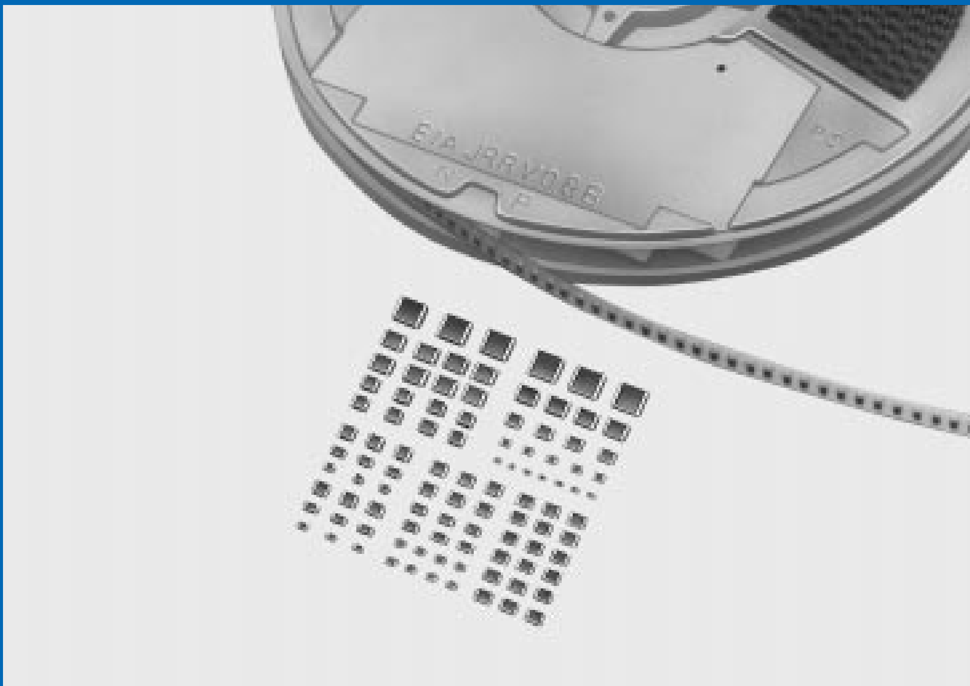
Chip Monolithic Ceramic Capacitors

CHIP
MONOLITHIC
CERAMIC
CAPACITORS



GLOBAL PART NUMBERS
JUNE 2001

Innovator in Electronics

Murata Manufacturing Co., Ltd.

Cat.No.C02E-9

CONTENTS

- Please refer to "Specifications and Test Methods" at the end of each chapter of 5 – 17 .

● Part Numbering

(The structure of the "Global Part Numbers" that have been adopted since June 2001 and the meaning of each code are described herein. If you have any questions about details, inquire at your usual Murata sales office or distributor.)

Chip Monolithic Ceramic Capacitors

(Global 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
	P	Soldering Electrode
ER	**F**	High-frequency and high-power Type
	H	High-frequency and high-power Type (Ribbon Terminal)
	A	High-frequency Type
	D	High-frequency Type (Ribbon Terminal)
GQ	**M**	High-frequency for Flow/Reflow Soldering
GM	**A**	Monolithic Microchip
GN	**M**	Capacitor Array
LL	**L**	Low ESL Wide-width Type
GJ	**6**	Low Dissipation
	2	Smoothing Type
GA	**2**	for AC250V (r.m.s.)
	3	Safety Standard Recognized Type

❸Dimension (L×W)

Code	Dimension (L×W)	EIA
03	0.6×0.3 mm	0201
05	0.5×0.5 mm	0202
08	0.8×0.8 mm	0303
11	1.25×1.0 mm	0504
15	1.0×0.5 mm	0402
18	1.6×0.8 mm	0603
1D	1.4×1.4 mm	
1X	Depends on individual standards.	
21	2.0×1.25 mm	0805
22	2.8×2.8 mm	1111
31	3.2×1.6 mm	1206
32	3.2×2.5 mm	1210
3X	Depends on individual standards.	
42	4.5×2.0 mm	1808
43	4.5×3.2 mm	1812
52	5.7×2.8 mm	2211
55	5.7×5.0 mm	2220

❹Dimension (T)

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

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

❺Temperature Characteristics

Code	Temperature Characteristics	Temperature Range	Capacitance Change or Temperature Coefficient	Operating Temperature Range
1X	SL	20 to 85°C	+350 to -1000ppm/°C	-55 to 125°C
5C	C0G	-55 to 125°C	0±30ppm/°C	-55 to 125°C
6C	C0H	-55 to 125°C	0±60ppm/°C	-55 to 125°C
6P	P2H	-55 to 85°C	-150±60ppm/°C	-55 to 125°C
6R	R2H	-55 to 85°C	-220±60ppm/°C	-55 to 125°C

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6S	S2H	-55 to 85°C	-330±60ppm/°C	-55 to 125°C
6T	T2H	-55 to 85°C	-470±60ppm/°C	-55 to 125°C
7U	U2J	-55 to 85°C	-750±120ppm/°C	-55 to 125°C
B3	B	-25 to 85°C	±10%	-25 to 85°C *
E4	Z5U	10 to 85°C	+22, -56%	10 to 85°C
F5	Y5V	-30 to 85°C	+22, -82%	-30 to 85°C
R3	R	-55 to 125°C	±15%	-55 to 125°C
R6	X5R	-55 to 85°C	±15%	-55 to 85°C
R7	X7R	-55 to 125°C	±15%	-55 to 125°C
9E	ZLM	-25 to 20°C	-4700+100/-2500ppm/°C	-25 to 85°C
		20 to 85°C	-4700+500/-1000ppm/°C	

* GRM series 630V : -55 to 125°C

❻Rated Voltage

Code	Rated Voltage
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
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; 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

❽Capacitance Tolerance

Code	Capacitance Tolerance	TC	Series	Capacitance Step	
B	±0.1pF	CΔ	**GJ6**	≦5pF	E24 Series,1pF
C	±0.25pF	CΔ–SL	**GRP/GRM/ERF/ERH/ERA/ERD/GQM**	≦5pF	* 1pF
		CΔ	**GJ6**	<10pF	E24 Series,1pF
D	±0.5pF	CΔ–SL	**GRP/GRM**	6.0 to 9.0pF	* 1pF
		CΔ	**ERF/ERH/ERA/ERD/GQM/GJ6**	5.1 to 9.1pF	E24 Series
G	±2%	CΔ	**GJ6**	≧10pF	E12 Series
		CΔ	**GQM**	≧10pF	E24 Series
J	±5%	CΔ–SL	**GRP/GRM**	≧10pF	E12 Series
		CΔ	**ERF/ERH/ERA/ERD/GQM/GJ6**	≧10pF	E24 Series
K	±10%	B,R,X7R,X5R,ZLM	**GRP/GRM/GA3**	E6 Series	
M	±20%	Z5U	**GRM**	E3 Series	
		B,R,X7R	**GMA/LLL**	E6 Series	
		B	**GA2**	E3 Series	
Z	+80%, -20%	F,Y5V	**GRP/GRM/GJ2**	E3 Series	
R	Depends on individual standards.				

***** E24 series is also available.

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❾Individual Specification Code

Code	Series	Individual Specification	Temperature Characteristics Type *4	Inner Electrode	Under coat metal of Outer Electrode
A01	GRM *1	Standard Type	TC	Base Metal	Base Metal
	GRM *1/GRP/LLL		HiK		
A11	GRM *1	Special Dimension Type (Tolerances of L×W×T are ±0.15mm)	HiK	Base Metal	Base Metal
A12	GRM *1	Special Characteristics (Applied Voltage is ×1.25 of Rated Voltage at High Temperature Load Test)	HiK	Base Metal	Base Metal
A61	GRM *1	Special Characteristics (Under special control)	HiK	Base Metal	Base Metal
B01	GJ6/GQM	Standard Type	TC	Base Metal (Cu)	Base Metal
C01	GRM *1	Standard Type	HiK	Base Metal	Precious Metal
C11	GRM *1	Special Dimension Type (Tolerances of L×W are ±0.2mm, others)	HiK	Base Metal	Precious Metal
C12	GRM *1	Special Dimension Type (Length is 3.2±0.2, Width is 1.6±0.2mm, Thickness is 1.2 ±0.1mm)	HiK	Base Metal	Precious Metal
D01	ERA/ERD/ERF/ERH	Standard Type (Non-coated type for ERH series)	TC	Precious Metal	Precious Metal
	GRM *1/GRP		TC		
	GRM *1/GJ2/GMA/GRP/LLL		HiK		
D02	ERH	Standard Type (Coated with Resin)	TC	Precious Metal	Precious Metal
	GRP	Standard Type (Ceramic Material of Relaxor Type)	HiK		
D11	GJ2	Special Dimension Type (Thickness is 1.8±0.2mm)	HiK	Precious Metal	Precious Metal
	GRP	Special Dimension Type (Thickness is 0.25±0.05mm)	TC		
D12	GJ2	Special Dimension Type (Thickness is 2.2±0.3mm)	HiK	Precious Metal	Precious Metal
V01	GRM *2	Standard Type (New Ceramic Material)	TC	Precious Metal	Precious Metal
W01	GRM *3/GA3	Standard Type	HiK	Base Metal	Base Metal
	GRM *3		TC		
W02	GA3	Special Dimension Type (Tolerance of Thickness is ±0.3mm)	HiK	Base Metal	Base Metal
W03	GRM *3	Special Dimension Type (Tolerance of Thickness is ±0.2mm)	HiK	Base Metal	Base Metal
Y01	GRM *3	Standard Type	TC	Precious Metal	Precious Metal
	GRM *3		HiK		
Y02	GA2/GA3	Special Dimension Type (Tolerance of Thickness is ±0.3mm)	HiK	Precious Metal	Precious Metal
	GRM *3		TC		
Y05	GRM *3	Special Dimension Type (Thickness is 2.7+0/-0.3mm)	HiK	Precious Metal	Precious Metal
Y06	GA3	Special Dimension Type (Thickness is 2.7±0.3mm)	HiK	Precious Metal	Precious Metal
Y21	GRM *2	Standard Type	TC	Precious Metal	Precious Metal
Z01	GRM *1/GRP	Standard Type (New Ceramic Material)	TC	Precious Metal	Precious Metal

*1 Apply to rated voltage 100V and under.
*2 Apply to rated voltage 200/500V.
*3 Apply to rated voltage 250V, 630V to 3.15kV.
*4 "TC"means Temperature Conpensating Type and "HiK" means High Dielectric Type.

❿Packaging

Code	Packaging
E	ø178mm 2mm Pitch Paper Taping
F	ø330mm 2mm Pitch Paper Taping
L	ø178mm 4mm Pitch Plastic Taping
D	ø178mm 4mm Pitch Paper Taping
K	ø330mm 4mm Pitch Plastic Taping
J	ø330mm 4mm Pitch Paper Taping
B	Bulk
C	Bulk Case
T	Bulk Tray

Selection Guide of Chip Monolithic Ceramic Capacitors

Start

Application?

- **General Electronics** → **Function and circuit?**
- **Specified Applications**

General Electronics

for Filter / for Synchronize Circuit / for Oscillation Circuit

Soldering Electrode
C0G Char.
GRP_5C/GRM_5C Series
(0.5pF-39000pF)

Capacitor Arrays
C0G Char.
GNM_5C Series
(10pF-360pF)

for Temperature Compensation

Soldering Electrode for temperature compensation
GRP_/GRM_ Series
(0.5pF-39000pF)

Capacitor Arrays for temperature compensation
GNM_5C Series
(10pF-360pF)

for Bypassing / for De-coupling

Soldering Electrode
Y5V Char.
GRP_F5/GRM_F5 Series
(2200pF-10µF)

Microchip
Y5V Char.
GMA_F5 Series
(4700pF-0.1µF)

Capacitor Arrays
Y5V Char.
GNM_F1 Series
(22000pF-0.15µF)

Low-ESL
Y5V Char.
LLL31_F5 Series
(0.22µF-1.0µF)

for Coupling / for Time Constant Circuit

Soldering Electrode
X5R/X7R Char.
GRP_R6,R7/GRM_R6,R7 Series
(220pF-10µF)

Soldering Electrode
C0G/C0H Char.
GRP/GRM_5C/6C Series
(0.5pF-39000pF)

Thin Layer Large-capacitance Type
X5R Char.
10µF
GRM21BR6 Series
(22µF)

Microchip
GMA_R7 Series
(470pF-10000pF)

Capacitor Arrays
GNM Series
(390pF-1.0µF)

Low-ESL
LLL Series
(2200pF-1.0µF)

Specified Applications

for High-frequency

High-frequency/High-power type Soldering Electrode
ERF Series
(0.75pF-1000pF)

High-freqeuncy/High-Power Ribbon Terminal type
ERH Series
(0.75pF-1000pF)

High-frequency type
ERA Series
(0.75pF-1000pF)

High-frequency Ribbon Terminal type
ERD Series
(0.75pF-1000pF)

High-frequency for flow/reflow soldering
GQM Series
(0.5pF-100pF)

for Ultra-thin Circuit

Thin type Soldering Electrode
GRP15X Series
(0.5pF-4700pF)

for Smoothing

GJ2 Series
(1µF-100µF)

Low-dissipation

GJ615 Series
(0.5pF-18pF)

for Ultrasonic Sensors

ZLM Char.
GRM2199E Series
(1000pF/1500pF)

Medium-voltage

630V/1kV/2kV/3.15kV
Low-dissipation
GRM Series
(10pF-1000pF)

250/630V
High-capacitance
GRM Series
(1000pF-0.47µF)

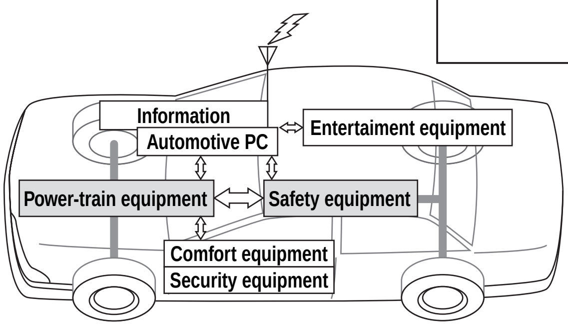
Safety Standard Recognized

AC250V which meet Japanese Law
GA2 Series
(470pF-0.1µF)

UL/IEC Safety Standard Recognized
GA3 Series
(100pF-33000pF)

for Automotive*(Power-train, safety equipment)

GCM/GCP Series
(0.5pF-2.2µF)



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

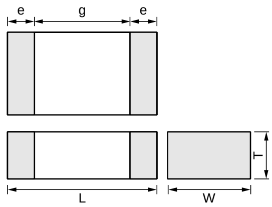
Chip Monolithic Ceramic Capacitors

muRata

for Flow/Reflow Soldering GRP15/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 and 100V 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: 3.2x1.6x1.15 mm.
   GRM18, 21 and GRM31 types are suited to flow and reflow soldering.
   GRP15 types is applied to only reflow soldering.
4. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placement on PCBs.
5. The GRP/GRM series is available in paper or plastic embossed tape and reel packaging for automatic placement. Bulk case packaging is also available for GRP15, GRM18, GRM21 ectronic equipment.
6. Dielectric layer of GRP15 Y5V 0.22uF/0.47uF/1.0uF are relaxor



Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRP155	1.0 ±0.05	0.5 ±0.05	0.5 ±0.05	0.15 to 0.3	0.4
GRM155					
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		
GRM319	3.2 ±0.15	1.6 ±0.15	0.85 ±0.1	0.3 to 0.8	1.5
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)

■ Applications

General electronic equipment.

Temperature Compensating Type GRP15 Series (1.0x0.5mm)

Part Number	GRP15								
L x W [EIA]	1.00x0.50 [0402]								
TC	C0G (**5C**)	C0H (**6C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)		T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)									
0.5pF(**R50**)	0.50(**5**)								
0.75pF(**R75**)	0.50(**5**)								
1.0pF(**1R0**)	0.50(**5**)								
2.0pF(**2R0**)	0.50(**5**)								
3.0pF(**3R0**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
4.0pF(**4R0**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
5.0pF(**5R0**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
6.0pF(**6R0**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
7.0pF(**7R0**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
8.0pF(**8R0**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
9.0pF(**9R0**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
10.0pF(**100**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
12.0pF(**120**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
15.0pF(**150**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
18.0pF(**180**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
22.0pF(**220**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
27.0pF(**270**)	0.50(**5**)		0.50(**5**)	0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)

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Part Number	GRP15								
L x W [EIA]	1.00x0.50 [0402]								
TC	C0G (**5C**)	C0H (**6C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)		T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)									
33.0pF(**330**)	0.50(**5**)			0.50(**5**)	0.50(**5**)			0.50(**5**)	0.50(**5**)
39.0pF(**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**)			
390pF(**391**)						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)

Part Number	GRM18												
L x W [EIA]	1.60x0.80 [0603]												
TC	C0G (**5C**)			C0H (**6C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)				T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	100 (**2A**)	200 (**2D**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)													
0.5pF(**R50**)	0.80(**8**)		0.80(**8**)										
0.75pF(**R75**)	0.80(**8**)		0.80(**8**)										
1.0pF(**1R0**)	0.80(**8**)		0.80(**8**)										
2.0pF(**2R0**)	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**)
4.0pF(**4R0**)	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**)
6.0pF(**6R0**)	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**)
8.0pF(**8R0**)	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**)
10.0pF(**100**)	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**)

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Part Number	**GRM18**												
L x W [EIA]	1.60x0.80 [0603]												
TC	C0G (**5C**)			C0H (**6C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)				T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	100 (**2A**)	200 (**2D**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)													
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**)
220pF(**221**)	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**)
330pF(**331**)	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**)
470pF(**471**)	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**)
820pF(**821**)	0.80(**8**)							0.80(**8**)					
1000pF(**102**)	0.80(**8**)							0.80(**8**)					
1200pF(**122**)	0.80(**8**)							0.80(**8**)					
1500pF(**152**)	0.80(**8**)							0.80(**8**)					

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

Temperature Compensating Type GRM21 Series (2.00x1.25mm)

Part Number	**GRM21**												
L x W [EIA]	2.00x1.25 [0805]												
TC	C0G (**5C**)			C0H (**6C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)				T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	100 (**2A**)	200 (**2D**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)													
12pF(**120**)			0.85(**9**)										
15pF(**150**)			0.85(**9**)										
18pF(**180**)			0.85(**9**)										
22pF(**220**)			0.85(**9**)										
27pF(**270**)			0.85(**9**)										
33pF(**330**)			0.85(**9**)										
39pF(**390**)			0.85(**9**)										
47pF(**470**)			0.85(**9**)										
56pF(**560**)			0.85(**9**)										
68pF(**680**)		0.85(**9**)	1.25(**B**)										
82pF(**820**)		0.85(**9**)	1.25(**B**)										
100pF(**101**)		0.85(**9**)	1.25(**B**)										
120pF(**121**)		0.85(**9**)	1.25(**B**)								0.85(**9**)		
150pF(**151**)		0.85(**9**)	1.25(**B**)								1.25(**B**)		
180pF(**181**)		0.85(**9**)	1.25(**B**)		0.85(**9**)						1.25(**B**)		
220pF(**221**)		0.85(**9**)	1.25(**B**)		0.85(**9**)	0.85(**9**)					1.25(**B**)		
270pF(**271**)		0.85(**9**)			0.85(**9**)	0.85(**9**)	0.85(**9**)				1.25(**B**)		
330pF(**331**)		0.85(**9**)			0.85(**9**)	0.85(**9**)	0.85(**9**)				1.25(**B**)		
390pF(**391**)		1.25(**B**)			1.25(**B**)	0.85(**9**)	0.85(**9**)				1.25(**B**)		
470pF(**471**)		1.25(**B**)			1.25(**B**)	0.85(**9**)	0.85(**9**)			0.85(**9**)	1.25(**B**)		
560pF(**561**)	0.60(**6**)	1.25(**B**)			1.25(**B**)	1.25(**B**)	1.25(**B**)			0.85(**9**)		1.25(**B**)	
680pF(**681**)	0.60(**6**)	1.25(**B**)				1.25(**B**)	1.25(**B**)			0.85(**9**)		1.25(**B**)	
820pF(**821**)	0.60(**6**)	1.25(**B**)					1.25(**B**)		0.60(**6**)	1.25(**B**)		1.25(**B**)	0.60(**6**)
1000pF(**102**)	0.60(**6**)	1.25(**B**)							0.60(**6**)	1.25(**B**)		1.25(**B**)	0.60(**6**)
1200pF(**122**)	0.60(**6**)								0.60(**6**)	1.25(**B**)		1.25(**B**)	0.60(**6**)
1500pF(**152**)	0.60(**6**)								0.85(**9**)	1.25(**B**)		1.25(**B**)	0.85(**9**)

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Part Number	**GRM21**												
L x W [EIA]	2.00x1.25 [0805]												
TC	C0G (**5C**)			C0H (**6C**)	P2H (**6P**)	R2H (**6R**)	S2H (**6S**)	SL (**1X**)				T2H (**6T**)	U2J (**7U**)
Rated Volt.	50 (**1H**)	100 (**2A**)	200 (**2D**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)													
1800pF(**182**)	0.60(**6**)								0.85(**9**)	1.25(**B**)		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**)				1.25(**B**)
3300pF(**332**)	0.60(**6**)			1.25(**B**)					1.25(**B**)				1.25(**B**)
3900pF(**392**)				1.25(**B**)				0.85(**9**)					
4700pF(**472**)								0.85(**9**)					
5600pF(**562**)								1.25(**B**)					
6800pF(**682**)								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)

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.	25 (**1E**)	50 (**1H**)	200 (**2D**)	500 (**2H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	500 (**2H**)	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**)											
10.0pF(**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**)											
100pF(**101**)				1.15(**M**)											
120pF(**121**)				1.15(**M**)											
150pF(**151**)													1.15(**M**)		
180pF(**181**)													1.15(**M**)		
220pF(**221**)													1.15(**M**)		
270pF(**271**)			1.15(**M**)										1.15(**M**)		
330pF(**331**)			1.15(**M**)												
390pF(**391**)			1.15(**M**)												
470pF(**471**)			1.15(**M**)												
560pF(**561**)												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.	25 (**1E**)	50 (**1H**)	200 (**2D**)	500 (**2H**)	25 (**1E**)	50 (**1H**)	50 (**1H**)	50 (**1H**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	500 (**2H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)															
680pF(**681**)						0.85(**9**)						1.15(**M**)			
820pF(**821**)						0.85(**9**)	0.85(**9**)					1.15(**M**)			
1000pF(**102**)						1.15(**M**)	1.15(**M**)	0.85(**9**)				1.15(**M**)			
1200pF(**122**)						1.15(**M**)	1.15(**M**)	1.15(**M**)				1.15(**M**)			
1500pF(**152**)						1.15(**M**)	1.15(**M**)	1.15(**M**)							
1800pF(**182**)								1.15(**M**)							
2200pF(**222**)											1.15(**M**)			1.15(**M**)	
2700pF(**272**)		0.85(**9**)									1.15(**M**)			1.15(**M**)	
3300pF(**332**)		0.85(**9**)									1.15(**M**)			1.15(**M**)	
3900pF(**392**)		1.15(**M**)								0.85(**9**)	1.15(**M**)			1.15(**M**)	0.85(**9**)
4700pF(**472**)		0.85(**9**)								0.85(**9**)	1.15(**M**)				0.85(**9**)
5600pF(**562**)		1.15(**M**)								0.85(**9**)					0.85(**9**)
6800pF(**682**)					0.85(**9**)					1.15(**M**)					1.15(**M**)
8200pF(**822**)					1.15(**M**)					1.15(**M**)					1.15(**M**)
10000pF(**103**)	0.85(**9**)								1.15(**M**)						
12000pF(**123**)									1.15(**M**)						
15000pF(**153**)									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	GRP15	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.	10 (**1A**)	6.3 (**0J**)	10 (**1A**)	6.3 (**0J**)	10 (**1A**)	6.3 (**0J**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)							
68000pF(**683**)	0.50(**5**)						
0.1µF(**104**)	0.50(**5**)						
0.33µF(**334**)			0.80(**8**)				
0.47µF(**474**)			0.80(**8**)				
0.68µF(**684**)			0.80(**8**)				
1.0µF(**105**)		0.80(**8**)	0.80(**8**)		0.85(**9**)		
1.5µF(**155**)				0.85(**9**)			
2.2µF(**225**)				1.25(**B**)			0.85(**9**)
3.3µF(**335**)				1.25(**B**)			1.30(**X**)
4.7µF(**475**)				1.25(**B**)		1.15(**M**)	1.60(**C**)
10µF(**106**)						1.60(**C**)	1.60(**C**)

The part numbering code is shown in each ( ).
3.3µF and 4.7µF for 6.3V is replaced with GRM21B series of L: 2±0.15, W: 1.25±0.15, T: 1.25±0.15.
T: 1.25±0.1mm is also available for GRM21 10V 1.0µF type.
3.3µF for 10V rated is replaced with GRM31X series of L: 3.2±0.2, W: 1.6±0.2, T: 1.2±0.1mm.
T: 1.15±0.1 is also available for GRM31, 16V, 1.0µF type.
Dimensions are shown in mm and Rated Voltage in Vdc.

