30(**3**)	0.50(**5**)
2.7pF(**2R7**)	**G, J**	0.30(**3**)	0.50(**5**)
2.8pF(**2R8**)	**G, J**	0.30(**3**)	0.50(**5**)
2.9pF(**2R9**)	**G, J**	0.30(**3**)	0.50(**5**)
3.0pF(**3R0**)	**G, J**	0.30(**3**)	0.50(**5**)
3.1pF(**3R1**)	**G, J**	0.30(**3**)	0.50(**5**)
3.2pF(**3R2**)	**G, J**	0.30(**3**)	0.50(**5**)
3.3pF(**3R3**)	**G, J**	0.30(**3**)	0.50(**5**)
3.4pF(**3R4**)	**G, J**	0.30(**3**)	0.50(**5**)
3.5pF(**3R5**)	**G, J**	0.30(**3**)	0.50(**5**)
3.6pF(**3R6**)	**G, J**	0.30(**3**)	0.50(**5**)
3.7pF(**3R7**)	**G, J**	0.30(**3**)	0.50(**5**)
3.8pF(**3R8**)	**G, J**	0.30(**3**)	0.50(**5**)
3.9pF(**3R9**)	**G, J**	0.30(**3**)	0.50(**5**)
4.0pF(**4R0**)	**G, J**	0.30(**3**)	0.50(**5**)
4.1pF(**4R1**)	**G, J**	0.30(**3**)	0.50(**5**)
4.2pF(**4R2**)	**G, J**	0.30(**3**)	0.50(**5**)
4.3pF(**4R3**)	**G, J**	0.30(**3**)	0.50(**5**)
4.4pF(**4R4**)	**G, J**	0.30(**3**)	0.50(**5**)
4.5pF(**4R5**)	**G, J**	0.30(**3**)	0.50(**5**)
4.6pF(**4R6**)	**G, J**	0.30(**3**)	0.50(**5**)
4.7pF(**4R7**)	**G, J**	0.30(**3**)	0.50(**5**)
4.8pF(**4R8**)	**G, J**	0.30(**3**)	0.50(**5**)
4.9pF(**4R9**)	**G, J**	0.30(**3**)	0.50(**5**)
5.0pF(**5R0**)	**F, G**	0.30(**3**)	0.50(**5**)
5.1pF(**5R1**)	**F, G**	0.30(**3**)	0.50(**5**)
5.2pF(**5R2**)	**F, G**	0.30(**3**)	0.50(**5**)
5.3pF(**5R3**)	**F, G**	0.30(**3**)	0.50(**5**)
5.4pF(**5R4**)	**F, G**	0.30(**3**)	0.50(**5**)
5.5pF(**5R5**)	**F, G**	0.30(**3**)	0.50(**5**)
5.6pF(**5R6**)	**F, G**	0.30(**3**)	0.50(**5**)
5.7pF(**5R7**)	**F, G**	0.30(**3**)	0.50(**5**)
5.8pF(**5R8**)	**F, G**	0.30(**3**)	0.50(**5**)
5.9pF(**5R9**)	**F, G**	0.30(**3**)	0.50(**5**)
6.0pF(**6R0**)	**F, G**	0.30(**3**)	0.50(**5**)
6.1pF(**6R1**)	**F, G**	0.30(**3**)	0.50(**5**)
6.2pF(**6R2**)	**F, G**	0.30(**3**)	0.50(**5**)
6.3pF(**6R3**)	**F, G**	0.30(**3**)	0.50(**5**)
6.4pF(**6R4**)	**F, G**	0.30(**3**)	0.50(**5**)
6.5pF(**6R5**)	**F, G**	0.30(**3**)	0.50(**5**)
6.6pF(**6R6**)	**F, G**	0.30(**3**)	0.50(**5**)
6.7pF(**6R7**)	**F, G**	0.30(**3**)	0.50(**5**)
6.8pF(**6R8**)	**F, G**	0.30(**3**)	0.50(**5**)
6.9pF(**6R9**)	**F, G**	0.30(**3**)	0.50(**5**)

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

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Part Number		**GRM03**	**GRM15**
L x W [EIA]		0.60x0.30 [0201]	1.00x0.50 [0402]
TC		C0G (**5C**)	C0G (**5C**)
Rated Volt.		25 (**1E**)	50 (**1H**)
Capacitance, Capacitance Tolerance and T Dimension			
7.0pF(**7R0**)	**F, G**	0.30(**3**)	0.50(**5**)
7.1pF(**7R1**)	**F, G**	0.30(**3**)	0.50(**5**)
7.2pF(**7R2**)	**F, G**	0.30(**3**)	0.50(**5**)
7.3pF(**7R3**)	**F, G**	0.30(**3**)	0.50(**5**)
7.4pF(**7R4**)	**F, G**	0.30(**3**)	0.50(**5**)
7.5pF(**7R5**)	**F, G**	0.30(**3**)	0.50(**5**)
7.6pF(**7R6**)	**F, G**	0.30(**3**)	0.50(**5**)
7.7pF(**7R7**)	**F, G**	0.30(**3**)	0.50(**5**)
7.8pF(**7R8**)	**F, G**	0.30(**3**)	0.50(**5**)
7.9pF(**7R9**)	**F, G**	0.30(**3**)	0.50(**5**)
8.0pF(**8R0**)	**F, G**	0.30(**3**)	0.50(**5**)
8.1pF(**8R1**)	**F, G**	0.30(**3**)	0.50(**5**)
8.2pF(**8R2**)	**F, G**	0.30(**3**)	0.50(**5**)
8.3pF(**8R3**)	**F, G**	0.30(**3**)	0.50(**5**)
8.4pF(**8R4**)	**F, G**	0.30(**3**)	0.50(**5**)
8.5pF(**8R5**)	**F, G**	0.30(**3**)	0.50(**5**)
8.6pF(**8R6**)	**F, G**	0.30(**3**)	0.50(**5**)
8.7pF(**8R7**)	**F, G**	0.30(**3**)	0.50(**5**)
8.8pF(**8R8**)	**F, G**	0.30(**3**)	0.50(**5**)
8.9pF(**8R9**)	**F, G**	0.30(**3**)	0.50(**5**)
9.0pF(**9R0**)	**F, G**	0.30(**3**)	0.50(**5**)
9.1pF(**9R1**)	**F, G**	0.30(**3**)	0.50(**5**)
9.2pF(**9R2**)	**F, G**	0.30(**3**)	0.50(**5**)
9.3pF(**9R3**)	**F, G**	0.30(**3**)	0.50(**5**)
9.4pF(**9R4**)	**F, G**	0.30(**3**)	0.50(**5**)
9.5pF(**9R5**)	**F, G**	0.30(**3**)	0.50(**5**)
9.6pF(**9R6**)	**F, G**	0.30(**3**)	0.50(**5**)
9.7pF(**9R7**)	**F, G**	0.30(**3**)	0.50(**5**)
9.8pF(**9R8**)	**F, G**	0.30(**3**)	0.50(**5**)
9.9pF(**9R9**)	**F, G**	0.30(**3**)	0.50(**5**)

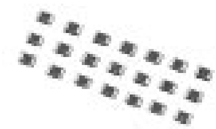
The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

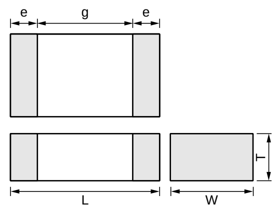
Chip Monolithic Ceramic Capacitors

Thin Type (Flow/Reflow)

■ Features

1. This series is suited to flow and reflow soldering. Capacitor terminations are made of metal highly resistant to migration.
2. Large capacitance values enable excellent bypass effects to be realized.
3. Its thin package makes this series ideally suited for the production of small electronic products and for mounting underneath ICs.





Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRM15X	1.0 ±0.05	0.5 ±0.05	0.25 ±0.05	0.1 to 0.3	0.4

■ Applications

Thin equipment such as IC cards

Temperature Compensating Type

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	EIA
GRM15X5C1H1R0CDB4	C0G (EIA)	50	1.0 ±0.25pF	1.00	0.50	0.25	0402
GRM15X5C1H2R0CDB4	C0G (EIA)	50	2.0 ±0.25pF	1.00	0.50	0.25	0402
GRM15X5C1H3R0CDB4	C0G (EIA)	50	3.0 ±0.25pF	1.00	0.50	0.25	0402
GRM15X5C1H4R0CDB4	C0G (EIA)	50	4.0 ±0.25pF	1.00	0.50	0.25	0402
GRM15X5C1H5R0CDB4	C0G (EIA)	50	5.0 ±0.25pF	1.00	0.50	0.25	0402
GRM15X5C1H6R0DDB4	C0G (EIA)	50	6.0 ±0.5pF	1.00	0.50	0.25	0402
GRM15X5C1H7R0DDB4	C0G (EIA)	50	7.0 ±0.5pF	1.00	0.50	0.25	0402
GRM15X5C1H8R0DDB4	C0G (EIA)	50	8.0 ±0.5pF	1.00	0.50	0.25	0402
GRM15X5C1H9R0DDB4	C0G (EIA)	50	9.0 ±0.5pF	1.00	0.50	0.25	0402
GRM15X5C1H100JDB4	C0G (EIA)	50	10 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H120JDB4	C0G (EIA)	50	12 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H150JDB4	C0G (EIA)	50	15 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H180JDB4	C0G (EIA)	50	18 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H220JDB4	C0G (EIA)	50	22 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H270JDB4	C0G (EIA)	50	27 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H330JDB4	C0G (EIA)	50	33 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H390JDB4	C0G (EIA)	50	39 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H470JDB4	C0G (EIA)	50	47 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H560JDB4	C0G (EIA)	50	56 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H680JDB4	C0G (EIA)	50	68 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H820JDB4	C0G (EIA)	50	82 ±5%	1.00	0.50	0.25	0402
GRM15X5C1H101JDB4	C0G (EIA)	50	100 ±5%	1.00	0.50	0.25	0402
GRM15X5C1E121JDB4	C0G (EIA)	25	120 ±5%	1.00	0.50	0.25	0402
GRM15X5C1E151JDB4	C0G (EIA)	25	150 ±5%	1.00	0.50	0.25	0402
GRM15X5C1E181JDB4	C0G (EIA)	25	180 ±5%	1.00	0.50	0.25	0402
GRM15X5C1E221JDB4	C0G (EIA)	25	220 ±5%	1.00	0.50	0.25	0402

High Dielectric Constant Type

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	EIA
GRM15XR71H221KA86	X7R (EIA)	50	220 ±10%	1.00	0.50	0.25	0402
GRM15XR71H331KA86	X7R (EIA)	50	330 ±10%	1.00	0.50	0.25	0402
GRM15XR71H471KA86	X7R (EIA)	50	470 ±10%	1.00	0.50	0.25	0402
GRM15XR71H681KA86	X7R (EIA)	50	680 ±10%	1.00	0.50	0.25	0402
GRM15XR71H102KA86	X7R (EIA)	50	1000 ±10%	1.00	0.50	0.25	0402
GRM15XR71H152KA86	X7R (EIA)	50	1500 ±10%	1.00	0.50	0.25	0402
GRM15XR71E222KA86	X7R (EIA)	25	2200 ±10%	1.00	0.50	0.25	0402
GRM15XR71C332KA86	X7R (EIA)	16	3300 ±10%	1.00	0.50	0.25	0402
GRM15XR71C472KA86	X7R (EIA)	16	4700 ±10%	1.00	0.50	0.25	0402
GRM15XR71C682KA86	X7R (EIA)	16	6800 ±10%	1.00	0.50	0.25	0402
GRM15XR61A223KA86	X5R (EIA)	10	22000 ±10%	1.00	0.50	0.25	0402
GRM15XR61A333KA86	X5R (EIA)	10	33000 ±10%	1.00	0.50	0.25	0402

GRM Series Specifications and Test Methods

No.	Item	Specifications		Test Method
		Temperature Compensating Type	High Dielectric Type	
1	Operating Temperature Range	−55 to +125℃	B1, B3, F1, R6 : −25 to +85℃ R1, R7 : −55 to +125℃ E4 : +10 to +85℃ F5 : −30 to +85℃	Reference temperature : 25℃ (2Δ, 3Δ, 4Δ, B1, B3, F1, R1, R6 : 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
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 : 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)	[B1, B3, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.025 max. W.V. : 16/10V : 0.035 max. W.V. : 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [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.	

Item \ Char.	ΔC to ΔU, 1X (1000pF and below)	ΔC to ΔU, 1X (more than 1000pF) R6, R7, F5 B1, B3, F1	E4
Frequency	1±0.1MHz	1±0.1kHz	1±0.1kHz
Voltage	0.5 to 5Vrms	1±0.2Vrms	0.5±0.05Vrms

Continued on the following page.

GRM Series Specifications and Test Methods

Continued from the preceding page.

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 1 below) (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 2 below)
		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.) *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.	
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. 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 (GR□03), 5N (GR□15, GRM18)

Step	Temperature (℃)
1	Reference Temperature ±2
2	−55±3 (for ΔC)/−25±3 (for other TC)
3	Reference Temperature ±2
4	125±3 (for ΔC)/85±3 (for other TC)
5	Reference Temperature ±2

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

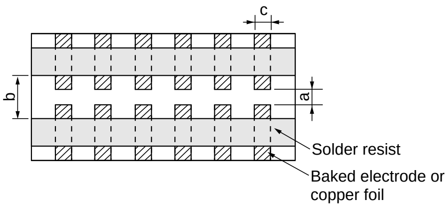


Fig. 1a

(in mm)

Type	a	b	c
GRM02	0.2	0.56	0.23
GR□03	0.3	0.9	0.3
GR□15	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

Continued from the preceding page.

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
11	Vibration Resistance	Appearance	No defects or abnormalities	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 3 mutually perpendicular directions (total of 6 hours).
		Capacitance	Within the specified tolerance	Within the specified tolerance	
		Q/D.F.	30pF and over : Q≧1000 30pF and below : Q≧400+20C C : Nominal Capacitance (pF)	[B1, B3, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.025 max. W.V. : 16/10V : 0.035 max. W.V. : 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [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.	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 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.
13	Solderability of Termination		75% of the terminations are to be soldered evenly and continuously.	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.
14	Resistance to Soldering Heat		The measured and observed characteristics should satisfy the specifications in the following table.	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
		Appearance	No defects or abnormalities	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, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.025 max. W.V. : 16/10V : 0.035 max. W.V. : 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [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)	More than 10,000MΩ or 500Ω · F (Whichever is smaller)	
		Dielectric Strength	No defects	No defects	

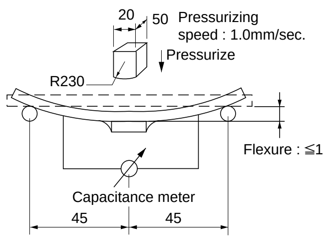


Fig. 3a

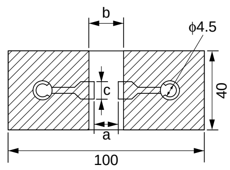


Fig. 2a

t : 1.6mm (GR□02/03/15 : t : 0.8mm)

Type	a	b	c
GRM02	0.2	0.56	0.23
GR□03	0.3	0.9	0.3
GR□15	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)

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

Continued on the following page.

GRM Series Specifications and Test Methods

Continued from the preceding page.

<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="6">15</td><td rowspan="6">Temperature Cycle</td><td></td><td colspan="2">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 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>Appearance</td><td colspan="2">No defects or abnormalities</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td><td>B1, B3, R1, R6, R7, C8
: Within ±7.5%
F1, F5, E4 : Within ±20%</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over : Q≧1000
30pF and below :
Q≧400+20C

C : Nominal Capacitance (pF)</td><td>[B1, B3, R1, R6, R7, E4, C8]
W.V. : 25V min. : 0.025 max.
W.V. : 16/10V : 0.035 max.
W.V. : 6.3/4V
: 0.05 max. (C<3.3μF)
: 0.1 max. (C≧3.3μF)
[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.</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 defects</td></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Humidity (Steady State)</td><td></td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">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.</td></tr>
<tr><td>Appearance</td><td colspan="2">No defects or abnormalities</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF
(Whichever is larger)</td><td>B1, B3, R1, R6, R7, C8
: Within ±12.5%
F1, F5 : Within ±30%</td></tr>
<tr><td>Q/D.F.</td><td>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)</td><td>[B1, B3, R1, R6, R7, E4, C8]
W.V. : 25V min. : 0.05 max.
W.V. : 16/10V : 0.05 max.
W.V. : 6.3/4V
: 0.075 max. (C<3.3μF)
: 0.125 max. (C≧3.3μF)
[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.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
</table>

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GRM Series Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric 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 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, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.05 max. W.V. : 16/10V : 0.05 max. W.V. : 6.3V : 0.075 max. (C<3.3μF) : 0.125 max. (C≧3.3μF) [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)		
18	High Temperature Load		The measured and observed characteristics should satisfy the specifications in the following table.		Apply *200% 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. *150% for 500V
		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, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.05 max. W.V. : 16/10V : 0.05 max. W.V. : 6.3V : 0.075 max.(C<3.3μF) : 0.125 max.(C≧3.3μF) [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)		

Chip Monolithic Ceramic Capacitors

Large Capacitance Type

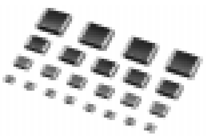
■ Features

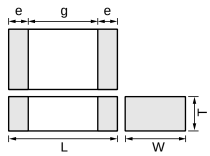
1. Smaller size and higher capacitance value
2. High reliability and no polarity
3. Excellent pulse responsibility and noise reduction due to the low impedance at high frequency
4. Ta replacement

■ Applications

General electronic equipment

Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GRM033	0.6 ±0.03	0.3 ±0.03	0.3 ±0.03	0.1 to 0.2	0.2
GRM155	1.0 ±0.05	0.5 ±0.05	0.5 ±0.05	0.15 to 0.35	0.3
GRM185	1.6 ±0.1	0.8 ±0.1	0.5 +0/-0.2	0.2 to 0.5	0.5
GRM188	1.6 ±0.1	0.8 ±0.1	0.8 ±0.1	0.2 to 0.5	0.5
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		
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		
GRM32C	3.2 ±0.3	2.5 ±0.2	1.6 ±0.2	0.3	1.0
GRM32D			2.0 ±0.2		
GRM32E			2.5 ±0.2		
GRM43D	4.5 ±0.4	3.2 ±0.3	2.0 ±0.2	0.3	2.0
GRM43E			2.5 ±0.2		
GRM43S			2.8 ±0.2		
GRM55F	5.7 ±0.4	5.0 ±0.4	3.2 ±0.2	0.3	2.0





High Dielectric Constant Type X5R (R6) Characteristics

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM188R61E474KA12	X5R (EIA)	25	0.47µF ±10%	1.60	0.80	0.80
GRM188R61E105KA12	X5R (EIA)	25	1.0µF ±10%	1.60	0.80	0.80
GRM21BR61E105KA99	X5R (EIA)	25	1.0µF ±10%	2.00	1.25	1.25
GRM219R61E225KA12	X5R (EIA)	25	2.2µF ±10%	2.00	1.25	0.85
GRM21BR61E225KA12	X5R (EIA)	25	2.2µF ±10%	2.00	1.25	1.25
GRM21BR61E335KA12	X5R (EIA)	25	3.3µF ±10%	2.00	1.25	1.25
GRM21BR61E475KA12	X5R (EIA)	25	4.7µF ±10%	2.00	1.25	1.25
GRM319R61E475KA12	X5R (EIA)	25	4.7µF ±10%	3.20	1.60	0.85
GRM31CR61E106KA12	X5R (EIA)	25	10µF ±10%	3.20	1.60	1.60
GRM32ER61E226KE15	X5R (EIA)	25	22µF ±10%	3.20	2.50	2.50
GRM188R61C474KA93	X5R (EIA)	16	0.47µF ±10%	1.60	0.80	0.80
GRM185R61C105KE44	X5R (EIA)	16	1.0µF ±10%	1.60	0.80	0.50
GRM188R61C105KA93	X5R (EIA)	16	1.0µF ±10%	1.60	0.80	0.80
GRM216R61C105KA88	X5R (EIA)	16	1.0µF ±10%	2.00	1.25	0.60
GRM188R61C225KE15	X5R (EIA)	16	2.2µF ±10%	1.60	0.80	0.80
GRM219R61C225KA88	X5R (EIA)	16	2.2µF ±10%	2.00	1.25	0.85
GRM21BR61C225KA88	X5R (EIA)	16	2.2µF ±10%	2.00	1.25	1.25
GRM316R61C225KA88	X5R (EIA)	16	2.2µF ±10%	3.20	1.60	0.60
GRM21BR61C335KA88	X5R (EIA)	16	3.3µF ±10%	2.00	1.25	1.25
GRM21BR61C475KA88	X5R (EIA)	16	4.7µF ±10%	2.00	1.25	1.25
GRM319R61C475KA88	X5R (EIA)	16	4.7µF ±10%	3.20	1.60	0.85
GRM32ER61C226KE20	X5R (EIA)	16	22µF ±10%	3.20	2.50	2.50
GRM43ER61C226KE01	X5R (EIA)	16	22µF ±10%	4.50	3.20	2.50
GRM32ER61C476KE15	X5R (EIA)	16	47µF ±10%	3.20	2.50	2.50
GRM155R61A154KE19	X5R (EIA)	10	0.15µF ±10%	1.00	0.50	0.50
GRM155R61A224KE19	X5R (EIA)	10	0.22µF ±10%	1.00	0.50	0.50
GRM185R61A105KE36	X5R (EIA)	10	1.0µF ±10%	1.60	0.80	0.50
GRM188R61A225KE34	X5R (EIA)	10	2.2µF ±10%	1.60	0.80	0.80
GRM188R61A225ME34	X5R (EIA)	10	2.2µF ±10%	1.60	0.80	0.80
GRM216R61A225KE24	X5R (EIA)	10	2.2µF ±10%	2.00	1.25	0.60
GRM219R61A225KA01	X5R (EIA)	10	2.2µF ±10%	2.00	1.25	0.85
GRM316R61A225KA01	X5R (EIA)	10	2.2µF ±10%	3.20	1.60	0.60
GRM219R61A335KE19	X5R (EIA)	10	3.3µF ±10%	2.00	1.25	0.85
GRM21BR61A335KA73	X5R (EIA)	10	3.3µF ±10%	2.00	1.25	1.25
GRM316R61A335KE19	X5R (EIA)	10	3.3µF ±10%	3.20	1.60	0.60
GRM219R61A475KE34	X5R (EIA)	10	4.7µF ±10%	2.00	1.25	0.85

Continued on the following page. ↗

Continued from the preceding page.

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM21BR61A475KA73	X5R (EIA)	10	4.7µF ±10%	2.00	1.25	1.25
GRM316R61A475KE19	X5R (EIA)	10	4.7µF ±10%	3.20	1.60	0.60
GRM319R61A475KA01	X5R (EIA)	10	4.7µF ±10%	3.20	1.60	0.85
GRM21BR61A106KE19	X5R (EIA)	10	10µF ±10%	2.00	1.25	1.25
GRM21BR61A106ME19	X5R (EIA)	10	10µF ±20%	2.00	1.25	1.25
GRM319R61A106KA19	X5R (EIA)	10	10µF ±10%	3.20	1.60	0.85
GRM31MR61A106KE19	X5R (EIA)	10	10µF ±10%	3.20	1.60	1.15
GRM32NR61A226KE19	X5R (EIA)	10	22µF ±10%	3.20	2.50	1.35
GRM32ER61A476KE20	X5R (EIA)	10	47µF ±10%	3.20	2.50	2.50
GRM43ER61A476KE19	X5R (EIA)	10	47µF ±10%	4.50	3.20	2.50
GRM033R60J153KE01	X5R (EIA)	6.3	15000pF ±10%	0.60	0.30	0.30
GRM033R60J223KE01	X5R (EIA)	6.3	22000pF ±10%	0.60	0.30	0.30
GRM033R60J333KE01	X5R (EIA)	6.3	33000pF ±10%	0.60	0.30	0.30
GRM033R60J393KE19	X5R (EIA)	6.3	39000pF ±10%	0.60	0.30	0.30
GRM033R60J473KE19	X5R (EIA)	6.3	47000pF ±10%	0.60	0.30	0.30
GRM033R60J683KE19	X5R (EIA)	6.3	68000pF ±10%	0.60	0.30	0.30
GRM033R60J104KE19	X5R (EIA)	6.3	0.10µF ±10%	0.60	0.30	0.30
GRM155R60J154KE01	X5R (EIA)	6.3	0.15µF ±10%	1.00	0.50	0.50
GRM155R60J224KE01	X5R (EIA)	6.3	0.22µF ±10%	1.00	0.50	0.50
GRM155R60J334KE01	X5R (EIA)	6.3	0.33µF ±10%	1.00	0.50	0.50
GRM155R60J474KE19	X5R (EIA)	6.3	0.47µF ±10%	1.00	0.50	0.50
GRM155R60J105KE19	X5R (EIA)	6.3	1.0µF ±10%	1.00	0.50	0.50
GRM185R60J105KE21	X5R (EIA)	6.3	1.0µF ±10%	1.60	0.80	0.50
GRM185R60J105KE26	X5R (EIA)	6.3	1.0µF ±10%	1.60	0.80	0.50
GRM185R60J225KE26	X5R (EIA)	6.3	2.2µF ±10%	1.60	0.80	0.50
GRM188R60J225KE01	X5R (EIA)	6.3	2.2µF ±10%	1.60	0.80	0.80
GRM188R60J225KE19	X5R (EIA)	6.3	2.2µF ±10%	1.60	0.80	0.80
GRM188R60J475KE19	X5R (EIA)	6.3	4.7µF ±10%	1.60	0.80	0.80
GRM219R60J475KE01	X5R (EIA)	6.3	4.7µF ±10%	2.00	1.25	0.85
GRM219R60J475KE19	X5R (EIA)	6.3	4.7µF ±10%	2.00	1.25	0.85
GRM219R60J475KE32	X5R (EIA)	6.3	4.7µF ±10%	2.00	1.25	0.85
GRM219R60J106KE19	X5R (EIA)	6.3	10µF ±10%	2.00	1.25	0.85
GRM219R60J106ME19	X5R (EIA)	6.3	10µF ±20%	2.00	1.25	0.85
GRM21BR60J106KE01	X5R (EIA)	6.3	10µF ±10%	2.00	1.25	1.25
GRM21BR60J106KE19	X5R (EIA)	6.3	10µF ±10%	2.00	1.25	1.25
GRM21BR60J106ME01	X5R (EIA)	6.3	10µF ±20%	2.00	1.25	1.25
GRM21BR60J106ME19	X5R (EIA)	6.3	10µF ±20%	2.00	1.25	1.25
GRM319R60J106KE01	X5R (EIA)	6.3	10µF ±10%	3.20	1.60	0.85
GRM319R60J106KE19	X5R (EIA)	6.3	10µF ±10%	3.20	1.60	0.85
GRM31MR60J106KE19	X5R (EIA)	6.3	10µF ±10%	3.20	1.60	1.15
GRM31CR60J156KE19	X5R (EIA)	6.3	15µF ±10%	3.20	1.60	1.60
GRM21BR60J226ME39	X5R (EIA)	6.3	22µF ±20%	2.00	1.25	1.25
GRM31CR60J226KE19	X5R (EIA)	6.3	22µF ±10%	3.20	1.60	1.60
GRM31CR60J226ME19	X5R (EIA)	6.3	22µF ±20%	3.20	1.60	1.60
GRM32DR60J226KA01	X5R (EIA)	6.3	22µF ±10%	3.20	2.50	2.00
GRM32DR60J336ME19	X5R (EIA)	6.3	33µF ±10%	3.20	2.50	2.00
GRM43DR60J336KE01	X5R (EIA)	6.3	33µF ±10%	4.50	3.20	2.00
GRM31CR60J476ME19	X5R (EIA)	6.3	47µF ±20%	3.20	1.60	1.60
GRM32ER60J476ME20	X5R (EIA)	6.3	47µF ±20%	3.20	2.50	2.50
GRM43ER60J476KE01	X5R (EIA)	6.3	47µF ±10%	4.50	3.20	2.50
GRM32ER60J107ME20	X5R (EIA)	6.3	100µF ±20%	3.20	2.50	2.50
GRM43SR60J107ME20	X5R (EIA)	6.3	100µF ±20%	4.50	3.20	2.80
GRM188R60G106ME47	X5R (EIA)	4	10µF ±20%	1.60	0.80	0.80

High Dielectric Constant Type X6S/X7R/X7S (C8/R7/C7) Characteristics

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance (µF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM188C80G475KE19	X6S(EIA)	4	4.7 ±10%	1.60	0.80	0.80
GRM21BR71E225KA73	X7R (EIA)	25	2.2 ±10%	2.00	1.25	1.25
GRM55ER71E156KA01	X7R (EIA)	25	15 ±10%	5.70	5.00	2.50
GRM31CR71C106KAC7	X7R (EIA)	16	10 ±10%	3.20	1.60	1.60
GRM32ER71A226KE20	X7R (EIA)	10	22 ±10%	3.20	2.50	2.50
GRM32ER71A226ME20	X7R (EIA)	10	22 ±20%	3.20	2.50	2.50
GRM43ER71A226KE01	X7R (EIA)	10	22 ±10%	4.50	3.20	2.50
GRM21BC71A335KA73	X7S(EIA)	10	3.3 ±10%	2.00	1.25	1.25
GRM21BC71A475KA73	X7S(EIA)	10	4.7 ±10%	2.00	1.25	1.25

High Dielectric Constant Type Y5V (F5) Characteristics

Part Number	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance (µF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM188F51A225ZE01	Y5V (EIA)	10	2.2 +80/-20%	1.60	0.80	0.80
GRM188F51A475ZE20	Y5V (EIA)	10	4.7 +80/-20%	1.60	0.80	0.80
GRM31CF51A226ZE01	Y5V (EIA)	10	22 +80/-20%	3.20	1.60	1.60
GRM32CF51A226ZA01	Y5V (EIA)	10	22 +80/-20%	3.20	2.50	1.60
GRM155F50J105ZE01	Y5V (EIA)	6.3	1.0 +80/-20%	1.00	0.50	0.50
GRM188F50J225ZE01	Y5V (EIA)	6.3	2.2 +80/-20%	1.60	0.80	0.80
GRM188F50J475ZE20	Y5V (EIA)	6.3	4.7 +80/-20%	1.60	0.80	0.80
GRM21BF50J106ZE01	Y5V (EIA)	6.3	10 +80/-20%	2.00	1.25	1.25
GRM31CF50J226ZE01	Y5V (EIA)	6.3	22 +80/-20%	3.20	1.60	1.60
GRM32EF50J107ZE20	Y5V (EIA)	6.3	100 +80/-20%	3.20	2.50	2.50

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>B1, B3, F1 : −25 to +85℃
R6 : −55 to +85℃
F5 : −30 to +85℃
C8 : −55 to +105℃, C7 : -55 to +125℃</td><td>Reference temperature : 25℃
(B1, B3, 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
GRM155 B3/R6 1A 124 to 224
GRM185 B3/R6 1A 105
GRM188 B3/R6 1C/1A 225
GRM219 B3/R6 1A 475
GRM21B B3/R6 1C/1A 106</td><td>The capacitance 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, C7, C8 : 0.1 max.
F1, F5 : 0.2 max.

✻Table 1
GRM155 B3/R6 1A 124 to 224
GRM185 B3/R6 1A 105
GRM188 B3/R6 1C/1A 225
GRM219 B3/R6 1A 475
GRM21B B3/R6 1C/1A 106</td><td>The 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 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℃)
F5 : Within +22/−82% (−30 to +85℃)
C7 : Within ±22% (−55 to +125℃)
C8 : Within ±22% (−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>Reference tempereture ±2</td><td rowspan="4">No bias</td></tr>
<tr><td>2</td><td>–55±3 (for R6, C7, C8)/
–25±3 (for B1, B3, F1)
–30±3 (for F5)</td></tr>
<tr><td>3</td><td>Reference tempereture ±2</td></tr>
<tr><td>4</td><td>85±3 (for B1, B3, F1, R6, F5)
125±3 (for C7)/
105±3 (for C8)</td></tr>
<tr><td>5</td><td>20±2</td><td rowspan="4">50% of the rated voltage</td></tr>
<tr><td>6</td><td>–25±3 (for B1, F1)</td></tr>
<tr><td>7</td><td>20±2</td></tr>
<tr><td>8</td><td>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%
F1: Within +30/−95%</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

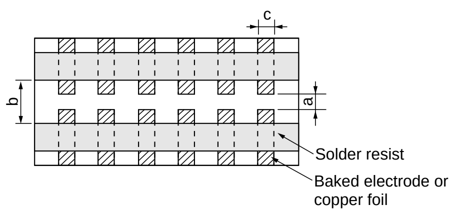
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defects should occur.


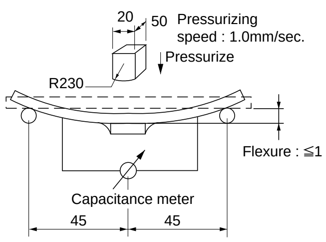
Fig. 1a</td><td>Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 1a using an eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1sec.
The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*5N : GR□15/GRM18, 2N : GR□33
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</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 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, R6, C7, C8 : 0.1 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.


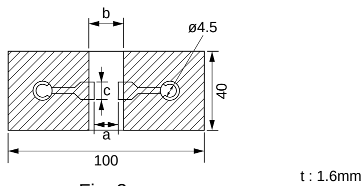
Fig.3a</td><td>Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2a using an eutectic solder. Then apply a force in the direction shown in Fig. 3a for 5±1 sec. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the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


Fig. 2a
(GR□03, GR□15 : t : 0.8mm)
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</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>

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Specifications and Test Methods

Continued from the preceding page.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="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.

•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, R6, C7, C8 : Within ±7.5%
F1, F5 : Within ±20%</td></tr>
<tr><td>Q/D.F.</td><td>B1, B3, R6, C7, C8 : 0.1 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, R6, C7, C8 : Within ±7.5%
F1, F5 : Within ±20%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R6, C7, C8 : 0.1 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, R6, C7, C8 : Within ±12.5%
F1, F5 : Within ±30%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R6, C7, C8 : 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, R6, C7, C8 : Within ±12.5%
F1, F5 : Within ±30%</td></tr>
<tr><td>D.F.</td><td>B1, B3, R6, C7, C8 : 0.1 max.
F1, F5 : 0.4 max.</td></tr>
<tr><td>I.R.</td><td>More than 25Ω · F</td></tr>
</table>

Chip Monolithic Ceramic Capacitors

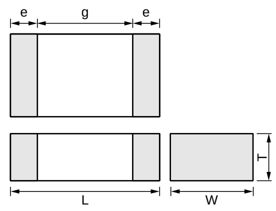
High-Q GJM Series

■ 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]	0.60x0.30 [0201]	1.00x0.50 [0402]
TC	C0G (**5C**)	C0G (**5C**)
Rated Volt.	25 (**1E**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
0.30pF(**R30**)	0.30(**3**)	0.50(**5**)
0.40pF(**R40**)	0.30(**3**)	0.50(**5**)
0.50pF(**R50**)	0.30(**3**)	0.50(**5**)
0.60pF(**R60**)	0.30(**3**)	0.50(**5**)
0.70pF(**R70**)	0.30(**3**)	0.50(**5**)
0.75pF(**R75**)	0.30(**3**)	0.50(**5**)
0.80pF(**R80**)	0.30(**3**)	0.50(**5**)
0.90pF(**R90**)	0.30(**3**)	0.50(**5**)
1.0pF(**1R0**)	0.30(**3**)	0.50(**5**)
1.1pF(**1R1**)	0.30(**3**)	0.50(**5**)
1.2pF(**1R2**)	0.30(**3**)	0.50(**5**)
1.3pF(**1R3**)	0.30(**3**)	0.50(**5**)
1.4pF(**1R4**)	0.30(**3**)	0.50(**5**)
1.5pF(**1R5**)	0.30(**3**)	0.50(**5**)
1.6pF(**1R6**)	0.30(**3**)	0.50(**5**)
1.7pF(**1R7**)	0.30(**3**)	0.50(**5**)
1.8pF(**1R8**)	0.30(**3**)	0.50(**5**)
1.9pF(**1R9**)	0.30(**3**)	0.50(**5**)
2.0pF(**2R0**)	0.30(**3**)	0.50(**5**)
2.1pF(**2R1**)	0.30(**3**)	0.50(**5**)
2.2pF(**2R2**)	0.30(**3**)	0.50(**5**)
2.3pF(**2R3**)	0.30(**3**)	0.50(**5**)
2.4pF(**2R4**)	0.30(**3**)	0.50(**5**)
2.5pF(**2R5**)	0.30(**3**)	0.50(**5**)
2.6pF(**2R6**)	0.30(**3**)	0.50(**5**)
2.7pF(**2R7**)	0.30(**3**)	0.50(**5**)
2.8pF(**2R8**)	0.30(**3**)	0.50(**5**)
2.9pF(**2R9**)	0.30(**3**)	0.50(**5**)
3.0pF(**3R0**)	0.30(**3**)	0.50(**5**)
3.1pF(**3R1**)	0.30(**3**)	0.50(**5**)
3.2pF(**3R2**)	0.30(**3**)	0.50(**5**)
3.3pF(**3R3**)	0.30(**3**)	0.50(**5**)
3.4pF(**3R4**)	0.30(**3**)	0.50(**5**)

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Part Number	**GJM03**	**GJM15**
L x W [EIA]	0.60x0.30 [0201]	1.00x0.50 [0402]
TC	C0G (**5C**)	C0G (**5C**)
Rated Volt.	25 (**1E**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
3.5pF(**3R5**)	0.30(**3**)	0.50(**5**)
3.6pF(**3R6**)	0.30(**3**)	0.50(**5**)
3.7pF(**3R7**)	0.30(**3**)	0.50(**5**)
3.8pF(**3R8**)	0.30(**3**)	0.50(**5**)
3.9pF(**3R9**)	0.30(**3**)	0.50(**5**)
4.0pF(**4R0**)	0.30(**3**)	0.50(**5**)
4.1pF(**4R1**)	0.30(**3**)	0.50(**5**)
4.2pF(**4R2**)	0.30(**3**)	0.50(**5**)
4.3pF(**4R3**)	0.30(**3**)	0.50(**5**)
4.4pF(**4R4**)	0.30(**3**)	0.50(**5**)
4.5pF(**4R5**)	0.30(**3**)	0.50(**5**)
4.6pF(**4R6**)	0.30(**3**)	0.50(**5**)
4.7pF(**4R7**)	0.30(**3**)	0.50(**5**)
4.8pF(**4R8**)	0.30(**3**)	0.50(**5**)
4.9pF(**4R9**)	0.30(**3**)	0.50(**5**)
5.0pF(**5R0**)	0.30(**3**)	0.50(**5**)
5.1pF(**5R1**)	0.30(**3**)	0.50(**5**)
5.2pF(**5R2**)	0.30(**3**)	0.50(**5**)
5.3pF(**5R3**)	0.30(**3**)	0.50(**5**)
5.4pF(**5R4**)	0.30(**3**)	0.50(**5**)
5.5pF(**5R5**)	0.30(**3**)	0.50(**5**)
5.6pF(**5R6**)	0.30(**3**)	0.50(**5**)
5.7pF(**5R7**)	0.30(**3**)	0.50(**5**)
5.8pF(**5R8**)	0.30(**3**)	0.50(**5**)
5.9pF(**5R9**)	0.30(**3**)	0.50(**5**)
6.0pF(**6R0**)	0.30(**3**)	0.50(**5**)
6.1pF(**6R1**)	0.30(**3**)	0.50(**5**)
6.2pF(**6R2**)	0.30(**3**)	0.50(**5**)
6.3pF(**6R3**)	0.30(**3**)	0.50(**5**)
6.4pF(**6R4**)	0.30(**3**)	0.50(**5**)
6.5pF(**6R5**)	0.30(**3**)	0.50(**5**)
6.6pF(**6R6**)	0.30(**3**)	0.50(**5**)
6.7pF(**6R7**)	0.30(**3**)	0.50(**5**)
6.8pF(**6R8**)	0.30(**3**)	0.50(**5**)
6.9pF(**6R9**)		0.50(**5**)
7.0pF(**7R0**)		0.50(**5**)
7.1pF(**7R1**)		0.50(**5**)
7.2pF(**7R2**)		0.50(**5**)
7.3pF(**7R3**)		0.50(**5**)
7.4pF(**7R4**)		0.50(**5**)
7.5pF(**7R5**)		0.50(**5**)
7.6pF(**7R6**)		0.50(**5**)
7.7pF(**7R7**)		0.50(**5**)
7.8pF(**7R8**)		0.50(**5**)
7.9pF(**7R9**)		0.50(**5**)
8.0pF(**8R0**)		0.50(**5**)
8.1pF(**8R1**)		0.50(**5**)
8.2pF(**8R2**)		0.50(**5**)
8.3pF(**8R3**)		0.50(**5**)
8.4pF(**8R4**)		0.50(**5**)
8.5pF(**8R5**)		0.50(**5**)
8.6pF(**8R6**)		0.50(**5**)

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Part Number	**GJM03**	**GJM15**
L x W [EIA]	0.60x0.30 [0201]	1.00x0.50 [0402]
TC	C0G (**5C**)	C0G (**5C**)
Rated Volt.	25 (**1E**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)		
8.7pF(**8R7**)		0.50(**5**)
8.8pF(**8R8**)		0.50(**5**)
8.9pF(**8R9**)		0.50(**5**)
9.0pF(**9R0**)		0.50(**5**)
9.1pF(**9R1**)		0.50(**5**)
9.2pF(**9R2**)		0.50(**5**)
9.3pF(**9R3**)		0.50(**5**)
9.4pF(**9R4**)		0.50(**5**)
9.5pF(**9R5**)		0.50(**5**)
9.6pF(**9R6**)		0.50(**5**)
9.7pF(**9R7**)		0.50(**5**)
9.8pF(**9R8**)		0.50(**5**)
9.9pF(**9R9**)		0.50(**5**)
10pF(**100**)		0.50(**5**)
12pF(**120**)		0.50(**5**)
15pF(**150**)		0.50(**5**)
18pF(**180**)		0.50(**5**)
20pF(**200**)		0.50(**5**)

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

Chip Monolithic Ceramic Capacitors

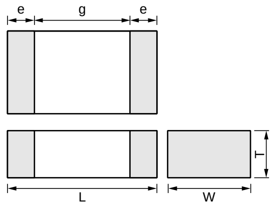
Tight Tolerance High-Q GJM Series

■ 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]		0.60x0.30 [0201]	1.00x0.50 [0402]
TC		C0G (**5C**)	C0G (**5C**)
Rated Volt.		25 (**1E**)	50 (**1H**)
Capacitance, Capacitance Tolerance and T Dimension			
0.20pF(**R20**)	**M, N**	0.30(**3**)	0.50(**5**)
0.30pF(**R30**)	**K, M**	0.30(**3**)	0.50(**5**)
0.40pF(**R40**)	**K, M**	0.30(**3**)	0.50(**5**)
0.50pF(**R50**)	**K, M**	0.30(**3**)	0.50(**5**)
0.60pF(**R60**)	**K, M**	0.30(**3**)	0.50(**5**)
0.70pF(**R70**)	**K, M**	0.30(**3**)	0.50(**5**)
0.80pF(**R80**)	**K, M**	0.30(**3**)	0.50(**5**)
0.90pF(**R90**)	**K, M**	0.30(**3**)	0.50(**5**)
1.0pF(**1R0**)	**K, M**	0.30(**3**)	0.50(**5**)
1.1pF(**1R1**)	**K, M**	0.30(**3**)	0.50(**5**)
1.2pF(**1R2**)	**K, M**	0.30(**3**)	0.50(**5**)
1.3pF(**1R3**)	**K, M**	0.30(**3**)	0.50(**5**)
1.4pF(**1R4**)	**K, M**	0.30(**3**)	0.50(**5**)
1.5pF(**1R5**)	**K, M**	0.30(**3**)	0.50(**5**)
1.6pF(**1R6**)	**K, M**	0.30(**3**)	0.50(**5**)
1.7pF(**1R7**)	**K, M**	0.30(**3**)	0.50(**5**)
1.8pF(**1R8**)	**K, M**	0.30(**3**)	0.50(**5**)
1.9pF(**1R9**)	**K, M**	0.30(**3**)	0.50(**5**)
2.0pF(**2R0**)	**G, J**	0.30(**3**)	0.50(**5**)
2.1pF(**2R1**)	**G, J**	0.30(**3**)	0.50(**5**)
2.2pF(**2R2**)	**G, J**	0.30(**3**)	0.50(**5**)
2.3pF(**2R3**)	**G, J**	0.30(**3**)	0.50(**5**)
2.4pF(**2R4**)	**G, J**	0.30(**3**)	0.50(**5**)
2.5pF(**2R5**)	**G, J**	0.30(**3**)	0.50(**5**)
2.6pF(**2R6**)	**G, J**	0.30(**3**)	0.50(**5**)
2.7pF(**2R7**)	**G, J**	0.30(**3**)	0.50(**5**)
2.8pF(**2R8**)	**G, J**	0.30(**3**)	0.50(**5**)
2.9pF(**2R9**)	**G, J**	0.30(**3**)	0.50(**5**)
3.0pF(**3R0**)	**G, J**	0.30(**3**)	0.50(**5**)
3.1pF(**3R1**)	**G, J**	0.30(**3**)	0.50(**5**)
3.2pF(**3R2**)	**G, J**	0.30(**3**)	0.50(**5**)
3.3pF(**3R3**)	**G, J**	0.30(**3**)	0.50(**5**)
3.4pF(**3R4**)	**G, J**	0.30(**3**)	0.50(**5**)

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Part Number		**GJM03**	**GJM15**
L x W [EIA]		0.60x0.30 [0201]	1.00x0.50 [0402]
TC		C0G (**5C**)	C0G (**5C**)
Rated Volt.		25 (**1E**)	50 (**1H**)
Capacitance, Capacitance Tolerance and T Dimension			
3.5pF(**3R5**)	**G, J**	0.30(**3**)	0.50(**5**)
3.6pF(**3R6**)	**G, J**	0.30(**3**)	0.50(**5**)
3.7pF(**3R7**)	**G, J**	0.30(**3**)	0.50(**5**)
3.8pF(**3R8**)	**G, J**	0.30(**3**)	0.50(**5**)
3.9pF(**3R9**)	**G, J**	0.30(**3**)	0.50(**5**)
4.0pF(**4R0**)	**G, J**	0.30(**3**)	0.50(**5**)
4.1pF(**4R1**)	**G, J**	0.30(**3**)	0.50(**5**)
4.2pF(**4R2**)	**G, J**	0.30(**3**)	0.50(**5**)
4.3pF(**4R3**)	**G, J**	0.30(**3**)	0.50(**5**)
4.4pF(**4R4**)	**G, J**	0.30(**3**)	0.50(**5**)
4.5pF(**4R5**)	**G, J**	0.30(**3**)	0.50(**5**)
4.6pF(**4R6**)	**G, J**	0.30(**3**)	0.50(**5**)
4.7pF(**4R7**)	**G, J**	0.30(**3**)	0.50(**5**)
4.8pF(**4R8**)	**G, J**	0.30(**3**)	0.50(**5**)
4.9pF(**4R9**)	**G, J**	0.30(**3**)	0.50(**5**)
5.0pF(**5R0**)	**F, G**	0.30(**3**)	0.50(**5**)
5.1pF(**5R1**)	**F, G**	0.30(**3**)	0.50(**5**)
5.2pF(**5R2**)	**F, G**	0.30(**3**)	0.50(**5**)
5.3pF(**5R3**)	**F, G**	0.30(**3**)	0.50(**5**)
5.4pF(**5R4**)	**F, G**	0.30(**3**)	0.50(**5**)
5.5pF(**5R5**)	**F, G**	0.30(**3**)	0.50(**5**)
5.6pF(**5R6**)	**F, G**	0.30(**3**)	0.50(**5**)
5.7pF(**5R7**)	**F, G**	0.30(**3**)	0.50(**5**)
5.8pF(**5R8**)	**F, G**	0.30(**3**)	0.50(**5**)
5.9pF(**5R9**)	**F, G**	0.30(**3**)	0.50(**5**)
6.0pF(**6R0**)	**F, G**	0.30(**3**)	0.50(**5**)
6.1pF(**6R1**)	**F, G**	0.30(**3**)	0.50(**5**)
6.2pF(**6R2**)	**F, G**	0.30(**3**)	0.50(**5**)
6.3pF(**6R3**)	**F, G**	0.30(**3**)	0.50(**5**)
6.4pF(**6R4**)	**F, G**	0.30(**3**)	0.50(**5**)
6.5pF(**6R5**)	**F, G**	0.30(**3**)	0.50(**5**)
6.6pF(**6R6**)	**F, G**	0.30(**3**)	0.50(**5**)
6.7pF(**6R7**)	**F, G**	0.30(**3**)	0.50(**5**)
6.8pF(**6R8**)	**F, G**	0.30(**3**)	0.50(**5**)
6.9pF(**6R9**)	**F, G**		0.50(**5**)
7.0pF(**7R0**)	**F, G**		0.50(**5**)
7.1pF(**7R1**)	**F, G**		0.50(**5**)
7.2pF(**7R2**)	**F, G**		0.50(**5**)
7.3pF(**7R3**)	**F, G**		0.50(**5**)
7.4pF(**7R4**)	**F, G**		0.50(**5**)
7.5pF(**7R5**)	**F, G**		0.50(**5**)
7.6pF(**7R6**)	**F, G**		0.50(**5**)
7.7pF(**7R7**)	**F, G**		0.50(**5**)
7.8pF(**7R8**)	**F, G**		0.50(**5**)
7.9pF(**7R9**)	**F, G**		0.50(**5**)
8.0pF(**8R0**)	**F, G**		0.50(**5**)
8.1pF(**8R1**)	**F, G**		0.50(**5**)
8.2pF(**8R2**)	**F, G**		0.50(**5**)
8.3pF(**8R3**)	**F, G**		0.50(**5**)
8.4pF(**8R4**)	**F, G**		0.50(**5**)
8.5pF(**8R5**)	**F, G**		0.50(**5**)
8.6pF(**8R6**)	**F, G**		0.50(**5**)

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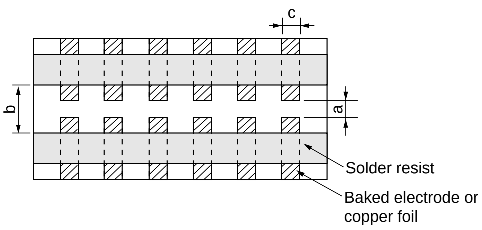
Part Number		GJM03	GJM15
L x W [EIA]		0.60x0.30 [0201]	1.00x0.50 [0402]
TC		C0G (**5C**)	C0G (**5C**)
Rated Volt.		25 (**1E**)	50 (**1H**)
Capacitance, Capacitance Tolerance and T Dimension			
8.7pF(**8R7**)	**F, G**		0.50(**5**)
8.8pF(**8R8**)	**F, G**		0.50(**5**)
8.9pF(**8R9**)	**F, G**		0.50(**5**)
9.0pF(**9R0**)	**F, G**		0.50(**5**)
9.1pF(**9R1**)	**F, G**		0.50(**5**)
9.2pF(**9R2**)	**F, G**		0.50(**5**)
9.3pF(**9R3**)	**F, G**		0.50(**5**)
9.4pF(**9R4**)	**F, G**		0.50(**5**)
9.5pF(**9R5**)	**F, G**		0.50(**5**)
9.6pF(**9R6**)	**F, G**		0.50(**5**)
9.7pF(**9R7**)	**F, G**		0.50(**5**)
9.8pF(**9R8**)	**F, G**		0.50(**5**)
9.9pF(**9R9**)	**F, G**		0.50(**5**)

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

Specifications and Test Methods

<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 max. : Q≧400+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 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>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 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>

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Specifications and Test Methods

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<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>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 either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

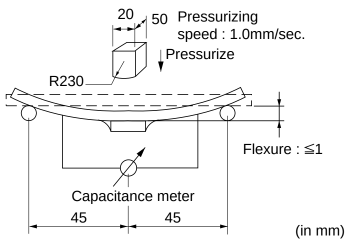
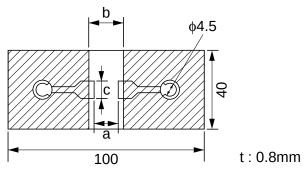



Fig. 3</td></tr>
<tr><td><table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>**GJM03**</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>**GJM15**</td><td>0.4</td><td>1.5</td><td>0.5</td></tr></table>(in mm)
Fig. 2</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</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>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.<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>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>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>

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Specifications and Test Methods

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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 below : $Q \geqq 100+\frac{10}{3}C$ C : Nominal Capacitance (pF)	
		I.R.	More than 500MΩ or 25Ω · F (Whichever is smaller)	
		Dielectric Strength	No failure	
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	10pF and over, 30pF and below : $Q \geqq 275+\frac{5}{2}C$ 10pF and below : Q≧200+10C C : Nominal Capacitance (pF)	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)	
		Dielectric Strength	No failure	
19	ESR		0.5pF≦C≦1pF : 350mΩ 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≦20pF : 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

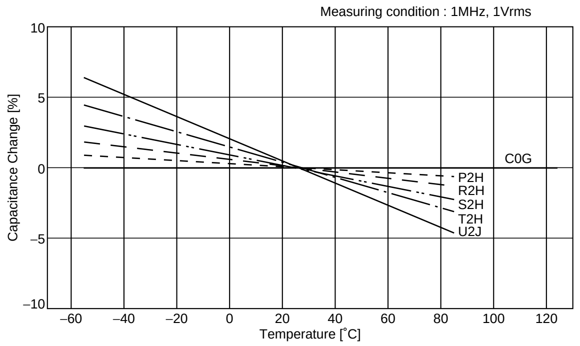
∗1 : Nominal values denote the temperature coefficient within a range of 25 to 125℃.