High Dielectric Constant Type X7R (R7) Characteristics

TC	X7R (**R7**)																
Part Number	**GRP15**				**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.	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)																	
220pF (**221**)				0.50 (**5**)				0.80 (**8**)									
330pF (**331**)				0.50 (**5**)				0.80 (**8**)									
470pF (**471**)				0.50 (**5**)				0.80 (**8**)									
680pF (**681**)				0.50 (**5**)				0.80 (**8**)									
1000pF (**102**)				0.50 (**5**)				0.80 (**8**)									
1500pF (**152**)				0.50 (**5**)				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**)						0.80 (**8**)									
22000pF (**223**)		0.50 (**5**)						0.80 (**8**)									
33000pF (**333**)	0.50 (**5**)						0.80 (**8**)					0.85 (**9**)					
47000pF (**473**)	0.50 (**5**)						0.80 (**8**)					1.25 (**B**)					
68000pF (**683**)							0.80 (**8**)					1.25 (**B**)					
0.10µF (**104**)						0.80 (**8**)	0.80 (**8**)				1.25 (**B**)	1.25 (**B**)					
0.15µF (**154**)					0.80 (**8**)						1.25 (**B**)	1.25 (**B**)					
0.22µF (**224**)					0.80 (**8**)						0.85 (**9**)	1.25 (**B**)					
0.33µF (**334**)											1.25 (**B**)						0.85 (**9**)
0.47µF (**474**)										0.85 (**9**)	1.25 (**B**)						1.15 (**M**)
0.68µF (**684**)										0.85 (**9**)						0.85 (**9**)	
1.00µF (**105**)										1.25 (**B**)				0.85 (**9**)	0.85 (**9**)	1.15 (**M**)	
1.5µF (**155**)															1.15 (**M**)		

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TC	X7R (**R7**)																
Part Number	**GRP15**				**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.	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)																	
2.2µF (**225**)														1.15 (**M**)	1.15 (**M**)		

The part numbering code is shown in each ( ).
0.10µF, 50V rated are GRM21 series of L: 2±0.15, W: 1.25±0.15, T: 1.25±0.15.
T: 1.25±0.1mm is also available for GRM31 1.0µF for 16V.
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.

High Dielectric Constant Type Y5V(F5) Characteristics

TC	Y5V (**F5**)																			
Part Number	**GRP15**					**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.	6.3 (**0J**)	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	6.3 (**0J**)	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)
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**)						0.80 (**8**)										
0.10µF (**104**)			0.50 (**5**)					0.80 (**8**)						0.85 (**9**)					
0.22µF (**224**)		0.50 (**5**)					0.80 (**8**)						0.85 (**9**)	1.25 (**B**)					
0.47µF (**474**)		0.50 (**5**)				0.80 (**8**)	0.80 (**8**)						1.25 (**B**)						1.15 (**M**)
1.0µF (**105**)	0.50 (**5**)					0.80 (**8**)					0.85 (**9**)	0.85 (**9**)	0.85 (**9**)				0.85 (**9**)	1.15 (**M**)	
2.2µF (**225**)											1.25 (**B**)	1.25 (**B**)	1.25 (**B**)			0.85 (**9**)	1.15 (**M**)		
4.7µF (**475**)											1.25 (**B**)					1.15 (**M**)	1.15 (**M**)		
10.0µF (**106**)															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.

High Dielectric Constant Type Z5U(E4) Characteristics

TC	Z5U (**E4**)		
Part Number	**GRM18**	**GRM21**	**GRM31**
L x W [EIA]	1.60x0.80 [0603]	2.00x1.25 [0805]	3.20x1.60 [1206]
Rated Volt.	50 (**1H**)	50 (**1H**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)			
10000pF(**103**)	0.80(**8**)		
22000pF(**223**)	0.80(**8**)		
47000pF(**473**)		0.60(**6**)	
0.10µF(**104**)		0.85(**9**)	
0.22µF(**224**)			0.85(**9**)

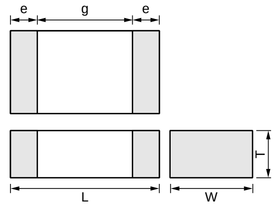
The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

Chip Monolithic Ceramic Capacitors

muRata

2

for Reflow Soldering GRM32/43/55 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 10V, 16V, 25V, 50V and 100V ratings. These capacitors have temperature characteristics ranging from C0G to Y5V.
3. This series consists of type LxWxT: 3.2x2.5x0.85mm to LxWxT: 5.7x5.9x2.0mm. These are suited to only reflow soldering.
4. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placement on PCBs.
5. The GRM series is available in paper or plastic embossed tape and reel packaging for automatic placement.

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

■ Applications

General electronic equipment.

Temperature Compensating Type GRM32 Series (3.20x2.50mm)

Part Number	**GRM32**					
L x W [EIA]	3.20x2.50 [1210]					
TC	C0G (**5C**)		SL (**1X**)			
Rated Volt.	200 (**2D**)	500 (**2H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	500 (**2H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)						
150pF(**151**)		1.35(**N**)				
180pF(**181**)		1.35(**N**)				
330pF(**331**)						1.15(**M**)
390pF(**391**)						1.15(**M**)
470pF(**471**)						1.35(**N**)
560pF(**561**)	1.35(**N**)					
680pF(**681**)	1.35(**N**)					
820pF(**821**)	1.35(**N**)					
1000pF(**102**)	1.35(**N**)					
1500pF(**152**)					1.35(**N**)	
5600pF(**562**)				1.35(**N**)		
6800pF(**682**)				1.35(**N**)		
10000pF(**103**)			1.35(**N**)			
12000pF(**123**)			1.35(**N**)			

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

Temperature Compensating Type GRM43 Series (4.50x3.20mm)

Part Number	GRM43					
L x W [EIA]	4.50x3.20 [1812]					
TC	C0G (**5C**)		SL (**1X**)			
Rated Volt.	200 (**2D**)	500 (**2H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	500 (**2H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)						
220pF(**221**)		1.80(**R**)				
270pF(**271**)		1.80(**R**)				
330pF(**331**)		1.80(**R**)				
390pF(**391**)		1.80(**R**)				
470pF(**471**)		1.80(**R**)				
560pF(**561**)						1.15(**M**)
680pF(**681**)						1.15(**M**)
820pF(**821**)						1.35(**N**)
1000pF(**102**)						1.80(**R**)
1200pF(**122**)	1.80(**R**)					1.80(**R**)
1500pF(**152**)	1.80(**R**)					
1800pF(**182**)	1.80(**R**)				1.35(**N**)	
2200pF(**222**)	1.80(**R**)					
2700pF(**272**)	1.80(**R**)				1.80(**R**)	
3300pF(**332**)					1.80(**R**)	
3900pF(**392**)					1.80(**R**)	
8200pF(**822**)				1.35(**N**)		
10000pF(**103**)				1.80(**R**)		
12000pF(**123**)				1.80(**R**)		
15000pF(**153**)			1.80(**R**)	1.80(**R**)		

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

Temperature Compensating Type GRM55 Series (5.70x5.00mm)

Part Number	GRM55				
L x W [EIA]	5.70x5.00 [2220]				
TC	C0G (**5C**)		SL (**1X**)		
Rated Volt.	200 (**2D**)	500 (**2H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)					
560pF(**561**)		1.80(**R**)			
680pF(**681**)		1.80(**R**)			
820pF(**821**)		1.80(**R**)			
1000pF(**102**)		1.80(**R**)			
3300pF(**332**)	1.35(**N**)				
3900pF(**392**)	1.80(**R**)				
4700pF(**472**)	1.80(**R**)				1.35(**N**)
5600pF(**562**)	1.80(**R**)				1.80(**R**)
6800pF(**682**)					1.80(**R**)
8200pF(**822**)					1.80(**R**)
18000pF(**183**)			1.15(**M**)	1.15(**M**)	
22000pF(**223**)			1.35(**N**)	1.35(**N**)	
27000pF(**273**)			1.80(**R**)	1.80(**R**)	
33000pF(**333**)			1.80(**R**)	1.80(**R**)	
39000pF(**393**)			1.80(**R**)	1.80(**R**)	

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

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

Part Number	**GRM32**								
L x W [EIA]	3.20x2.50 [1210]								
TC	X5R (**R6**)	X7R (**R7**)				Y5V (**F5**)			
Rated Volt.	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)	100 (**2A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)									
68000pF(**683**)					1.35(**N**)				
0.1µF(**104**)					1.35(**N**)				1.35(**N**)
0.68µF(**684**)				1.35(**N**)					
1.0µF(**105**)				1.80(**R**)				1.8(**R**)	
2.2µF(**225**)		1.15(**M**)	1.80(**R**)						
3.3µF(**335**)		1.35(**N**)							
4.7µF(**475**)		1.80(**R**)					0.85(**9**)		
10µF(**106**)	2.50(**E**)					1.35(**N**)	1.35(**N**)		

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

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

Part Number	**GRM43**	
L x W [EIA]	4.50x3.20 [1812]	
TC	X7R (**R7**)	
Rated Volt.	50 (**1H**)	100 (**2A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)		
0.15µF(**154**)		1.80(**R**)
0.22µF(**224**)		1.80(**R**)
0.33µF(**334**)		1.60(**C**)
0.47µF(**474**)		2.00(**D**)
2.2µF(**225**)	2.50(**E**)	

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

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

Part Number	**GRM55**		
L x W [EIA]	5.70x5.00 [2220]		
TC	X7R (**R7**)		Y5V (**F5**)
Rated Volt.	50 (**1H**)	100 (**2A**)	100 (**2A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)			
0.47µF(**474**)			1.80(**R**)
0.68µF(**684**)		1.60(**C**)	
1.0µF(**105**)	1.80(**R**)	2.00(**D**)	
1.5µF(**155**)	1.80(**R**)		

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

Chip Monolithic Ceramic Capacitors

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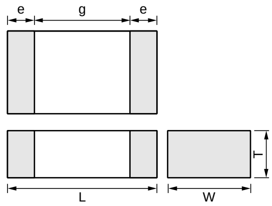
Ultra-small GRP03 Series

■ Features

1. Small chip size (LxWxT: 0.6x0.3x0.3mm).
2. Terminations are made of metal highly resistant to migration.
3. GRP03 type is suited to only reflow soldering.
4. Stringent dimensional tolerances are allow highly reliable, high speed autom atic chip placements on PCBs.
5. GRP03 series are suited to miniature micro wave module, portable equipment and high-frequency circuit.



Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRP033	0.6 ±0.03	0.3 ±0.03	0.3 ±0.03	0.1 to 0.2	0.2

■ Applications

- Miniature micro wave module.
- Portable equipment.
- High-frequency circuit.

Part Number	**GRP03**			
L x W	0.6x0.3			
TC	C0G (**5C**)	X7R (**R7**)		Y5V (**F5**)
Rated Volt.	25 (**1E**)	6.3 (**0J**)	16 (**1C**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)				
0.5pF(**R50**)	0.3(**3**)			
1pF(**1R0**)	0.3(**3**)			
2pF(**2R0**)	0.3(**3**)			
3pF(**3R0**)	0.3(**3**)			
4pF(**4R0**)	0.3(**3**)			
5pF(**5R0**)	0.3(**3**)			
6pF(**6R0**)	0.3(**3**)			
7pF(**7R0**)	0.3(**3**)			
8pF(**8R0**)	0.3(**3**)			
9pF(**9R0**)	0.3(**3**)			
10pF(**100**)	0.3(**3**)			
12pF(**120**)	0.3(**3**)			
15pF(**150**)	0.3(**3**)			
18pF(**180**)	0.3(**3**)			
22pF(**220**)	0.3(**3**)			
27pF(**270**)	0.3(**3**)			
33pF(**330**)	0.3(**3**)			
39pF(**390**)	0.3(**3**)			
47pF(**470**)	0.3(**3**)			
56pF(**560**)	0.3(**3**)			
68pF(**680**)	0.3(**3**)			
82pF(**820**)	0.3(**3**)			
100pF(**101**)	0.3(**3**)		0.3(**3**)	
150pF(**151**)			0.3(**3**)	
220pF(**221**)			0.3(**3**)	
330pF(**331**)			0.3(**3**)	
470pF(**471**)			0.3(**3**)	
680pF(**681**)			0.3(**3**)	

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Part Number	GRP03			
L x W	0.6x0.3			
TC	C0G (**5C**)	X7R (**R7**)		Y5V (**F5**)
Rated Volt.	25 (**1E**)	6.3 (**0J**)	16 (**1C**)	10 (**1A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)				
1000pF(**102**)			0.3(**3**)	
1500pF(**152**)		0.3(**3**)		
2200pF(**222**)		0.3(**3**)		0.3(**3**)
3300pF(**332**)		0.3(**3**)		
4700pF(**472**)		0.3(**3**)		0.3(**3**)
6800pF(**682**)		0.3(**3**)		
10000pF(**103**)		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

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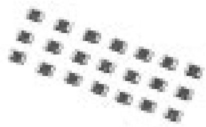
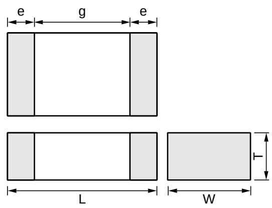
Thin Type (Flow/Reflow)

■ 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.
GRP15X	1.0 ±0.05	0.5 ±0.05	0.25 ±0.05	0.15 to 0.3	0.4

■ Applicaton

Thin equipment such as IC cards.

Part Number	TC Code	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRP15X5C1E121JD11	C0G	25	120 ±5%	1.00	0.50	0.25
GRP15X5C1E151JD11	C0G	25	150 ±5%	1.00	0.50	0.25
GRP15X5C1E181JD11	C0G	25	180 ±5%	1.00	0.50	0.25
GRP15X5C1E221JD11	C0G	25	220 ±5%	1.00	0.50	0.25
GRP15X5C1H1R0CD11	C0G	50	1 ±0.25pF	1.00	0.50	0.25
GRP15X5C1H2R0CD11	C0G	50	2 ±0.25pF	1.00	0.50	0.25
GRP15X5C1H3R0CD11	C0G	50	3 ±0.25pF	1.00	0.50	0.25
GRP15X5C1H4R0CD11	C0G	50	4 ±0.25pF	1.00	0.50	0.25
GRP15X5C1H5R0CD11	C0G	50	5 ±0.25pF	1.00	0.50	0.25
GRP15X5C1H6R0DD11	C0G	50	6 ±0.5pF	1.00	0.50	0.25
GRP15X5C1H7R0DD11	C0G	50	7 ±0.5pF	1.00	0.50	0.25
GRP15X5C1H8R0DD11	C0G	50	8 ±0.5pF	1.00	0.50	0.25
GRP15X5C1H9R0DD11	C0G	50	9 ±0.5pF	1.00	0.50	0.25
GRP15X5C1H100JD11	C0G	50	10 ±5%	1.00	0.50	0.25
GRP15X5C1H120JD11	C0G	50	12 ±5%	1.00	0.50	0.25
GRP15X5C1H150JD11	C0G	50	15 ±5%	1.00	0.50	0.25
GRP15X5C1H180JD11	C0G	50	18 ±5%	1.00	0.50	0.25
GRP15X5C1H220JD11	C0G	50	22 ±5%	1.00	0.50	0.25
GRP15X5C1H270JD11	C0G	50	27 ±5%	1.00	0.50	0.25
GRP15X5C1H330JD11	C0G	50	33 ±5%	1.00	0.50	0.25
GRP15X5C1H390JD11	C0G	50	39 ±5%	1.00	0.50	0.25
GRP15X5C1H470JD11	C0G	50	47 ±5%	1.00	0.50	0.25
GRP15X5C1H560JD11	C0G	50	56 ±5%	1.00	0.50	0.25
GRP15X5C1H680JD11	C0G	50	68 ±5%	1.00	0.50	0.25
GRP15X5C1H820JD11	C0G	50	82 ±5%	1.00	0.50	0.25
GRP15X5C1H101JD11	C0G	50	100 ±5%	1.00	0.50	0.25

GRM/GRP Series Specifications and Test Methods

No.	Item	Specification: Temperature Compensating Type	Specification: High Dielectric Type	Test Method
1	Operating Temperature	−55 to +125℃	R6 : −55 to +85℃ R7 : −55 to +125℃ E4 : +10 to +85℃ F5 : −30 to +85℃	
2	Rated Voltage	See the previous page.		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, shall be maintained within the rated voltage range.
3	Appearance	No defects or abnormalities.		Visual inspection.
4	Dimensions	Within the specified dimensions.		Using calipers on micrometer.
5	Dielectric Strength	No defects or abnormalities.		No failure shall be observed when *300% of the rated voltage (C0Δ to U2J and SL) or *250% of the rated voltage (X5R, X7R, Z5U and Y5V) 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	More than 10,000MΩ or 500Ω • F (Whichever is smaller)		The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 2 minutes of charging.
7	Capacitance	Within the specified tolerance.		The capacitance/Q/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table. (Table 1)
8	Q/ Dissipation Factor (D.F.)	30pFmin. : Q≧1000 30pFmax. : Q≧400+20C C : Nominal Capacitance (pF)	[R6, R7] W.V. : 25Vmin. : 0.025max. W.V. : 16/10V : 0.035max. W.V. : 6.3V 0.05max.(C<3.3μF) 0.1max.(C≧3.3μF) [E4] W.V. : 25Vmin. : 0.025max. [F5] W.V. : 25Vmin. : 0.05max.(C<10μF) : 0.09max.(C≧1.0μF) W.V. : 16V : 0.07max.(C<1.0μF) : 0.09max.(C≧1.0μF) W.V. : 10Vmax. : 0.125max.	(see No. 7)
9	Capacitance Temperature Characteristics — Capacitance Change	Within the specified tolerance. (Table A)	R6 : Within±15% (−55 to +85℃) R7 : Within±15% (−55 to +125℃) E4 : Within +22/−56% (+10 to +85℃) F5 : Within +22/−82% (−30 to +85℃)	The capacitance change shall 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 step 1 through 5 (C0Δ : +25℃ to +125℃ : other temp. coeffs. : +25℃ to +85℃) the capacitance shall be within the specified tolerance for the temperature coefficient and capacitance change as Table A. The capacitance drift is caluculated by dividing the differences between the maximum and minimum measured values in the step 1,3 and 5 by the cap value in step 3. (Table 2) (2) High Dielectric Constant Type The ranges of capacitance change compared with the above 25℃ value over the temperature ranges shown in the table shall be within the specified ranges.
	Capacitance Temperature Characteristics — Temperature Coefficient	Within the specified tolerance. (Table A)	——	
	Capacitance Temperature Characteristics — Capacitance Drift	Within ±0.2% or ±0.05pF (Whichever is larger.) *Not apply to 1X/25V	——	

Table 1 (Test Method, No. 7–8):

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

Table 2 (Test Method, No. 9):

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

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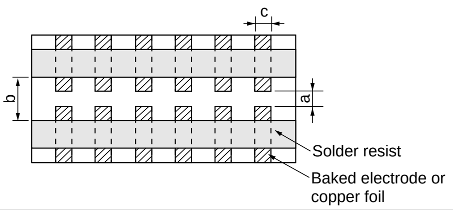
GRM/GRP Series Specifications and Test Methods

Continued from the preceding page.