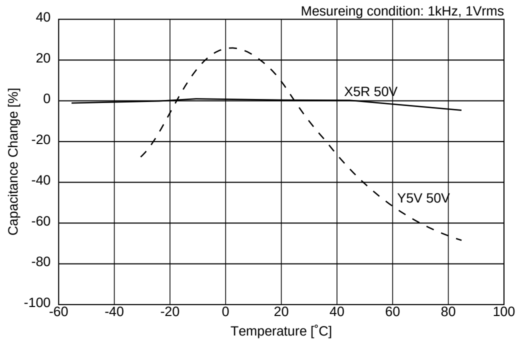
(2)

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	0.37	−0.90	0.82	−0.54	0.55	−0.36
4C	0±250	0.56	−0.88	1.54	−1.13	1.02	−0.75

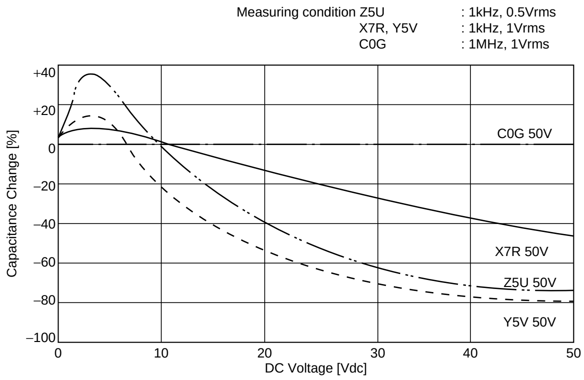
∗2 : Nominal values denote the temperature coefficient within a range of 20 to 125℃.

■ Capacitance-Temperature Characteristics

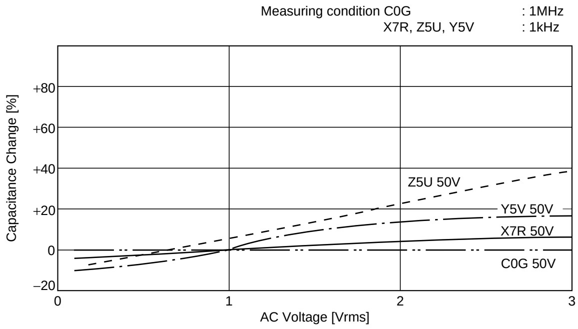




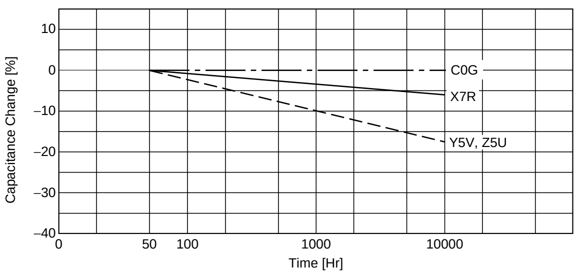
■ Capacitance-DC Voltage Characteristics



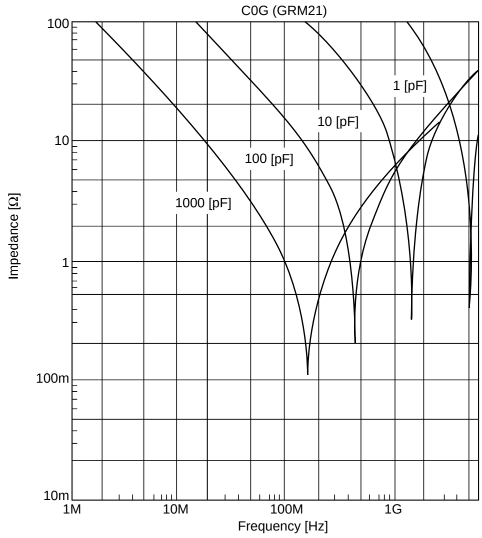
■ Capacitance-AC Voltage Characteristics



■ Capacitance Change-Aging



■ Impedance-Frequency Characteristics



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GRM Series Data

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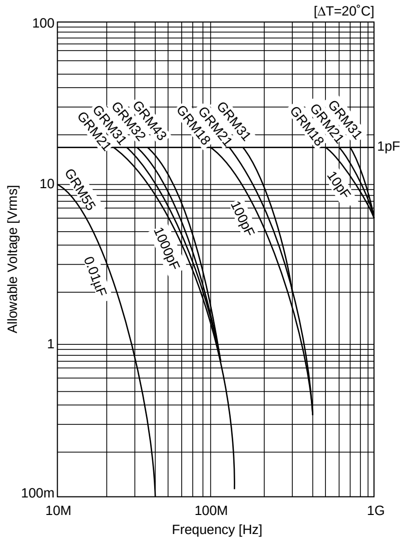
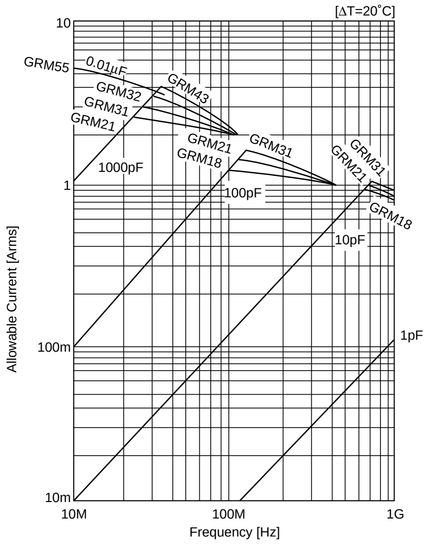
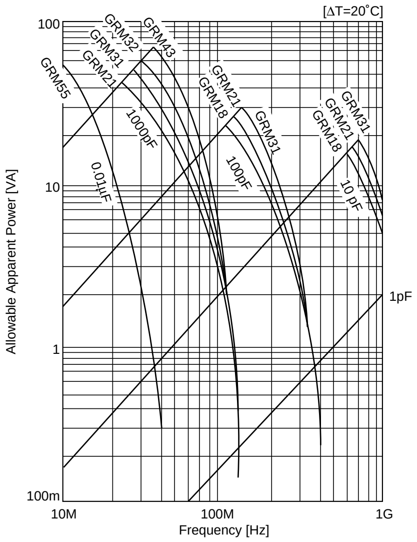
■ Allowable Voltage-Frequency



■ Allowable Current-Frequency



■ Allowable Apparent Power

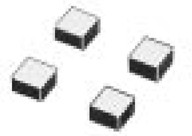


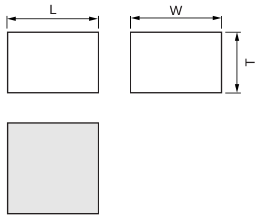
Chip Monolithic Ceramic Capacitors

Microchips 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
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	TC Code (Standard)	Rated Voltage (Vdc)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)
GMA05XR72A101MD01	X7R (EIA)	100	100pF ±20%	0.5	0.5	0.35
GMA05XR72A151MD01	X7R (EIA)	100	150pF ±20%	0.5	0.5	0.35
GMA05XR72A221MD01	X7R (EIA)	100	220pF ±20%	0.5	0.5	0.35
GMA085R72A331MD01	X7R (EIA)	100	330pF ±20%	0.8	0.8	0.5
GMA085R72A471MD01	X7R (EIA)	100	470pF ±20%	0.8	0.8	0.5
GMA085R72A681MD01	X7R (EIA)	100	680pF ±20%	0.8	0.8	0.5
GMA085R72A102MD01	X7R (EIA)	100	1000pF ±20%	0.8	0.8	0.5
GMA05XF52A102ZD01	Y5V (EIA)	100	1000pF +80/-20%	0.5	0.5	0.35
GMA085F52A103ZD01	Y5V (EIA)	100	10000pF +80/-20%	0.8	0.8	0.5
GMA05XR71H331MD01	X7R (EIA)	50	330pF ±20%	0.5	0.5	0.35
GMA05XR71H471MD01	X7R (EIA)	50	470pF ±20%	0.5	0.5	0.35
GMA05XR71C681MD01	X7R (EIA)	16	680pF ±20%	0.5	0.5	0.35
GMA05XR71C102MD01	X7R (EIA)	16	1000pF ±20%	0.5	0.5	0.35
GMA085R71C102MD01	X7R (EIA)	16	1000pF ±20%	0.8	0.8	0.5
GMA05XR71C152MD01	X7R (EIA)	16	1500pF ±20%	0.5	0.5	0.35
GMA085R71C152MD01	X7R (EIA)	16	1500pF ±20%	0.8	0.8	0.5
GMA05XR71C222MD01	X7R (EIA)	16	2200pF ±20%	0.5	0.5	0.35
GMA085R71C222MD01	X7R (EIA)	16	2200pF ±20%	0.8	0.8	0.5
GMA085R71C332MD01	X7R (EIA)	16	3300pF ±20%	0.8	0.8	0.5
GMA085R71C472MD01	X7R (EIA)	16	4700pF ±20%	0.8	0.8	0.5
GMA085R71C682MD01	X7R (EIA)	16	6800pF ±20%	0.8	0.8	0.5
GMA085R71C103MD01	X7R (EIA)	16	10000pF ±20%	0.8	0.8	0.5
GMA05XF51C472ZD01	Y5V (EIA)	16	4700pF +80/-20%	0.5	0.5	0.35
GMA05XF51C682ZD01	Y5V (EIA)	16	6800pF +80/-20%	0.5	0.5	0.35
GMA05XF51C103ZD01	Y5V (EIA)	16	10000pF +80/-20%	0.5	0.5	0.35
GMA085F51C473ZD01	Y5V (EIA)	16	47000pF +80/-20%	0.8	0.8	0.5
GMA05XF51A153ZD01	Y5V (EIA)	10	15000pF +80/-20%	0.5	0.5	0.35
GMA085F51A104ZD01	Y5V (EIA)	10	0.10μF +80/-20%	0.8	0.8	0.5

Specifications and Test Methods

No.	Item		Specifications	Test Method
1	Operating Temperature Range		R7 : −55 to +125℃ F5 : −30 to +85℃	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 abnormality	Visual inspection
4	Dimensions		See the previous pages.	Visual inspection
5	Dielectric Strength		No defects or abnormality	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		10,000MΩ min.	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.
8	Dissipation Factor (D.F.)		R7 : 0.035 max. F5 : 0.09 max. (for 16V) : 0.125 max. (for 10V)	

Frequency	1±0.1kHz
Voltage	1±0.2Vrms

No.	Item		Specifications	Test Method
9	Capacitance Temperature Characteristics	No bias	R7 : Within +/–15% (–55 to +125°C) F5 : Within +22/–82% (–30 to +85°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.* In case of applying voltage, the capacitance change should be measured after 1 more min. with applying voltage in equilibration of each temp. stage.

Step	Temperature (°C)	Applying Voltage (V)
1	Reference Tempereture±2	No bias
2	–55±3 (for R7) –30±3 (for F5)	
3	Reference Tempereture±2	
4	125±3 (for R7) 85±3 (for F5)	

*Initial measurement for high dielectric constant type
Perform a heat treatment at 150 +0/−10°C for one hour and then let sit for 48±4 hours at room temperature.
Perform the initial measurement.

No.	Item		Specifications	Test Method
10	Mechanical Strength	Bond Strength	Pull force : 3.0g 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 20µm (0.0008 inch) gold wire to the capacitor terminal using an ultrasonic wedge bond. Then, pull wire.
		Die Shear Strength	Die Shear force : 200g 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 abnormality	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 : 0.035 max. F5 : 0.09 max. (for 16V) : 0.125 max. (for 10V)	
12	Temperature Cycle	Appearance	No marked defect	The capacitor should be set for 48±4 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.
		Capacitance Change	R7 : Within ±7.5% F5 : Within ±20%	
		D.F.	R7 : 0.035 max. F5 : 0.09 max. (for 16V) 0.125 max. (for 10V)	
		I.R.	10,000MΩ min.	
		Dielectric Strength	No failure	

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

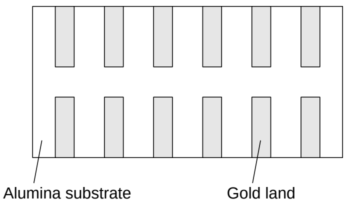
Continued on the following page.

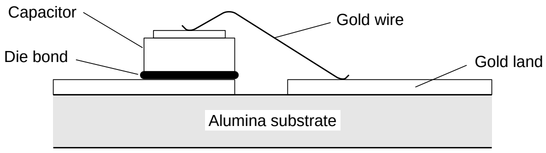
Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specifications	Test Method
13	Humidity (Steady State)	Appearance	No marked defect	Set the capacitor for 500±12 hours at 40±20℃, in 90 to 95% humidity. Take it out and set it for 48±4 hours at room temperature, then measure.
		Capacitance Change	R7 : Within ±12.5% F5 : Within ±30%	
		D.F.	R7 : 0.05 max. F5 : 0.125 max. (for 16V) 0.15 max. (for 10V)	
		I.R.	1,000MΩ min.	
		Dielectric Strength	No failure	
14	Humidity Load	Appearance	No marked defect	Apply the rated voltage for 500±12 hours at 40±2℃, in 90 to 95% humidity and set it for 48±4 hours at room temperature,then measure. The charge/discharge current is less than 50mA. • Initial measurement for F1/F5 Perform a heat treatment at 150+0/−10℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.
		Capacitance Change	R7 : Within ±12.5% F5 : Within +30/−40%	
		D.F.	R7 : 0.05 max. F5 : 0.125 max. (for 16V) 0.15 max. (for 10V)	
		I.R.	500MΩ min.	
		Dielectric Strength	No failure	
15	High Temperature Load	Appearance	No marked defect	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 48±4 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 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	R7 : Within ±12.5% F5 : Within +30/−40%	
		D.F.	R7 : 0.05 max. F5 : 0.125 max. (for 16V) 0.15 max. (for 10V)	
		I.R.	1,000MΩ min.	
		Dielectric Strength	No failure	

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.





Chip Monolithic Ceramic Capacitors

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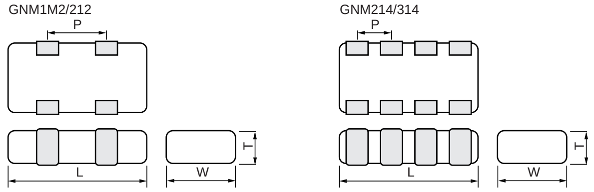
Capacitor Arrays GNM Series



Part Number	Dimensions (mm) L	W	T	P
GNM1M2	1.37 ±0.15	1.0 ±0.15	0.6 ±0.1 0.8 +0/-0.15	0.64 ±0.05
GNM212	2.0 ±0.15	1.25 ±0.15	0.85 ±0.1	1.0 ±0.1
GNM214			0.6 ±0.1	0.5 ±0.05
GNM314	3.2 ±0.15	1.6 ±0.15	0.8 ±0.1 1.0 ±0.1	0.8 ±0.1

■ Features

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

■ Applications

General electronic equipment

Temperature Compensating Type

Part Number		GNM1M	GNM21	GNM31	
L x W		1.37x1.0	2.0x1.25	3.2x1.6	
TC		C0G (**5C**)	C0G (**5C**)	C0G (**5C**)	
Rated Volt.		50 (**1H**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
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**)
27pF(**270**)	**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**)
39pF(**390**)	**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**)
270pF(**271**)	**K**				0.8(**4**)
330pF(**331**)	**K**				0.8(**4**)

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

High Dielectric Constant Type GNM1M Series

Part Number		GNM1M					
L x W		1.37x1.00					
TC		X5R (**R6**)			X7R (**R7**)		
Rated Volt.		16 (**1C**)	10 (**1A**)	6.3 (**0J**)	50 (**1H**)	25 (**1E**)	16 (**1C**)
Capacitance, Capacitance Tolerance and T Dimension							
1000pF(**102**)	**K, M**				0.6(**2**)		
2200pF(**222**)	**K, M**					0.6(**2**)	
4700pF(**472**)	**K, M**					0.6(**2**)	
10000pF(**103**)	**K, M**					0.6(**2**)	
22000pF(**223**)	**K, M**						0.6(**2**)

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Part Number		GNM1M					
L x W		1.37x1.00					
TC		X5R (**R6**)			X7R (**R7**)		
Rated Volt.		16 (**1C**)	10 (**1A**)	6.3 (**0J**)	50 (**1H**)	25 (**1E**)	16 (**1C**)
Capacitance, Capacitance Tolerance and T Dimension							
47000pF(**473**)	**K, M**						0.6(**2**)
0.10µF(**104**)	**K, M**		0.8(**2**)				
1.0µF(**105**)	**K, M**	0.8(**2**)	0.8(**2**)	0.8(**2**)			

The part numbering code is shown in each ( ). The (2) code in T (mm) means number of elements (two).
Dimensions are shown in mm and Rated Voltage in Vdc.
Please refer to Specificaion and Test Methods (2) about 1.0µF products.

High Dielectric Constant Type GNM21 Series

Part Number		GNM21				
L x W		2.0x1.25				
TC		X5R (**R6**)		X7R (**R7**)		
Rated Volt.		16 (**1C**)	10 (**1A**)	50 (**1H**)	25 (**1E**)	16 (**1C**)
Capacitance, Capacitance Tolerance and T Dimension						
1000pF(**102**)	**K, M**			0.6(**4**)		
2200pF(**222**)	**K, M**				0.6(**4**)	
4700pF(**472**)	**K, M**				0.6(**4**)	
10000pF(**103**)	**K, M**				0.6(**4**)	
22000pF(**223**)	**K, M**					0.85(**4**)
47000pF(**473**)	**K, M**					0.85(**4**)
0.10µF(**104**)	**K, M**					0.85(**4**)
0.47µF(**474**)	**K, M**	0.85(**2**)				
1.0µF(**105**)	**K, M**	0.85(**2**)	0.85(**4**)			
2.2µF(**225**)	**K, M**		0.85(**2**)			

The part numbering code is shown in each ( ). The (2) code in T (mm) means number of elements (two).
Dimensions are shown in mm and Rated Voltage in Vdc.
Please refer to Specificaion and Test Methods (2) about X5R, 10V products.

High Dielectric Constant Type GNM31 Series

Part Number		GNM31			
L x W		3.2x1.6			
TC		X7R (**R7**)			X5R (**R6**)
Rated Volt.		100 (**2A**)	50 (**1H**)	16 (**1C**)	10 (**1A**)
Capacitance, Capacitance Tolerance and T Dimension					
220pF(**221**)	**K, M**	0.8(**4**)			
330pF(**331**)	**K, M**	0.8(**4**)			
470pF(**471**)	**K, M**	0.8(**4**)	0.8(**4**)		
680pF(**681**)	**K, M**	0.8(**4**)	0.8(**4**)		
1000pF(**102**)	**K, M**	0.8(**4**)	0.8(**4**)		
1500pF(**152**)	**K, M**	0.8(**4**)	0.8(**4**)		
2200pF(**222**)	**K, M**	0.8(**4**)	0.8(**4**)		
3300pF(**332**)	**K, M**	0.8(**4**)	0.8(**4**)		
4700pF(**472**)	**K, M**	0.8(**4**)	0.8(**4**)		
6800pF(**682**)	**K, M**		0.8(**4**)		
10000pF(**103**)	**K, M**		0.8(**4**)		

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Part Number		GNM31			
L x W		3.2x1.6			
TC		X7R (**R7**)			X5R (**R6**)
Rated Volt.		100 (**2A**)	50 (**1H**)	16 (**1C**)	10 (**1A**)
Capacitance, Capacitance Tolerance and T Dimension					
15000pF(**153**)	**K, M**		0.8(**4**)		
22000pF(**223**)	**K, M**			0.8(**4**)	
33000pF(**333**)	**K, M**			0.8(**4**)	
47000pF(**473**)	**K, M**			1.0(**4**)	
68000pF(**683**)	**K, M**			1.0(**4**)	
0.10μF(**104**)	**K, M**			1.0(**4**)	
1.0μF(**105**)	**K, M**				0.85(**4**)

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

GNM Series Specifications and Test Methods (1)

No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
1	Operating Temperature Range		5C : –55 to +125°C	R7 : –55 to +125°C R6 : –30 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, 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 (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.
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 25°C and 75%RH max. and within 2 minutes of charging.
7	Capacitance		Within the specified tolerance		The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table. (Table 8-2)
8	Q/ Dissipation Factor (D.F.)		30pF min. : Q≧1000 30pF max. : Q≧400+20C C : Nominal Capacitance (pF)	(Table 8-1)	
9	Capacitance Temperature Characteristics	Capacitance Change	Within the specified tolerance (Table A)	(Table 9-1)	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 9-2) (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.
		Temperature Coefficent	Within the specified tolerance (Table A)		
		Capacitance Drift	Within ±0.2% or ±0.05pF (Whichever is larger.)		
10	Adhesive Strength of Termination		No removal of the terminations or other defect should occur. (Fig. 1 drawing)		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 10-1)

Table 8-1

Char.	25V min.	16V	10V	6.3V
R7, R6	0.025 max.	0.035 max.	0.035 max.	0.05 max.

Table 8-2

Item \ Char.	5C	R7
Frequency	1±0.1MHz	1±0.1kHz
Voltage	0.5 to 5Vrms	1.0±0.2Vrms

Table 9-1

Char.	Temp. Range	Reference Temp.	Cap. Change
R7	–55°C to +125°C	25°C	Within ±15%
R6	–55°C to +85°C		

Table 9-2

Step	Temperature (°C)
1	25±2
2	–55±3 (for 5C/R7), –30±3 (for F5)
3	25±2
4	125±3 (for 5C/R7), 85±3 (for F5)
5	20±2

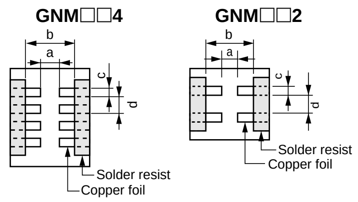

Table 10-1

Type	a	b	c	d
GNM1M2	0.5	1.6	0.32	0.32
GNM212	0.4	1.8	0.15	0.5
GNM214	0.6	2.0	0.25	0.25
GNM314	0.8	2.5	0.4	0.4

(in mm)

Fig. 1

Continued on the following page.

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GNM 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 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 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><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>R7, R6</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="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 either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

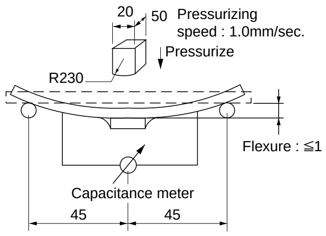
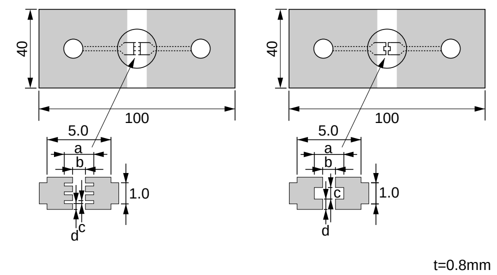



Fig. 3</td></tr>
<tr><td colspan="2">•GNM□□4 •GNM□□2
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>GNM1M2</td><td>2.0±0.05</td><td>0.5±0.05</td><td>0.32±0.05</td><td>0.32±0.05</td></tr><tr><td>GNM212</td><td>2.0±0.05</td><td>0.6±0.05</td><td>0.5±0.05</td><td>0.5±0.05</td></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></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 rowspan="6">Resistance to Soldering Heat</td><td></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>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 : 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><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>R7, R6</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>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.

<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="6">15</td><td rowspan="6">Temperature Cycle</td><td></td><td colspan="2">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 (temperature compensating type) or 48±4 hours (high dielectric constant type) 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 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>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 : 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>
<table>
<tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr>
<tr><td>R7, R6</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>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>
<tr><td rowspan="6">16</td><td rowspan="6">Humidity Steady State</td><td></td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="6">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>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td><td>R7, R6 : Within ±12.5%</td></tr>
<tr><td>Q/D.F.</td><td>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)</td><td>
<table>
<tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V/6.3V</th></tr>
<tr><td>R7, R6</td><td>0.05 max.</td><td>0.05 max.</td><td>0.05 max.</td></tr>
</table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="6">17</td><td rowspan="6">Humidity Load</td><td></td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="6">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 temprature, then muasure.
The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5% or ±0.75pF (Whichever is larger)</td><td>R7, R6 : Within ±12.5%</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over : Q≧200
30pF and below : Q≧100+10C/3
C : Nominal Capacitance (pF)</td><td>
<table>
<tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V/6.3V</th></tr>
<tr><td>R7, R6</td><td>0.05 max.</td><td>0.05 max.</td><td>0.05 max.</td></tr>
</table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 500MΩ or 25Ω · 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.

<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="5">18</td><td colspan="2">High Temperature Load</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table.</td><td rowspan="5">Apply 200% of the rated voltage for 1000±12 hours at the maximun 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 maximun operating temperature ±3°C. Remove and let sit for 24±2 hours at room temperature.Perform initial measurement.</td></tr>
<tr><td></td><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±3% or ±0.3pF (Whichever is larger)</td><td>R7, R6 : Within ±12.5%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>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)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V/6.3V</th></tr><tr><td>R7, R6</td><td>0.04 max.</td><td>0.05 max.</td><td>0.05 max.</td></tr></table></td></tr>
<tr><td></td><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
</table>

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)

<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></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>50Ω · F min.</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 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 25°C at the frequency and voltage shown in the table.
<table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>R6</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>0.1 max.</td></tr>
<tr><td>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td><table><tr><th>Char.</th><th>Temp. Range</th><th>Reference Temp.</th><th>Cap. Change</th></tr><tr><td>R6</td><td>−55 to +85°C</td><td>25°C</td><td>Within ±15%</td></tr></table></td><td>The capacitance change should be measured affter 5 min.at each specified temperature stage.
<table><tr><th>Step</th><th>Temperature (℃)</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>85±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.
• 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>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defects should occur.

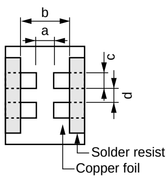



Fig. 1</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1 using a eutectic solder.
Then apply 5N force in parallel with the test jig for 10±1 sec. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering 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>0.4</td><td>1.8</td><td>0.15</td><td>0.5</td></tr></table>(in mm)</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 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 3 mutually perpendicular directions (total of 6 hours).</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.</td><td>0.1 max.</td></tr>
</table>

Continued on the following page.

GNM Series Specifications and Test Methods (2)

Continued from the preceding page.

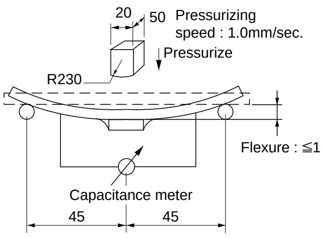
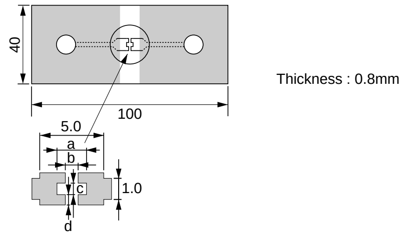
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>12</td><td colspan="2">Deflection</td><td>No cracking or marking defects shal occur.


Fig. 3</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 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>2.0±0.5</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></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°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.</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.</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">16</td><td rowspan="5">High Temperature High Humidity (Steady)</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. The charge/discharge currentis 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>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="5">17</td><td rowspan="5">Durability</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Apply 125% 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>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>

Chip Monolithic Ceramic Capacitors

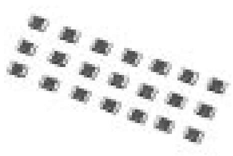
for Ultrasonic Sensors GRM Series

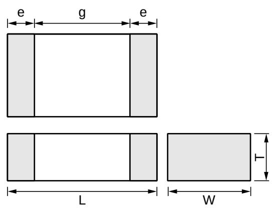
■ Features

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

■ Applications

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

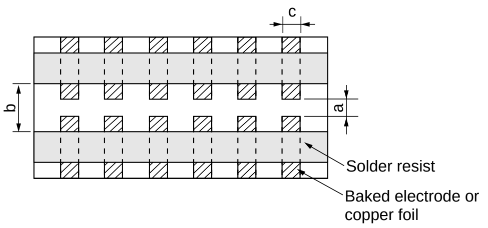




Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRM219	2.0 ±0.1	1.25 ±0.1	0.85 ±0.1	0.2 to 0.7	0.7

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

Specifications and Test Methods

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


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

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="2">12</td><td colspan="2" rowspan="2">Deflection</td><td>No 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 either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.

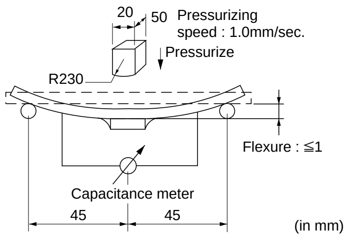
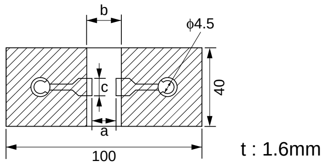
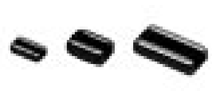
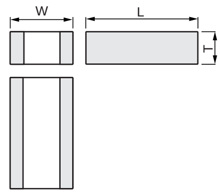



Fig.3</td></tr>
<tr><td>
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr></table>
(in mm)
Fig. 2</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td>75% of the terminations are to be soldered evenly and continuously.</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="5">14</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder 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.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>0.01 max.</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">15</td><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (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.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (℃)</td><td>-25^{+0}_{-3}</td><td>Room Temp.</td><td>85^{+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>Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>0.01 max.</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>Appearance</td><td>No defects or abnormalities</td><td rowspan="5">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.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>0.02 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="4">17</td><td rowspan="4">Humidity Load</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. 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>0.02 max.</td></tr>
<tr><td>I.R.</td><td>More than 500MΩ</td></tr>
<tr><td rowspan="4">18</td><td rowspan="4">High Temperature Load</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="4">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.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>D.F.</td><td>0.02 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
</table>

Chip Monolithic Ceramic Capacitors

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
LLL185	1.6 ±0.1	0.8 ±0.1	0.6 max.
LLL216	2.0 ±0.1	1.25 ±0.1	0.6 ±0.1
LLL219			0.85 ±0.1
LLL317	3.2 ±0.15	1.6 ±0.15	0.7 ±0.1
LLL31M			1.15 ±0.1

Reversed geometry Low ESL Type

Part Number	**LLL18**						**LLL21**						**LLL31**					
L x W	1.6x0.8						2.0x1.25						3.2x1.6					
TC	X7R (**R7**)					X7S (**C7**)	X7R (**R7**)					X7S (**C7**)	X7R (**R7**)					X5R (**R6**)
Rated Volt.	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	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**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)																		
2200pF (**222**)	0.5 (**5**)																	
3300pF (**332**)	0.5 (**5**)																	
4700pF (**472**)	0.5 (**5**)						0.6 (**6**)											
6800pF (**682**)		0.5 (**5**)					0.6 (**6**)											
10000pF (**103**)		0.5 (**5**)	0.5 (**5**)				0.6 (**6**)						0.7 (**7**)					
15000pF (**153**)		0.5 (**5**)	0.5 (**5**)				0.6 (**6**)						0.7 (**7**)	0.7 (**7**)				
22000pF (**223**)		0.5 (**5**)	0.5 (**5**)				0.6 (**6**)	0.6 (**6**)					0.7 (**7**)	0.7 (**7**)				
33000pF (**333**)			0.5 (**5**)				0.85 (**9**)	0.6 (**6**)	0.6 (**6**)				0.7 (**7**)	0.7 (**7**)				
47000pF (**473**)			0.5 (**5**)					0.6 (**6**)	0.6 (**6**)				0.7 (**7**)	0.7 (**7**)				
68000pF (**683**)			0.5 (**5**)					0.6 (**6**)	0.6 (**6**)				0.7 (**7**)	0.7 (**7**)				
0.10µF (**104**)				0.5 (**5**)				0.6 (**6**)	0.6 (**6**)				1.15 (**M**)	0.7 (**7**)				
0.15µF (**154**)					0.5 (**5**)			0.85 (**9**)	0.6 (**6**)				1.15 (**M**)	0.7 (**7**)				
0.22µF (**224**)					0.5 (**5**)					0.6 (**6**)				1.15 (**M**)				
0.33µF (**334**)						0.5 (**5**)				0.6 (**6**)				1.15 (**M**)	0.7 (**7**)			
0.47µF (**474**)						0.5 (**5**)				0.85 (**9**)				1.15 (**M**)	0.7 (**7**)			

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Part Number	LLL18						LLL21						LLL31					
L x W	1.6x0.8						2.0x1.25						3.2x1.6					
TC	X7R (**R7**)					X7S (**C7**)	X7R (**R7**)					X7S (**C7**)	X7R (**R7**)					X5R (**R6**)
Rated Volt.	50 (**1H**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	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**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)																		
0.68µF (**684**)											0.85 (**9**)				1.15 (**M**)	0.7 (**7**)		
1.0µF (**105**)						0.5 (**5**)					0.85 (**9**)				1.15 (**M**)	0.7 (**7**)		
1.5µF (**155**)											0.85 (**9**)					1.15 (**M**)	0.7 (**7**)	
2.2µF (**225**)												0.85 (**9**)				1.15 (**M**)	0.7 (**7**)	
4.7µF (**475**)																	1.15 (**M**)	
10µF (**106**)																		1.25 (**B**)

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

Reversed geometry Low ESL Type Low Profile

Part Number	LLL18				LLL21						LLL31			
L x W	1.6x0.8				2.0x1.25						3.2x1.6			
TC	X7R (**R7**)			X7S (**C7**)	X7R (**R7**)					X7S (**C7**)	X7R (**R7**)			
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**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)														
680pF(**681**)					0.5(**5**)									
1000pF(**102**)					0.5(**5**)									
1500pF(**152**)					0.5(**5**)									
2200pF(**222**)					0.5(**5**)									
3300pF(**332**)					0.5(**5**)									
4700pF(**472**)					0.5(**5**)									
6800pF(**682**)					0.5(**5**)									
10000pF(**103**)	0.5(**5**)	0.5(**5**)			0.5(**5**)	0.5(**5**)					0.5(**5**)			
15000pF(**153**)	0.5(**5**)	0.5(**5**)			0.5(**5**)	0.5(**5**)					0.5(**5**)	0.5(**5**)		
22000pF(**223**)		0.5(**5**)				0.5(**5**)	0.5(**5**)				0.5(**5**)	0.5(**5**)		
33000pF(**333**)		0.5(**5**)				0.5(**5**)	0.5(**5**)				0.5(**5**)	0.5(**5**)		
47000pF(**473**)		0.5(**5**)					0.5(**5**)					0.5(**5**)	0.5(**5**)	
68000pF(**683**)			0.5(**5**)				0.5(**5**)					0.5(**5**)	0.5(**5**)	
0.10µF(**104**)			0.5(**5**)				0.5(**5**)					0.5(**5**)	0.5(**5**)	
0.15µF(**154**)								0.5(**5**)					0.5(**5**)	
0.22µF(**224**)				0.5(**5**)				0.5(**5**)					0.5(**5**)	
0.33µF(**334**)				0.5(**5**)				0.5(**5**)					0.5(**5**)	
0.47µF(**474**)									0.5(**5**)					0.5(**5**)
0.68µF(**684**)														0.5(**5**)
1.0µF(**105**)										0.5(**5**)				

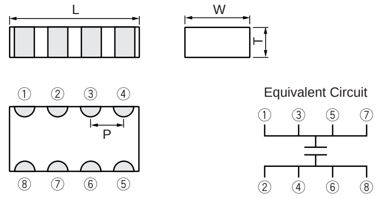
The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

■ 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	1.6x0.8	2.0x1.25					3.2x1.6		
TC	X7S (**C7**)	X7R (**R7**)				X7S (**C7**)	X7R (**R7**)		
Rated Volt.	4 (**0G**)	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	4 (**0G**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)									
10000pF(**103**)		0.85(**9**)							
15000pF(**153**)		0.85(**9**)							
22000pF(**223**)		0.85(**9**)							
33000pF(**333**)		0.85(**9**)							
47000pF(**473**)		0.85(**9**)							
68000pF(**683**)			0.85(**9**)						
0.10µF(**104**)			0.85(**9**)				0.85(**9**)		
0.15µF(**154**)			0.85(**9**)				1.15(**M**)		
0.22µF(**224**)			0.85(**9**)				0.85(**9**)		
0.33µF(**334**)	0.5(**5**)			0.85(**9**)			0.85(**9**)		
0.47µF(**474**)	0.5(**5**)			0.85(**9**)			0.85(**9**)		
0.68µF(**684**)				0.85(**9**)			0.85(**9**)		
1.0µF(**105**)	0.5(**5**)				0.85(**9**)			0.85(**9**)	
1.5µF(**155**)					0.85(**9**)			0.85(**9**)	
2.2µF(**225**)						0.85(**9**)			0.85(**9**)
4.7µF(**475**)						0.85(**9**)			

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

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Eight Terminals Low ESL Type Low Profile

Part Number	**LLA21**					**LLA31**		
L x W	2.0x1.25					3.2x1.6		
TC	X7R (**R7**)				X7S (**C7**)	X7R (**R7**)		
Rated Volt.	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)								
10000pF(**103**)	0.5(**5**)							
15000pF(**153**)	0.5(**5**)							
22000pF(**223**)	0.5(**5**)							
33000pF(**333**)		0.5(**5**)						
47000pF(**473**)		0.5(**5**)						
68000pF(**683**)		0.5(**5**)						
0.10µF(**104**)		0.5(**5**)				0.5(**5**)		
0.15µF(**154**)			0.5(**5**)	0.5(**5**)		0.5(**5**)		
0.22µF(**224**)			0.5(**5**)	0.5(**5**)		0.5(**5**)		

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Part Number	**LLA21**					**LLA31**		
L x W	2.0x1.25					3.2x1.6		
TC	X7R (**R7**)				X7S (**C7**)	X7R (**R7**)		
Rated Volt.	25 (**1E**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)								
0.33µF(**334**)			0.5(**5**)	0.5(**5**)			0.5(**5**)	
0.47µF(**474**)				0.5(**5**)			0.5(**5**)	
0.68µF(**684**)				0.5(**5**)			0.5(**5**)	
1.0µF(**105**)					0.5(**5**)			0.5(**5**)
1.5µF(**155**)					0.5(**5**)			0.5(**5**)
2.2µF(**225**)					0.5(**5**)			0.5(**5**)

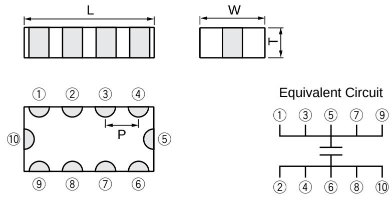
The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

■ 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
LLM219	2.0 ±0.1	1.25 ±0.1	0.85 ±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
LLM31M	3.2 ±0.15	1.6 ±0.15	1.15±0.1	0.8 ±0.1

Ten Terminals Low ESL Type

Part Number	**LLM21**				**LLM31**		
L x W	2.0x1.25				3.2x1.6		
TC	X7R (**R7**)			X7S (**C7**)	X7R (**R7**)		
Rated Volt.	25 (**1E**)	16 (**1C**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)							
10000pF(**103**)	0.85(**9**)						
15000pF(**153**)	0.85(**9**)						
22000pF(**223**)	0.85(**9**)						
33000pF(**333**)	0.85(**9**)						
47000pF(**473**)	0.85(**9**)						
68000pF(**683**)		0.85(**9**)					
0.10µF(**104**)		0.85(**9**)			1.15(**M**)		
0.15µF(**154**)		0.85(**9**)			1.15(**M**)		
0.22µF(**224**)		0.85(**9**)			1.15(**M**)		
0.33µF(**334**)			0.85(**9**)		1.15(**M**)		
0.47µF(**474**)			0.85(**9**)		1.15(**M**)		
0.68µF(**684**)			0.85(**9**)		1.15(**M**)		
1.0µF(**105**)			0.85(**9**)		1.15(**M**)		
1.5µF(**155**)			0.85(**9**)			1.15(**M**)	
2.2µF(**225**)				0.85(**9**)		1.15(**M**)	
3.3µF(**335**)							1.15(**M**)
4.7µF(**475**)							1.15(**M**)

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

Ten Terminals Low ESL Type Low Profile

Part Number	**LLM21**				**LLM31**		
L x W	2.0x1.25				3.2x1.6		
TC	X7R (**R7**)			X7S (**C7**)	X7R (**R7**)		
Rated Volt.	25 (**1E**)	16 (**1C**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)							
10000pF(**103**)	0.5(**5**)						
15000pF(**153**)	0.5(**5**)						
22000pF(**223**)	0.5(**5**)						
33000pF(**333**)		0.5(**5**)					
47000pF(**473**)		0.5(**5**)					
68000pF(**683**)		0.5(**5**)					
0.10µF(**104**)		0.5(**5**)			0.5(**5**)		
0.15µF(**154**)			0.5(**5**)		0.5(**5**)		

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Part Number	**LLM21**				**LLM31**		
L x W	2.0x1.25				3.2x1.6		
TC	X7R (**R7**)			X7S (**C7**)	X7R (**R7**)		
Rated Volt.	25 (**1E**)	16 (**1C**)	6.3 (**0J**)	4 (**0G**)	16 (**1C**)	10 (**1A**)	6.3 (**0J**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)							
0.22µF(**224**)			0.5(**5**)		0.5(**5**)		
0.33µF(**334**)			0.5(**5**)			0.5(**5**)	
0.47µF(**474**)			0.5(**5**)			0.5(**5**)	
0.68µF(**684**)			0.5(**5**)			0.5(**5**)	
1.0µF(**105**)				0.5(**5**)			
1.5µF(**155**)				0.5(**5**)			
2.2µF(**225**)				0.5(**5**)			0.5(**5**)

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

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>R6 : −55 to +85°C
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>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>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.
<table>
<tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr>
<tr><td>C≦10μF (10V min.)</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±24kHz</td><td>0.5±0.1Vrms</td></tr>
</table></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 max.; 0.035 max. *1</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>R6</td><td>−55 to +85</td><td>25°C</td><td>Within ±15%</td></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 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.</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 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 max.; 0.035 max. *1</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 solution at 270±5°C for 10±0.5 seconds. Let sit at room temperature for 48±4 hours, then measure.

• Initial measurement.
Perform a heat treatment at 150^{+0}_{-10}°C for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>W.V.: 25V min.; 0.025 max.
W.V.: 16V max.; 0.035 max. *1</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>

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Specifications and Test Methods

Continued from the preceding page.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="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 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>
• Initial measurement.
Perform a heat treatment at 150 $^{+0}_{-10}$ °C for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5% *1</td></tr>
<tr><td>D.F.</td><td>W.V.: 25V min.; 0.025 max.
W.V.: 16V max.; 0.035 max. *1</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 48±4 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5% *1</td></tr>
<tr><td>D.F.</td><td>0.05 max. *1</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Humidity Load</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5% *1</td></tr>
<tr><td>D.F.</td><td>0.05 max. *1</td></tr>
<tr><td>I.R.</td><td>More than 500MΩ or 25Ω · F *1
(Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="5">17</td><td rowspan="5">High Temperature Load</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Let sit for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA.

•Initial measurement.
Apply 200% (*2) of the rated DC voltage for one hour at the maximum operating temperature ±3°C. Remove and let sit for 48±4 hours at room temperature.
Perform initial measurement. (*1)</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5% *1</td></tr>
<tr><td>D.F.</td><td>W.V.: 25V min.; 0.04 max.
W.V.: 16V max.; 0.05 max. *1</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 50Ω · F *1
(Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>

*1 : The ligure Indicates typical inspection.Please refer to individual specifications.
*2 : Some of the parts are applicable in rated voltage×150%. Please refer to individual specifications.

Chip Monolithic Ceramic Capacitors

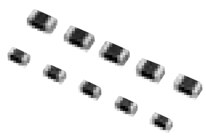
High Frequency for Flow/Reflow Soldering GQM Series

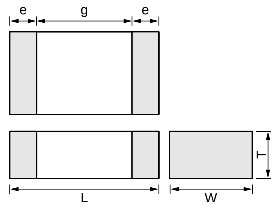
■ Features

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.
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	1.60x0.80		2.00x1.25	
TC	C0G (**5C**)		C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)				
0.50pF(**R50**)	0.80(**8**)		0.85(**9**)	
0.75pF(**R75**)	0.80(**8**)		0.85(**9**)	
1.0pF(**1R0**)	0.80(**8**)		0.85(**9**)	
1.1pF(**1R1**)	0.80(**8**)		0.85(**9**)	
1.2pF(**1R2**)	0.80(**8**)		0.85(**9**)	
1.3pF(**1R3**)	0.80(**8**)		0.85(**9**)	
1.5pF(**1R5**)	0.80(**8**)		0.85(**9**)	
1.6pF(**1R6**)	0.80(**8**)		0.85(**9**)	
1.8pF(**1R8**)	0.80(**8**)		0.85(**9**)	
2.0pF(**2R0**)	0.80(**8**)		0.85(**9**)	
2.2pF(**2R2**)	0.80(**8**)		0.85(**9**)	
2.4pF(**2R4**)	0.80(**8**)		0.85(**9**)	
2.7pF(**2R7**)	0.80(**8**)		0.85(**9**)	
3.0pF(**3R0**)	0.80(**8**)		0.85(**9**)	
3.3pF(**3R3**)	0.80(**8**)		0.85(**9**)	
3.6pF(**3R6**)	0.80(**8**)		0.85(**9**)	
3.9pF(**3R9**)	0.80(**8**)		0.85(**9**)	
4.0pF(**4R0**)	0.80(**8**)		0.85(**9**)	
4.3pF(**4R3**)	0.80(**8**)		0.85(**9**)	
4.7pF(**4R7**)	0.80(**8**)		0.85(**9**)	
5.0pF(**5R0**)	0.80(**8**)		0.85(**9**)	
5.1pF(**5R1**)	0.80(**8**)		0.85(**9**)	
5.6pF(**5R6**)	0.80(**8**)		0.85(**9**)	
6.0pF(**6R0**)	0.80(**8**)		0.85(**9**)	
6.2pF(**6R2**)	0.80(**8**)		0.85(**9**)	
6.8pF(**6R8**)	0.80(**8**)		0.85(**9**)	
7.0pF(**7R0**)		0.80(**8**)	0.85(**9**)	
7.5pF(**7R5**)		0.80(**8**)	0.85(**9**)	
8.0pF(**8R0**)		0.80(**8**)	0.85(**9**)	
8.2pF(**8R2**)		0.80(**8**)	0.85(**9**)	
9.0pF(**9R0**)		0.80(**8**)	0.85(**9**)	
9.1pF(**9R1**)		0.80(**8**)	0.85(**9**)	
10pF(**100**)		0.80(**8**)	0.85(**9**)	

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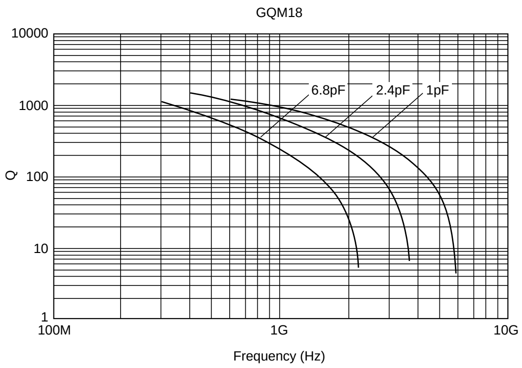
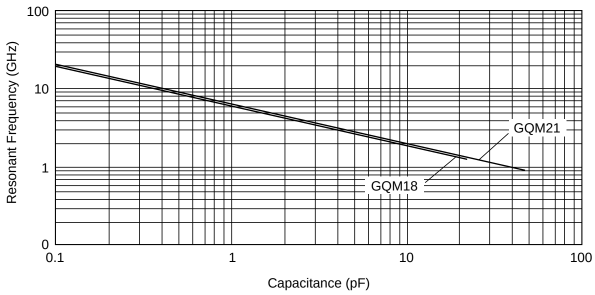
Part Number	GQM18		GQM21	
L x W	1.60x0.80		2.00x1.25	
TC	C0G (**5C**)		C0G (**5C**)	
Rated Volt.	100 (**2A**)	50 (**1H**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)				
11pF(**110**)		0.80(**8**)	0.85(**9**)	
12pF(**120**)		0.80(**8**)	0.85(**9**)	
13pF(**130**)		0.80(**8**)	0.85(**9**)	
15pF(**150**)		0.80(**8**)	0.85(**9**)	
16pF(**160**)		0.80(**8**)	0.85(**9**)	
18pF(**180**)		0.80(**8**)	0.85(**9**)	
20pF(**200**)		0.80(**8**)		0.85(**9**)
22pF(**220**)		0.80(**8**)		0.85(**9**)
24pF(**240**)		0.80(**8**)		0.85(**9**)
27pF(**270**)		0.80(**8**)		0.85(**9**)
30pF(**300**)		0.80(**8**)		0.85(**9**)
33pF(**330**)		0.80(**8**)		0.85(**9**)
36pF(**360**)		0.80(**8**)		0.85(**9**)
39pF(**390**)		0.80(**8**)		0.85(**9**)
43pF(**430**)		0.80(**8**)		0.85(**9**)
47pF(**470**)		0.80(**8**)		0.85(**9**)
51pF(**510**)		0.80(**8**)		0.85(**9**)
56pF(**560**)		0.80(**8**)		0.85(**9**)
62pF(**620**)		0.80(**8**)		0.85(**9**)
68pF(**680**)		0.80(**8**)		0.85(**9**)
75pF(**750**)		0.80(**8**)		0.85(**9**)
82pF(**820**)		0.80(**8**)		0.85(**9**)
91pF(**910**)		0.80(**8**)		0.85(**9**)
100pF(**101**)		0.80(**8**)		0.85(**9**)

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

■ Q-Frequency Characteristics

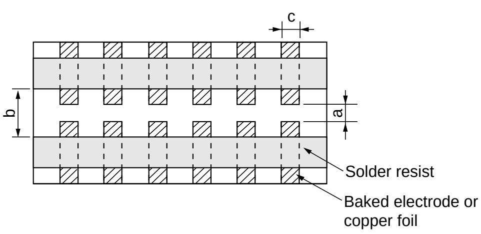


■ Resonant Frequency-Capacitance



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℃
(2C, 3C, 4C : 20℃)</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.</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>

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Specifications and Test Methods

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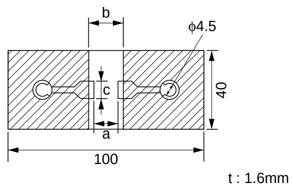
No.	Item		Specifications	Test Method
12	Deflection		No crack or marked defect should occur.	Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
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		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 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.
		Appearance	No marking defects	
		Capacitance Change	Within ±2.5% or ±0.25 pF (Whichever is larger)	
		Q	30pF min. : Q≧1400 30pF max. : Q≧800+20C C : Nominal Capacitance (pF)	
		I.R.	More than 10,000MΩ	
		Dielectric Strength	No failure	
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 at room temperature, then measure.
		Appearance	No marking defects	
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	
		Q	30pF min. : Q≧1400 30pF max. : Q≧800+20C C : Nominal Capacitance (pF)	
		I.R.	More than 10,000MΩ	
		Dielectric Strength	No failure	
16	Humidity Steady State		The measured and observed characteristics should satisfy the specifications in the following table.	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.
		Appearance	No marking defects	
		Capacitance Change	Within ±5% or ±0.5pF (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	
		Dielectric Strength	No failure	



Type	a	b	c
GQM18	1.0	3.0	1.2
GQM21	1.2	4.0	1.65

(in mm)

Fig. 2

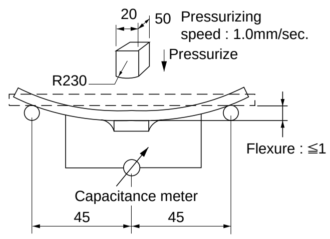


Fig. 3

Temperature cycle (No. 15):

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

13

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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	
		Dielectric Strength	No failure	
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	
		Dielectric Strength	No failure	

Table A

(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

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

Chip Monolithic Ceramic Capacitors

muRata

High Frequency Type ERB Series

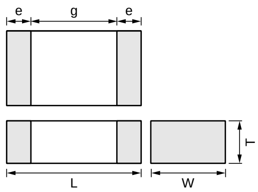
SMD Type

■ 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	1.6x0.8	2.0x1.25			3.2x2.5				
TC	C0G (**5C**)	C0G (**5C**)			C0G (**5C**)				
Rated Volt.	250 (**2E**)	250 (**2E**)	100 (**2A**)	50 (**1H**)	500 (**2H**)	300 (**YD**)	250 (**2E**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)									
0.50pF(**R50**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
0.75pF(**R75**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
1.0pF(**1R0**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
1.1pF(**1R1**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
1.2pF(**1R2**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
1.3pF(**1R3**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
1.5pF(**1R5**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
1.6pF(**1R6**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
1.8pF(**1R8**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
2.0pF(**2R0**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
2.2pF(**2R2**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
2.4pF(**2R4**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
2.7pF(**2R7**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
3.0pF(**3R0**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
3.3pF(**3R3**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
3.6pF(**3R6**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
3.9pF(**3R9**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
4.3pF(**4R3**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
4.7pF(**4R7**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
5.1pF(**5R1**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
5.6pF(**5R6**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
6.2pF(**6R2**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
6.8pF(**6R8**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
7.5pF(**7R5**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
8.2pF(**8R2**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
9.1pF(**9R1**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
10pF(**100**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
11pF(**110**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
12pF(**120**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
13pF(**130**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				

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Part Number	**ERB18**	**ERB21**			**ERB32**				
L x W	1.6x0.8	2.0x1.25			3.2x2.5				
TC	C0G (**5C**)	C0G (**5C**)			C0G (**5C**)				
Rated Volt.	250 (**2E**)	250 (**2E**)	100 (**2A**)	50 (**1H**)	500 (**2H**)	300 (**YD**)	250 (**2E**)	100 (**2A**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T (mm) Dimension (T Dimension part numbering code)									
15pF(**150**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
16pF(**160**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
18pF(**180**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
20pF(**200**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
22pF(**220**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
24pF(**240**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
27pF(**270**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
30pF(**300**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
33pF(**330**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
36pF(**360**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
39pF(**390**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
43pF(**430**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
47pF(**470**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
51pF(**510**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
56pF(**560**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
62pF(**620**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
68pF(**680**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
75pF(**750**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
82pF(**820**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
91pF(**910**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
100pF(**101**)	0.8(**8**)	1.25(**B**)			1.50(**Q**)				
120pF(**121**)			1.25(**B**)		1.50(**Q**)				
130pF(**131**)			1.25(**B**)			1.50(**Q**)			
150pF(**151**)				1.25(**B**)		1.50(**Q**)			
160pF(**161**)				1.25(**B**)			1.50(**Q**)		
180pF(**181**)							1.50(**Q**)		
200pF(**201**)							1.50(**Q**)		
220pF(**221**)							1.50(**Q**)		
240pF(**241**)								1.50(**Q**)	
270pF(**271**)								1.50(**Q**)	
300pF(**301**)								1.50(**Q**)	
330pF(**331**)								1.50(**Q**)	
360pF(**361**)								1.50(**Q**)	
390pF(**391**)								1.50(**Q**)	
430pF(**431**)								1.50(**Q**)	
470pF(**471**)								1.50(**Q**)	
510pF(**511**)									1.50(**Q**)
560pF(**561**)									1.50(**Q**)
620pF(**621**)									1.50(**Q**)
680pF(**681**)									1.50(**Q**)
750pF(**751**)									1.50(**Q**)
820pF(**821**)									1.50(**Q**)
910pF(**911**)									1.50(**Q**)
1000pF(**102**)									1.50(**Q**)

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

Specifications and Test Methods

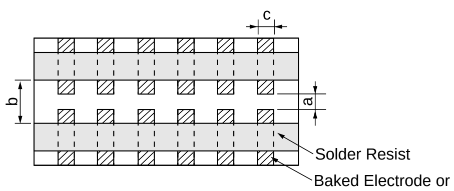
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>−55 to +125℃</td><td>Reference Temperature: 25°C</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><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.
<table><tr><td>Frequency</td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td>1±0.2Vrms</td></tr></table></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.
<table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>−55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table></td></tr>
<tr><td>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>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defects should occur.