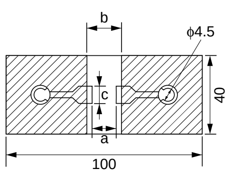
No.	Item		Specification: Temperature Compensating Type	Specification: High Dielectric Type	Test Method
10	Adhesive Strength of Termination		No removal of the terminations or other defect shall occur.		Solder the capacitor to the test jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply 10N✻ force in parallel with the test jig for 10±1sec. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and gree of defects such as heat shock. ✻2N (GRP03) 5N (GRP15,GRM18)
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 shall 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, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).
		Capacitance	Within the specified tolerance.		
		Q/D.F.	30pFmin. : Q≧1000 30pFmax. : Q≧400+20C C : Nominal Capacitance (pF)	[R6, R7] W.V. : 25Vmin. : 0.025max. W.V. : 16/10V : 0.035max. W.V. : 6.3V : 0.05max. (C<3.3μF) 0.1max. (C≧3.3μF) [E4] W.V. : 25Vmin. : 0.025max. [F5] W.V. : 25Vmin. : 0.05max. (C<1.0μF) : 0.09max. (C≧1.0μF) W.V. : 16V : 0.07max. (C<1.0μF) : 0.09max. (C≧1.0μF) W.V. : 10Vmax.:0.125max.	
12	Deflection		No crack or marked defect shall 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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.



Type	a	b	c
GRP03	0.3	0.9	0.3
GRP15	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)

Fig.1



t : 1.6mm (GRP03/15 : 0.8mm)

Type	a	b	c
GRP03	0.3	0.9	0.3
GRP15	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)

Fig.2

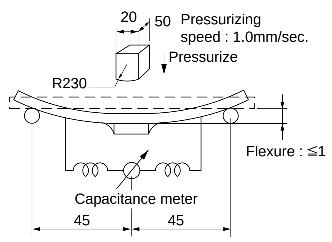


Fig.3

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GRM/GRP Series Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification Temperature Compensating Type	Specification High Dielectric Type	Test Method
13	Solderability of Termination		75% of the terminations is 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 propotion). 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℃.
14	Resistance to Soldering Heat		The measured and observed characteristics shall satisfy the specifications in the following table.		Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type), then measure. •Initial measurement for high dielectric constant type 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. *Preheating for GRM32/43/55 Step 1: 100℃ to 120℃, 1 min. Step 2: 170℃ to 200℃, 1 min.
		Appearance	No marking defects.		
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	R6, R7 : Within ±7.5% E4, F5 : Within ±20%	
		Q/D.F.	30pFmin. : Q≧1000 30pFmax. : Q≧400+20C C : Nominal Capacitance (pF)	[R6, R7] W.V. : 25Vmin. : 0.025max. W.V. : 16/10V : 0.035max. W.V. : 6.3V : 0.05max. (C<3.3μF) 0.1max. (C≧3.3μF) [E4] W.V. : 25Vmin. : 0.025max. [F5] W.V. : 25Vmin. : 0.05max. (C<1.0μF) : 0.09max. (C≧1.0μF) W.V.:16V : 0.07max. (C<1.0μF) : 0.09max. (C≧1.0μF) W.V. : 10Vmax. : 0.125max.	
		I.R.	More than 10,000MΩ or 500Ω • F (Whichever is smaller)		
		Dielectric Strength	No failure		
15	Temperature Cycle		The measured and observed characteristics shall safisfy the specifications in the following table.		Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours (temperature compensating type) or 48±4 hour (high dielectric constant type) at room temperature, then measure. Step 1: Temp. Min. Operating Temp.+0/−3, Time 30±3 min. Step 2: Room Temp., Time 2 to 3 min. Step 3: Max. Operating Temp.+3/−0, Time 30±3 min. Step 4: Room Temp., Time 2 to 3 min. •Initial measurement for high dielectric constant type 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.
		Appearance	No marking defects.		
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	R6, R7 : Within ±7.5% E4, F5 : Within ±20%	
		Q/D.F.	30pFmin. : Q≧1000 30pFmax. : Q≧400+20C C : Nominal Capacitance (pF)	[R6, R7] W.V. : 25Vmin. : 0.025max. W.V. : 16/10V : 0.035max. W.V. : 6.3V 0.05max. (C<3.3μF) 0.1max. (C≧3.3μF) [E4] W.V. : 2.5Vmin. : 0.025max. [F5] W.V. : 25Vmin. : 0.05max. (C<1.0μF) : 0.09max. (C≧1.0μF) W.V. : 16V : 0.07max. (C<1.0μF) : 0.09max. (C≧1.0μF) W.V. : 10Vmax. : 0.125max.	
		I.R.	More than 10,000MΩ or 500Ω • F (Whichever is smaller)		
		Dielectric Strength	No failure		

*Preheating for GRM32/43/55 (No. 14)

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

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

Continued on the following page.

GRM/GRP Series Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification: Temperature Compensating Type	Specification: High Dielectric Type	Test Method
16	Humidity Steady State		The measured and observed characteristics shall satisfy the specifications in the following table.		Sit the capacitor at 40±2℃ and 90 to 95% humiduty for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
		Appearance	No marking defects.		
		Capacitance Change	Within ±5% or ±0.5pF (Whichever is larger)	R6, R7 : Within ±12.5% E4, F5 : Within ±30%	
		Q/D.F.	30pF and over : Q≧350 10pF and over 30pF and below : Q≧275+5C/2 10pF and below : Q≧200+10C C : Nominal Capacitance (pF)	[R6, R7] W.V. : 25Vmin. : 0.05max. W.V. : 16/10V : 0.05max. W.V. : 6.3V 0.075max. (C<3.3μF) 0.125max. (C≧3.3μF) [E4] W.V. : 25Vmin. : 0.05max. [F5] W.V. : 25Vmin. : 0.075max. (C<1.0μF) : 0.125max.(C≧1.0μF) W.V. : 16V : 0.1max. (C<1.0μF) : 0.125max. (C≧1.0μF) W.V. : 10Vmax. : 0.15max.	
		I.R.	More than 1,000MΩ or 50Ω • F(Whichever is smaller)		
		Dielectric Strength	No failure		
17	Humidity Load		The measured and observed characteristics shall 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 (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then muasure.The charge/discharge current is less than 50mA. •Initial measurement for F5/10Vmax. Apply the rated DC voltage for 1 hour at 40±2℃. Remove and let sit for 48±4 hours at room temperature. Perform initial measurement.
		Appearance	No marking defects.		
		Capacitance Change	Within ±7.5% or ±0.75pF (Whichever is larger)	R6, R7 : Within ±12.5% E4 : Within ±30% F5 : Within ±30% [W.V. : 10Vmax.] F5 : Within +30/−40%	
		Q/D.F.	30pF and over : Q≧200 30pF and below : Q≧100+10C/3 C : Nominal Capacitance (pF)	[R6, R7] W.V. : 25Vmin. : 0.05max. W.V. : 16/10V : 0.05max. W.V. : 6.3V 0.075max. (C<3.3μF) 0.125max. (C≧3.3μF) [E4] W.V. : 25Vmin. : 0.05max. [F5] W.V. : 25Vmin. : 0.075max. (C<1.0μF) : 0.125max. (C≧1.0μF) W.V. : 16V : 0.1max. (C<1.0μF) : 0.125max. (C≧1.0μF) W.V. : 10Vmax. : 0.15max.	
		I.R.	More than 500MΩ or 25Ω • F(Whichever is smaller)		
		Dielectric Strength	No failure		

Continued on the following page.

GRM/GRP Series Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification: Temperature Compensating Type	Specification: High Dielectric Type	Test Method
18	High Temperature Load		The measured and observed characteristics shall satisfy the specifications in the following table.		Apply 200% of the rated voltage for 1000±12 hours at the maximun operating temperature ±3℃. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) 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℃. Remove and let sit for 48±4 hours at room temperature. Perform initial measurement. *150% for 500V and C≧10μF
		Appearance	No marking defects.		
		Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	R6, R7 : Within ±12.5% E4 : Within ±30% F5 : Within ±30% (Cap<1.0μF) F5 : Within +30/−40%(Cap≧1.0μF)	
		Q/D.F.	30pF and over : Q≧350 10pF and over 30pF and below : Q≧275+5C/2 10pF and below : Q≧200+10C C : Nominal Capacitance (pF)	[R6, R7] W.V. : 25Vmin. : 0.05max. W.V. : 16/10V : 0.05max. W.V. : 6.3V 0.075max. (C<3.3μF) 0.125max. (C≧3.3μF) [E4] W.V. : 25Vmin. : 0.05max [F5] W.V. : 25Vmin. : 0.075max. (C<1.0μF) : 0.125max.(C≧1.0μF) W.V. : 16V : 0.1max. (C<1.0μF) : 0.125max. (C≧1.0μF) W.V. : 10Vmax. : 0.15max.	
		I.R.	More than 1,000MΩ or 50Ω•F(Whichever is smaller)		
		Dielectric Strength	No failure		
19	Notice		When mounting capacitor of 500V rated voltage, perform the epoxy resin coating(min.1.0mm thickness)		

Table A

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

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

Chip Monolithic Ceramic Capacitors

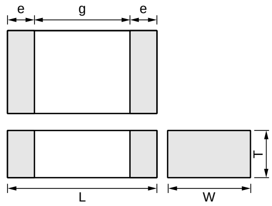
Thin Layer Large-capacitance Type

■ 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.

■ Applications

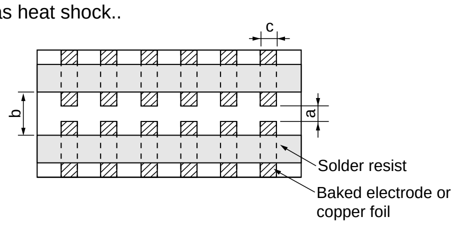
General electronic equipment.



Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GRM21B	2.0 ±0.1	1.25 ±0.1	1.25 ±0.1	0.2 to 0.7	0.7
GRM32D	3.2 ±0.3	2.5 ±0.2	2.0 ±0.2	0.3	1.0

Part Number	TC Code	Rated Voltage (Vdc)	Capacitance (μF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM21BR60J106KE01	X5R	6.3	10 ±10%	2.00	1.25	1.25
GRM32DR60J226KA01	X5R	6.3	22 ±10%	3.20	2.50	2.00

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>R6 : −55℃ to +85℃
R7 : −55℃ to +125℃</td><td></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, shall 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 shall 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 shall be measured with a DC voltage not exceeding the rated voltage at 25℃ 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. shall be measured at 25℃ 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</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></td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>0.1max.</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℃</td><td>25℃</td><td>Within±15%</td></tr>
<tr><td>R7</td><td>−55 to +125℃</td><td>25℃</td><td>Within±15%</td></tr>
</table></td><td>The capacitance change shall be measured after 5 min. at each specified temperature stage.
The ranges of capacitance change compared with the 25℃ value over the temparature ranges shown in the table shall be within the spacified ranges.
<table>
<tr><th>Step</th><th>Temperature (°C)</th></tr>
<tr><td>1</td><td>25±2</td></tr>
<tr><td>2</td><td>−55±3</td></tr>
<tr><td>3</td><td>25±2</td></tr>
<tr><td>4</td><td>125±3</td></tr>
<tr><td>5</td><td>25±2</td></tr>
</table></td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect shall 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±1sec. The soldering shall be done either with an iron or using the reflow method and shall 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>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>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)
Fig.1</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 shall 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, shall be traversed in approximately 1 minute. This motion shall 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>0.1max.</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification	Test Method
12	Deflection		No crack or marked defect shall 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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.

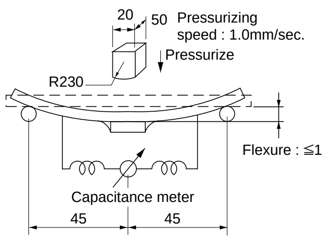
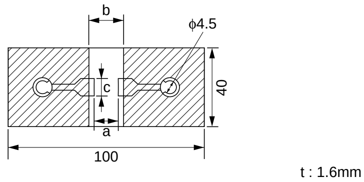


Fig.3



Type	a	b	c
GRM18	1.0	3.0	1.2
GRM21	1.2	4.0	1.65
GRM32	2.2	5.0	2.9
GRM43	3.5	7.0	3.7
GRM55	4.5	8.0	5.6

(in mm)

Fig.2

No.	Item		Specification	Test Method
13	Solderability of Termination		75% of the terminations is 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 propotion). 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℃.
14	Resistance to Soldering Heat	Appearance	No marking defects.	Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 48±4 hours, then measure. •Initial measurement Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.
		Capacitance Change	R6/R7 : Within ±7.5%	
		D.F.	0.1max.	
		I.R.	50Ω • F min	
		Dielectric Strength	No failure	
15	Temperature Sudden Change	Appearance	No marking defects.	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.
		Capacitance Change	R6/R7 : Within ±7.5%	
		D.F.	0.1max.	
		I.R.	50Ω • F 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

•Initial measurement
Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature.
Perform the initial measurement.

No.	Item		Specification	Test Method
16	High Temperature High Humidity (Steady)	Appearance	No marking defects.	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 initial measurement at 150 $^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature. Perform initial measurement. •Measurement after test Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature, then measure.
		Capacitance Change	R6/R7 : Within ±12.5%	
		D.F.	0.2max.	
		I.R.	12.5Ω • F min	
		Dielectric Strength	No failure	

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification	Test Method
17	Durability	Appearance	No marking defects.	Apply 150% of the rated voltage for 1000±12 hours at the maximun operating temperature ±3℃. The charge/discharge current is less than 50mA. •Initial measurement Perform initial measurement at 150^{+0}_{-10}℃ for one hour and then let sit for 48±4 hours at room temperature. Perform initial measurement. •Measurement after test Perform a heat treatment at 150^{+0}_{-10}℃ for one hour and then let sit for 48±4 hours at room temperature, then measure.
		Capacitance Change	R6/R7 : Within ±12.5%	
		D.F.	0.2max.	
		I.R.	25Ω•F min	
		Dielectric Strength	No failure	

5

Chip Monolithic Ceramic Capacitors

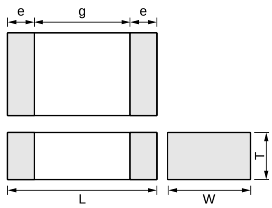
High-power Type

■ 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.
GJ6155	1.0 ±0.05	0.5 ±0.05	0.5 ±0.05	0.15 to 0.3	0.4

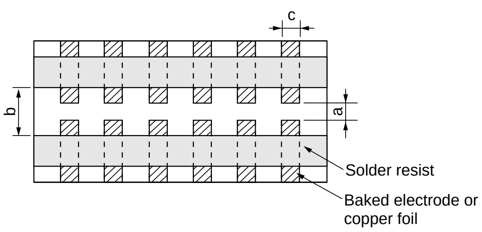
Part Number	TC Code	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GJ61555C1HR50CB01	C0G	50	0.50 ±0.25pF	1.00	0.50	0.50
GJ61555C1HR75CB01	C0G	50	0.75 ±0.25pF	1.00	0.50	0.50
GJ61555C1H1R0CB01	C0G	50	1.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H1R1CB01	C0G	50	1.1 ±0.25pF	1.00	0.50	0.50
GJ61555C1H1R2CB01	C0G	50	1.2 ±0.25pF	1.00	0.50	0.50
GJ61555C1H1R3CB01	C0G	50	1.3 ±0.25pF	1.00	0.50	0.50
GJ61555C1H1R5CB01	C0G	50	1.5 ±0.25pF	1.00	0.50	0.50
GJ61555C1H1R6CB01	C0G	50	1.6 ±0.25pF	1.00	0.50	0.50
GJ61555C1H1R8CB01	C0G	50	1.8 ±0.25pF	1.00	0.50	0.50
GJ61555C1H2R0CB01	C0G	50	2.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H2R2CB01	C0G	50	2.2 ±0.25pF	1.00	0.50	0.50
GJ61555C1H2R4CB01	C0G	50	2.4 ±0.25pF	1.00	0.50	0.50
GJ61555C1H2R7CB01	C0G	50	2.7 ±0.25pF	1.00	0.50	0.50
GJ61555C1H3R0CB01	C0G	50	3.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H3R3CB01	C0G	50	3.3 ±0.25pF	1.00	0.50	0.50
GJ61555C1H3R6CB01	C0G	50	3.6 ±0.25pF	1.00	0.50	0.50
GJ61555C1H3R9CB01	C0G	50	3.9 ±0.25pF	1.00	0.50	0.50
GJ61555C1H4R0CB01	C0G	50	4.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H4R3CB01	C0G	50	4.3 ±0.25pF	1.00	0.50	0.50
GJ61555C1H4R7CB01	C0G	50	4.7 ±0.25pF	1.00	0.50	0.50
GJ61555C1H5R0CB01	C0G	50	5.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H5R1CB01	C0G	50	5.1 ±0.25pF	1.00	0.50	0.50
GJ61555C1H5R6CB01	C0G	50	5.6 ±0.25pF	1.00	0.50	0.50
GJ61555C1H6R0CB01	C0G	50	6.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H6R0DB01	C0G	50	6.0 ±0.5pF	1.00	0.50	0.50
GJ61555C1H6R2CB01	C0G	50	6.2 ±0.25pF	1.00	0.50	0.50
GJ61555C1H6R8CB01	C0G	50	6.8 ±0.25pF	1.00	0.50	0.50
GJ61555C1H7R0CB01	C0G	50	7.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H7R0DB01	C0G	50	7.0 ±0.5pF	1.00	0.50	0.50
GJ61555C1H7R5CB01	C0G	50	7.5 ±0.25pF	1.00	0.50	0.50
GJ61555C1H8R0CB01	C0G	50	8.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H8R0DB01	C0G	50	8.0 ±0.5pF	1.00	0.50	0.50
GJ61555C1H8R2CB01	C0G	50	8.2 ±0.25pF	1.00	0.50	0.50
GJ61555C1H9R0CB01	C0G	50	9.0 ±0.25pF	1.00	0.50	0.50
GJ61555C1H9R0DB01	C0G	50	9.0 ±0.5pF	1.00	0.50	0.50
GJ61555C1H9R1CB01	C0G	50	9.1 ±0.25pF	1.00	0.50	0.50
GJ61555C1H100JB01	C0G	50	10.0 ±5%	1.00	0.50	0.50
GJ61555C1H100RB01	C0G	50	10 ±2.5%	1.00	0.50	0.50

Continued on the following page.

Continued from the preceding page.

Part Number	TC Code	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GJ61555C1H120JB01	C0G	50	12 ±5%	1.00	0.50	0.50
GJ61555C1H150JB01	C0G	50	15 ±5%	1.00	0.50	0.50
GJ61555C1H180JB01	C0G	50	18 ±5%	1.00	0.50	0.50

Specifications and Test Methods

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th>Specification</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></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, shall 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 shall 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 shall 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 shall be measured at 25℃ at the frequency and voltage shown in the table.
<table>
<tr><th>Item \ Char.</th><th>C0G(1000pF and below)</th></tr>
<tr><td>Frequency</td><td>1±0.1MHz</td></tr>
<tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</td></tr>
</table></td></tr>
<tr><td>8</td><td colspan="2">Q</td><td>30pF min. : Q≧1,000
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-1)</td><td rowspan="3">The capacitance change shall 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, (C0G : +25℃ to+125℃ : other temp. coeffs. : +25℃ to 85℃) the capacitance shall 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 step 1, 3 and 5 by the cap 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-1)</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 shall 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±1sec.
The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.


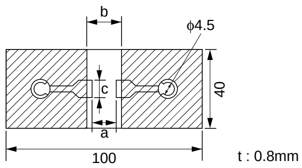
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>GJ615</td><td>0.4</td><td>1.5</td><td>0.5</td></tr>
</table>
(in mm)
Fig.1</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification: Temperature Compensating Type	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 shall 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, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).
		Capacitance	Within the specified tolerance.	
		Q	30pF min. : Q≧1,000 30pF max. : Q≧400+20C C : Nominal Capacitance (pF)	
12	Deflection		No cracking or marking defects shall occur.	Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2 using a eutectic solder. Then apply a force in the direction shown in Fig.3. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock..



Type	a	b	c
GJ615	0.4	1.5	0.5

(in mm)

Fig.2

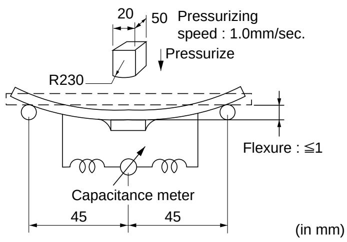


Fig.3

No.	Item		Specification: Temperature Compensating Type	Test Method
13	Solderability of Termination		75% of the terminations is 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℃.
14	Resistance to Soldering Heat		The measured and observed characteristics shall satisfy the specifications in the following table.	Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 24±2 hours.
		Appearance	No marking defects.	
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	
		Q	30pF and over : Q≧1,000 30pF and below : Q≧400+20C C : Nominal Capacitance (pF)	
		I.R.	More than 10,000MΩ or 500Ω • F (Whichever is smaller)	
		Dielectric Strength	No failure	
15	Temperature Cycle		The measured and observed characteristics shall 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 and over : Q≧1,000 30pF and below : Q≧400+20C C : Nominal Capacitance (pF)	
		I.R.	More than 10,000MΩ or 500Ω • F (Whichever is smaller)	
		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

No.	Item		Specification: Temperature Compensating Type	Test Method
16	Humidity, Steady State		The measured and observed characteristics shall satisfy the specifications in the following table.	Sit the capacitor 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 and over. : Q≧350 10pF and over, 30pF and below : Q≧275+ $\frac{5}{2}$ C 10pF and below : Q≧200+10C C : Nominal Capacitance (pF)	
		I.R.	More than 10,000MΩ or 500Ω • F (Whichever is smaller)	

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification: Temperature Compensating Type	Test Method
17	Humidity Load		The measured and observed characteristics shall satisfy the specifications in the following table.	Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects.	
		Capacitance Change	Within ±7.5% or ±0.75pF (Whichever is larger)	
		Q	30pF and over : Q≧200 30pF and below : Q≧100+ $\frac{10}{3}$ C C : Nominal Capacitance (pF)	
		I.R.	More than 500MΩ or 25Ω • F (Whichever is smaller)	
		Dielectric Strength	No failure	
18	High Temperature Load		The measured and observed characteristics shall satisfy the specifications in the following table.	Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3℃. Let sit for 24±2 hours (temperature compensating type) at room temperature, then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects.	
		Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	
		Q	30pF and over. : Q≧350 10pF and over, 30pF and below : Q≧275+ $\frac{5}{2}$ C 10pF and below : Q≧200+10C C : Nominal Capacitance (pF)	
		I.R.	More than 1,000MΩ or 50Ω • F (Whichever is smaller)	
		Dielectric Strength	No failure	
19	ESR		0.5pF≦C≦1pF : 350mΩ . pF below 1pF<C≦5pF : 300mΩ below 5pF<C≦10pF : 250mΩ below	The ESR shall be measured at room Temp. and frequency 1±0.2GHz with the equivalent of BOONTON Model 34A.
			10pF<C≦20pF : 400mΩ below	The ESR shall be measured at room Temp. and frequency 500±50MHz with the equivalent of HP8753B.