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

Continued on the following page.

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 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

Specifications: No crack or marked defect should occur.

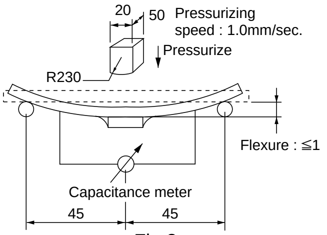


Fig.3a

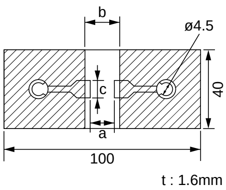


Fig. 2a

Test Method: 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 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)

13 Solderability of Termination

Specifications: 95% of the terminations are to be soldered evenly and continuously.

Test Method: 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℃.

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.

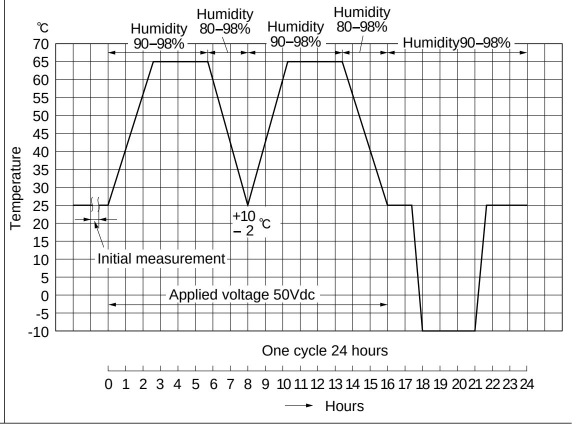
16 Humidity

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.



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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+ $\frac{5}{2}$ C C<10pF : Q≧200+10C I.R.: 1,000MΩ min. Dielectric Strength: No failure 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

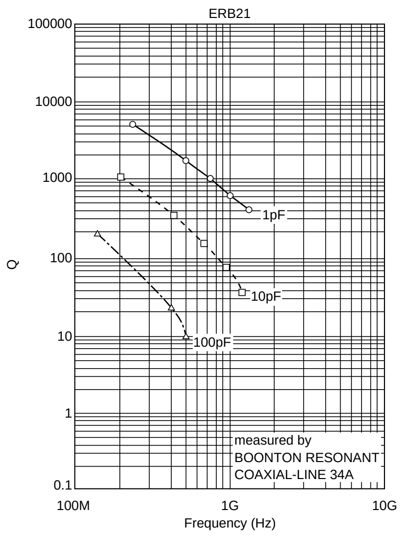
Char.	Nominal Values (ppm/℃) Note 1	Capacitance Change from 25℃ (%)					
		−55		−30		−10	
		Max.	Min.	Max.	Min.	Max.	Min.
5C	0±30	0.58	−0.24	0.40	−0.17	0.25	−0.11

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

ERB Series Data

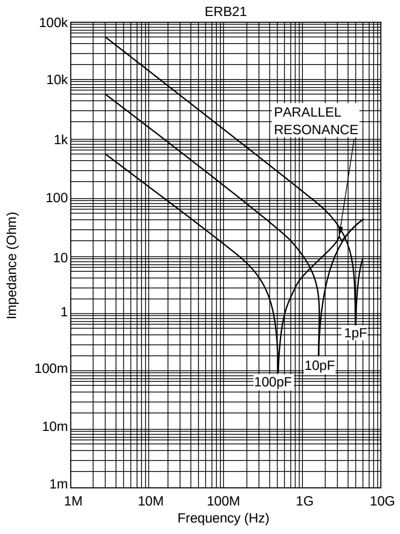
■ Q-Frequency Characteristics

ERB Series



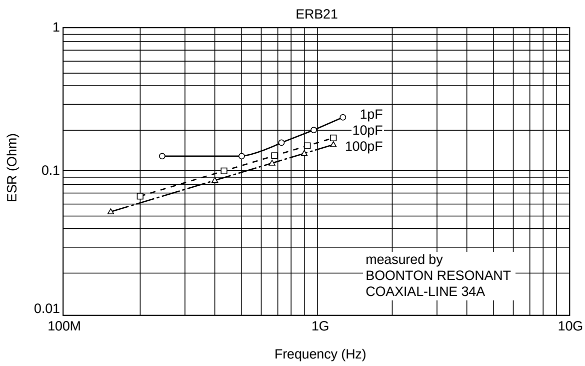
■ Impedance-Frequency Characteristics

ERB Series



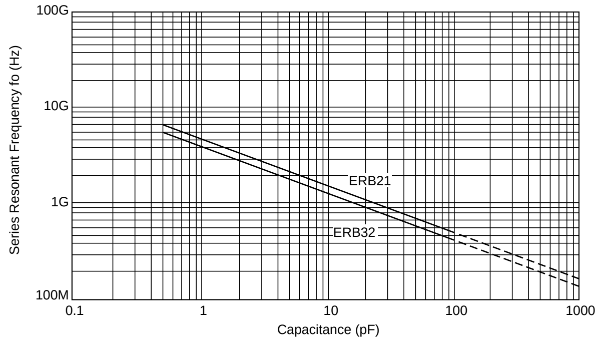
■ ESR-Frequency Characteristics

ERB Series

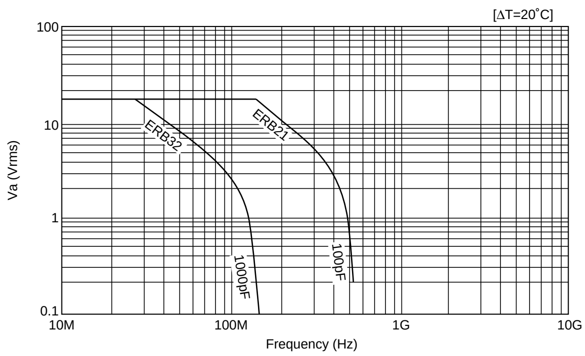


■ Resonant Frequency-Capacitance

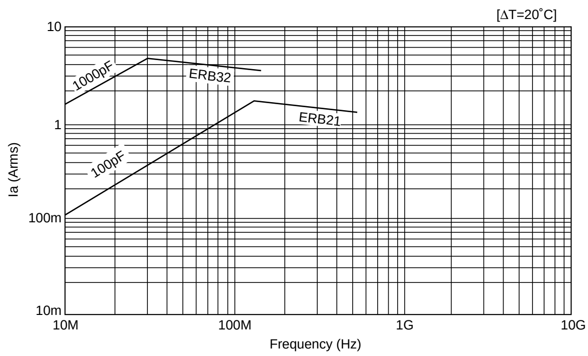
ERB Series



■ Allowable Voltage-Frequency



■ Allowable Current-Frequency



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ERB Series Data

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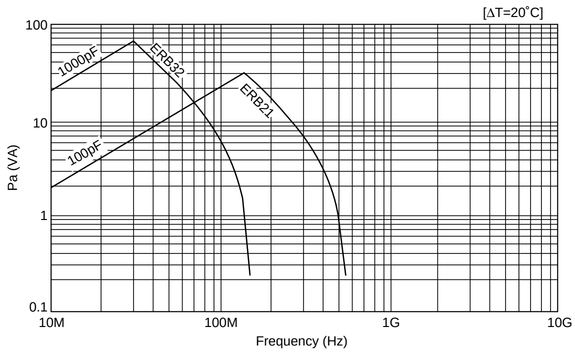
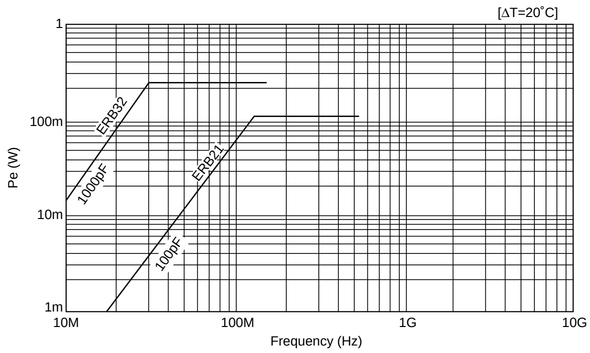
■ Allowable Apparent Power-Frequency



■ Allowable Effective Power-Frequency



Package

■ Packaging Code

Packaging Type	Tape Carrier Packaging	Bulk Case Packaging	Bulk Packaging	
			Bulk Packaging in a Bag	Bulk Packaging in a Tray
Packaging Code	**D, L, K, J**	**C**	**B**	**T**

■ 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		
Ultra Miniaturized	**GRM02**	0.4	0.2	0.2	20,000	-	-	-	-	-
	GRM03	0.6	0.3	0.3	15,000	-	50,000	-	-	1,000
For Flow/Reflow	**GRM18**	1.6	0.8	0.8	4,000	-	10,000	-	15,000	1,000
	GRM21	2.0	1.25	0.6	4,000	-	10,000	-	10,000	1,000
				0.85/1.0	4,000	-	10,000	-	-	1,000
				1.25	-	3,000	-	10,000	5,000 2)	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
For Reflow	**GRM15X**	1.0	0.5	0.25	10,000	-	50,000	-	-	1,000
	GRM155	1.0	0.5	0.5	10,000	-	50,000	-	50,000	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	-	1,000
	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	0.8	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
Micro Chip	**GMA05**	0.5	0.5	0.35	-	-	-	-	-	400 1)
	GMA08	0.8	0.8	0.5	-	-	-	-	-	400 1)
Array	**GNM1M**	1.37	1.0	0.6	4,000	-	10,000	-	-	1,000
	GNM31	3.2	1.6	0.8	4,000	-	10,000	-	-	1,000
				1.0	-	3,000	-	10,000	-	1,000
	GNM21	2.0	1.25	0.6/0.85	4,000	-	10,000	-	-	1,000
Low ESL	**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
				0.85	-	3,000	-	10,000	-	1,000
	LLM31	3.2	1.6	0.5	-	4,000	-	10,000	-	1,000
				1.15	-	3,000	-	10,000	-	1,000

1) Tray 2) 10µF, 1.0µF, 3.3/4.7µF of 6.3V R6 rated are not available by bulk case.

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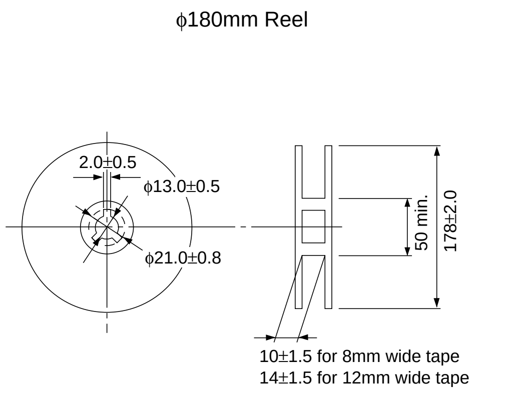
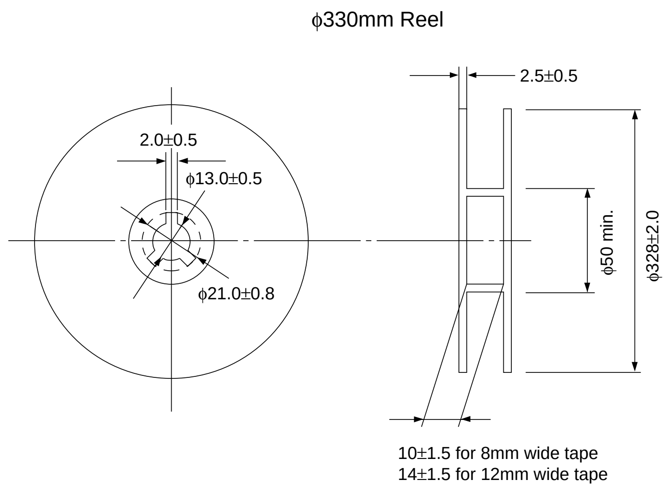
■ Tape Carrier Packaging

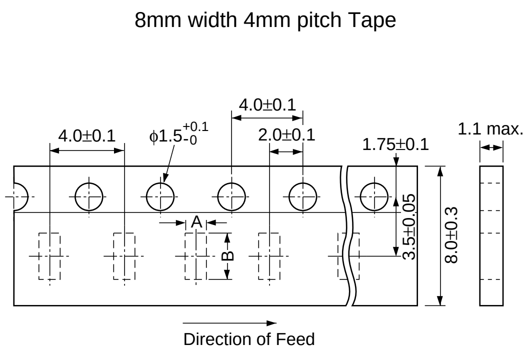
(1) Dimensions of Reel

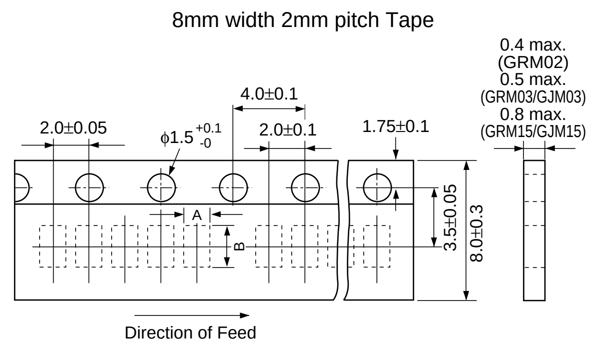




(in mm)

(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**	0.37	0.67
GJM15 **GRM15**	0.65	1.15

*Nominal Value

(in mm)

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Package

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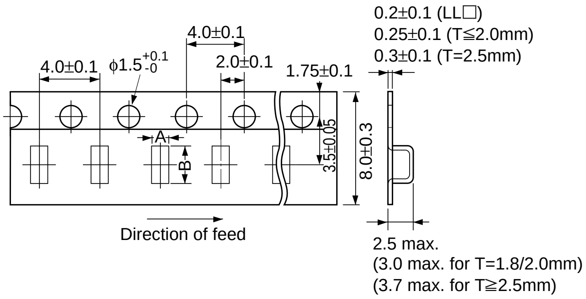
(3) Dimensions of Embossed Tape

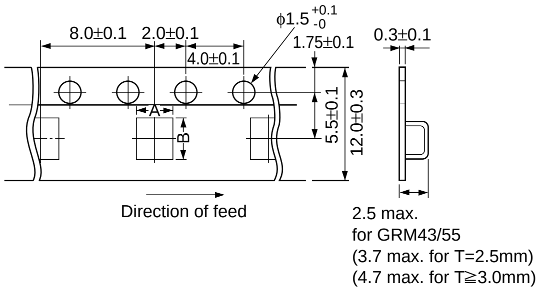
8mm width 4mm pitch Tape



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

*Nominal Value

12mm width 8mm pitch Tape



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

*Nominal Value

(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.

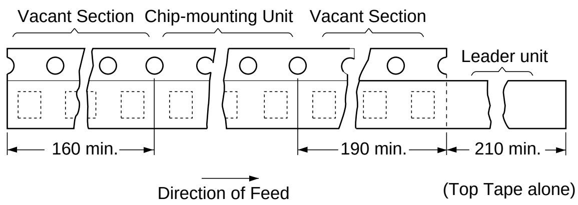
④ Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.

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

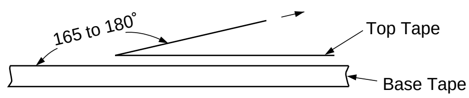
⑥ Cumulative tolerance of sprocket holes, 10 pitches: ±0.3mm.

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

*GRM02, GRM03, GJM03 : 0.05 to 0.5N



(in mm)



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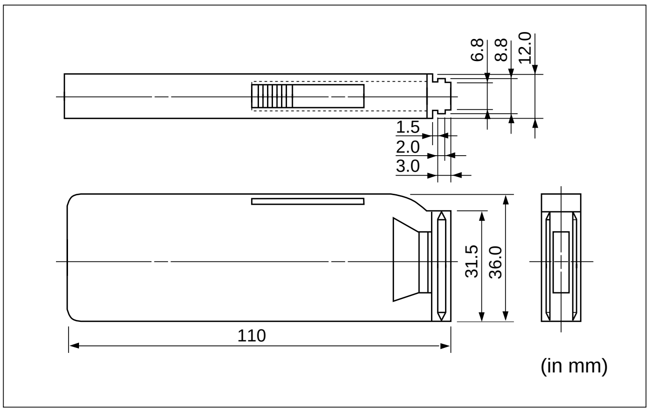
■ Dimensions of Bulk Case Packaging

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



⚠Caution

■ Storage and Operating Conditions

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.

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.

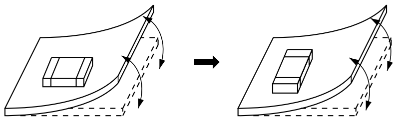
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND FUMING WHEN THE PRODUCTS IS USED.

■ Soldering and Mounting

1. Mounting Position

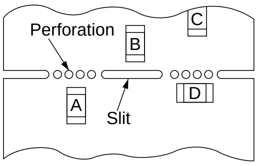
Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[Component Direction]



Locate chip horizontal to the direction in which stress acts

[Chip Mounting Close to Board Separation Point]



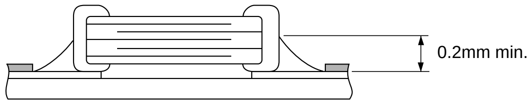
Chip arrangement
Worst A-C-(B~D) Best

(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. Solder Paste Printing

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

[Optimum Solder Amount for Reflow Soldering]



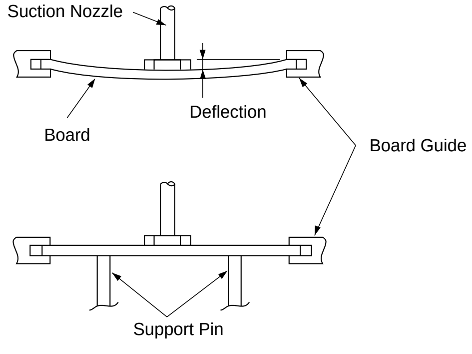
3. Chip Placing

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



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⚠Caution

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4. Reflow Soldering

- Sudden heating of the chip results in distortion due to excessive expansion and construction forces within the chip causing cracked chips. So when preheating, keep temperature differential, ΔT, within the range shown in Table 1. The smaller the ΔT, the less stress on the chip.
- 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 above table.

Table 1

Part Number	Temperature Differential
GRM02/03/15/18/21/31 **GJM03/15** **LLL18/21/31** **ERB18/21** **GQM18/21**	ΔT≦190℃
GRM32/43/55 **LLA18/21/31** **LLM21/31** **GNM** **ERB32**	ΔT≦130℃

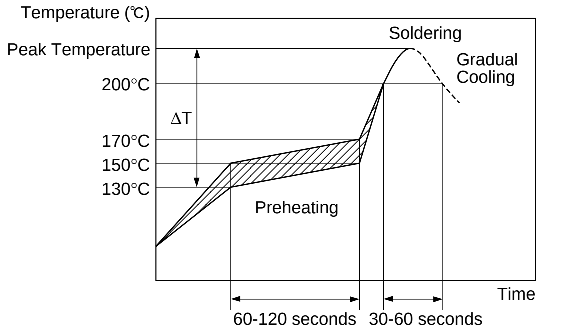
Recommended Conditions

	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

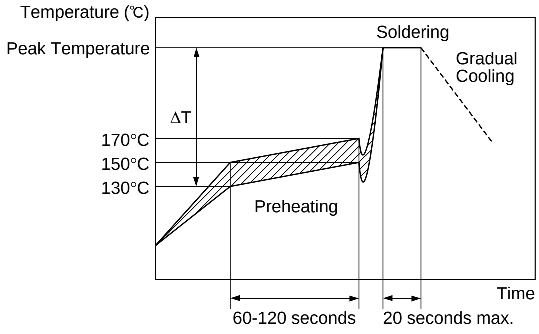
Pb-Sn Solder: Sn-37Pb
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Reflow Soldering]

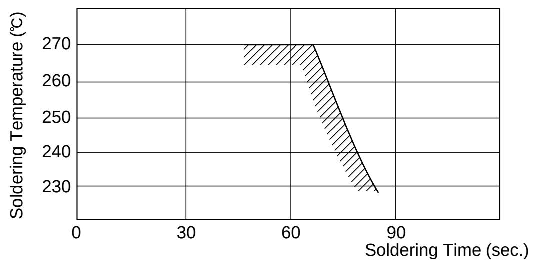
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]



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

Inverting the PCB

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

5. Leaded Component Insertion

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

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6. Flow Soldering

- Sudden heating of the chip results in thermal distortion causing cracked chips. And an excessively long soldering time or high soldering temperature results in leaching of the outer electrodes, causing poor adhesion or a reduction in capacitance value due to loss of contact between electrodes and end termination.
- When preheating, keep the temperature differential between solder temperature and chip surface temperature, ΔT, within the range shown in Table 2. The smaller the ΔT, the less stress on the chip.
  When components are immersed in solvent after mounting, be sure to maintain the temperature difference between the component and solvent within the range shown in Table 2.
  Do not apply flow soldering to chips not listed in Table 2.

Table 2

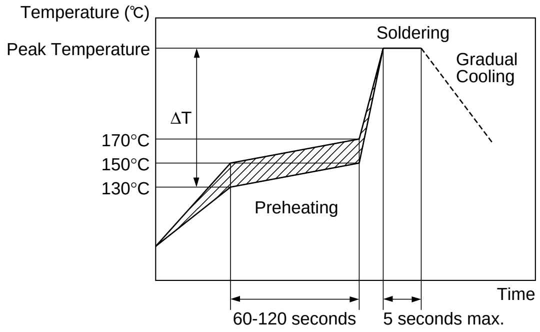
Part Number	Temperature Differential
GRM18/21/31 **LLL21/31** **ERB18/21** **GQM18/21**	ΔT≦150℃

Recommended Conditions

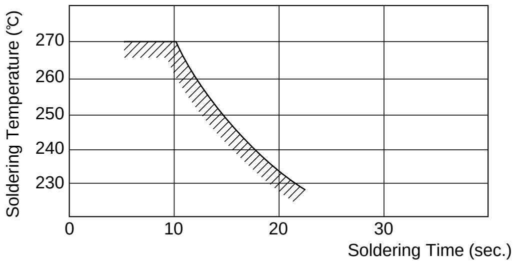
	Pb-Sn Solder	Lead Free Solder
Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N_2

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

[Standard Conditions for Flow Soldering]

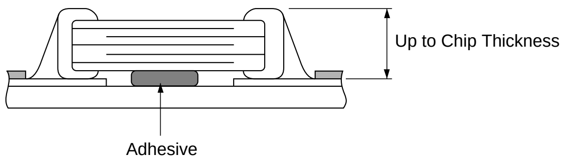


[Allowable Soldering Temperature and Time]



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

- Optimum Solder Amount for Flow Soldering



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⚠Caution

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7. Correction with a Soldering Iron

(1) For Chip Type Capacitors

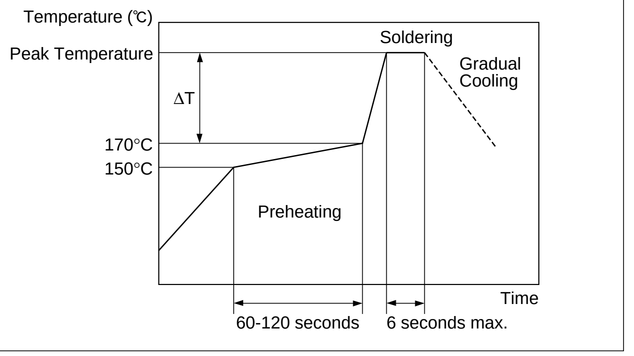
● Sudden heating of the chip results in distortion due to a high internal temperature differential, causing cracked chips. When preheating, keep temperature differential, ΔT, within the range shown in Table 3. The smaller the ΔT, the less stress on the chip.

Table 3

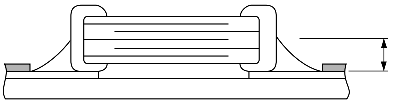
Part Number	Temperature Differential	Peak Temperature	Atmosphere
GRM15/18/21/31 **GJM15** **LLL18/21/31** **GQM18/21** **ERB18/21**	ΔT≦190℃	300°C max. 3 seconds max. / termination	Air
GRM32/43/55 **GNM** **LLA18/21/31** **LLM21/31** **ERB32**	ΔT≦130℃	270°C max. 3 seconds max. / termination	Air

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

[Standard Conditions for Soldering Iron Temperature]



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



(2) For Microstrip Types

● Solder 1mm away from the ribbon terminal base, being careful that the solder tip does not directly contact the capacitor. Preheating is unnecessary.

● Complete soldering within 3 seconds with a soldering tip less than 270°C in temperature.

8. Washing

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

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

■ Rating

Die Bonding/Wire Bonding (GMA Series)

1. Die Bonding of Capacitors

•Use the following materials Braze 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 braze alloy.

(2) Place braze 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:
20 micro m (0.0008 inch), 25 micro m (0.001 inch) diameter

•Bonding

(1) Thermocompression, ultrasonic ball bonding.

(2) Required stage temperature : 200 to 250 degree C

(3) Required wedge or capillary weight : 0.5N to 2N.

(4) Bond the capacitor and base substrate or other devices with gold wire.

Notice

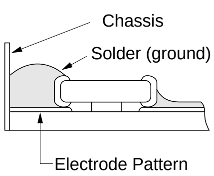
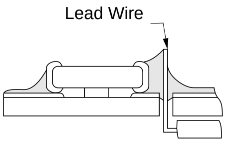
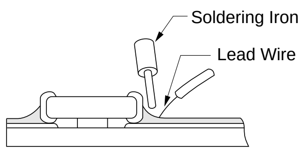
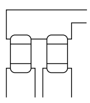
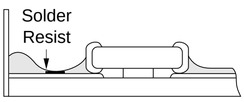
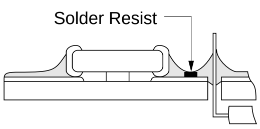
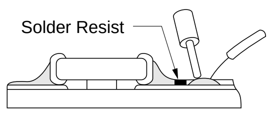
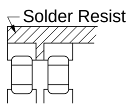
■ Soldering and Mounting

1. PCB Design

(1) Notice for Pattern Forms

Unlike leaded components, chip components are susceptible to flexing stresses since they are mounted directly on the substrate.
They are also more sensitive to mechanical and thermal stresses than leaded components.
Excess solder fillet height can multiply these stresses and cause chip cracking. When designing substrates, take land patterns and dimensions into consideration to eliminate the possibility of excess solder fillet height.