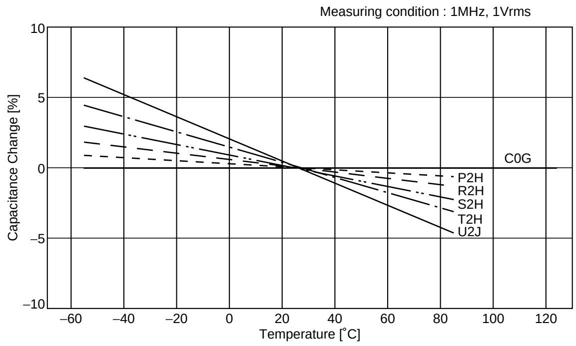
Table A

Char. Code	Temp. Coeff. (ppm/℃) Note 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

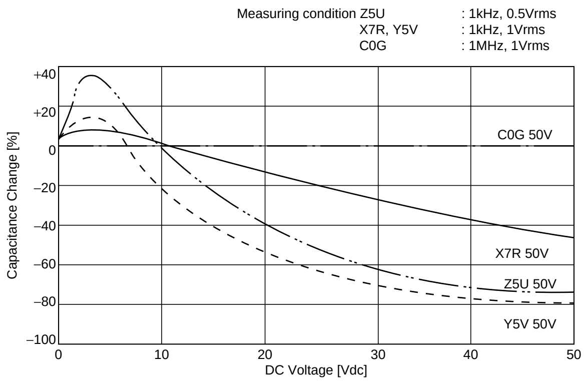
Note 1 : Nominal values denote the temperature coefficient within a range of 25 to 125℃.(for C0Δ)

GRM/GRP Series Data

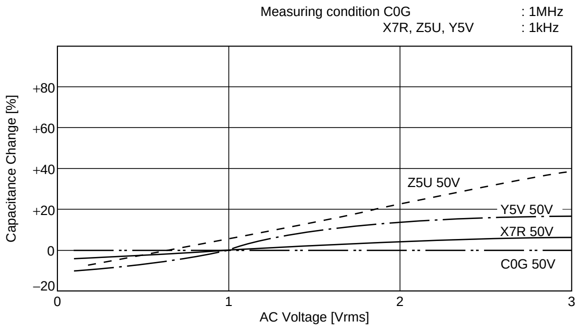
■ Capacitance-Temperature Characterstics



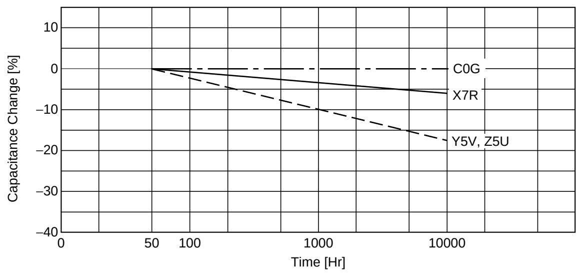
■ Capcitance-DC Voltage Characteristics



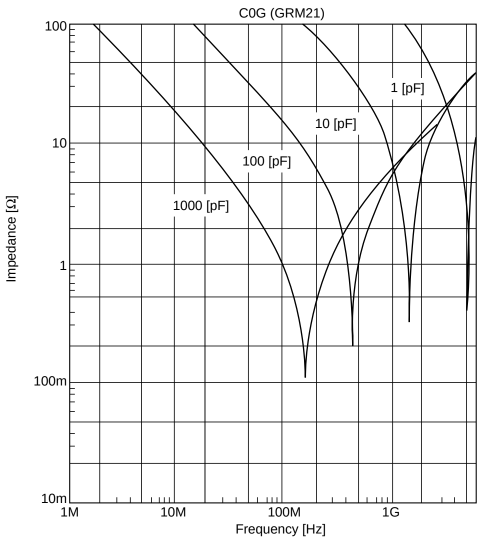
■ Capcitance-AC Voltage Characteristics



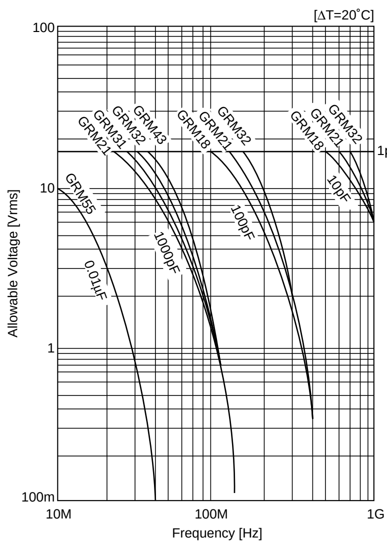
■ Capacitance Change-Aging



■ Impedance-Frequency Characteristics



■ Allowable Voltage-Frequency



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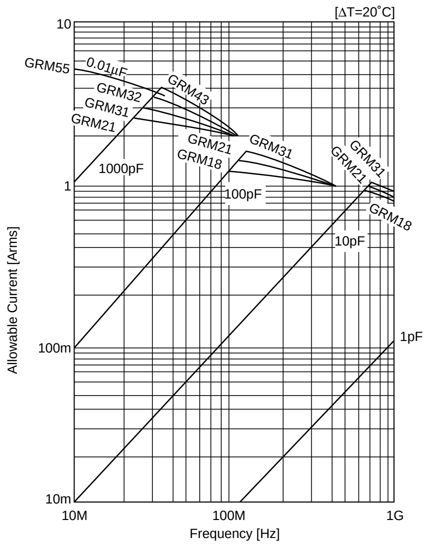
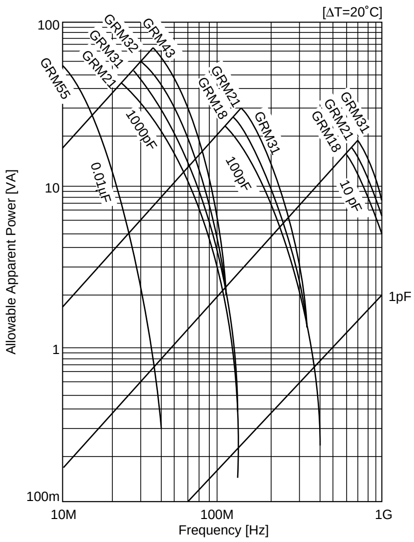
GRM/GRP Series Data

Continued from the preceding page.

■ Allowable Current-Frequency



■ Allowable Appearant Power



Chip Monolithic Ceramic Capacitors

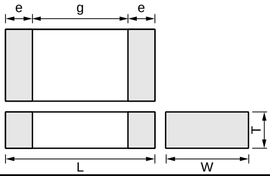
for Smoothing

■ Features

1. Heat generation is low at high frequency because of low dielectric loss.
2. Compared with aluminum electrolytic capacitors, capacitance can be lower to obtain the same smoothing performance.
3. Ceramic capacitor has no polarity and ensures long life time.

■ Applications

• DC-DC converter
• Noise elimination LCD bias circuit
(Use for only alumina, paper or glass epoxy board)



Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GJ221B	2.0 ±0.1	1.25 ±0.1	1.25 ±0.1	0.2 to 0.7	0.7
GJ231M	3.2 ±0.15	1.6 ±0.15	1.15 ±0.1	0.3 to 0.8	1.5
GJ232N	3.2 ±0.3	2.5 ±0.2	1.35 ±0.15	0.3	1.0
GJ232C			1.6 ±0.15		
GJ232R			1.8 ±0.2		
GJ243R	4.5 ±0.4	3.2 ±0.3	1.8 ±0.2	0.3	2.0
GJ243X			2.2 ±0.3		

Part Number	TC	Rated Voltage (Vdc)	Capacitance (µF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GJ221BF50J106ZD01	Y5V	6.3	10 +80.-20%	2.00	1.25	1.25
GJ231MF50J226ZD01	Y5V	6.3	22 +80.-20%	3.20	1.60	1.15
GJ232CF50J476ZD01	Y5V	6.3	47 +80.-20%	3.20	2.50	1.60
GJ243RF50J107ZD11	Y5V	6.3	100 +80.-20%	4.50	3.20	1.80
GJ232NF51A226ZD01	Y5V	10	22 +80.-20%	3.20	2.50	1.35
GJ243RF51A107ZD11	Y5V	10	100 +80.-20%	4.50	3.20	1.80
GJ232RF51H475ZD01	Y5V	50	4.7 +80.-20%	3.20	2.50	1.80
GJ243XF51H106ZD12	Y5V	50	10 +80.-20%	4.50	3.20	2.20
GJ232RF52A105ZD01	Y5V	100	1 +80.-20%	3.20	2.50	1.8

Specifications and Test Methods

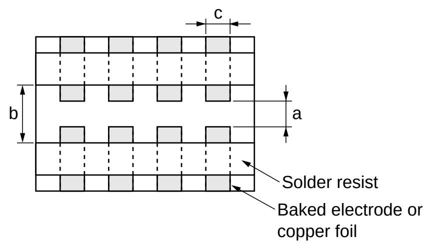
<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>F5 : −30°C to 85°C</td><td></td></tr>
<tr><td>2</td><td>Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage 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, shall be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td>No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td>Dimensions</td><td>Within the specified dimension.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td>No defects or abnormalities.</td><td>No failure shall be observed when 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.</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td>More than 10,000MΩ or 500Ω · F.
(Whichever is smaller)</td><td>The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at normal temperature and humidity and within 2 minutes* of charging.
*5minutes for c>47μF.</td></tr>
<tr><td>7</td><td>Capacitance</td><td>Within the specified tolerance.</td><td rowspan="2">The capacitance/D.F. shall 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</td><td>1±0.1kHz</td><td>1±0.2Vrms</td></tr><tr><td>C>10μF</td><td>120±24Hz</td><td>0.5±0.1Vrms</td></tr></table></td></tr>
<tr><td>8</td><td>Dissipation Factor (D.F.)</td><td>0.07 max. (50/100V)
0.09 max. (10/16/25V)
0.15 max. (6.3V)</td></tr>
<tr><td>9</td><td>Capacitance Temperature Characteristics</td><td><table><tr><th>Char.</th><th>Temp. Range</th><th>Reference Temp.</th><th>Cap. Change Rate</th></tr><tr><td>F5</td><td>-30 to +85°C</td><td>25°C</td><td>Within $^{+22}_{-82}$%</td></tr></table></td><td>The capacitance change shall be measured after 5 min. at each specified temperature stage.
The ranges of capacitance change compared to 25°C with the temperature ranges shown in the table shall be within the specified ranges.</td></tr>
<tr><td>10</td><td>Adhesive Strength of Termination</td><td>No removal of the terminations or other defects shall occur.


Fig.1</td><td>Solder the capacitor on the testing 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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defect such as heat shock.
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GJ218</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GJ221</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GJ231</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GJ232</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GJ243</td><td>3.5</td><td>7.0</td><td>3.7</td></tr></table>(in mm)</td></tr>
<tr><td>11</td><td>Vibration Resistance</td><td><table><tr><th>Item</th><th colspan="3">Frequency</th></tr><tr><td>Appearance</td><td colspan="3">No defects or abnormalities.</td></tr><tr><td>Capacitance Change</td><td colspan="3">Within the specified tolerance.</td></tr><tr><td rowspan="2">D.F.</td><td>50, 100V</td><td>10, 16, 25V</td><td>6.3V</td></tr><tr><td>0.07 max.</td><td>0.09 max.</td><td>0.15 max.</td></tr><tr><td>Dielectric Strength</td><td colspan="3">No failure</td></tr></table></td><td>Solder the capacitor on the testing jig (glass epoxy board) in the same manner and under the same conditions as (10).
The capacitor shall be subjected to 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, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).</td></tr>
</table>

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Specifications and Test Methods

Continued from the preceding page.

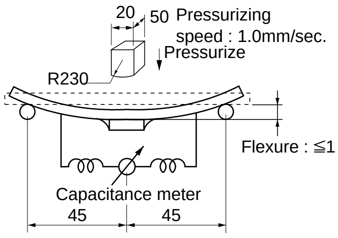
<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>12</td><td>Deflection</td><td>No cracks or marking defects shall occur.


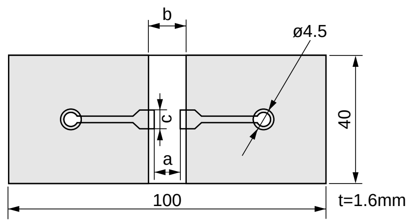
Fig.3</td><td>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2 using a eutectic solder. Then apply a force in the direction shown in Fig.3 for 5±1 sec. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering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


Fig.2
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr>
<tr><td>GJ218</td><td>1.0</td><td>3.0</td><td>1.2</td></tr>
<tr><td>GJ221</td><td>1.2</td><td>4.0</td><td>1.65</td></tr>
<tr><td>GJ231</td><td>2.2</td><td>5.0</td><td>2.0</td></tr>
<tr><td>GJ232</td><td>2.2</td><td>5.0</td><td>2.9</td></tr>
<tr><td>GJ243</td><td>3.5</td><td>7.0</td><td>3.7</td></tr>
</table>
(in mm)</td></tr>
<tr><td>13</td><td>Solderability of Termination</td><td>75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor first ethanol (JIS-K-8101)a solution of rosin (JIS-K-5902) (25% rosin in weight proportion), then in an eutectic solder solution for 2±0.5 seconds at 230±5°C after preheating in the following table. then set it for 48±4 hours at room temperature and measure.</td></tr>
<tr><td>14</td><td>Resistance to Soldering Heat</td><td>The measured values shall satisfy the values in the following table.
<table>
<tr><th>Item</th><th colspan="3">Specification</th></tr>
<tr><td>Appearance</td><td colspan="3">No marked defect</td></tr>
<tr><td>Capacitance Change</td><td colspan="3">Within ±20%</td></tr>
<tr><td>I. R.</td><td colspan="3">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>50, 100V
0.07 max.</td><td>10, 16, 25V
0.09 max.</td><td>6.3V
0.15 max.</td></tr>
<tr><td>Dielectric Strength</td><td colspan="3">No failure</td></tr>
</table></td><td>The capacitor shall be set for 48±4 hours at room temperature after one hour heat of treatment at 150.$^{+0}_{-10}$ °C.
Immerse the capacitor in a eutectic solder solution at 270± 5°C for 10±0.5 seconds after preheating in the flowing table. Then set it for 48T4 hours at room temperature and measure.</td></tr>
<tr><td>15</td><td>Temperature Cycle</td><td>No marking defects.
<table>
<tr><th>Item</th><th colspan="3">Specification</th></tr>
<tr><td>Appearance</td><td colspan="3">No marked defect</td></tr>
<tr><td>Capacitance Change</td><td colspan="3">Within ±20%</td></tr>
<tr><td>I. R.</td><td colspan="3">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>50, 100V
0.07 max.</td><td>10, 16, 25V
0.09 max.</td><td>6.3V
0.15 max.</td></tr>
<tr><td>Dielectric Strength</td><td colspan="3">No failure</td></tr>
</table></td><td>The capacitor shall be set for 48±4 hours at room temperature after one hour heat of treatment at 150$^{+0}_{-10}$ °C.
Then measure for the initial measurement. Fix capacitor to the supporting jig in the same manner and under the same conditions as in (10) and conduct the five cycles according to the temperature and time shown in the following table.
Set it for 48±4 hours at room temperature, then measure.
<table>
<tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Temp. (ºC)</td><td>Min. Operating Temp. $^{+3}_{-0}$</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>16</td><td>Humidity Steady State</td><td>No marking defects.
<table>
<tr><th>Item</th><th colspan="3">Specification</th></tr>
<tr><td>Appearance</td><td colspan="3">No marked defect</td></tr>
<tr><td>Capacitance Change</td><td colspan="3">Within ±30%</td></tr>
<tr><td>I. R.</td><td colspan="3">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>50, 100V
0.1 max.</td><td>10, 16, 25V
0.125 max.</td><td>6.3V
0.2 max.</td></tr>
<tr><td>Dielectric Strength</td><td colspan="3">No failure</td></tr>
</table></td><td>Set the capacitor for 500±12 hours at 40±2°C and 90 to 95% humidity. Take it out and set it for 48T4 hours at room temperature, then measure.</td></tr>
<tr><td>17</td><td>Humidity Load</td><td>No marking defects.
<table>
<tr><th>Item</th><th colspan="3">Specification</th></tr>
<tr><td>Appearance</td><td colspan="3">No marked defect</td></tr>
<tr><td>Capacitance Change</td><td colspan="3">Within ±30%</td></tr>
<tr><td>I. R.</td><td colspan="3">More than 500MΩ or 25Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>50, 100V
0.1 max.</td><td>10, 16, 25V
0.125 max.</td><td>6.3V
0.2 max.</td></tr>
<tr><td>Dielectric Strength</td><td colspan="3">No failure</td></tr>
</table></td><td>Apply the rated voltage for 500±12 hours at 40±2°C and 90 to 95% humidity and set it for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

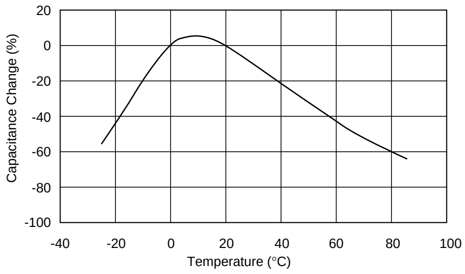
Continued from the preceding page.

<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>18</td><td>High Temperature Load</td><td>No marked defect.
<table>
<tr><th>Item</th><th colspan="3">Specification</th></tr>
<tr><td>Appearance</td><td colspan="3">No marked defect</td></tr>
<tr><td>Capacitance Change</td><td colspan="3">Within ±30%</td></tr>
<tr><td>I. R.</td><td colspan="3">More than 1,000MΩ or 50Ω · F
(Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>50, 100V
0.1 max.</td><td>10, 16, 25V
0.125 max.</td><td>6.3V
0.2 max.</td></tr>
<tr><td>Dielectric Strength</td><td colspan="3">No failure</td></tr>
</table></td><td>The voltage treatment shall 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°C then it shall be set for 48±4 hours at room temperature and the measurement shall 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.
*150% for C>10μF</td></tr>
</table>

Characteristics Data

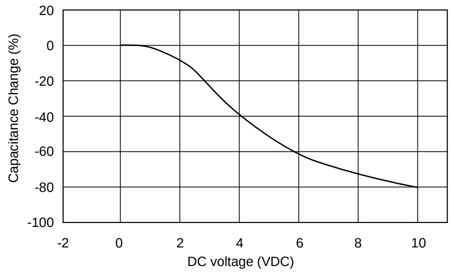
■ Capacitance-Temperature Characterstics

Samples : GJ231MF51A106Z
Equipment : HP4284A
Measuring conditions : 1kHz, 1Vrms



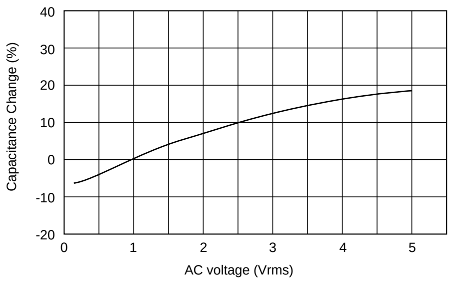
■ Capcitance-DC Voltage Characteristics

Samples : GJ231MF51A106Z
Equipment : HP4284A
Measuring conditions : 1kHz, 1Vrms,
Applied AC voltage per 30 sec.



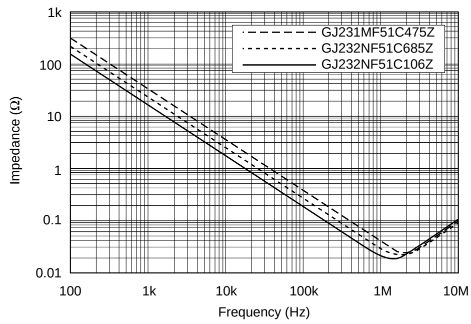
■ Capcitance-AC Voltage Characteristics

Samples : GJ231MF51A106Z
Equipment : HP4284A
Measuring conditions : 1kHz, 1Vrms,
Applied AC voltage per 30 sec.



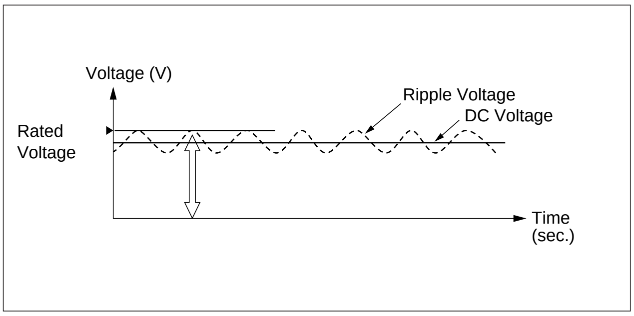
■ Impedance-Frequency Characteristics

Equipment : HP4192A



■ Allowable Ripple Current

Ripple current should be less than "Allowable ripple current value" shown in the following table.
And temperature rise of the chip surface (ΔT) should be below 20°C. When AC and DC voltage are superimposed, keep the peak value of the voltage within the rated voltage.