Pattern Forms

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

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Notice

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(2) Land Dimensions

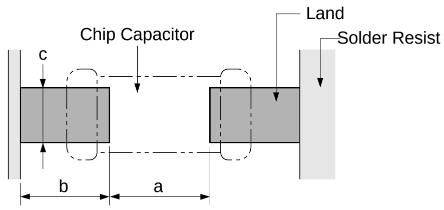

Table 1 Flow Soldering Method

Part Number \ Dimensions	Dimensions (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	Dimensions (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
LLL18	0.8×1.6	0.2–0.4	0.3–0.4	1.0–1.4
LLL21	1.25×2.0	0.4–0.6	0.3–0.5	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)

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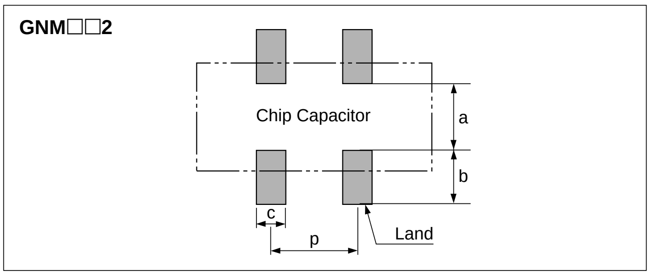
Notice

Continued from the preceding page.

● GNM, LLA Series for reflow soldering method



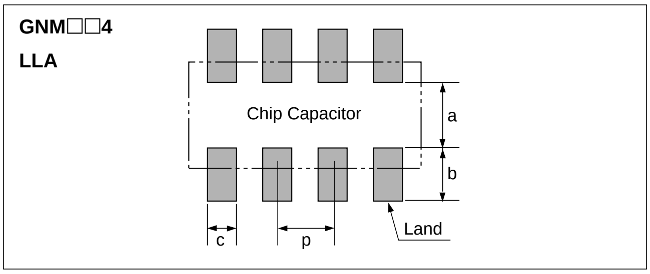


Table 3 GNM, LLA Series for Reflow Soldering Land Dimensions

Part Number	Dimensions (mm)					
	L	W	a	b	c	p
GNM1M2	1.37	1.0	0.45 to 0.5	0.5 to 0.55	0.3 to 0.35	0.64±0.1
GNM212	2.0	1.25	0.6 to 0.7	0.5 to 0.7	0.4 to 0.5	1.0±0.1
GNM214	2.0	1.25	0.6 to 0.7	0.5 to 0.7	0.25 to 0.35	0.5±0.05
GNM314	3.2	1.6	0.8 to 1.0	0.7 to 0.9	0.3 to 0.4	0.8±0.05
LLA18	1.6	0.8	0.45 to 0.55	0.25 to 0.35	0.15 to 0.25	0.4
LLA21	2.0	1.25	0.7 to 0.8	0.4 to 0.6	0.2 to 0.3	0.5
LLA31	3.2	1.6	0.8 to 1.0	0.7 to 0.9	0.3 to 0.4	0.8

● LLM Series for reflow soldering method

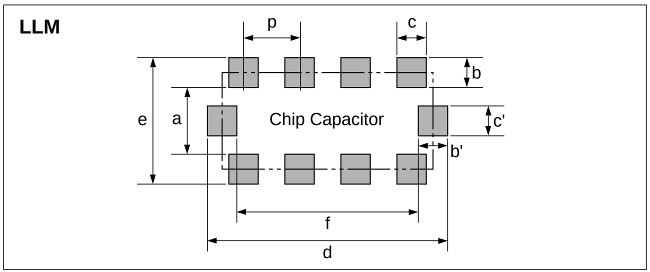


Table 4 LLM Series for Reflow Soldering Land Dimensions

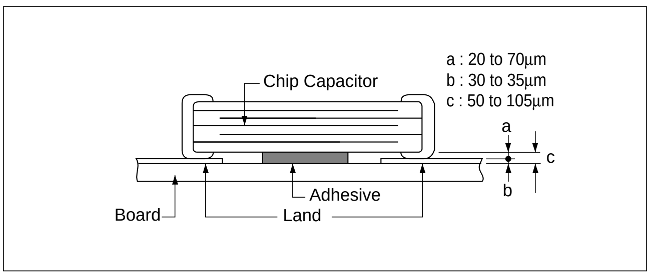
Part Number	Dimensions (mm)						
	a	b, b'	c, c'	d	e	f	p
LLM21	0.6 to 0.8	(0.3 to 0.5)	0.3	2.0 to 2.6	1.3 to 1.8	1.4 to 1.6	0.5
LLM31	1.0	(0.3 to 0.5)	0.4	3.2 to 3.6	1.6 to 2.0	2.6	0.8

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 below to obtain enough bonding strength.
The chip's electrode thickness and land thickness must be taken into consideration.

● Low viscosity adhesive causes chips to slip after mounting. Adhesive must have a viscosity of 5000Pa • s (500ps) min. (at 25℃)



● Adhesive Coverage*

Part Number	Adhesive Coverage*
GRM18, GQM18	0.05mg min.
GRM21, LLL21, GQM21	0.1mg min.
GRM31, LLL31	0.15mg min.

*Nominal Value

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3. Adhesive Curing

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

Inverting the PCB

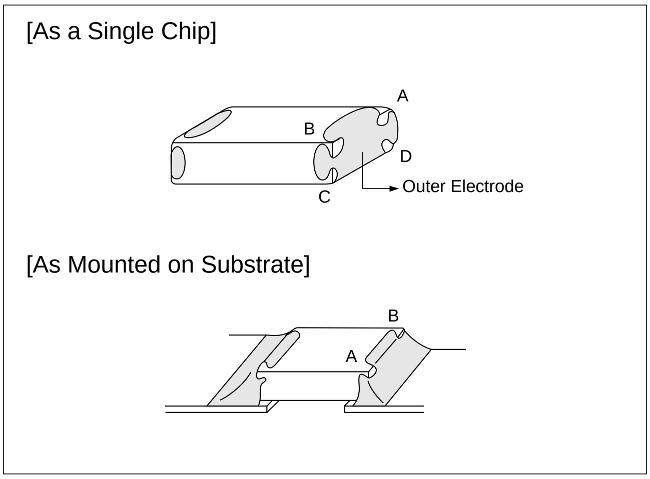
Make sure not to impose an abnormal mechanical shock on the PCB.

4. Flux Application

- An excessive amount of flux generates a large quantity of flux gas, causing deteriorated solderability. So apply flux thinly and evenly throughout. (A foaming system is generally used for flow soldering).
- Flux containing too high a percentage of halide may cause corrosion of the outer electrodes unless sufficiently cleaned. Use flux with a halide content of 0.2wt% max. But do not use strong acidic flux.
  Wash thoroughly because water soluble flux causes deteriorated insulation resistance between outer electrodes unless sufficiently cleaned.

5. Flow Soldering

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



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

■ Others

1. Resin Coating
   When selecting resin materials, select those with low contraction.
2. Circuit Design
   These capacitors on this catalog are not safety recognized products
3. Remarks
   The above notices are for standard applications and conditions. Contact us when the products are used in special mounting conditions. Select optimum conditions for operation as they determine the reliability of the product after assembly.
   The data here in are given in typical values, not guaranteed ratings.

Reference Data

1. Solderability

(1) Test Method

Subject the chip capacitor to the following conditions.
Then apply flux (a 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.

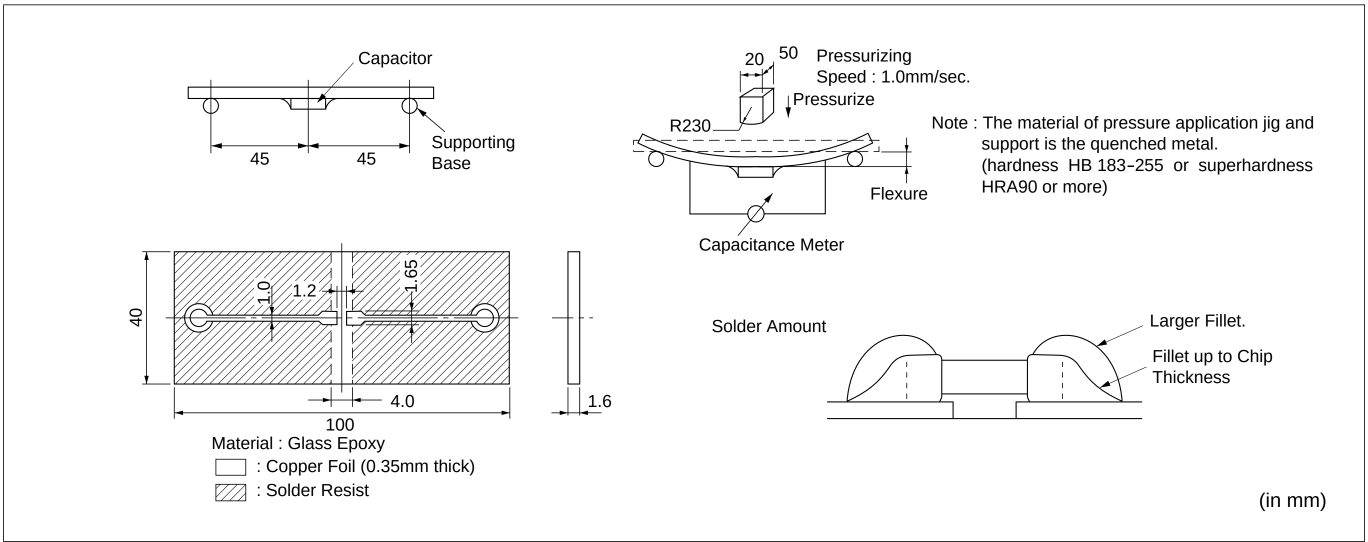
Table 1

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 shall 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%

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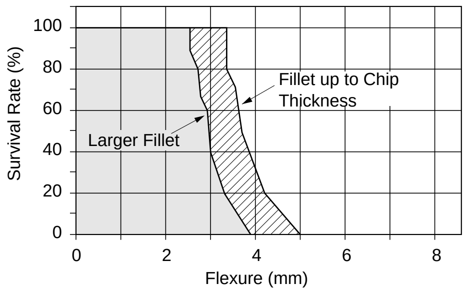
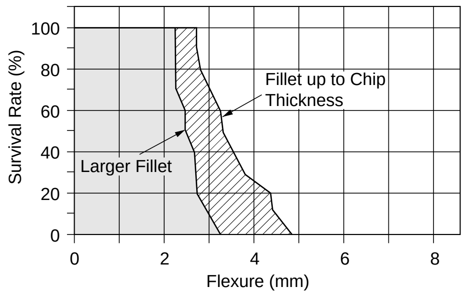
Continued from the preceding page.

(4) Results

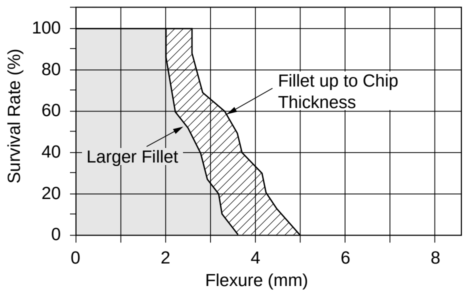
GRM21 5C (T=0.6)



GRM21 R7 (T=0.6)



GRM21 F5 (T=0.6)

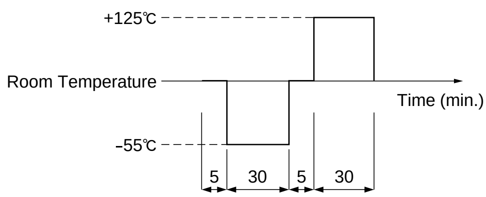


3. Temperature Cycling for Solder Fillet Height

(1) Test Method

Solder the chips to the substrate 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

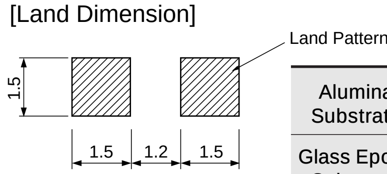
Alumina (Thickness : 0.64mm)
Glass epoxy (Thickness : 1.64mm)
Paper phenol (Thickness : 1.64mm)

[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]



(in mm)

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

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.

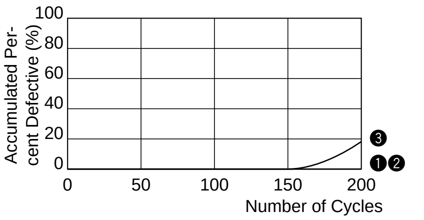
Table 3

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

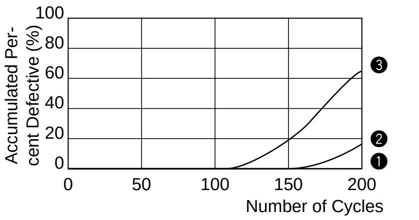
(4) Results

Alumina Substrate (Thickness 0.64mm)

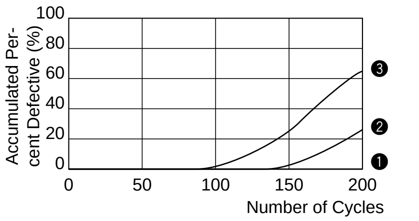
GRM21 5C (T=0.6)



GRM21 R7 (T=0.6)

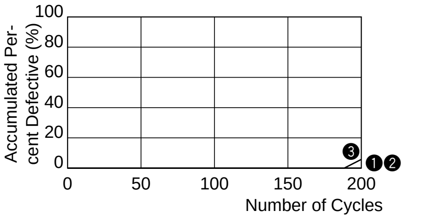


GRM21 F5 (T=0.6)

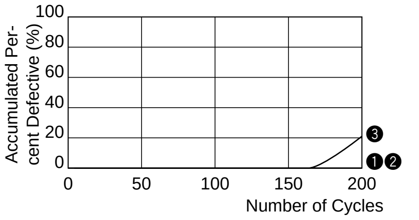


Glass Epoxy Substrate (Thickness 1.6mm)

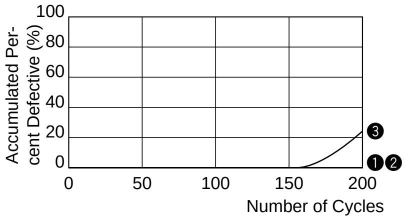
GRM21 5C (T=0.6)



GRM21 R7 (T=0.6)

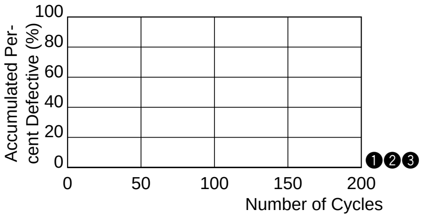


GRM21 F5 (T=0.6)

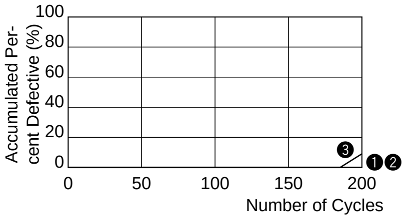


Paper Phenol Substrate (Thickness 1.6mm)

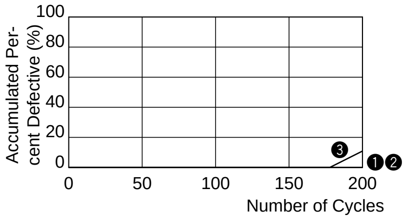
GRM21 5C (T=0.6)



GRM21 R7 (T=0.6)



GRM21 F5 (T=0.6)



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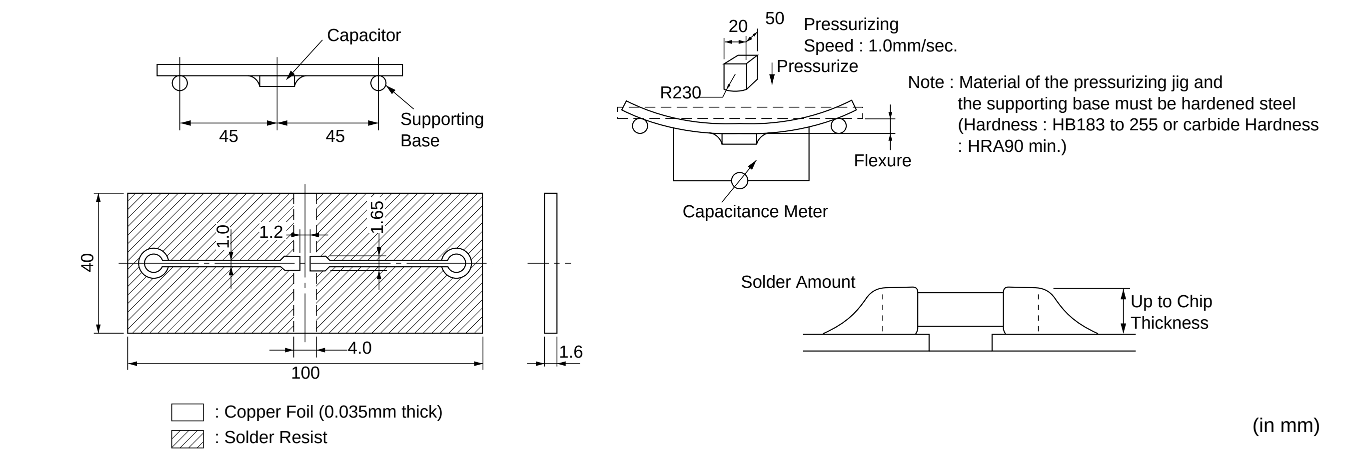
4. Board Bending Strength for Board Material

(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

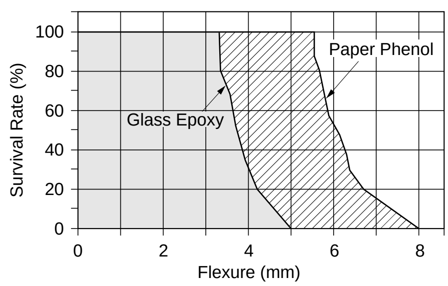
Products should be determined to be defective if the change in capacitance has exceeded the values specified in Table 4.

Table 4

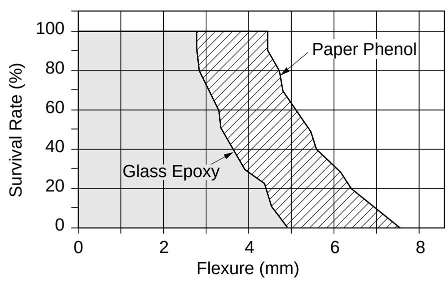
Characteristics	Change in Capacitance
5C	Within ±5% or ±0.5pF, whichever is greater
R7	Within ±12.5%
F5	Within ±20%

(4) Results

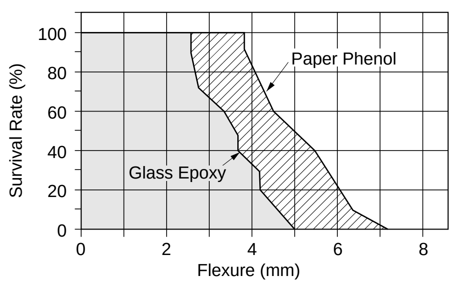
GRM21 5C (T=0.6)



GRM21 R7 (T=0.6)



GRM21 F5 (T=0.6)



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Reference Data

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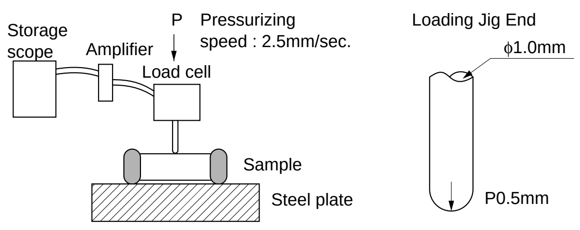
5. Break Strength

(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.

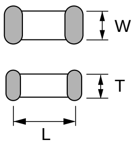


(2) Test Samples

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 Characteristics	γ R7 Characteristics	γ F5 Characteristics
GRM21	1.5	1.2	300	180	160
GRM31	2.7	1.5			

(in mm)

(4) Explanation

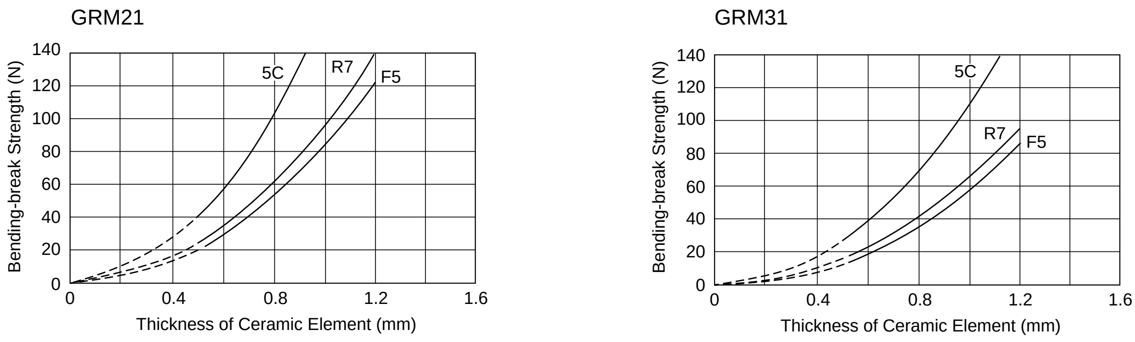
Break strength, P, is proportionate to the square of the thickness of the ceramic element and is expressed as a curve of secondary degree.

The formula is :

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

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

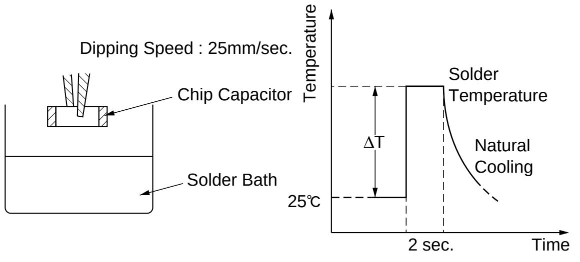
(5) Results



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 shall be determined to be defective.

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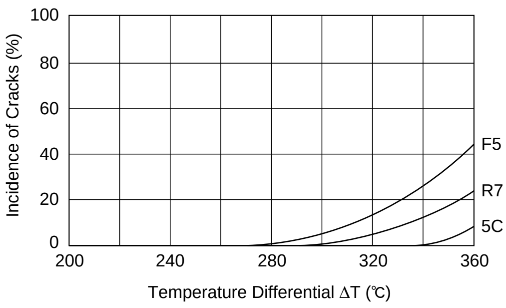
(4) Results



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.

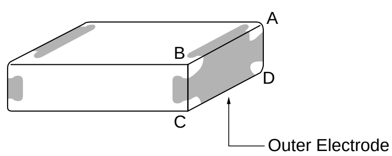
② Flow soldering :
After dipping the test sample with a pair of tweezers in wave solder (eutectic solder), check for leaching that may have occurred on the outer electrode.

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.

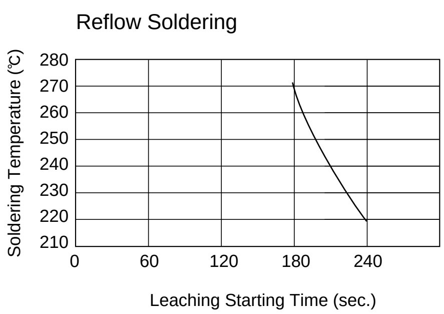
④ Flux to be used : An ethanol solution of 25% rosin.

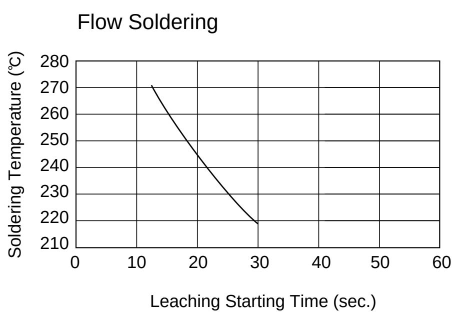
(2) Test samples
GRM21 : For flow/reflow soldering T=0.6mm

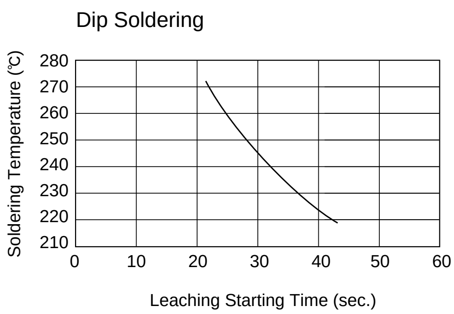
(3) Acceptance criteria
The starting time of leaching should be defined as the time when the outer electrode has lost 25% of the total edge length of A-B-C-D as illustrated :



(4) Results







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Reference Data

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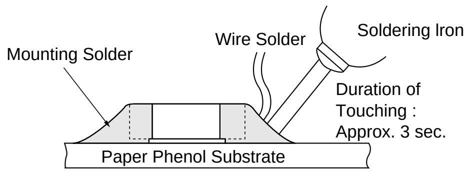
8. Thermal Shock when Making Corrections with a Soldering Iron

(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

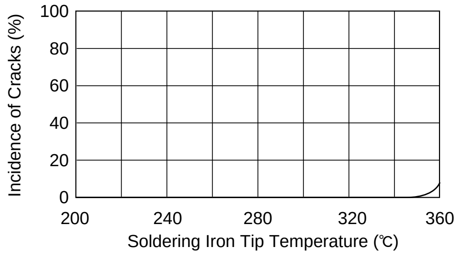
GRM21 5C/R7/F5 Characteristics T=0.6mm

(3) Acceptance Criteria for Defects

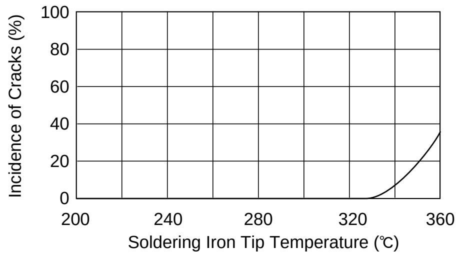
Observe the appearance of the test sample with a 60-power optical microscope. Those units displaying any breaks or cracks are determined to be defective.

(4) Results

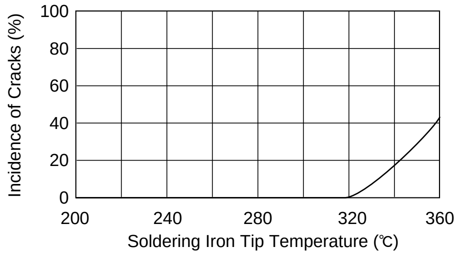
GRM21 5C (T=0.6)



GRM21 R7 (T=0.6)

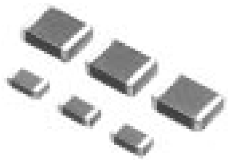


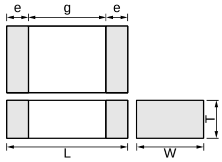
GRM21 F5 (T=0.6)



Chip Monolithic Ceramic Capacitors

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
GRM42D	4.5 ±0.3	2.0 ±0.2	2.0 ±0.3	0.3	2.9

* GRM31A7U3D, GRM32A7U3D, GRM32B7U3D : 1.8mm min.

■ Features

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

■ Applications

1. Ideal for use on high frequency pulse circuits such as snubber circuits for switching power supplies, DC-DC converters, ballasts (inverter fluorescent lamps), etc.
2. Ideal for use as the ballast in liquid crystal back lighting inverters.
3. Please contact our sales representatives or engineers before using our products for other applications not specified above.

SL/U2J Characteristics

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.

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Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
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.
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.
GRM42D1X3F100JY02L	DC3150	SL (JIS)	10 ±5%	4.5	2.0	2.0	2.9	0.3 min.
GRM42D1X3F120JY02L	DC3150	SL (JIS)	12 ±5%	4.5	2.0	2.0	2.9	0.3 min.
GRM42D1X3F150JY02L	DC3150	SL (JIS)	15 ±5%	4.5	2.0	2.0	2.9	0.3 min.
GRM42D1X3F180JY02L	DC3150	SL (JIS)	18 ±5%	4.5	2.0	2.0	2.9	0.3 min.
GRM42D1X3F220JY02L	DC3150	SL (JIS)	22 ±5%	4.5	2.0	2.0	2.9	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.

Application Specific Products, C0G Characteristics

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.

Please contact us in case that the C0G char. DC3150V items are considered to use for the application which is not LCD back lighting inverters circuit.

Specifications and Test Methods

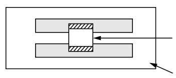
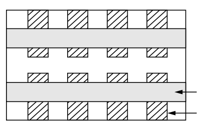
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>−55 to +125℃</td><td></td></tr>
<tr><td>2</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></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 20℃ 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>C0G/U2J char. : 1,000 min.
SL char. : 400+20C*1 min.</td></tr>
<tr><td>8</td><td colspan="2">Capacitance Temperature Characteristics</td><td>Temp. Coefficient
C0G char. :
0±30ppm/°C (Temp. Range : +25 to +125°C)
0+30, −72ppm/°C (Temp. Range : −55 to +25°C)
U2J char. :
−750±120 ppm/℃ (Temp. Range : +25 to +125℃)
−750+120, −347 ppm/℃ (Temp. Range : −55 to +25℃)
SL char. :
+350 to −1000 ppm/℃ (Temp. Range : +20 to +85℃)</td><td>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 (SL char. : +20 to +85°C) the capacitance should be within the specified tolerance for the temperature coefficient.
<table>
<tr><th>Step</th><th>Temperature (℃)</th></tr>
<tr><td>1</td><td>25±2 (20±2 for SL char.)</td></tr>
<tr><td>2</td><td>Min. Operating Temp.±3</td></tr>
<tr><td>3</td><td>25±2 (20±2 for SL char.)</td></tr>
<tr><td>4</td><td>Max. Operating Temp.±2</td></tr>
<tr><td>5</td><td>25±2 (20±2 for SL char.)</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 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.


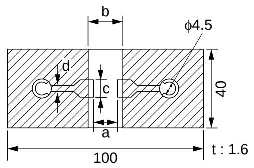
Fig. 1</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board).
The capacitor should be subjected to a simple harmonic motion having a total amplitude 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 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>C0G/U2J char. : 1,000 min.
SL char. : 400+20C*1 min.</td></tr>
</table>

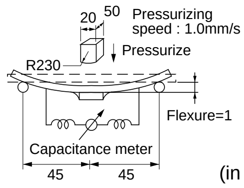
*1 "C" expresses nominal capacitance value (pF).

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>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>2.0×1.25</td><td>1.2</td><td>4.0</td><td>1.65</td><td rowspan="4">1.0</td></tr>
<tr><td>3.2×1.6</td><td>2.2</td><td>5.0</td><td>2.0</td></tr>
<tr><td>3.2×2.5</td><td>2.2</td><td>5.0</td><td>2.9</td></tr>
<tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td></tr>
</table>
Fig. 2</td><td>Solder the capacitor to the testing 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 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.


(in mm)
Fig. 3</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 [*1]room condition for 24±2 hrs., then measure.
•Immersing speed : 25±2.5mm/s

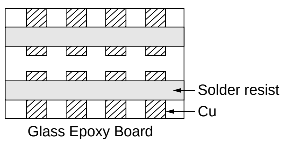
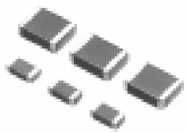
*Preheating for more than 3.2×2.5mm
<table>
<tr><th>Step</th><th>Temperature</th><th>Time</th></tr>
<tr><td>1</td><td>100 to 120℃</td><td>1 min.</td></tr>
<tr><td>2</td><td>170 to 200℃</td><td>1 min.</td></tr>
</table></td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5%</td></tr>
<tr><td>Q</td><td>C0G/U2J char. : 1,000 min.
SL char. : 400+20C[*2] 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 using a eutectic solder.
Perform the 5 cycles according to the 4 heat treatments listed in the following table.
Let sit for 24±2 hrs. at [*1]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>


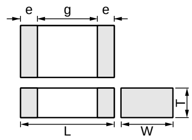
Fig. 4</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5%</td></tr>
<tr><td>Q</td><td>C0G char. : 1,000 min.
U2J char. : 500 min.
SL char. : 400+20C[*2] min.</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>In accordance with item No.4</td></tr>
<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 [*1]room condition, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0%</td></tr>
<tr><td>Q</td><td>C0G/U2J char. : 350 min.
SL char. : 275+5/2C[*2] 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 [*1]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>C0G/U2J char. : 350 min.
SL char. : 275+5/2C[*2] 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>

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

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

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.

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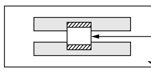
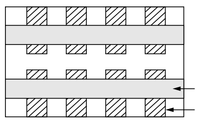
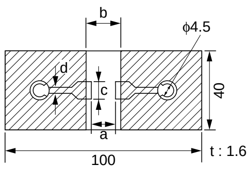
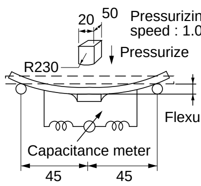
Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GRM31BR72J222KW01L	DC630	X7R (EIA)	2200pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR72J332KW01L	DC630	X7R (EIA)	3300pF ±10%	3.2	1.6	1.25	1.2	0.3 min.
GRM31BR72J472KW01L	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.
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

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 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.
5	Insulation Resistance (I.R.)		C≧0.01μF : More than 100MΩ • μF C<0.01μF : More than 10,000MΩ	The insulation resistance should be measured with DC500±50V (DC250±50V in case of rated voltage : DC250V) and within 60±5 sec. of charging.
6	Capacitance		Within the specified tolerance	The capacitance/D.F. should be measured at 25℃ at a frequency of 1±0.2kHz and a voltage of AC1±0.2V(r.m.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.
7	Dissipation Factor (D.F.)		0.025 max.	
8	Capacitance Temperature Characteristics		Cap. Change Within ±15% (Temp. Range : −55 to +125℃)	The range of capacitance change compared with the 25℃ value within −55 to +125℃ should be within the specified range. •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	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 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.  Fig. 1
10	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 3 mutually perpendicular directions (total of 6 hrs.). 
		Capacitance	Within the specified tolerance	
		D.F.	0.025 max.	
11	Deflection		No cracking or marking defects should occur. 	Solder the capacitor to the testing 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 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.  (in mm) Fig. 3

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

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

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Specifications and Test Methods

Continued from the preceding page.

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 •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 Step 1: 100 to 120℃, 1 min. Step 2: 170 to 200℃, 1 min.
		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 using a eutectic solder. 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. Step 1: Min. Operating Temp.±3, 30±3 Step 2: Room Temp., 2 to 3 Step 3: Max. Operating Temp.±2, 30±3 Step 4: Room Temp., 2 to 3 •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 ±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	
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	

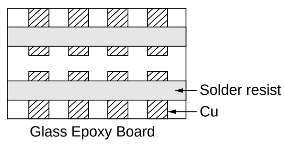

Fig. 4

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

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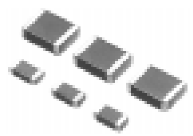
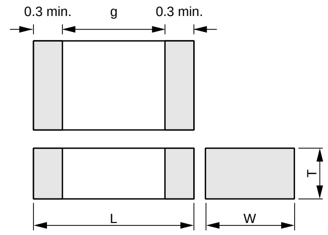
Chip Monolithic Ceramic Capacitors

muRata

Only for Information Devices/Tip & Ring





■ Features

1. These items are designed specifically for tele-communication devices (IEEE802.3) in Ethernet LAN.
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.

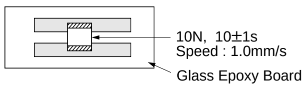
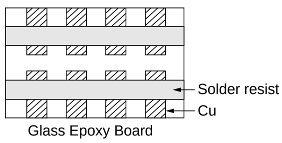
Part Number	Dimensions (mm)			
	L	W	T	g min.
GR442Q	4.5 ±0.3	2.0 ±0.2	1.5 +0, -0.3	2.5
GR443D	4.5 ±0.4	3.2 ±0.3	2.0 +0, -0.3	
GR443Q			1.5 +0, -0.3	

■ Applications

Ideal for use on telecommunication devices in Ethernet LAN

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.

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, provided the charge/discharge current is less than 50mA. Rated voltage: DC2kV — Test Voltage: 120% of the rated voltage, Time: 60±1 sec.; Test Voltage: AC1500V(r.m.s.), Time: 60±1 sec.
5	Pulse Voltage	No self healing break downs 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/D.F. should be measured at 25℃ at a frequency of 1±0.2kHz and a voltage of AC1±0.2V(r.m.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.
8	Dissipation Factor (D.F.)	0.025 max.	
9	Capacitance Temperature Characteristics	Cap. Change within ±15% (Temp. Range : −55 to +125℃)	The range of capacitance change compared with the 25℃ value within the specified range. •Pretreatment Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min. and then let sit for 24±2 hrs. at *room condition.
10	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 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.  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 3 mutually perpendicular directions (total of 6 hrs.). 
	Vibration Resistance — Capacitance	Within the specified tolerance	
	Vibration Resistance — 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. ↗

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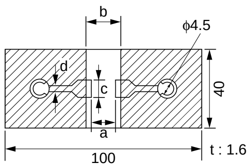
Specifications and Test Methods

Continued from the preceding page.

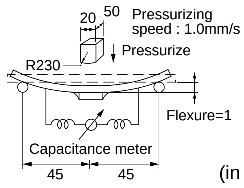
No.	Item		Specifications	Test Method
12	Deflection		No cracking or marking defects should occur.	Solder the capacitor to the testing jig (glass epoxy board) shown in Fig. 2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
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	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.
		Capacitance Change	Within ±10%	
		D.F.	0.025 max.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	In accordance with item No.4	
15	Temperature Cycle	Appearance	No marking defects	Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig. 4 using a eutectic solder. 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. •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 3,000MΩ	
		Dielectric Strength	In accordance with item No.4	
16	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	

No. 12 Deflection – Fig. 2



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	

Fig. 2



(in mm)

Fig. 3

No. 14 *Preheating

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

No. 15 Temperature Cycle

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

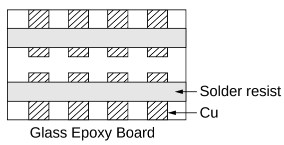


Fig. 4

* "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

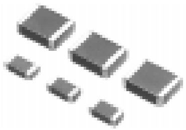
Continued from the preceding page.

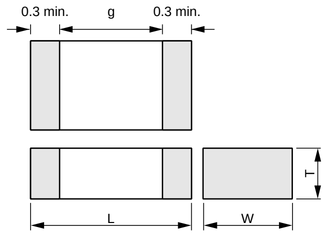
No.	Item		Specifications	Test Method
17	Life	Appearance	No marking defects	Apply 110% of the rated voltage for 1,000 $^{+48}_{-0}$ hrs. at maximum operating temperature ±3℃. Remove and let sit for 24 ±2 hrs. at *room condition, then measure. The charge/discharge current is less than 50mA. •Pretreatment 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

■ Applications

For strobe circuit

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	

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

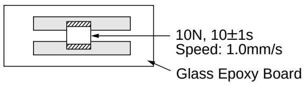
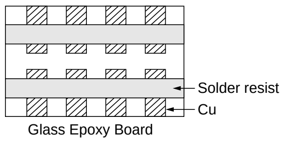
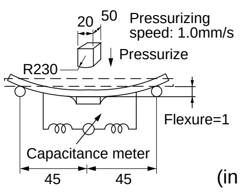
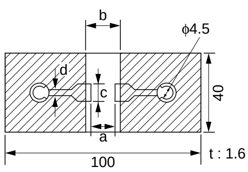
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>−55 to +125℃</td><td>−</td></tr>
<tr><td>2</td><td colspan="2">Appearance</td><td>No defects or abnormalities</td><td>Visual inspection</td></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 25℃ at a frequency of 1±0.2kHz and a voltage of AC1±0.2V(r.m.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>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)</td><td>The range of capacitance change compared with the 25℃ value within −55 to +125℃ should be within the specified range.
•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 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.


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 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>
<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 using a eutectic solder.
Then apply a force in the direction shown in Fig. 3.
The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.


(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>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>
</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="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 min.
Immerse the capacitor in solder solution at 260±5°C 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$^{+0}_{-10}$°C for 60±5 min. and then let sit for 24±2 hrs. at *room condition.

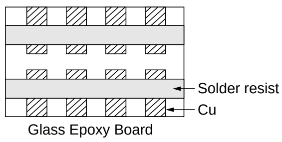
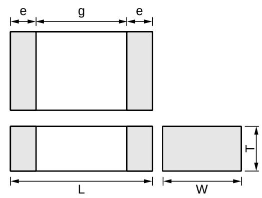
*Preheating for more than 3.2×2.5mm<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100 to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170 to 200°C</td><td>1 min.</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>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 using a eutectic solder.
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 (°C)</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$^{+0}_{-10}$°C 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°C 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$^{+0}_{-10}$°C 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>
<tr><td rowspan="5">16</td><td rowspan="5">Life</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Apply DC350V for 1,000$^{+48}_{-0}$hrs. at maximum operating temperature ±3°C. 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.</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>
<tr><td rowspan="5">17</td><td rowspan="5">Humidity Loading</td><td>Appearance</td><td>No marking defects</td><td rowspan="5">Apply the rated voltage at 40±2°C 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.</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°C, Relative humidity: 45 to 75%, Atmospheric pressure: 86 to 106kPa

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	0.3	2.5
GA243D	4.5 ±0.4	3.2 ±0.3	2.0 +0, -0.3		
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

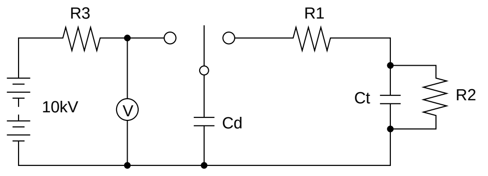
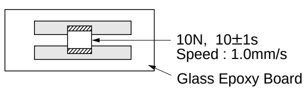
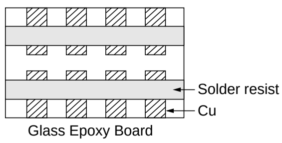
Noise suppression filters for switching power supplies, telephones, facsimiles, modems.

■ Reference standard

GA2 series obtains no safety approval.
This series is based on JIS C 5102, JIS C 5150, and 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. Nominal Capacitance / Test voltage C≧10,000pF / AC575V(r.m.s.) C<10,000pF / AC1500V(r.m.s.)
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 25℃ at a frequency of 1±0.2kHz and a voltage of AC1±0.2V(r.m.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.
7	Dissipation Factor (D.F.)		0.025 max.	
8	Capacitance Temperature Characteristics		Cap. Change Within ±15% (Temp. Range : −55 to +125℃)	The range of capacitance change compared with the 25℃ value within −55 to +125℃ should be within the specified range. •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 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.  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 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. ↗

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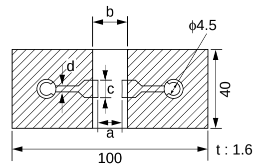
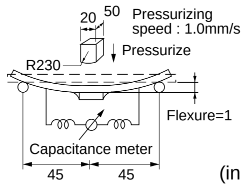
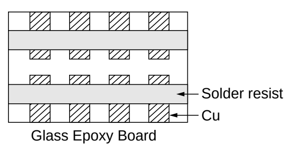
Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specifications	Test Method
12	Deflection		No cracking or marking defects should occur.  <table><tr><td>L×W (mm)</td><td colspan="4">Dimension (mm)</td></tr><tr><td></td><td>a</td><td>b</td><td>c</td><td>d</td></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	Solder the capacitor to the testing 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 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.  (in mm) Fig. 3
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 <table><tr><td>Step</td><td>Temperature</td><td>Time</td></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>
		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 using a eutectic solder. 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><td>Step</td><td>Temperature (℃)</td><td>Time (min.)</td></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
		Capacitance Change	Within ±15%	
		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

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 85±2℃. 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

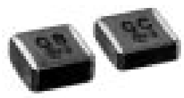
Safety Standard Recognized Type GC (UL, IEC60384-14 Class X1/Y2)

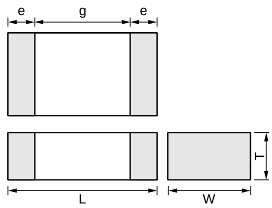
■ Features

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





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

■ Standard Recognition

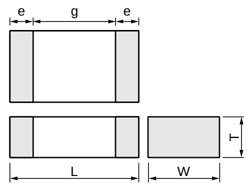
	Standard No.	Status of Recognition		Rated Voltage
		Type GB	Type GC	
UL	UL1414	–	◎*	AC250V (r.m.s.)
BSI	EN132400	–	◎	
VDE		◎	◎	
SEV		◎	◎	
SEMKO		◎	◎	
EN132400 Class		X2	X1, Y2	

*: Line-By-Pass only

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. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
2. The type GD can be used as a Y3-class capacitor.
3. Available for equipment based on IEC/EN60950 and UL1950.
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.
GA342D	4.5 ±0.3	2.0 ±0.2	2.0 ±0.2*	0.3	2.5
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		

* GA342D1X : 2.0±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	Status of Recognition Type GD	Rated Voltage
SEMKO	EN132400	Y3	◎	AC250V(r.m.s.)

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.
GA342D1XGD270JY02L	AC250 (r.m.s.)	SL (JIS)	27 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD330JY02L	AC250 (r.m.s.)	SL (JIS)	33 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD390JY02L	AC250 (r.m.s.)	SL (JIS)	39 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD470JY02L	AC250 (r.m.s.)	SL (JIS)	47 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD560JY02L	AC250 (r.m.s.)	SL (JIS)	56 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD680JY02L	AC250 (r.m.s.)	SL (JIS)	68 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGD820JY02L	AC250 (r.m.s.)	SL (JIS)	82 ±5%	4.5	2.0	2.0	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

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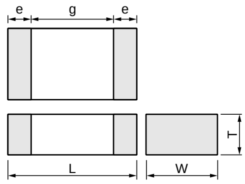
Safety Standard Recognized Type GF (IEC60384-14 Class Y2, X1/Y2)

■ Features

1. A new monolithic structure for small, high capacitance capable of operating at high voltage levels.
2. The type GF can be used as a Y2-class capacitor.
3. 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.
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.
GA342D	4.5 ±0.3	2.0 ±0.2	2.0 ±0.2*	0.3	2.5
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

■ 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 Type GF Size : 4.5×2.0mm	Size : 5.7×2.8mm and over	Rated Voltage
UL	UL1414	X1, Y2	–	◎	AC250V (r.m.s.)
SEMKO	EN132400	Y2	◎	◎	

Applications

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

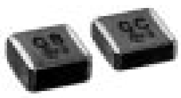
Part Number	Rated Voltage (V)	TC Code (Standard)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g min. (mm)	Electrode e (mm)
GA342D1XGF100JY02L	AC250 (r.m.s.)	SL (JIS)	10 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF120JY02L	AC250 (r.m.s.)	SL (JIS)	12 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF150JY02L	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.
GA342D1XGF270JY02L	AC250 (r.m.s.)	SL (JIS)	27 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF330JY02L	AC250 (r.m.s.)	SL (JIS)	33 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF390JY02L	AC250 (r.m.s.)	SL (JIS)	39 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF470JY02L	AC250 (r.m.s.)	SL (JIS)	47 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF560JY02L	AC250 (r.m.s.)	SL (JIS)	56 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF680JY02L	AC250 (r.m.s.)	SL (JIS)	68 ±5%	4.5	2.0	2.0	2.5	0.3 min.
GA342D1XGF820JY02L	AC250 (r.m.s.)	SL (JIS)	82 ±5%	4.5	2.0	2.0	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.
GA352QR7GF471KW01L	AC250 (r.m.s.)	X7R (EIA)	470 ±10%	5.7	2.8	1.5	4.0	0.3 min.
GA352QR7GF681KW01L	AC250 (r.m.s.)	X7R (EIA)	680 ±10%	5.7	2.8	1.5	4.0	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.
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.

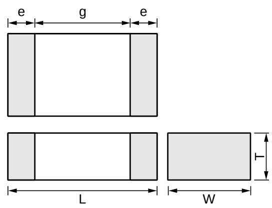
Chip Monolithic Ceramic Capacitors

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

■ Features
1. 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 GB can be used as an X2-class capacitor.
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		

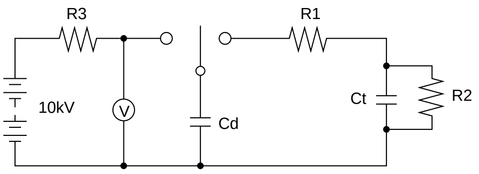
■ Standard Recognition

	Standard No.	Status of Recognition		Rated Voltage
		Type GB	Type GC	
UL	UL1414	–	◎*	AC250V (r.m.s.)
BSI	EN132400	–	◎	
VDE		◎	◎	
SEV		◎	◎	
SEMKO		◎	◎	
EN132400 Class		X2	X1, Y2	

*: Line-By-Pass only

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

<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 for 60±1 sec., provided the charge/discharge current is less than 50mA.
<table>
<tr><th></th><th>Test Voltage</th></tr>
<tr><td>Type GB</td><td>DC1075V</td></tr>
<tr><td>Type GC/GD/GF</td><td>AC1500V(r.m.s.)</td></tr>
</table></td></tr>
<tr><td>5</td><td colspan="2">Pulse Voltage (Application: Type GD/GF)</td><td>No self healing break downs 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/Q/D.F. should be measured at 20℃ at a frequency of 1±0.2kHz (SL char. : 1±0.2MHz) and a voltage of AC1±0.2V(r.m.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 *1room condition.</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (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>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td>
<table>
<tr><th>Char.</th><th>Capacitance Change</th></tr>
<tr><td>X7R</td><td>Within ±15%</td></tr>
</table>
Temperature characteristic guarantee is −55 to +125℃
<table>
<tr><th>Char.</th><th>Temperature Coefficient</th></tr>
<tr><td>SL</td><td>+350 to −1000ppm/℃</td></tr>
</table>
Temperature characteristic guarantee is +20 to +85℃</td><td>The range of capacitance change compared with the 25℃ (SL char. : 20℃) value within −55 to +125℃ should be within the specified range.
•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 *1room condition.</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Discharge Test (Application: Type GC)</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">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</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>11</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 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.

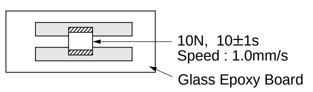



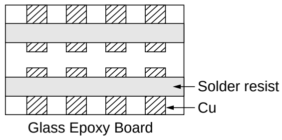
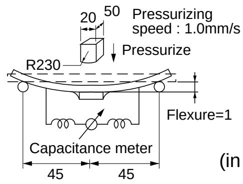
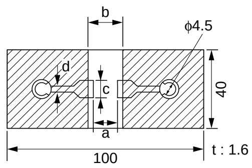
Fig. 1</td></tr>
</table>

*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.

<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 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 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
(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 *1room condition 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 *1room 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><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.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specifications</th><th>Test Method</th></tr>
<tr><td rowspan="5">16</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 using a eutectic solder.
Perform the 5 cycles according to the 4 heat treatments listed in the following table.
Let sit for 24±2 hrs. at *1room 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 for X7R char.
Perform a heat treatment at 150 $^{+0}_{-10}$ ℃ for 60±5 min. and then let sit for 24±2 hrs. at *1room condition.

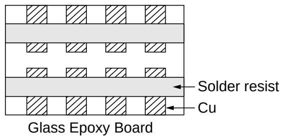
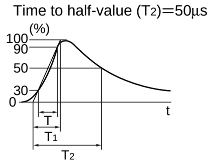



Fig. 4</td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±15%</td></tr><tr><td>SL</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr></table></td></tr>
<tr><td>D.F.
Q</td><td><table><tr><th>Char.</th><th>Specification</th></tr><tr><td>X7R</td><td>D.F.≦0.05</td></tr><tr><td>SL</td><td>Q≧400+20C*2 (C<30pF)
Q≧1000 (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 rowspan="5">17</td><td rowspan="5">Humidity (Steady State)</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

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 *1room condition, 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 *1room condition.</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 rowspan="5">18</td><td rowspan="5">Life</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

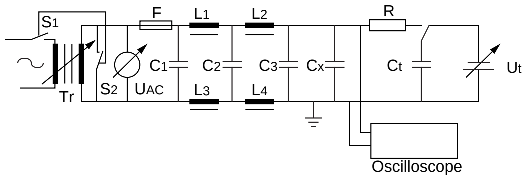
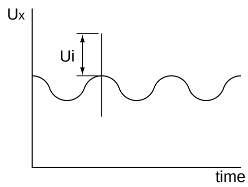
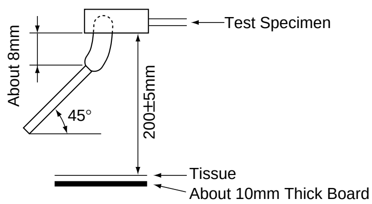
Impulse Voltage
Each individual capacitor should be subjected to a 2.5kV (Type GC/GF : 5kV) Impulses (the voltage value means zero to peak) for three times. Then the capacitors are applied to life test.
Front time (T1)=1.2µs=1.67T
Time to half-value (T2)=50µs

Apply voltage as Table for 1,000 hrs. at 125 $^{+3}_{-0}$ ℃, relative humidity 50% max.
<table><tr><th>Type</th><th>Applied Voltage</th></tr><tr><td>GB</td><td>AC312.5V(r.m.s.), except that once each hour the voltage is increased to AC1,000V(r.m.s.) for 0.1 sec.</td></tr><tr><td>GC
GD
GF</td><td>AC425V(r.m.s.), except that once each hour the voltage is increased to AC1,000V(r.m.s.) for 0.1 sec.</td></tr></table>Let sit for 24±2 hrs. at *1room condition, 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 *1room condition.</td></tr>
<tr><td>Capacitance Change</td><td><table><tr><th>Char.</th><th>Capacitance Change</th></tr><tr><td>X7R</td><td>Within ±20%</td></tr><tr><td>SL</td><td>Within ±3.0% or ±0.3pF
(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>
</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.

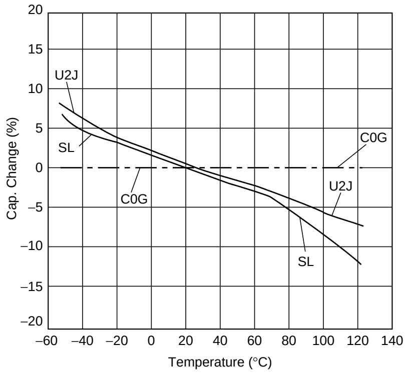
No.	Item		Specifications	Test Method
19	Humidity Loading	Appearance	No marking defects	Before this test, the test shown in the following is performed. ·Item 11 Adhesive Strength of Termination (apply force is 5N) ·Item 13 Deflection Apply the rated voltage at 40±2℃ and relative humidity of 90 to 95% for 500^{+24}_{-0} hrs. Remove and let sit for 24±2 hrs. at *1room condition, 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 *1room condition.
		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)	
		I.R.	More than 3,000MΩ	
		Dielectric Strength	In accordance with item No.4	
20	Active Flammability		The cheese-cloth should not be on fire.	The capacitor should be individually wrapped in at least one but not more than two complete layers of cheese-cloth. The capacitor should be subjected to 20 discharges. The interval between successive discharges should be 5 sec. The U_{AC} should be maintained for 2 min. after the last discharge.  $C_{1,2}$: 1μF±10% C_3 : 0.033μF±5% 10kV $L_{1\ to\ 4}$: 1.5mH±20% 16A Rod core choke C_t : 3μF±5% 10kV R : 100Ω±2% C_x : Capacitor under test U_{AC} : U_R±5% F : Fuse, Rated 16A U_R : Rated Voltage U_t : Voltage applied to C_t  Type / Ui **GB, GD** / 2.5kV **GC, GF** / 5kV
21	Passive Flammability		The burning time should not exceed 30 sec. The tissue paper should not ignite.	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. 