Allowable ripple current value

Series	Rated Voltage	Allowable ripple current value (r.m.s.)		
		100kHz≦ f <300kHz	300kHz≦ f <500kHz	500kHz≦ f <1MHz
GJ221	4V / 6.3V	1.4Ar.m.s.	1.5Ar.m.s.	1.6Ar.m.s.
GJ231		1.5Ar.m.s.	1.6Ar.m.s.	1.6Ar.m.s.
GJ232		1.7Ar.m.s.	1.8Ar.m.s.	2.0Ar.m.s.
GJ243		1.4Ar.m.s.	1.3Ar.m.s.	1.2Ar.m.s.
GJ218	10V	1.4Ar.m.s.	1.5Ar.m.s.	1.6Ar.m.s.
GJ231		1.5Ar.m.s.	1.6Ar.m.s.	1.6Ar.m.s.
GJ232		1.7Ar.m.s.	1.8Ar.m.s.	2.0Ar.m.s.
GJ243		1.4Ar.m.s.	1.3Ar.m.s.	1.2Ar.m.s.
GJ231	16V	1.5Ar.m.s.	1.6Ar.m.s.	1.6Ar.m.s.
GJ232		1.7Ar.m.s.	1.8Ar.m.s.	2.0Ar.m.s.
GJ232	25V / 35V / 50V	2.0Ar.m.s.	2.2Ar.m.s.	2.2Ar.m.s.
GJ243		2.0Ar.m.s.	2.2Ar.m.s.	2.2Ar.m.s.
GJ232	100V	1.6Ar.m.s.	1.7Ar.m.s.	1.8Ar.m.s.

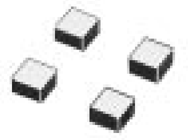
Chip Monolithic Ceramic Capacitors

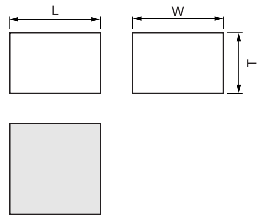
Microchips

8

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

■ Applications
• Optical device for telecommunication.
• IC, IC packaging built-in.
• 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	Rated Voltage (Vdc)	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)
GMA05XF51A153ZD01	Y5V	10	15000pF +80/-20%	0.5	0.5	0.35
GMA085F51A104ZD01	Y5V	10	0.1μF +80/-20%	0.8	0.8	0.5
GMA05XR71C102MD01	X7R	16	1000pF ±20%	0.5	0.5	0.35
GMA05XR71C152MD01	X7R	16	1500pF ±20%	0.5	0.5	0.35
GMA05XR71C222MD01	X7R	16	2200pF ±20%	0.5	0.5	0.35
GMA085R71C103MD01	X7R	16	10000pF ±20%	0.8	0.8	0.5
GMA05XF51C472ZD01	Y5V	16	4700pF +80/-20%	0.5	0.5	0.35
GMA05XF51C682ZD01	Y5V	16	6800pF +80/-20%	0.5	0.5	0.35
GMA085F51C473ZD01	Y5V	16	47000pF +80/-20%	0.8	0.8	0.5
GMA05XR71H471MD01	X7R	50	470pF ±20%	0.5	0.5	0.35

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature</td><td>R7 : −55℃ to +125℃
F5 : −30℃ to +85℃</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, shall 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>See the previous pages.</td><td>Visual inspection.</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td>No defects or abnormalities.</td><td>No failure shall 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.</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>10,000MΩ min.</td><td>The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at normal temperature and 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>The capacitance shall be measured at 25℃ with 1±0.1kHz in frequency and 1±0.2Vr.m.s. in voltage.</td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td>R7 : 0.035 max.
F5 : 0.09 max. (for 16V)
: 0.125 max. (for 10V)</td><td>D.F. shall be measured under the same conditions at the capacitance.</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 Rate</th></tr><tr><td>R7</td><td>−55 to +125℃</td><td>25℃</td><td>Within±15%</td></tr><tr><td>F5</td><td>−30 to +85℃</td><td>25℃</td><td>Within$\pm^{22}_{82}$%</td></tr></table></td><td>The range of capacitance change in reference to 25℃ within the temperature range shown in the table shall be within the specified ranges.
The capacitance change shall be measured after 5 min. at each specified temperature stage.</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Mechanical Strength</td><td>Bond Strength</td><td>Pull force : 3.0g min.</td><td>MIL-STD-883 Method 2011 Condition D
Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20) and bond a 20µm (0.0008 inch) gold wire to the capacitor terminal using an ultrasonic wedge bond. Then, pull wire.</td></tr>
<tr><td>Die Shear Strength</td><td>Die Shear force : 200g min.</td><td>MIL-STD-883 Method 2019
Mount the capacitor on a gold metallized alumina substrate with Au-Sn (80/20). Apply the force parallel to the substrate.</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="3">Ramp frequency from 10 to 55Hz then return to 10Hz all within 1 minute. Amplitude : 1.5 mm (0.06 inch) max. total excursion.
Apply this motion for a period of 2 hours in each of 3 mutually perpendicular directions (total 6 hours).</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance.</td></tr>
<tr><td>D.F.</td><td>R7 : 0.035 max.
F5 : 0.09 max. (for 16V)
: 0.125 max. (for 10V)</td></tr>
<tr><td>12</td><td colspan="2">Temperature Cycle</td><td>The measured values shall satisfy the values in the following table.<table><tr><th>Item</th><th>Specification</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>R7 ······· Within±7.5%
F5 ······· Within±20%</td></tr><tr><td>I.R.</td><td>More than 10,000MΩ</td></tr><tr><td>D.F.</td><td>R7 ······· 0.035 max.
F5 ······· 0.09 max.(for 16V)
0.125 max.(for 10V)</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table></td><td>The capacitor shall 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.<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>13</td><td colspan="2">Humidity (Steady State)</td><td>The measured values shall satisfy the values in the following table.<table><tr><th>Item</th><th>Specification</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>R7 ······· Within±12.5%
F5 ······· Within±30%</td></tr><tr><td>I.R.</td><td>More than 1,000MΩ</td></tr><tr><td>D.F.</td><td>R7 ······· 0.05 max.
F5 ······· 0.125 max.(for 16V)
0.15 max.(for 10V)</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table></td><td>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.</td></tr>
</table>

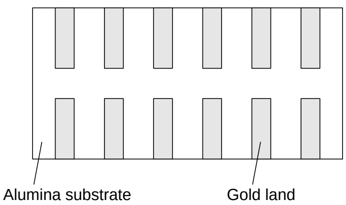
Continued on the following page. ↗

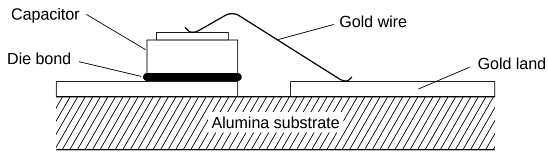
Specifications and Test Methods

Continued from the preceding page.

<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>14</td><td>Humidity Load</td><td>The measured values shall satisfy the values in the following table.
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>R7 ······· Within±12.5%
F5 ······· Within$^{+30}_{-40}$%</td></tr>
<tr><td>I.R.</td><td>More than 500MΩ</td></tr>
<tr><td>D.F.</td><td>R7 ······· 0.05 max.
F5 ······· 0.125 max.(for 16V)
0.15 max.(for 10V)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table></td><td>Apply the rated voltage for 500±12 hours at 40±20℃, 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 Y5V
Perform a heat treatment at 150$^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>15</td><td>High Temperature Load</td><td>The measured values shall satisfy the values in the following table.
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>R7 ······· Within±12.5%
F5 ······· Within$^{+30}_{-40}$%</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>D.F.</td><td>R7 ······· 0.05 max.
F5 ······· 0.125 max.(for 16V)
0.15 max.(for 10V)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table></td><td>A voltage treatment shall 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 shall be set for 48±4 hours at room temperature and the initial measurement shall 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.</td></tr>
</table>

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





8

muRata

Chip Monolithic Ceramic Capacitors

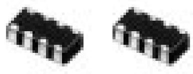
Capacitor Arrays

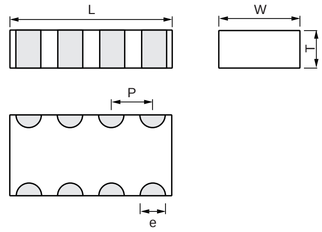
■ Features

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

■ Applications

General electronic equipment





Part Number	Dimensions (mm)				
	L	W	T	P	e
GNM314	3.2 ±0.15	1.6 ±0.15	0.8 ±0.1 1.0 ±0.1	0.8 ±0.1	0.4 ±0.15

Temperature Compensating Type

Part Number	**GNM31**	
L x W	3.2x1.6	
TC	C0G (**5C**)	
Rated Volt.	50 (**1H**)	100 (**2A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)		
10pF(**100**)	0.8(**4**)	0.8(**4**)
11pF(**110**)	0.8(**4**)	0.8(**4**)
12pF(**120**)	0.8(**4**)	0.8(**4**)
13pF(**130**)	0.8(**4**)	0.8(**4**)
15pF(**150**)	0.8(**4**)	0.8(**4**)
16pF(**160**)	0.8(**4**)	0.8(**4**)
18pF(**180**)	0.8(**4**)	0.8(**4**)
20pF(**200**)	0.8(**4**)	0.8(**4**)
22pF(**220**)	0.8(**4**)	0.8(**4**)
24pF(**240**)	0.8(**4**)	0.8(**4**)
27pF(**270**)	0.8(**4**)	0.8(**4**)
30pF(**300**)	0.8(**4**)	0.8(**4**)
33pF(**330**)	0.8(**4**)	0.8(**4**)
36pF(**360**)	0.8(**4**)	0.8(**4**)
39pF(**390**)	0.8(**4**)	0.8(**4**)
43pF(**430**)	0.8(**4**)	0.8(**4**)
47pF(**470**)	0.8(**4**)	0.8(**4**)
51pF(**510**)	0.8(**4**)	0.8(**4**)
56pF(**560**)	0.8(**4**)	0.8(**4**)
62pF(**620**)	0.8(**4**)	0.8(**4**)
68pF(**680**)	0.8(**4**)	0.8(**4**)
75pF(**750**)	0.8(**4**)	0.8(**4**)
82pF(**820**)	0.8(**4**)	0.8(**4**)
91pF(**910**)	0.8(**4**)	0.8(**4**)
100pF(**101**)	0.8(**4**)	0.8(**4**)
110pF(**111**)	0.8(**4**)	0.8(**4**)
120pF(**121**)	0.8(**4**)	0.8(**4**)
130pF(**131**)	0.8(**4**)	0.8(**4**)
150pF(**151**)	0.8(**4**)	0.8(**4**)
160pF(**161**)	0.8(**4**)	
180pF(**181**)	0.8(**4**)	

Continued on the following page.

Continued from the preceding page.

Part Number	**GNM31**	
L x W	3.2x1.6	
TC	C0G (**5C**)	
Rated Volt.	50 (**1H**)	100 (**2A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)		
200pF(**201**)	0.8(**4**)	
220pF(**221**)	0.8(**4**)	
240pF(**241**)	0.8(**4**)	
270pF(**271**)	0.8(**4**)	
300pF(**301**)	0.8(**4**)	
330pF(**331**)	0.8(**4**)	
360pF(**361**)	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

Part Number	**GNM31**						
L x W	3.2x1.6						
TC	X7R (**R7**)				Y5V (**F5**)		
Rated Volt.	16 (**1C**)	25 (**1E**)	50 (**1H**)	100 (**2A**)	16 (**1C**)	50 (**1H**)	100 (**2A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)							
220pF(**221**)				0.8(**4**)			
270pF(**271**)				0.8(**4**)			
330pF(**331**)				0.8(**4**)			
390pF(**391**)			0.8(**4**)	0.8(**4**)			
470pF(**471**)			0.8(**4**)	0.8(**4**)			
560pF(**561**)			0.8(**4**)	0.8(**4**)			
680pF(**681**)			0.8(**4**)	0.8(**4**)			
820pF(**821**)			0.8(**4**)	0.8(**4**)			
1000pF(**102**)			0.8(**4**)	0.8(**4**)			
1200pF(**122**)			0.8(**4**)	0.8(**4**)			
1500pF(**152**)			0.8(**4**)	0.8(**4**)			
1800pF(**182**)			0.8(**4**)	0.8(**4**)			
2200pF(**222**)			0.8(**4**)	0.8(**4**)			0.8(**4**)
2700pF(**272**)			0.8(**4**)	0.8(**4**)			
3300pF(**332**)			0.8(**4**)	0.8(**4**)			0.8(**4**)
3900pF(**392**)			0.8(**4**)	0.8(**4**)			
4700pF(**472**)			0.8(**4**)	0.8(**4**)			0.8(**4**)
5600pF(**562**)			0.8(**4**)				
6800pF(**682**)			0.8(**4**)				
8200pF(**822**)			0.8(**4**)				
10000pF(**103**)			0.8(**4**)				
12000pF(**123**)			0.8(**4**)				
15000pF(**153**)			0.8(**4**)				
18000pF(**183**)		0.8(**4**)					
22000pF(**223**)	0.8(**4**)					0.8(**4**)	
27000pF(**273**)	0.8(**4**)						
33000pF(**333**)	0.8(**4**)					0.8(**4**)	
39000pF(**393**)	0.8(**4**)						
47000pF(**473**)	1.0(**4**)					0.8(**4**)	
68000pF(**683**)	1.0(**4**)				0.8(**4**)		
0.10µF(**104**)	1.0(**4**)				0.8(**4**)		
0.15µF(**154**)					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.

muRata

Specifications and Test Methods

No.	Item		Specification: Temperature Compensating Type	Specification: High Dielectric Constant Type	Test Method
1	Operating Temperature		5C : −55 to +125℃	R7 : −55 to +125℃ F5 : −30 to +85℃	
2	Rated Voltage		See the previous page.		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, shall be maintained within the rated voltage range.
3	Appearance		No defects or abnormalities.		Visual inspection.
4	Dimensions		Within the specified dimension.		Using calipers.
5	Dielectric Strength		No defects or abnormalities.		No failure shall be observed when 300% of the rated voltage (C0G) or 250% of the rated voltage (X7R and Y5V) is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance (I.R.)		More than 10,000MΩ or 500Ω • F (Whichever is smaller)		The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 2 minutes of charging.
7	Capacitance		Within the specified tolerance.		The capacitance/Q/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table. (Table 8-1)
8	Q/Dissipation Factor (D.F.)		30pF min. : Q≧1,000 30pF max. : Q≧400+20C C : Nominal Capacitance (pF)	(Table 8-2)	
9	Capacitance Temperature Characteristics	Capacitance Change	Within the specified tolerance. (Table A-5)	(Table 9-1)	The capacitance change shall 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 step 1 through 5, the capacitance shall 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 step 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 25℃ value over the temperature ranges shown in the table shall be within the specified ranges.
		Temperature Coefficient	Within the specified tolerance. (Table A-5)		
		Capacitance Drift	Within ±0.2% or ±0.05pF (Whichever is larger)		
10	Adhesive Strength of Termination		No removal of the terminations or other defects shall occur.		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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock. (Fig.1)

Table 8-1 (Test Method, No. 7/8):

Item \ Char.	5C	R7, F5
Frequency	1±0.1MHz	1±0.1MHz
Voltage	0.5 to 5Vr.m.s.	1±0.2Vr.m.s.

Table 8-2 (High Dielectric Constant Type, No. 8):

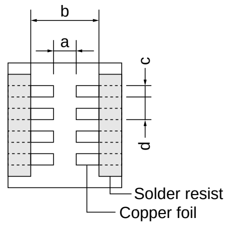
Char.	25V min.	16V
R7	0.025 max.	0.035 max.
F5	0.05 max.	0.07 max.

Table 9-1 (High Dielectric Constant Type, No. 9):

Char.	Temp. Range.	Reference Temp.	Cap. Change
R7	−55to +125℃	25℃	Within±15%
F5	−30to +85℃		Within $^{+22}_{-82}$%

Table 9-2 (Test Method, No. 9):

Step	Temperature(℃)
1	25±2
2	−55±3
3	25±2
4	125±3
5	25±2



Type	a	b	c	d
GNM31	0.8	2.5	0.4	0.8

(in mm)

Fig.1

Continued on the following page.

9

muRata

Specifications and Test Methods

Continued from the preceding page.

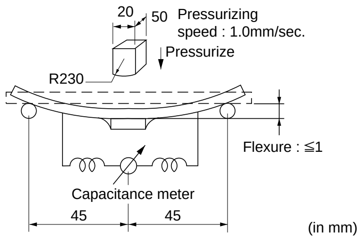
<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Constant Type</th></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</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 shall 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, shall be traversed in approximately 1 minute. This motion shall 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>Char. | 25V min. | 16V
R7 | 0.025 max. | 0.035 max.
F5 | 0.05 max. | 0.07 max.</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2" colspan="2">Deflection</td><td colspan="2">No cracking or marking defects shall 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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.


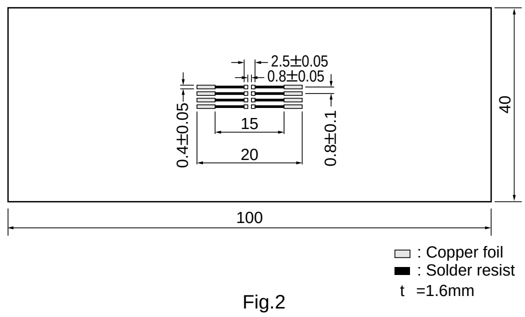
Fig.3</td></tr>
<tr><td colspan="2">

Fig.2</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td colspan="2">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 eutectic solder solution for 2±0.5 seconds at 230±5℃.</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 shall 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 solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type), then measure.

• Initial measurement for high dielectric constant type
Perform a heat treatment at 150$^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td><td>R7 ········ Within±7.5%
F5 ········ Within±20%</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over : Q≧1,000
30pF and below : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>Char. | 25V min. | 16V
R7 | 0.025 max. | 0.035 max.
F5 | 0.05 max. | 0.07 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω • F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="6">15</td><td rowspan="6">Temperature Cycle</td><td></td><td colspan="2">The measured and observed characteristics shall 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.
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
• Initial measurement for high dielectric constant type
Perform a heat treatment at 150$^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td><td>R7 ········ Within±7.5%
F5 ········ Within±20%</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over : Q≧1,000
30pF and below : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>Char. | 25V min. | 16V
R7 | 0.025 max. | 0.035 max.
F5 | 0.05 max. | 0.07 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω • F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification: Temperature Compensating Type	Specification: High Dielectric Constant Type	Test Method
16	Humidity, Steady State		The measured and observed characteristics shall satisfy the specifications in the following table.		Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
		Appearance	No marking defects.		
		Capacitance Change	Within ±5% or ±0.5pF (Whichever is larger)	R7 ········ Within±12.5% F5 ········ Within±30%	
		Q/D.F.	30pF and over : Q≧350 10pF and over, 30pF and below : $Q \geqq 275+\frac{5}{2}C$ 10pF and below : Q≧200+10C C : Nominal Capacitance (pF)	Char. / 25V min. / 16V R7 / 0.05 max. / 0.05 max. F5 / 0.075 max. / 0.1 max.	
		I.R.	More than 1,000MΩ or 50Ω • F (Whichever is smaller)		
17	Humidity Load		The measured and observed characteristics shall 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 (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.
		Appearance	No marking defects.		
		Capacitance Change	Within ±7.5% or ±0.75pF (Whichever is larger)	R7 ········ Within±12.5% F5 ········ Within±30%	
		Q/D.F.	30pF and over : Q≧200 30pF and below : $Q \geqq 100+\frac{10}{3}C$ C : Nominal Capacitance (pF)	Char. / 25V min. / 16V R7 / 0.05 max. / 0.05 max. F5 / 0.075 max. / 0.1 max.	
		I.R.	More than 500MΩ or 25Ω • F (Whichever is smaller)		
		Dielectric Strength	No failure		
18	High Temperature Load		The measured and observed characteristics shall satisfy the specifications in the following table.		Apply 200% of the rated voltage for 1,000±12 hours at the maximum operating temperature ±3℃. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA. •Initial measurement for high dielectric constant type. Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3℃. Remove and let sit for 48±4 hours at room temperature. Perform initial measurement.
		Appearance	No marking defects.		
		Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	R7 ········ Within±12.5% F5 ········ Within±30%	
		Q/D.F.	30pF and over : Q≧350 10pF and over, 30pF and below : $Q \geqq 275+\frac{5}{2}C$ 10pF and below : Q≧200+10C C : Nominal Capacitance (pF)	Char. / 25V min. / 16V R7 / 0.04 max. / 0.05 max. F5 / 0.075 max. / 0.1 max.	
		I.R.	More than 1,000MΩ or 50Ω • F (Whichever is smaller)		
		Dielectric Strength	No failure		

Table A

Char. Code	Temp. Coeff. (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℃.

Chip Monolithic Ceramic Capacitors

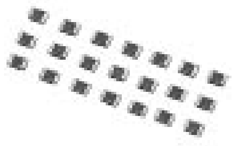
for Ultrasonic Sensors

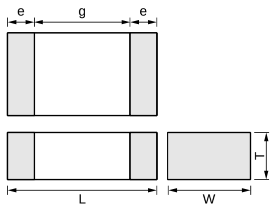
■ Features

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

■ Application

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

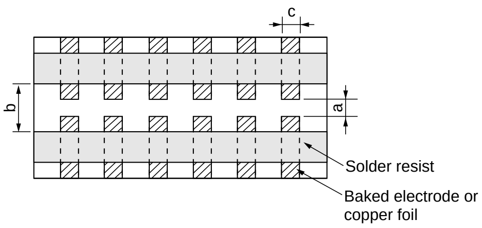




Part Number	Dimensions (mm)				
	L	W	T	e	g min.
GRM219	2.0 ±0.1	1.25 ±0.1	0.85 ±0.1	0.2 to 0.7	0.7

Part Number	TC Code	Rated Voltage (Vdc)	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GRM2199E2A102KD01	ZLM	100	1000 ±10%	2.0	1.25	0.85
GRM2199E2A152KD01	ZLM	100	1500 ±10%	2.0	1.25	0.85

Specifications and Test Methods

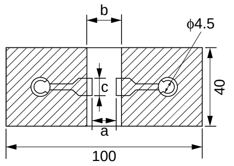
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature</td><td>−25℃ to +85℃</td><td></td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined 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, shall 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 shall 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 or 500Ω • F. (Whichever is smaller)</td><td>The insulation resistance shall 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. shall be measured at 20℃ with 1±0.1kHz in frequency and 1±0.2Vr.m.s. 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 shall be within the specified tolerance for the temperature coefficient.
The capacitance change shall 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 shall 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 shall be done either with an iron or using the reflow method and shall 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 shall 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, shall be traversed in approximately 1 minute. This motion shall 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>0.01 max.</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

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



t : 1.6mm

Type	a	b	c
GRM21	1.2	4.0	1.65

(in mm)

Fig.2

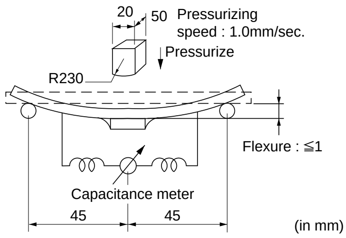


Fig.3

13	Solderability of Termination		75% of the terminations is 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℃.
14	Resistance to Soldering Heat	Appearance	No defects or abnormalities.	Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 24±2 hours , then measure.
		Capacitance Change	Within ±7.5%	
		D.F.	0.01 max.	
		I.R.	More than 10,000MΩ or 500Ω • F (Whichever is smaller)	
		Dielectric Strength	No failure	
15	Temperature Cycle	Appearance	No defects or abnormalities.	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room temperature, then measure.
		Capacitance Change	Within ±7.5%	
		D.F.	0.01 max.	
		I.R.	More than 10,000MΩ or 500Ω • F (Whichever is smaller)	
		Dielectric Strength	No failure	

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

16	Humidity, Steady State	Appearance	No defects or abnormalities.	Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure.
		Capacitance Change	Within ±12.5%	
		D.F.	0.02 max.	
		I.R.	More than 1,000MΩ or 50Ω • F (Whichever is smaller)	
		Dielectric Strength	No failure	
17	Humidity Load	Appearance	No defects or abnormalities.	Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	Within ±12.5%	
		D.F.	0.02 max.	
		I.R.	More than 500MΩ or 25Ω • F (Whichever is smaller)	
18	High Temperature Load	Appearance	No defects or abnormalities.	Apply 200% of the rated voltage for 1,000±12 hours at 85±3℃. Let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
		Capacitance Change	Within ±12.5%	
		D.F.	0.02 max.	
		I.R.	More than 1,000MΩ or 50Ω • F (Whichever is smaller)	

10

Chip Monolithic Ceramic Capacitors

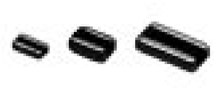
Low ESL

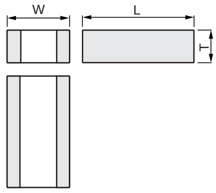
■ Features

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

■ Applications

- High speed micro processor.
- 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

LLL18 Series (1.6x0.8mm)

Part Number	**LLL18**			
L x W	1.6x0.8			
TC	X7R (**R7**)			
Rated Volt.	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)
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**)
6800pF(**682**)			0.5(**5**)	
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**)		
0.1µF(**104**)	0.5(**5**)			

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

LLL21 Series (2.0x1.25mm)

Part Number	**LLL21**			
L x W	2.0x1.25			
TC	X7R (**R7**)			
Rated Volt.	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)				
0.22pF(**224**)	0.6(**6**)			
4700pF(**472**)				0.6(**6**)
6800pF(**682**)				0.6(**6**)
10000pF(**103**)				0.6(**6**)
15000pF(**153**)				0.6(**6**)
22000pF(**223**)				0.6(**6**)
33000pF(**333**)		0.6(**6**)	0.6(**6**)	0.85(**9**)

Continued on the following page.

Continued from the preceding page.

Part Number	LLL21			
L x W	2.0x1.25			
TC	X7R (**R7**)			
Rated Volt.	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)				
47000pF(**473**)		0.6(**6**)	0.6(**6**)	
68000pF(**683**)		0.6(**6**)	0.6(**6**)	
0.1µF(**104**)		0.6(**6**)	0.6(**6**)	
0.15µF(**154**)		0.6(**6**)	0.85(**9**)	
0.22µF(**224**)		0.85(**9**)		
0.33µF(**334**)	0.6(**6**)			
0.47µF(**474**)	0.85(**9**)			

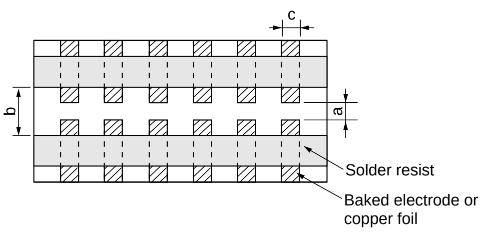
The part numbering code is shown in ( ).
Dimensions are shown in mm and Rated Voltage in Vdc.

LLL31 Series (3.2x1.6mm)

Part Number	LLL31			
L x W	3.2x1.6			
TC	X7R (**R7**)			
Rated Volt.	10 (**1A**)	16 (**1C**)	25 (**1E**)	50 (**1H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)				
10000pF(**103**)				0.7(**7**)
15000pF(**153**)				0.7(**7**)
22000pF(**223**)				0.7(**7**)
33000pF(**333**)				0.7(**7**)
47000pF(**473**)				0.7(**7**)
68000pF(**683**)				0.7(**7**)
0.1µF(**104**)		0.7(**7**)	0.7(**7**)	1.15(**M**)
0.15µF(**154**)		0.7(**7**)	0.7(**7**)	
0.22µF(**224**)		0.7(**7**)	1.15(**M**)	
0.33µF(**334**)		0.7(**7**)	1.15(**M**)	
0.47µF(**474**)		0.7(**7**)	1.15(**M**)	
0.68µF(**684**)	0.7(**7**)	1.15(**M**)		
1.0µF(**105**)	0.7(**7**)	1.15(**M**)		
1.5µF(**155**)	1.15(**M**)			
2.2µF(**225**)	1.15(**M**)			

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

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</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">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, shall 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 shall be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td>More than 10,000MΩ or 500Ω • F (Whichever is smaller)</td><td>The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25℃ and 75%RH max. and within 2 minutes of charging.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</td><td>Within the specified tolerance.</td><td rowspan="2">The capacitance/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table.<table><tr><th></th><th>R7</th></tr><tr><td>Frequency</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>1±0.2Vr.m.s.</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Dissipation Factor (D.F.)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td></tr></table></td></tr>
<tr><td>9</td><td colspan="2">Capacitance Temperature Characteristics</td><td><table><tr><th>Char.</th><th>Temp. Range (℃)</th><th>Reference Temp.</th><th>Cap. Change.</th></tr><tr><td>R7</td><td>−55 to +125</td><td>25℃</td><td>Within±15%</td></tr></table></td><td>The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table shall be within the specified ranges.
The capacitance change shall be measured after 5 min. at each specified temperature stage.</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect shall 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. *5N:LLL18
The soldering shall be done either with an iron or using the reflow method and shall 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>LLL18</td><td>0.3</td><td>1.2</td><td>2.0</td></tr><tr><td>LLL21</td><td>0.6</td><td>1.6</td><td>2.4</td></tr><tr><td>LLL31</td><td>1.0</td><td>3.0</td><td>3.7</td></tr></table>(in mm)
Fig.1</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="3">Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10).
The capacitor shall 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, shall be traversed in approximately 1 minute. This motion shall 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><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>R7</td><td>0.025 max.</td><td>0.035 max.</td></tr></table></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>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="2">12</td><td colspan="2" rowspan="2">Deflection</td><td>No crack or marked defect shall 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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.

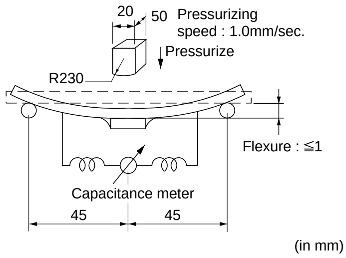
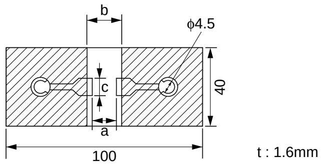



Fig.3</td></tr>
<tr><td><table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>LLL18</td><td>0.3</td><td>1.2</td><td>2.0</td></tr><tr><td>LLL21</td><td>0.6</td><td>1.6</td><td>2.4</td></tr><tr><td>LLL31</td><td>1.0</td><td>3.0</td><td>3.7</td></tr></table>(in mm)
Fig.2</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td>75% of the terminations 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 eutectic solder solution for 2±0.5 seconds at 230±5℃.</td></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="5">Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit at room temperature for 48±4 hours , then measure.

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

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11

Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification	Test Method
18	High Temperature Load	Appearance	No defects or abnormalities.	Apply 200% of the rated voltage for 1,000±12 hours at maximum operating temperature ±3℃. Let sit for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA. •Initial measurement. Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3℃. Remove and let sit for 48±4 hours at room temperature. Perform initial measurement.
		Capacitance Change	Within±12.5%	
		D.F.	Char. / 25V min. / 16V R7 / 0.05 max. / 0.05 max.	
		I.R.	More than 1,000MΩ or 50Ω • F (Whichever is smaller)	
		Dielectric Strength	No failure	

Chip Monolithic Ceramic Capacitors

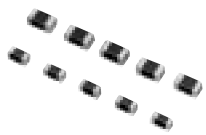
High Frequency for Flow/Reflow Soldering

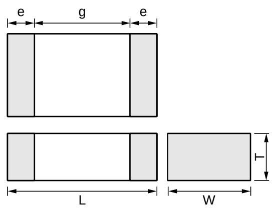
■ Features

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.	50 (**1H**)	100 (**2A**)	50 (**1H**)	100 (**2A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)				
0.5pF(**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**)
10.0pF(**100**)	0.80(**8**)			0.85(**9**)

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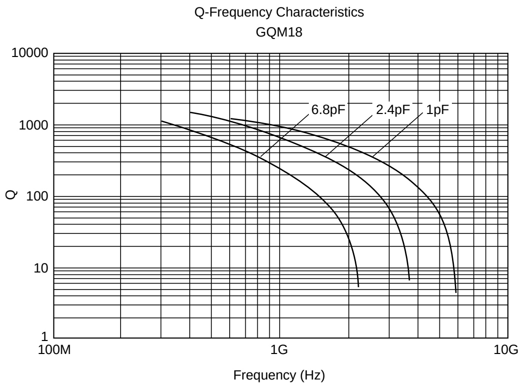
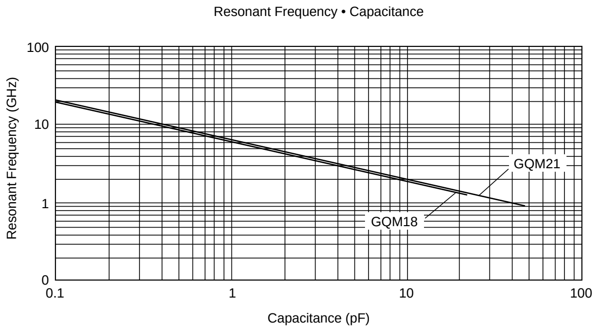
Part Number	GQM18		GQM21	
L x W	1.60x0.80		2.00x1.25	
TC	C0G (**5C**)		C0G (**5C**)	
Rated Volt.	50 (**1H**)	100 (**2A**)	50 (**1H**)	100 (**2A**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)				
11pF(**110**)	0.80(**8**)			0.85(**9**)
12pF(**120**)	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**)			0.85(**9**)	
30pF(**300**)			0.85(**9**)	
33pF(**330**)			0.85(**9**)	
36pF(**360**)			0.85(**9**)	
39pF(**390**)			0.85(**9**)	
43pF(**430**)			0.85(**9**)	
47pF(**470**)			0.85(**9**)	

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

■ Q-Frequency Characteristics

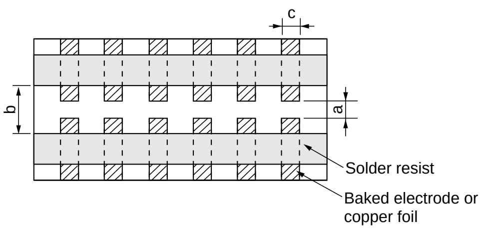


■ Resonant Frequency-Capacitance



12

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>C0G : −55℃ to 125℃</td><td></td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall 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 shall 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 or 500Ω • F. (Whichever is smaller)</td><td>The insulation resistance shall 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 shall be measured at 25℃ at the frequency and voltage shown in the table.
<table><tr><th>Item \ Char.</th><th>C0G(1000pF and below)</th></tr><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>Q≧1000</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-1)</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 shall be within the specified tolerance for the temperature coefficient and capacitance change as Table A.
The capacitance drift is caluculated by dividing the differences between the maximum and minimum measured values in the step 1, 3 and 5 by the cap. 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-1)</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 shall 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±1sec.
The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*5N (GQM18)

<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 shall 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, shall be traversed in approximately 1 minute. This motion shall 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>Q</td><td>Q≧1000</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>Specification</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 shall occur.</td><td rowspan="2">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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.

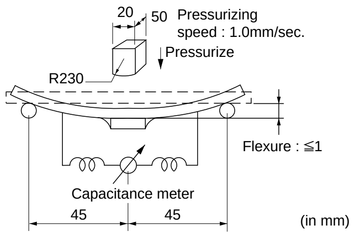
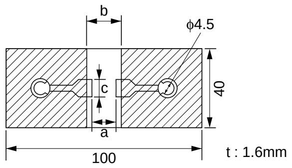



Fig.3</td></tr>
<tr><td>
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GQM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GQM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr></table>(in mm)
Fig.2</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td>75% of the terminations 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 eutectic solder solution for 2±0.5 seconds at 230±5℃.</td></tr>
<tr><td rowspan="6">14</td><td rowspan="6">Resistance to Soldering Heat</td><td></td><td>The measured and observed characteristics shall 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 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≧1000</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 shall 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≧1000</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">16</td><td rowspan="6">Humidity, Steady State</td><td></td><td>The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="6">Sit the capacitor 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>Q≧350</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 50Ω • F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
<tr><td rowspan="6">17</td><td rowspan="6">Humidity Load</td><td></td><td>The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="6">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>Appearance</td><td>No marking defects.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5% or ±0.75pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≧200</td></tr>
<tr><td>I.R.</td><td>More than 500MΩ or 25Ω • F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>

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Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification	Test Method
18	High Temperature Load		The measured and observed characteristics shall satisfy the specifications in the following table.	Apply 200% of the rated voltage for 1,000±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	Q≧350	
		I.R.	More than 1,000MΩ or 50Ω • F (Whichever is smaller)	
		Dielectric Strength	No failure	

Table A

Char. Code	Nominal Values (ppm/℃) Note 1	Capacitance Change from 25℃ (%)					
		−55℃		−30℃		−10℃	
		Max.	Min.	Max.	Min.	Max.	Min.
C0G	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 C0G)

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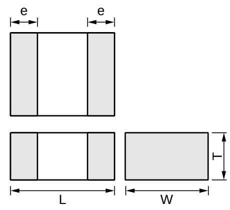
Chip Monolithic Ceramic Capacitors

High-Q & High Power Type

■ Features (ERF Series)

1. The dielectric is composed of low dielectric loss ceramic. This series is perfectly suited to high-frequency applications. (VHS-microwave band)
2. The series is ultraminiature, yet has a high-power capacity. This is the best capacitor available for transmitter and amplifier circuits such as those in broadcasting equipment and mobile base stations.
3. ERF1D type is designed for both flow and reflow soldering and ERF22 type is designed for reflow soldering.



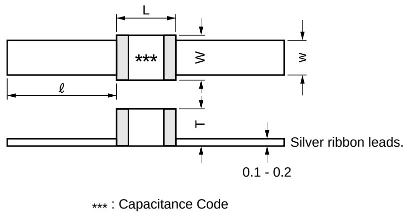
Part Number	Dimensions (mm)			
	L	W	T	e
ERF1DM	$1.4^{+0.6}_{-0.4}$	$1.4^{+0.6}_{-0.4}$	$1.15^{+0.50}_{-0.35}$	$0.25^{+0.25}_{-0.15}$
ERF22X	$2.8^{+0.6}_{-0.4}$	$2.8^{+0.6}_{-0.4}$	$2.3^{+0.5}_{-0.3}$	$0.4^{+0.4}_{-0.3}$

■ Applications

High-frequency and high-power circuits.

■ Features (ERH Series)

1. The dielectric is composed of low dielectric loss ceramics. This series is perfectly suited to high-frequency applications (VHS-microwave band).
2. The series is ultraminiature, yet has a high-power capacity. This is the best capacitor available for transmitter and amplifier circuits such as those in broadcasting equipment and mobile base stations.
3. ERH1X/3X Series capacitors withstand high temperatures because ribbon leads are attached with silver paste.
4. ERH1X/3X Series capacitors are easily soldered and especially well suited in applications where only a soldering iron can be used.



Part Number	Dimensions (mm)				
	L	W	T max.	ℓ	w
ERH1XC	1.6 ±0.4	1.4 ±0.4	1.6	5.0 min.	1.3 ±0.4
ERH3XX	3.2 ±0.4	2.8 ±0.4	3.0	9.0 ±2.0	2.35 ±0.15

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■ Applications

High-frequency and high-power circuits.

Part Number	**ERF1D**	**ERF22**					**ERH1X**	**ERH3X**				
L x W	1.40x1.40	2.80x2.80					1.60x1.40	3.20x2.80				
TC	C0G (**5C**)	C0G (**5C**)					C0G (**5C**)	C0G (**5C**)				
Rated Volt.	50 (**1H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	300 (**YD**)	500 (**2H**)	50 (**1H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	300 (**YD**)	500 (**2H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)												
0.5pF(**R50**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
0.6pF(**R60**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
0.7pF(**R70**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
0.8pF(**R80**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
0.9pF(**R90**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.0pF(**1R0**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.1pF(**1R1**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.2pF(**1R2**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.3pF(**1R3**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.4pF(**1R4**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.5pF(**1R5**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)

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Part Number	**ERF1D**	**ERF22**					**ERH1X**	**ERH3X**				
L x W	1.40x1.40	2.80x2.80					1.60x1.40	3.20x2.80				
TC	C0G (**5C**)	C0G (**5C**)					C0G (**5C**)	C0G (**5C**)				
Rated Volt.	50 (**1H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	300 (**YD**)	500 (**2H**)	50 (**1H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	300 (**YD**)	500 (**2H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)												
1.6pF(**1R6**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.7pF(**1R7**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.8pF(**1R8**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
1.9pF(**1R9**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
2.0pF(**2R0**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
2.1pF(**2R1**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
2.2pF(**2R2**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
2.4pF(**2R4**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
2.7pF(**2R7**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
3.0pF(**3R0**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
3.3pF(**3R3**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
3.6pF(**3R6**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
3.9pF(**3R9**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
4.3pF(**4R3**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
4.7pF(**4R7**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
5.1pF(**5R1**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
5.6pF(**5R6**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
6.2pF(**6R2**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
6.8pF(**6R8**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
7.5pF(**7R5**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
8.2pF(**8R2**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
9.1pF(**9R1**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
10.0pF(**100**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
11pF(**110**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
12pF(**120**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
13pF(**130**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
15pF(**150**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
16pF(**160**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
18pF(**180**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
20pF(**200**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
22pF(**220**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
24pF(**240**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
27pF(**270**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
30pF(**300**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
33pF(**330**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
36pF(**360**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
39pF(**390**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
43pF(**430**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
47pF(**470**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
51pF(**510**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
56pF(**560**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
62pF(**620**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
68pF(**680**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
75pF(**750**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
82pF(**820**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
91pF(**910**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
100pF(**101**)	1.15(**M**)					2.30(**X**)	1.60(**C**)					3.00(**X**)
110pF(**111**)					2.30(**X**)						3.00(**X**)	
120pF(**121**)					2.30(**X**)						3.00(**X**)	
130pF(**131**)					2.30(**X**)						3.00(**X**)	
150pF(**151**)					2.30(**X**)						3.00(**X**)	
160pF(**161**)					2.30(**X**)						3.00(**X**)	

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Part Number	**ERF1D**	**ERF22**					**ERH1X**	**ERH3X**				
L x W	1.40x1.40	2.80x2.80					1.60x1.40	3.20x2.80				
TC	C0G (**5C**)	C0G (**5C**)					C0G (**5C**)	C0G (**5C**)				
Rated Volt.	50 (**1H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	300 (**YD**)	500 (**2H**)	50 (**1H**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	300 (**YD**)	500 (**2H**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)												
180pF(**181**)					2.30(**X**)						3.00(**X**)	
200pF(**201**)					2.30(**X**)						3.00(**X**)	
220pF(**221**)				2.30(**X**)						3.00(**X**)		
240pF(**241**)				2.30(**X**)						3.00(**X**)		
270pF(**271**)				2.30(**X**)						3.00(**X**)		
300pF(**301**)				2.30(**X**)						3.00(**X**)		
330pF(**331**)				2.30(**X**)						3.00(**X**)		
360pF(**361**)				2.30(**X**)						3.00(**X**)		
390pF(**391**)				2.30(**X**)						3.00(**X**)		
430pF(**431**)				2.30(**X**)						3.00(**X**)		
470pF(**471**)				2.30(**X**)						3.00(**X**)		
510pF(**511**)			2.30(**X**)						3.00(**X**)			
560pF(**561**)			2.30(**X**)						3.00(**X**)			
620pF(**621**)			2.30(**X**)						3.00(**X**)			
680pF(**681**)			2.30(**X**)						3.00(**X**)			
750pF(**751**)		2.30(**X**)						3.00(**X**)				
820pF(**821**)		2.30(**X**)						3.00(**X**)				
910pF(**911**)		2.30(**X**)						3.00(**X**)				
1000pF(**102**)		2.30(**X**)						3.00(**X**)				