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

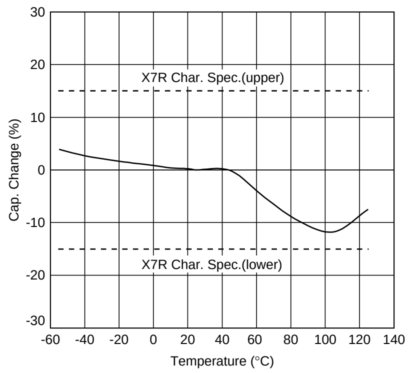
GRM/GR4/GR7/GA2/GA3 Series Data (Typical Example)

■ Capacitance-Temperature Characteristics

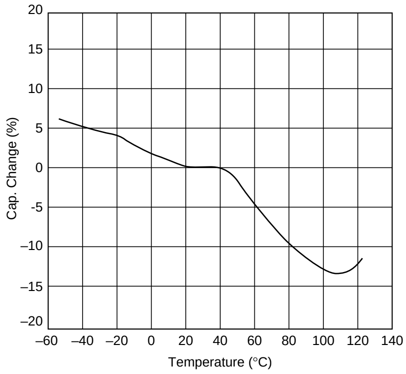
C0G/U2J/SL Characteristics



X7R Characteristics

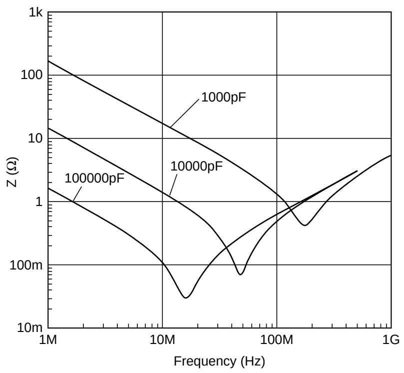


GR4 Series

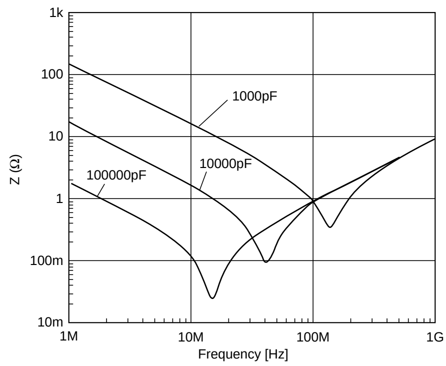


■ Impedance-Frequency Characteristics

GRM Series (X7R Char. 250V)



GRM Series (X7R Char. 630V)



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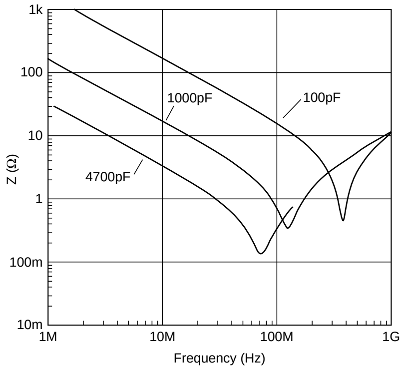
GRM/GR4/GR7/GA2/GA3 Series Data (Typical Example)

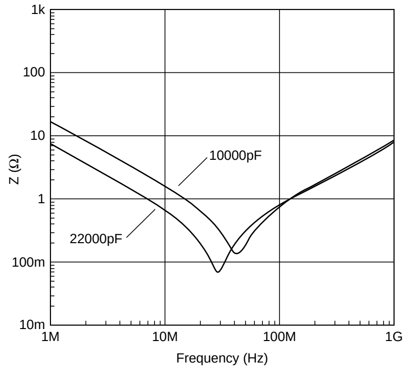
Continued from the preceding page.

■ Impedance-Frequency Characteristics

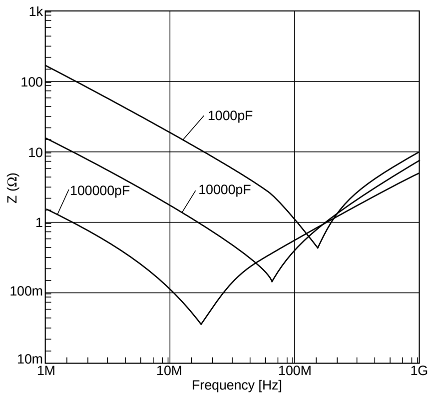
GR4 Series



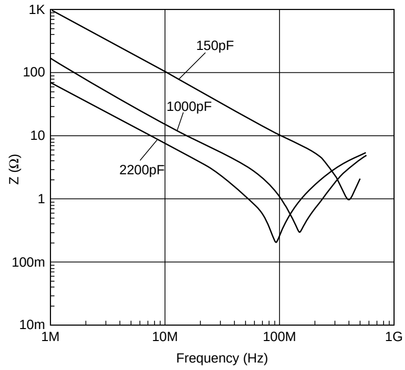
GR7 Series



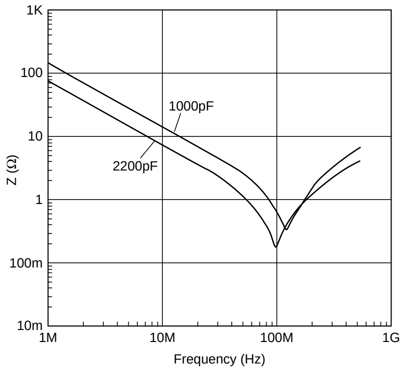
GA2 Series



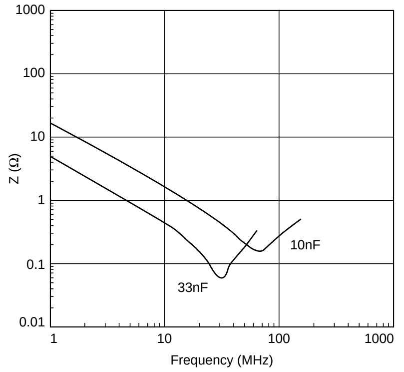
GA3 Series (Type GD)



GA3 Series (Type GF)



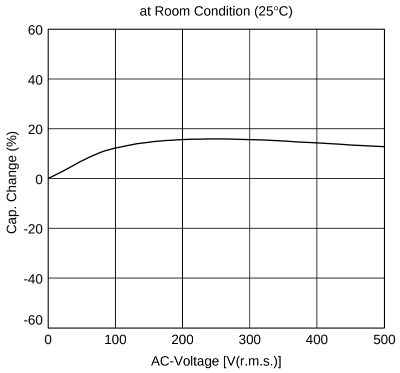
GA3 Series (Type GB)



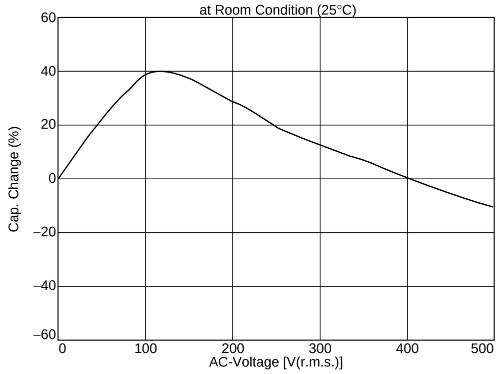
GRM/GR4/GR7/GA2/GA3 Series Data (Typical Example)

■ Capacitance-AC Voltage Characteristics

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



GA3 Series (Type GB)



Package

Taping is standard packaging method.

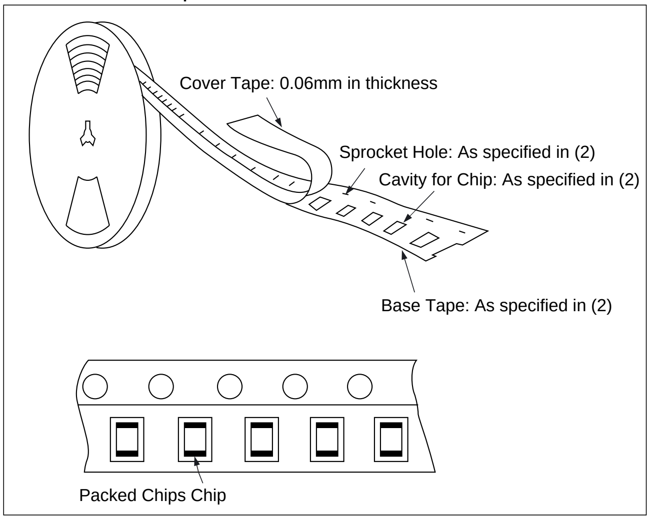
■ Minimum Quantity Guide

Part Number		Dimensions (mm)			Quantity (pcs.) ϕ180mm 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	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	1.5	-	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

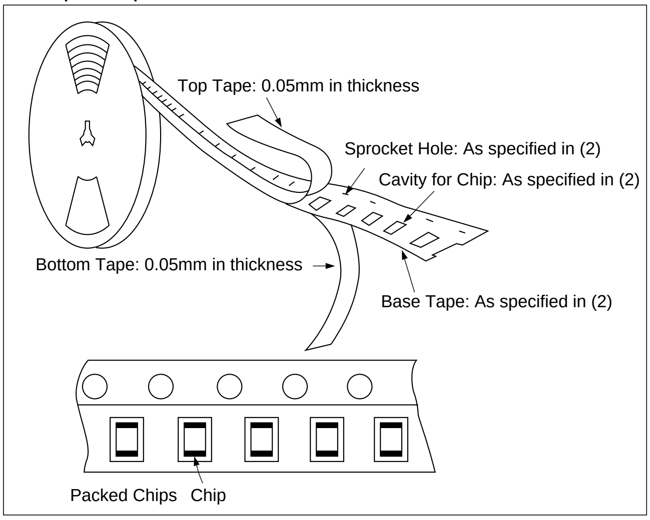
■ Tape Carrier Packaging

(1) Appearance of Taping

① Embossed Tape



② Paper Tape



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muRata

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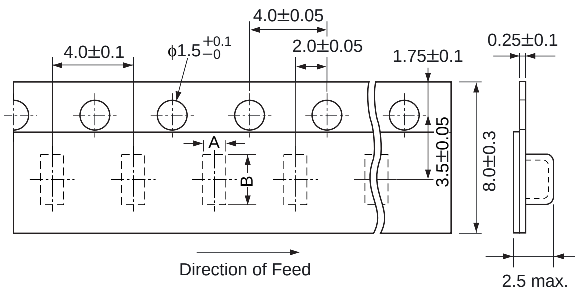
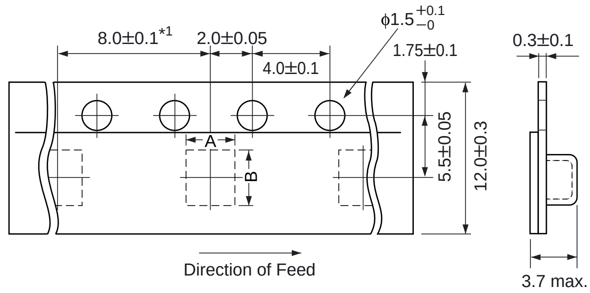
(2) Dimensions of Tape

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/GA255/GA355	5.4	6.1

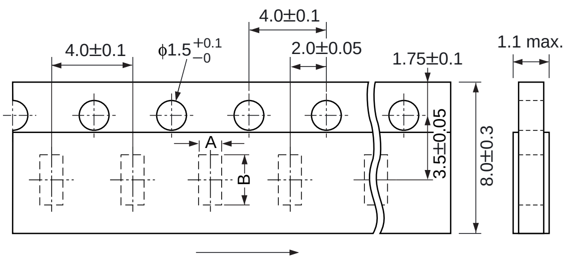
*1 4.0±0.1mm in case of GRM42/GR442/GA242/GA342

*Nominal Value

(in mm)

② Paper Tape

8mm width 4mm pitch Tape

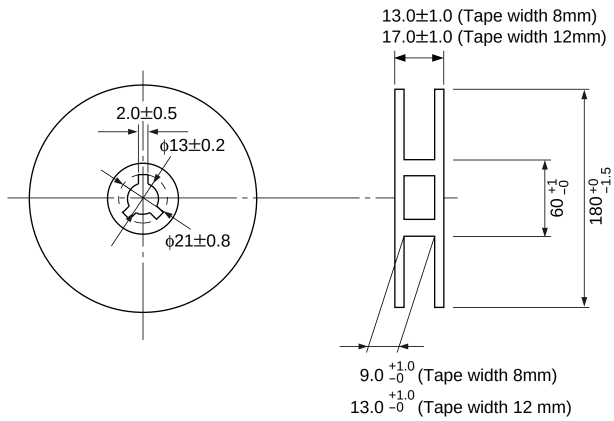


Part Number	A*	B*
GRM18	1.05	1.85
GRM21 (T=1.0mm)	1.45	2.25
GRM31/GR731 (T=1.0mm)	2.0	3.6
GRM32 (T=1.0mm)	2.9	3.6

*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 shall be attached to the end of the tape as shown at right.

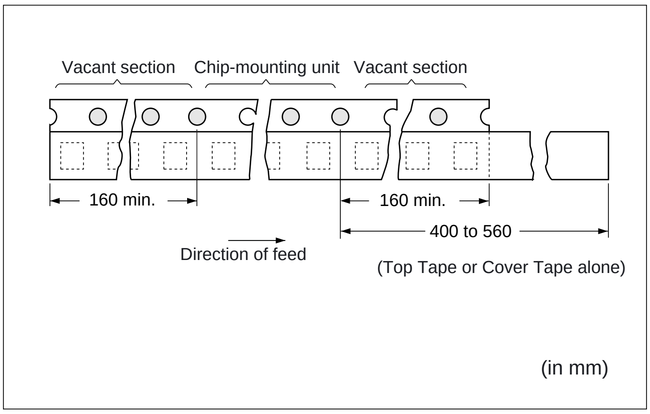
③ The top tape or cover tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

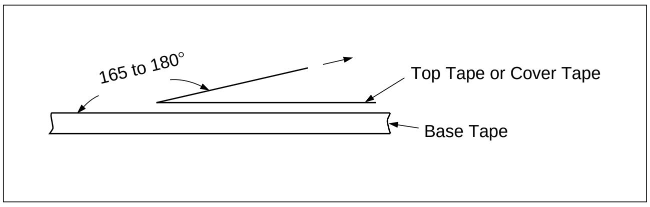
④ Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.

⑤ The top tape or cover tape and bottom tape shall not protrude beyond the edges of the tape and shall 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.





■ 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. 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.

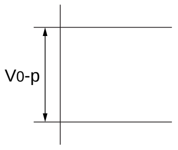
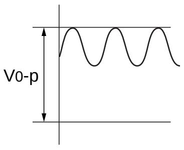
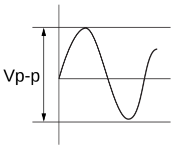
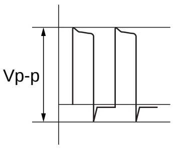
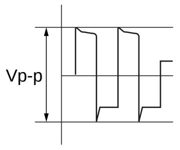
⚠Caution

■ 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.

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

2. Operating Temperature and Self-generated Heat

(1) In case of X7R char.

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 current, pulse current or the like, it may have the self-generated heat due to dielectric-loss.

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.)

(2) In case of C0G char.

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 current, pulse current or similar current, it may self-generate heat due to dielectric loss.

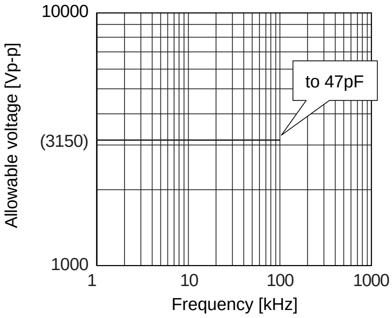
The frequency of the applied sine wave voltage should be less than 100kHz. The applied voltage should be less than the value shown in figure at right.

In case of non-sine wave which include a harmonic frequency, please contact our sales representatives or product engineers. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running.

Otherwise, accurate measurement cannot be ensured.)

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

C0G char., Rated Voltage: DC3.15kV



The sine-wave frequency VS allowable voltage

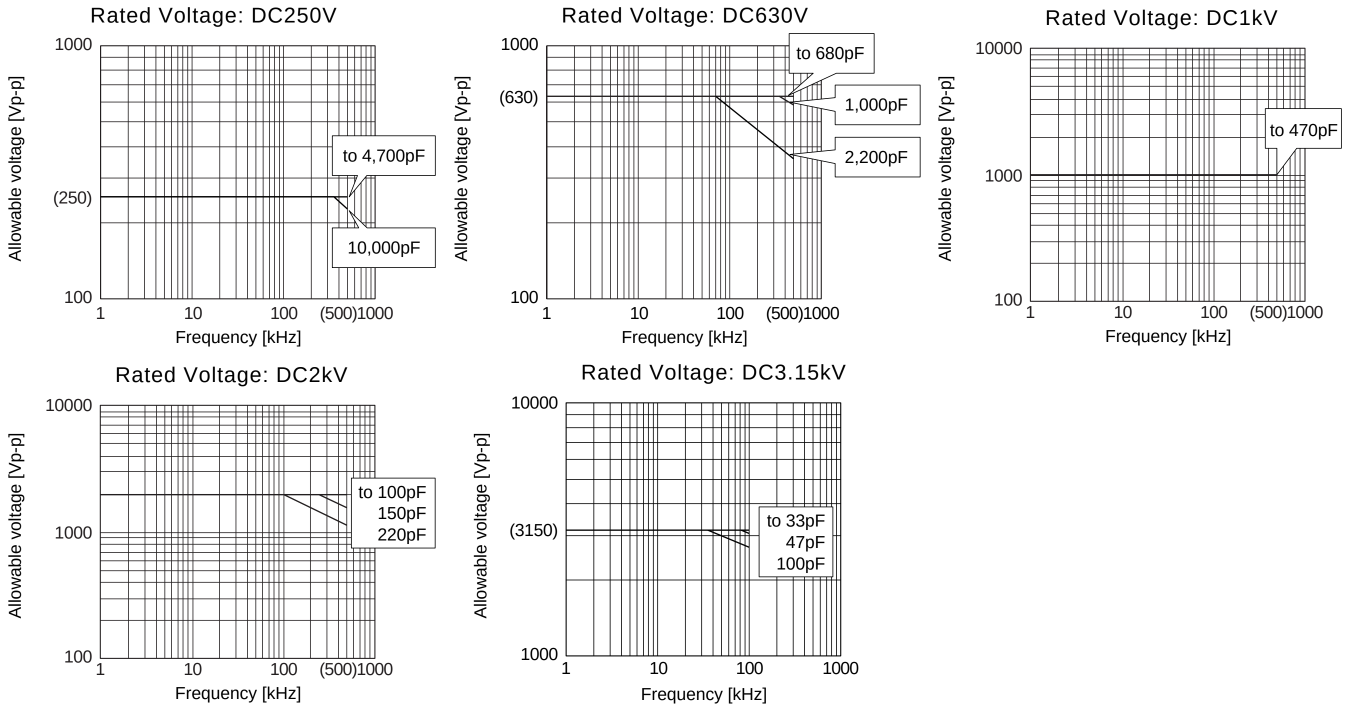
Continued on the following page. ↗

⚠Caution

Continued from the preceding page.

(3) In case of U2J char.
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 current, pulse current or similar current, it may self-generate heat due to dielectric loss.
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.
In case of non-sine wave which includes a harmonic frequency, please contact our sales representatives or product engineers. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running.
Otherwise, accurate measurement cannot be ensured.)

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



The sine-wave frequency VS allowable voltage

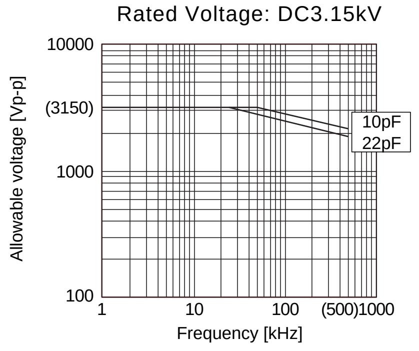
Continued on the following page.

⚠Caution

Continued from the preceding page.

(4) In case of GRM series SL char.
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 current, pulse current or similar current, it may self-generate heat due to dielectric loss.
The frequency of the applied sine wave voltage should be less than 500kHz. The applied voltage should be less than the value shown in figure at right.
In case of non-sine wave which include a harmonic frequency, please contact our sales representatives or product engineers. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running.
Otherwise, accurate measurement cannot be ensured.)

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

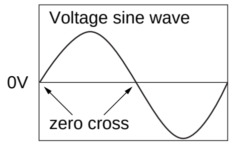


The sine-wave frequency VS allowable voltage

3. 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 -



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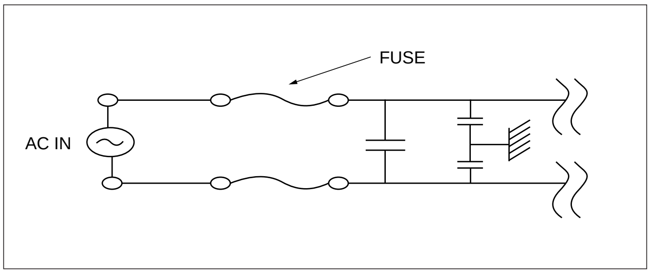
⚠Caution

Continued from the preceding page.

4. 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.



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

⚠Caution

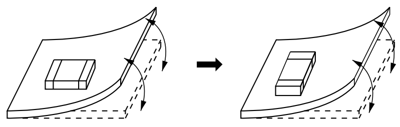
■ Caution (Soldering and Mounting)

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

2. Circuit Board Material
   In case that chip size is 4.5×3.2mm or more, a metal-board or metal-frame such as Aluminum board is not available because soldering heat causes expansion and shrinkage of a board or frame, which will cause a chip to crack.

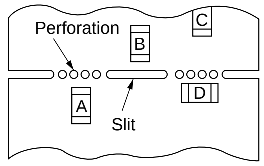
3. Land Layout for Cropping PC Board
   Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[Component Direction]



Locate chip horizontal to the direction in which stress acts.

[Chip Mounting Close to Board Separation Point]



Chip arrangement
Worst A>C>B~D Best

4. Soldering
   If a chip component is heated or cooled abruptly during soldering, it may crack due to the thermal shock. To prevent this, follow our recommendations below for adequate soldering conditions. Carefully perform pre-heating so that temperature difference (ΔT) between the solder and component surface is in the following range. The smaller the temperatures difference (ΔT) between the solder and component surface is, the smaller the influence on the chip is. When components are immersed in solvent after mounting, please set the slow cooling process to keep the temperature difference within 100°C.

Soldering Method \ Chip Size	3.2×1.6mm and under	3.2×2.5mm and over
Reflow Method or Soldering Iron Method	ΔT≦190°C	ΔT≦130°C
Flow Method or Dip Soldering Method	ΔT≦150°C	——

5. Soldering Iron
   When soldering chips with a soldering iron, it should be performed in following conditions.
   And pre-heating shown in clause 4.

Item	Conditions	
Chip Size	≦2.0×1.25mm	≧3.2×1.6mm
Temperature of Iron tip	300°C max.	270°C max.
Soldering Iron Wattage	20W max.	
Diameter of Iron tip	φ 3.0mm max.	
Soldering Time	3 sec. max.	
Caution	Do not allow the iron tip to directly touch the ceramic element.	

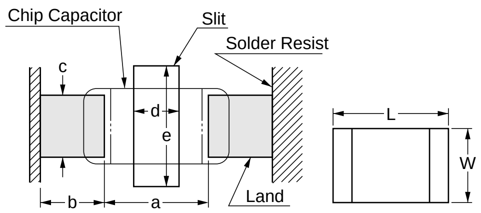
FAILURE TO FOLLOW THE ABOVE CAUTIONS MAY RESULT, WORST CASE, IN A SHORT CIRCUIT AND CAUSE FUMING OR PARTIAL DISPERSION WHEN THE PRODUCT IS USED.

■ 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

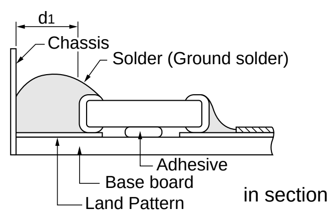
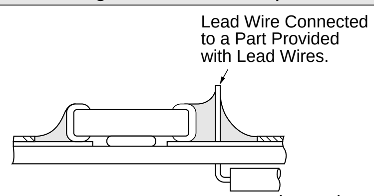
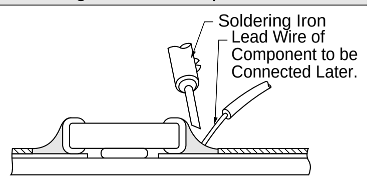
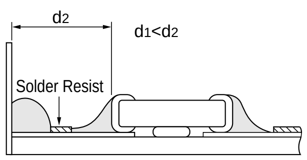
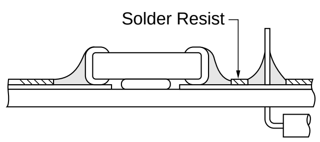
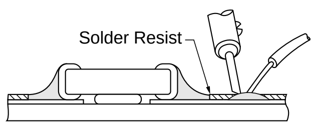
Flow soldering : 3.2×1.6 or less available.

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 Arrangements to be Avoided	 in section	 in section	 in section
Examples of Improvements by the Land Division	 in section	 in section	 in section

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Notice

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2. Mounting of Chips

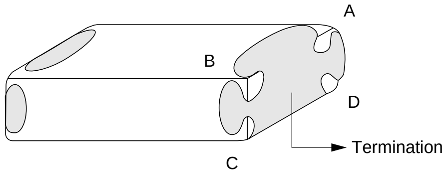
- Thickness of adhesives applied
  Keep thickness of adhesives applied (50-105µm or more) to reinforce the adhesive contact considering the thickness of the termination or capacitor (20-70µm) and the land pattern (30-35µm).

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

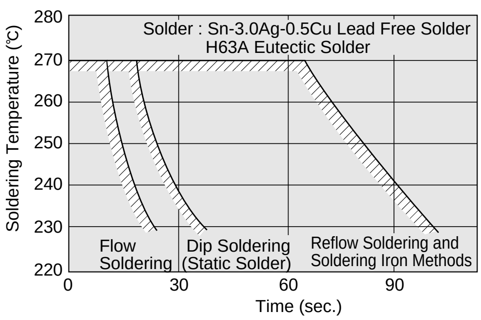
3. Soldering

(1) Limit 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.
In case of repeated soldering, the accumulated soldering time must be within the range shown at right.



Soldering Allowance Time



(2) Flux

- Please use it after confirming there is no problem in the reliability of the product beforehand with a intended equipment. The residue of flux might cause the decrease in nonconductivity and the corrosion of an external electrode, etc.

(3) Solder Amount

① Flow soldering and iron soldering
Use as little solder as possible, and confirm that the solder is securely placed.

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② Reflow soldering
When soldering, confirm that the solder is placed over 0.2mm of the surface of the terminations.

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

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.
The chip crack might be caused at the cool and heat cycle by bias of the amount of spreading of the resin and spreading thickness.
The resin for the coating and molding must use the thing that as the stress when stiffening is small, and the hygroscopic is as 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 a 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 characteristic.
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.

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