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>Specification</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">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, shall 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 shall 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 rowspan="2">6</td><td rowspan="2">Insulation Resistance (I.R.)</td><td>25℃</td><td>C≦ 470pF :1,000,000MΩ min.
470pF<C≦1,000pF : 100,000MΩ min.</td><td rowspan="2">The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25℃ and 125℃ standard humidity and within 2 minutes of charging.</td></tr>
<tr><td>125℃</td><td>C≦ 470pF : 100,000MΩ min.
470pF<C≦1,000pF : 10,000MΩ min.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</td><td>Within the specified tolerance.</td><td rowspan="2">The capacitance/Q shall be measured at 25℃ at the frequency and voltage shown in the table.
<table><tr><th>Item</th><th></th></tr><tr><td>Frequency</td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</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 Variation Rate</td><td>Within the specified tolerance. (Table A-7)</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 shall 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 step 1, 3 and 5 by the cap. value in step 3.
The capacitance change shall be measured after 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>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table></td></tr>
<tr><td>Temperature Coefficient</td><td>Within the specified tolerance. (Table A-7)</td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF
(Whichever is larger)</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Terminal Strength</td><td>Adhesive Strength of Termination (for chip type)</td><td>No removal of the terminations or other defects shall occur.</td><td>Solder the capacitor to the test jig (alumina substrate) shown in Fig.1 using solder containing 2.5% silver. The soldering shall be done either with an iron or in furnace and be conducted with care so the soldering is uniform and free of defects such as heat shock. Then apply a 10N* force in the direction of the arrow.
*ERF1D : 5N

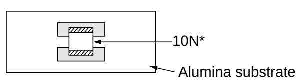



Fig.1</td></tr>
<tr><td>Tensile Strength (for micro-strip type)</td><td>Capacitor shall not be broken or damaged.</td><td>The capacitor body is fixed and a load is applied gradually in the axial direction until its value reaches 10N (5N for ERH1X).</td></tr>
<tr><td>Bending Strength of lead wire terminal (for micro-strip type)</td><td>Lead wire shall not be cut or broken.</td><td>Position the main body of the capacitor so the lead wire terminal is perpendicular, and load 2.5N to the lead wire terminal. Bend the main body by 90 degrees, bend back to original position, bend 90 degrees in the reverse direction, and then bend back to original position.</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

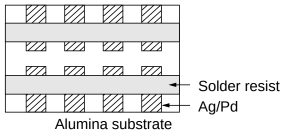
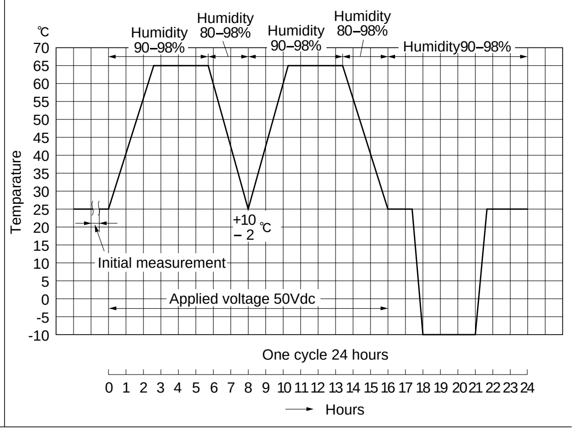
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="3">Solder the capacitor to the test jig (alumina substrate) shown in Fig.2 using solder containing 2.5% silver. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so the soldering is uniform and free of defects such as heat shock.The capacitor shall 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, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).


Fig. 2</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance.</td></tr>
<tr><td>Q</td><td>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)</td></tr>
<tr><td>12</td><td colspan="2">Solderability of Termination</td><td>95% 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 solder containing 2.5% silver for 5±0.5 seconds at 230±5℃. The dipping depth for microstrip type capacitors is up to 1 mm from the root of the terminal.</td></tr>
<tr><td>13</td><td colspan="2">Resistance to Soldering Heat</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>C≦ 220pF : Q≧10,000
220pF<C≦ 470pF : Q≧ 5,000
470pF<C≦1,000pF : Q≧ 3,000</td></tr>
<tr><td>I.R.</td><td>More than 30% of the initial specification value at 25℃.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>
C : Nominal Capacitance (pF)</td><td>Preheat the capacitor at 80 to 100℃ for 2 minutes and then at 150 to 200℃ for 5 minutes.
Immerse in solder containing 2.5% silver for 3±0.5 seconds at 270±5℃. Set at room temperature for 24±2 hours, then measure. The dipping depth for microstrip type capacitors is up to 2mm from the root of the terminal.</td></tr>
<tr><td>14</td><td colspan="2">Temperature Cycle</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±1% or ±0.25pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>C≦ 220pF : Q≧10,000
220pF<C≦ 470pF : Q≧ 5,000
470pF<C≦1,000pF : Q≧ 3,000</td></tr>
<tr><td>I.R.</td><td>More than 30% of the initial specification value at 25℃.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>
C : Nominal Capacitance (pF)</td><td>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. Then, repeat twice the successive cycles of immersion, each cycle consisting of immersion in a fresh water at 65^{+5}_{-0}℃ for 15 minutes and immersion in a saturated uqueous solution of salt at 0±3℃ for 15 minutes.
The cpapcitor is promptly washed with running water, dried with a dry cloth, and allowed to sit at room temperature for 24±2 hours.
<table>
<tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Temp.(℃)</td><td>-55^{+0}_{-3}</td><td>RoomTemp.</td><td>125^{+3}_{-0}</td><td>RoomTemp.</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>15</td><td colspan="2">Humidity</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>C≦ 220pF : Q≧10,000
220pF<C≦ 470pF : Q≧ 5,000
470pF<C≦1,000pF : Q≧ 3,000</td></tr>
<tr><td>I.R.</td><td>More than 30% of the initial specification value at 25℃.</td></tr>
</table>
C : Nominal Capacitance (pF)</td><td>Apply the 24-hour heat (−10 to +65℃) and humidity (80 to 98%) treatment shown below, 10 consecutive times. Remove, set for 24±2 hours at room temperature, and measure.

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

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Specifications and Test Methods

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No.	Item	Specification	Test Method
16	High Temperature Load	The measured and observed characteristics shall satisfy the specifications in the following table. **Item / Specification** 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 I.R.: More than 30% of the initial specification value at 25℃. C : Nominal Capacitance (pF)	Apply 150% of the rated voltage for 2,000±12 hours at 125±3℃. Remove and set for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.

Table A

Char. Code	Temp. Coeff. (ppm/℃) Note 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

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

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Chip Monolithic Ceramic Capacitors

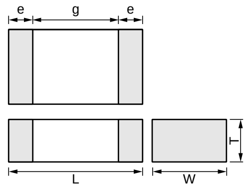
High Frequency Type

■ Features (ERA 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 ERA series improve solderability and decrease solder leaching.
3. ERA11A/21A series are designed for both flow and reflow soldering and ERA32 series are designed for reflow soldering.

■ Applications

High-frequency and high-power circuits.



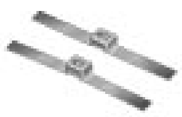
Part Number	Dimensions (mm)				
	L	W	T max.	e	g min.
ERA11A	$1.25^{+0.5}_{-0.3}$	$1.0^{+0.5}_{-0.3}$	1.0±0.2	0.15 min.	0.3
ERA21A	$2.0^{+0.5}_{-0.3}$	$1.25^{+0.5}_{-0.3}$	1.0±0.2	0.2 min.	0.5
ERA21B			1.25±0.2		
ERA32X	$3.2^{+0.6}_{-0.4}$	$2.5^{+0.5}_{-0.3}$	1.7±0.2	0.3 min.	0.5

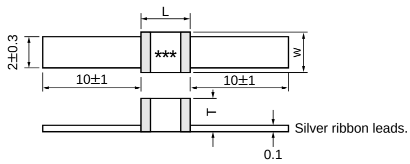
■ Features (ERD Series)

1. Negligible inductance is achieved by its monolithic structure so the series can be used at frequencies above 1GHz.
2. ERD Series capacitors withstand at high temperatures because ribbon leads are attached with silver paste.
3. ERD Series capacitors are easily soldered and are especially well suited in applications where only a soldering iron can be used.

■ Application

High-frequency and high-power circuits.





*** : Capacitance Code

Part Number	Dimensions (mm)		
	L max.	W max.	T max.
ERD32D	4.0	3.0	2.3

Part Number	**ERA11**			**ERA21**			**ERA32**			**ERD32**		
L x W	1.25x1.00			2.00x1.25			3.20x2.50			4.00x3.00		
TC	C0G (**5C**)			C0G (**5C**)			C0G (**5C**)			C0G (**5C**)		
Rated Volt.	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)												
0.5pF(**R50**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
0.6pF(**R60**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
0.7pF(**R70**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
0.8pF(**R80**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
0.9pF(**R90**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.0pF(**1R0**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.1pF(**1R1**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.2pF(**1R2**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.3pF(**1R3**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.4pF(**1R4**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.5pF(**1R5**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.6pF(**1R6**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.7pF(**1R7**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.8pF(**1R8**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
1.9pF(**1R9**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
2.0pF(**2R0**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
2.1pF(**2R1**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)

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Part Number	ERA11			ERA21			ERA32			ERD32		
L x W	1.25x1.00			2.00x1.25			3.20x2.50			4.00x3.00		
TC	C0G (**5C**)			C0G (**5C**)			C0G (**5C**)			C0G (**5C**)		
Rated Volt.	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)												
2.2pF(**2R2**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
2.4pF(**2R4**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
2.7pF(**2R7**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
3.0pF(**3R0**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
3.3pF(**3R3**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
3.6pF(**3R6**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
3.9pF(**3R9**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
4.3pF(**4R3**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
4.7pF(**4R7**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
5.1pF(**5R1**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
5.6pF(**5R6**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
6.2pF(**6R2**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
6.8pF(**6R8**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
7.5pF(**7R5**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
8.2pF(**8R2**)			1.00(**A**)			1.00(**A**)			1.70(**X**)			2.30(**D**)
9.1pF(**9R1**)			1.00(**A**)			1.25(**B**)			1.70(**X**)			2.30(**D**)
10pF(**100**)			1.00(**A**)			1.25(**B**)			1.70(**X**)			2.30(**D**)
11pF(**110**)			1.00(**A**)			1.25(**B**)			1.70(**X**)			2.30(**D**)
12pF(**120**)			1.00(**A**)			1.25(**B**)			1.70(**X**)			2.30(**D**)
13pF(**130**)			1.00(**A**)			1.25(**B**)			1.70(**X**)			2.30(**D**)
15pF(**150**)		1.00(**A**)				1.25(**B**)			1.70(**X**)			2.30(**D**)
16pF(**160**)		1.00(**A**)				1.25(**B**)			1.00(**X**)			2.30(**D**)
18pF(**180**)		1.00(**A**)				1.25(**B**)			1.70(**X**)			2.30(**D**)
20pF(**200**)		1.00(**A**)				1.25(**B**)			1.70(**X**)			2.30(**D**)
22pF(**220**)		1.00(**A**)				1.25(**B**)			1.70(**X**)			2.30(**D**)
24pF(**240**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
27pF(**270**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
30pF(**300**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
33pF(**330**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
36pF(**360**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
39pF(**390**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
43pF(**430**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
47pF(**470**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
51pF(**510**)	1.00(**A**)					1.25(**B**)			1.70(**X**)			2.30(**D**)
56pF(**560**)					1.25(**B**)				1.70(**X**)			2.30(**D**)
62pF(**620**)					1.25(**B**)				1.70(**X**)			2.30(**D**)
68pF(**680**)					1.25(**B**)				1.70(**X**)			2.30(**D**)
75pF(**750**)					1.25(**B**)				1.70(**X**)			2.30(**D**)
82pF(**820**)					1.25(**B**)				1.70(**X**)			2.30(**D**)
91pF(**910**)					1.25(**B**)				1.70(**X**)			2.30(**D**)
100pF(**101**)				1.00(**A**)					1.70(**X**)			2.30(**D**)
110pF(**111**)				1.25(**B**)					1.70(**X**)			2.30(**D**)
120pF(**121**)				1.25(**B**)					1.70(**X**)			2.30(**D**)
130pF(**131**)				1.25(**B**)					1.70(**X**)			2.30(**D**)
150pF(**151**)				1.25(**B**)					1.70(**X**)			2.30(**D**)
160pF(**161**)				1.25(**B**)					1.70(**X**)			2.30(**D**)
180pF(**181**)								1.70(**X**)			2.30(**D**)	
200pF(**201**)								1.70(**X**)			2.30(**D**)	
220pF(**221**)								1.70(**X**)			2.30(**D**)	
240pF(**241**)								1.70(**X**)			2.30(**D**)	
270pF(**271**)								1.70(**X**)			2.30(**D**)	
300pF(**301**)								1.70(**X**)			2.30(**D**)	

Continued on the following page.

Continued from the preceding page.

Part Number	**ERA11**			**ERA21**			**ERA32**			**ERD32**		
L x W	1.25x1.00			2.00x1.25			3.20x2.50			4.00x3.00		
TC	C0G (**5C**)			C0G (**5C**)			C0G (**5C**)			C0G (**5C**)		
Rated Volt.	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)	50 (**1H**)	100 (**2A**)	200 (**2D**)
Capacitance (Capacitance part numbering code) and T(mm) Dimension (T Dimension part numbering code)												
330pF(**331**)								1.70(**X**)			2.30(**D**)	
360pF(**361**)								1.70(**X**)			2.30(**D**)	
390pF(**391**)								1.70(**X**)			2.30(**D**)	
430pF(**431**)								1.70(**X**)			2.30(**D**)	
470pF(**471**)								1.70(**X**)			2.30(**D**)	
510pF(**511**)								1.70(**X**)			2.30(**D**)	
560pF(**561**)							1.70(**X**)			2.30(**D**)		
620pF(**621**)							1.70(**X**)			2.30(**D**)		
680pF(**681**)							1.70(**X**)			2.30(**D**)		
750pF(**751**)							1.70(**X**)			2.30(**D**)		
820pF(**821**)							1.70(**X**)			2.30(**D**)		
910pF(**911**)							1.70(**X**)			2.30(**D**)		
1000pF(**102**)							1.70(**X**)			2.30(**D**)		

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

14

Specifications and Test Methods

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</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">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, shall 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 shall 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.</td><td>The insulation resistance shall 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 shall be measured at 25℃ at the frequency and voltage shown in the table.<table><tr><th>Item / Char.</th><th>C0G (1,000pF and below)</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</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 Variation Rate</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 shall 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 step 1, 3 and 5 by the cap. value in step 3.
The capacitance change shall be measured after 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>125±3</td></tr><tr><td>5</td><td>25±2</td></tr></table></td></tr>
<tr><td>Temperature Coefficient</td><td>Within the specified tolerance. (Table A-6)</td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF
(Whichever is larger)</td></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Terminal Strength</td><td>Adhesive Strength of Termination (for chip type)</td><td>No removal of the terminations or other defects shall occur.</td><td>Solder the capacitor to the test jig (alumina substrate) shown in Fig.1 using solder containing 2.5% silver. The soldering shall be done either with an iron or in furnace and be conducted with care so the soldering is uniform and free of defects such as heat shock. Then apply a 10N* force in the direction of the arrow.
*5N (ERA11)

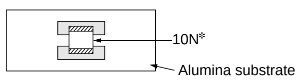



Fig.1</td></tr>
<tr><td>Tensile Strength (for micro-strip type)</td><td>Capacitor shall not be broken or damaged.</td><td>The capacitor body is fixed and a load is applied gradually in the axial direction until its value reaches 5N.</td></tr>
<tr><td>Bending Strength of lead wire terminal (for micro-strip type)</td><td>Lead wire shall not be cut or broken.</td><td>Position the main body of the capacitor so the lead wire terminal is perpendicular, and load 2.5N to the lead wire terminal. Bend the main body by 90 degrees, bend back to original position, bend 90 degrees in the reverse direction, and then bend back to original position.</td></tr>
</table>

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

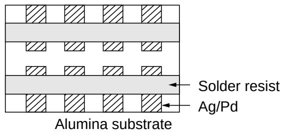
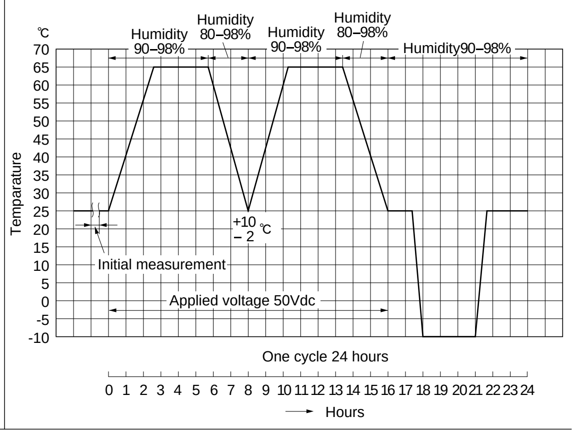
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="3">Solder the capacitor to the test jig (alumina substrate) shown in Fig.2 using solder containing 2.5% silver. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so the soldering is uniform and free of defects such as heat shock.The capacitor shall 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, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).


Fig.2</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance.</td></tr>
<tr><td>Q</td><td>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)</td></tr>
<tr><td>12</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 solder containing 2.5% silver for 5±0.5 seconds at 230±5℃. The dipping depth for microstrip type capacitors is up to 1 mm from the root of the terminal.</td></tr>
<tr><td>13</td><td colspan="2">Resistance to Soldering Heat</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>C≦ 220pF : Q≧10,000
220pF<C≦ 470pF : Q≧ 5,000
470pF<C≦1,000pF : Q≧ 3,000</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>
C : Nominal Capacitance (pF)</td><td>Preheat according to the conditions listed in the table below. Immerse in solder containing 2.5% silver for 3±0.5 seconds at 270±5℃. Set at room temperature for 24±2 hours, then measure. The dipping depth for microstrip type capacitors is up to 2mm from the root of the terminal.
<table>
<tr><th>Chip Size</th><th>Preheat Condition</th></tr>
<tr><td>2.0×1.25mm max.</td><td>1minute at 120 to 150℃</td></tr>
<tr><td>3.2×2.5mm</td><td>Each 1 minute at 100 to 120℃ and then 170 to 200℃</td></tr>
</table></td></tr>
<tr><td>14</td><td colspan="2">Temperature Cycle</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>C≧30pF : Q≧350
10pF≦C<30pF : Q≧275+ $\frac{5}{2}$ C
C<10pF : Q≧200+10C</td></tr>
<tr><td>I.R.</td><td>1,000MΩ min.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>
C : Nominal Capacitance (pF)</td><td>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>-55^{+0}_{-3}</td><td>RoomTemp.</td><td>125^{+3}_{-0}</td><td>RoomTemp.</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>15</td><td colspan="2">Humidity</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF
(Whichever is larger)</td></tr>
<tr><td>Q</td><td>C≧30pF : Q≧350
10pF≦C<30pF : Q≧275+ $\frac{5}{2}$ C
C<10pF : Q≧200+10C</td></tr>
<tr><td>I.R.</td><td>1,000MΩ min.</td></tr>
</table>
C : Nominal Capacitance (pF)</td><td>Apply the 24-hour heat (−10 to +65℃) and humidity (80 to 98%) treatment shown below, 10 consecutive times. Remove, set for 24±2 hours at room temperature, and measure.

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

Continued on the following page.

14

Specifications and Test Methods

Continued from the preceding page.

No.	Item	Specification	Test Method
16	High Temperature Load	The measured and observed characteristics shall satisfy the specifications in the following table. Item / Specification 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. C : Nominal Capacitance (pF)	Apply 200% of the rated voltage for 1,000±12 hours at 125±3℃. Remove and set for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.

Table A

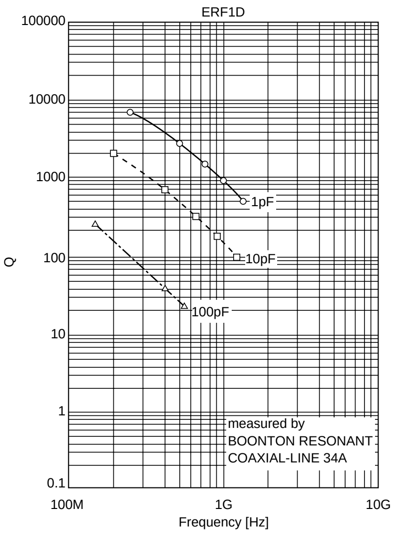
Char. Code	Temperature Coefficient (ppm/℃) Note 1	Capacitance Change from 25℃ Value (%)					
		−55℃		−30℃		−10℃	
		Max.	Min.	Max.	Min.	Max.	Min.
5C	0±30	0.58	−0.24	0.40	−0.17	0.25	−0.11

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

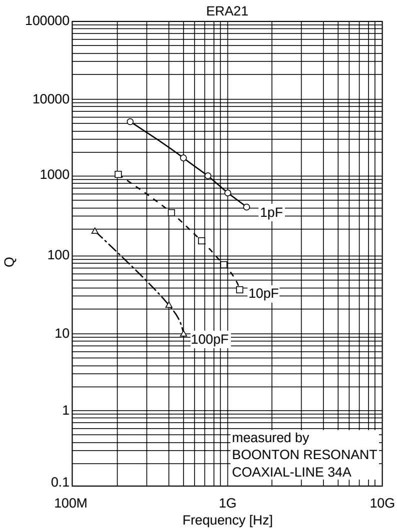
ERA/ERD/ERF/ERH Series Data

■ Q-Frequency Characteristics

ERF Series

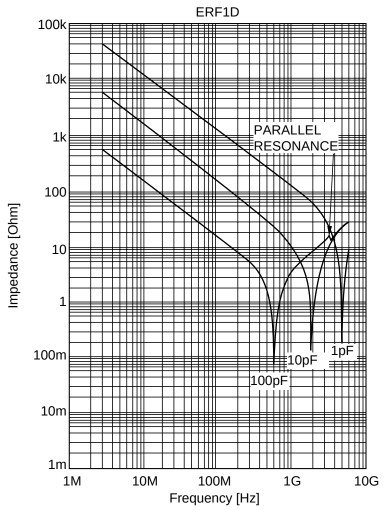


ERA Series

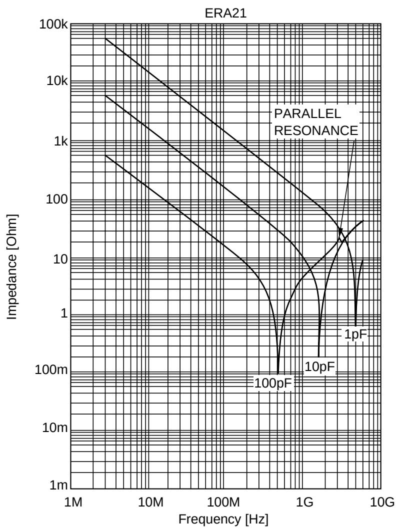


■ Impedance-Frequency Characteristics

ERF Series

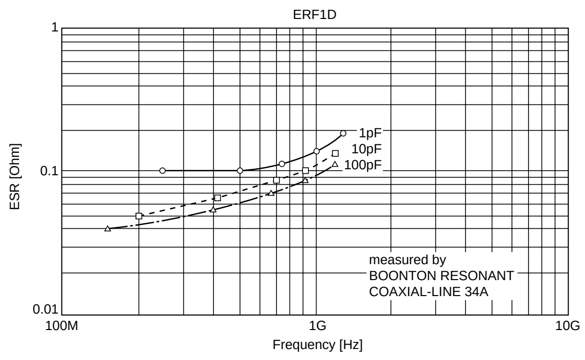


ERA Series

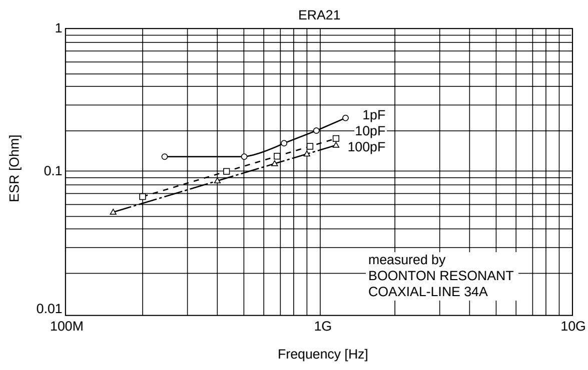


■ ESR-Frequency Characteristics

ERF Series



ERA Series



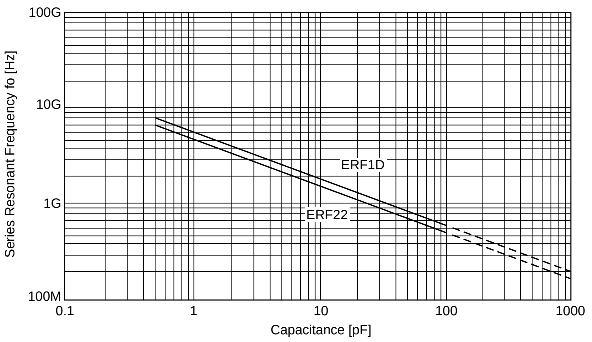
Continued on the following page.

ERA/ERD/ERF/ERH Series Data

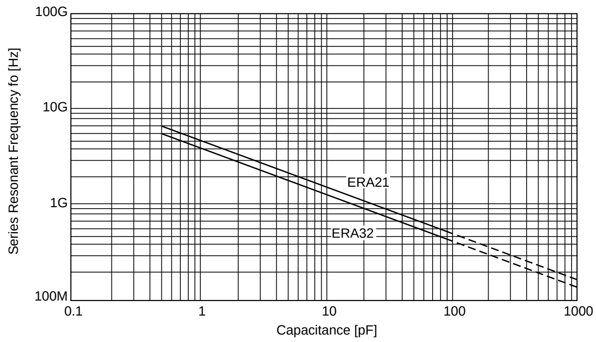
Continued from the preceding page.

■ Resonant Frequency-Capcitance

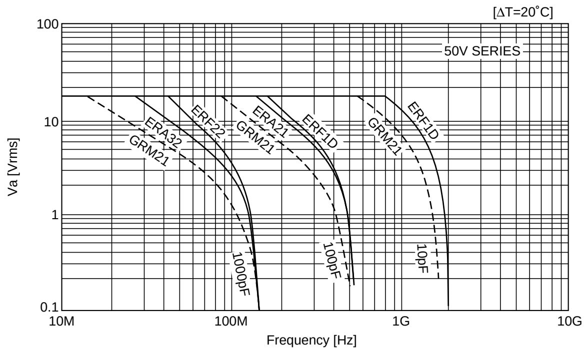
ERF Series



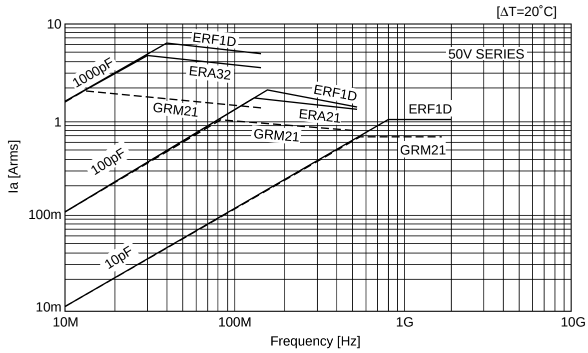
ERA Series



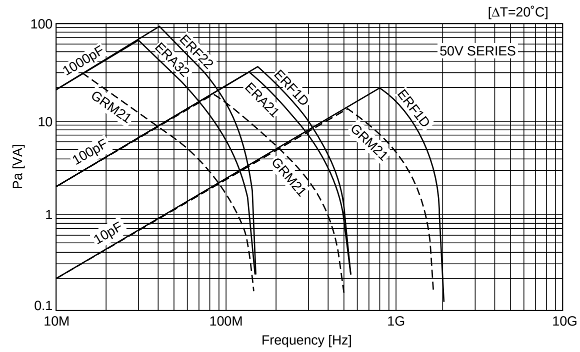
■ Allowable Voltage-Frequency



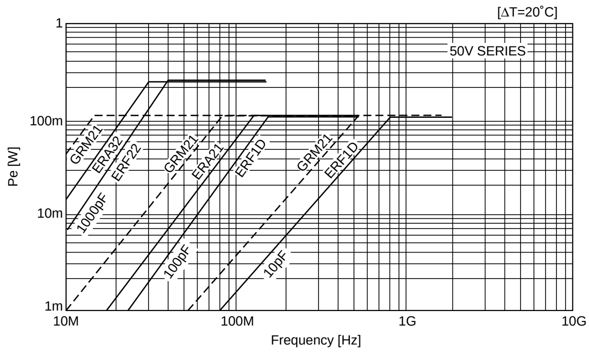
■ Allowable Current-Frequency



■ Allowable Appearent Power-Frequency



■ Allowable Effcteve 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, E, F**	**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	Plastic Tape	Paper Tape	Plastic Tape		
Ultra-miniaturized	**GRP03**	0.6	0.3	0.3	15,000	-	-	-	-	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	4,000	-	10,000	-	-	1,000
				1.25	-	3,000	-	10,000	5,000 3)	1,000
	GRM31	3.2	1.6	0.85	4,000	-	10,000	-	-	1,000
				1.15	-	3,000	-	10,000	-	1,000
				1.6	-	2,000	-	6,000	-	1,000
For Reflow	**GRP/GRM155**	1.0	0.5	0.5	10,000	-	50,000	-	50,000	1,000
	GRP15X	1.0	0.5	0.25	10,000	-	50,000	-	-	1,000
	GRM32	3.2	2.5	1.15	-	3,000	-	10,000	-	1,000
				1.35	-	2,000	-	8,000	-	1,000
				1.8/1.6	-	1,000	-	4,000	-	1,000
				2.0	-	1,000	-	4,000	-	1,000
				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	**GJ615**	1.0	0.5	0.5	10,000	-	50,000	-	50,000	1,000
Smoothing 1)	**GJ221**	2.0	1.25	1.25	-	3,000	-	10,000	-	-
	GJ231	3.2	1.6	1.15	-	3,000	-	10,000	-	-
				1.35	-	2,000	-	8,000	-	-
	GJ232	3.2	2.5	1.6	-	2,000	-	6,000	-	-
				1.8	-	1,000	-	4,000	-	-
	GJ243	4.5	3.2	1.8	-	1,000	-	3,000	-	-
				2.2	-	500	-	2,000	-	-
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
	ERA11	1.25	1.0	1.0	-	-	-	-	-	1,000
	ERA21	2.0	1.25	1.0/1.25	-	3,000	-	-	-	1,000
	ERA32	3.2	2.5	1.7	-	2,000	-	-	-	1,000
	ERF1D	1.4	1.4	1.15	-	2,000	-	-	-	1,000
	ERF22	2.8	2.8	2.3	-	1,000	-	-	-	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 2)
	GMA08	0.8	0.8	0.5	-	-	-	-	-	400 2)
Array	**GNM31**	3.2	1.6	0.8	4,000	-	10,000	-	-	1,000
				1.0	-	3,000	-	10,000	-	1,000
Low ESL	**LLL18**	0.8	1.6	0.6	4,000	-	10,000	-	-	1,000
	LLL21	1.25	2.0	0.6	-	4,000	-	10,000	-	1,000
				0.85	-	3,000	-	10,000	-	1,000
	LLL31	1.6	3.2	0.7	-	4,000	-	10,000	-	1,000
				1.15	-	3,000	-	10,000	-	1,000

1) Smoothing rated are available by taping packages only.
2) Tray
3) 3.3/4.7μF of 6.3 R6 rated are not available by bulk case.

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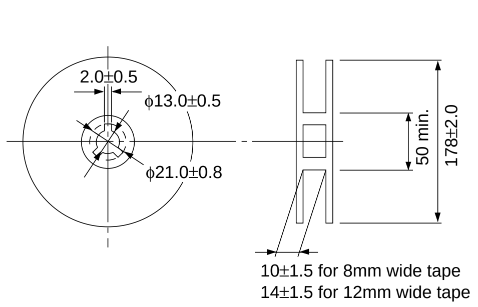
Package

Continued from the preceding page.

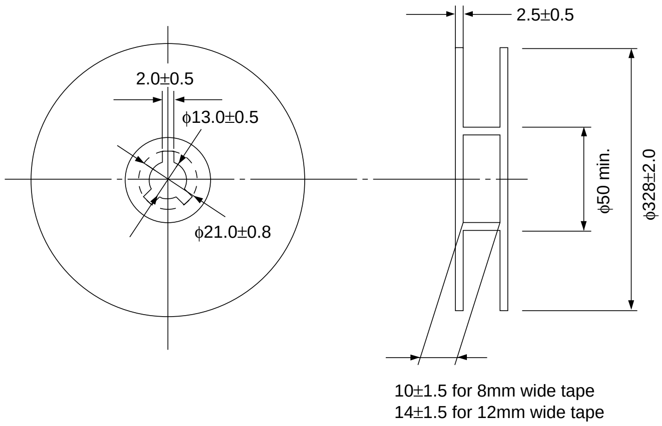
■ Tape Carrier Packaging

(1) Dimensions of Reel

φ180mm Reel



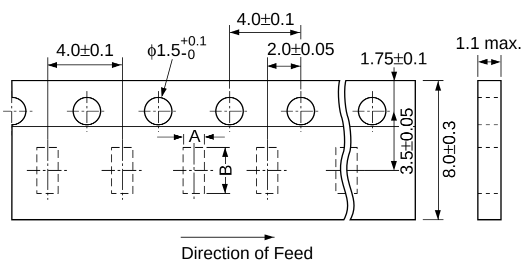
φ330mm Reel



(in mm)

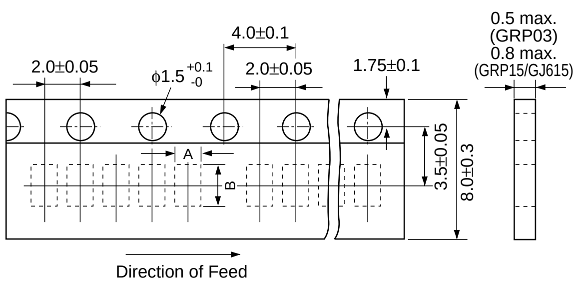
(2) Dimensions of Paper Tape

8mm width 4mm pitch Tape



Part Number	A	B
GRM18 **GQM18**	1.05±0.1	1.85±0.1
GRM21 (T≦1.0mm) **GQM21**	1.55±0.15	2.3±0.15
GRM31 **GNM31** (T≦0.8mm)	2.0±0.2	3.6±0.2
GRM32 (T=0.85mm)	2.8±0.2	3.6±0.2

8mm width 2mm pitch Tape



Part Number	A*	B*
GRP03	0.37	0.67
GJ615 **GRP/GRM15**	0.65	1.15

*Nominal Value

(in mm)

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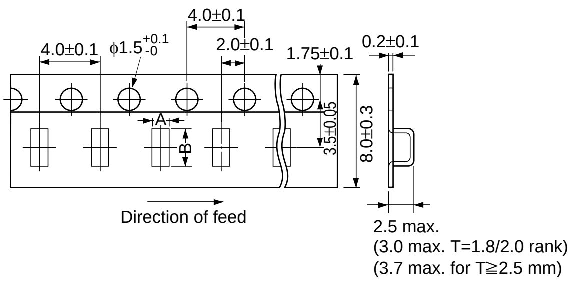
Package

Continued from the preceding page.

(3) Dimensions of Plastic Tape

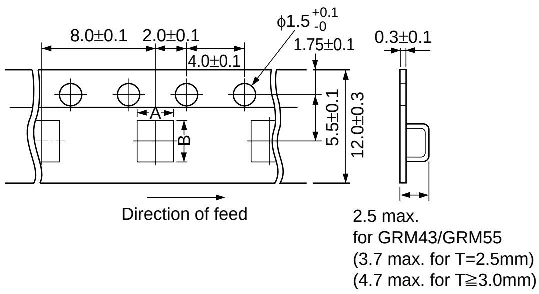
8mm width 4mm pitch Tape



Part Number	A	B
LLL18	1.05±0.1	1.85±0.1
GRM21 (T=1.25mm) **LLL21, GJ221**	1.45±0.2	2.25±0.2
GRM31 (T≧1.15mm) **LLL31** **GNM31** (T≧1.0mm) **GJ231**	1.9±0.2	3.5±0.2
GRM32 (T≧1.15mm) **GJ232**	2.8±0.2	3.5±0.2
ERA21	1.8*	2.6*
ERA32	2.8*	3.5*
ERF1D	2.0*	2.1*
ERF22	3.1*	3.2*

*Nominal Value

12mm width 8mm pitch Tape



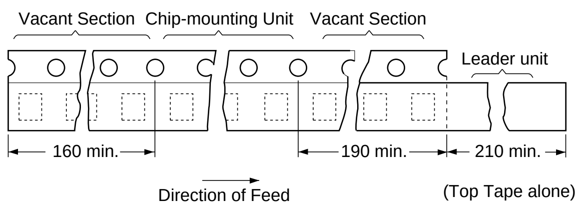
Part Number	A*	B*
GRM43, GJ243	3.6	4.9
GRM55	5.2	6.1

*Nominal Value

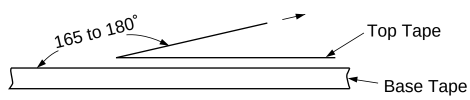
(in mm)

(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 shall be attached to the end of the tape as follows.
③ The top tape and base tape are not atteached at the end of the tape for a minimum of 5 pitches.
④ Missing capacitors number within 0.1% of the number per reel or 1 pc, whichever is greater, and are not continuous.
⑤ The top tape and bottom tape shall not protrude beyond the edges of the tape and shall not cover sprocked holes.
⑥ Cumulative tolerance of sprocket holes, 10 pitches : ±0.3mm.
⑦ Peeling off force : 0.1 to 0.6N* in the direction shown below. *GRP03:0.05 to 0.5N



(in mm)



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Package

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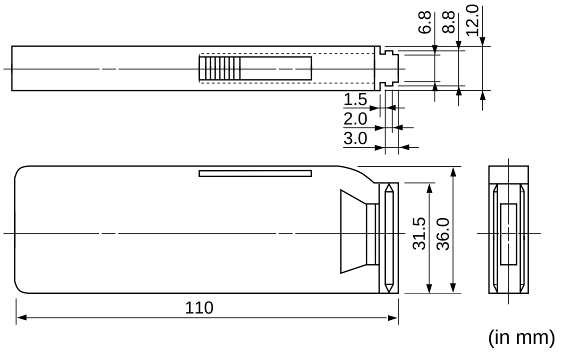
■ Dimensions of Bulk Case Packaging

The bulk case used 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 C. and an ambient humidity of 20-70%RH.
Use chip within 6 months. If 6 months or more have elapsed, check solderability before use.
(Reference Data 1. Solderability)

■ Handling

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

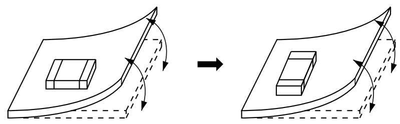
⚠Caution

■ Soldering and Mounting

1. Mounting Position

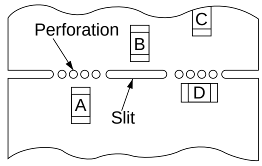
Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[Component Direction]



Locate chip horizontal to the direction in which stress acts

[Chip Mounting Close to Board Separation Point]



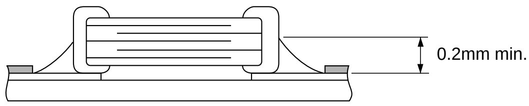
Chip arrangement
Worst A-C-(B~D) Best

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

2. 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]

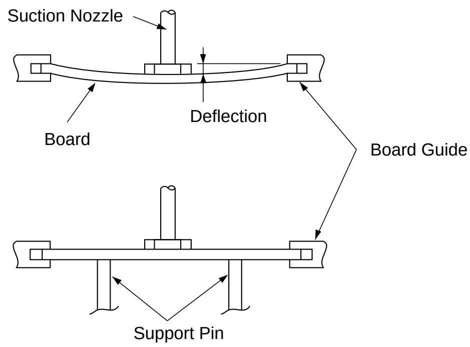


3. Chip Placing

- 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

Continued from the preceding page.

4. Reflow Soldering

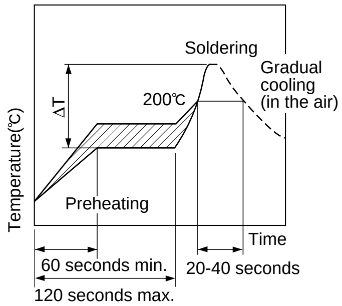
- Sudden heating of the chip results in distortion due to excessive expansion and construction forces within the chip causing cracked chips. So when preheating, keep temperature differential, ΔT, within the range shown in Table 1. The smaller the ΔT, the less stress on the chip.
- When components are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

Table 1

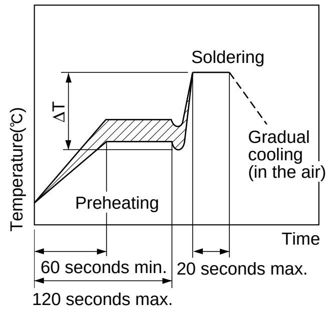
Part Number	Temperature Differential
GRP03/15, GRM18/21/31 **GJ615, GJ221/31** **LLL18/21/31** **ERA11/21/32, ERF1D** **GQM18/21**	ΔT≦190℃
GRM32/43/55 **GNM31, GJ232/43** **ERA32, ERF22**	ΔT≦130℃

[Standard Conditions for Reflow Soldering]

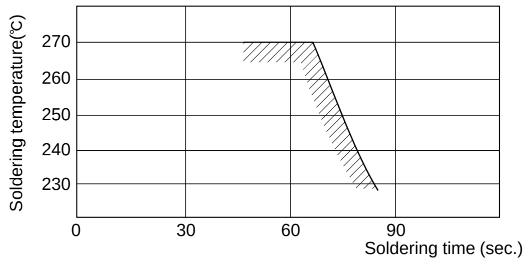
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]



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

Inverting the PCB

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

5. Leaded Component Insertion

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

Continued on the following page.

⚠Caution

Continued from the preceding page.

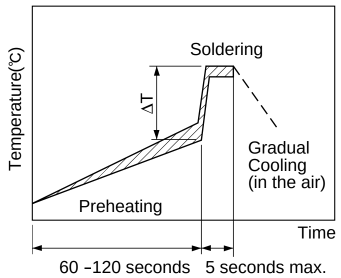
6. Flow Soldering

- Sudden heating of the chip results in thermal distortion causing cracked chips. And an excessively long soldering time or high soldering temperature results in leaching of the outer electrodes, causing poor adhesion or a reduction in capacitance value due to loss of contact between electrodes and end termination.
- When preheating, keep 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 5.

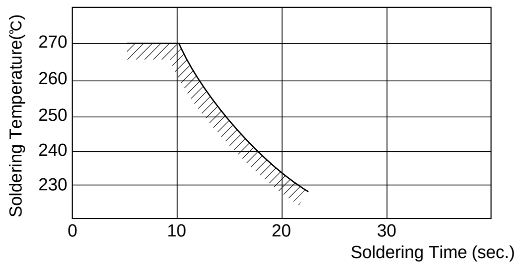
Table 2

Part Number	Temperature Differential
GRM18/21/31 **LLL21/31** **ERA11/21, ERF1D** **GQM18/21**	ΔT≦150℃

[Standard Conditions for Flow Soldering]

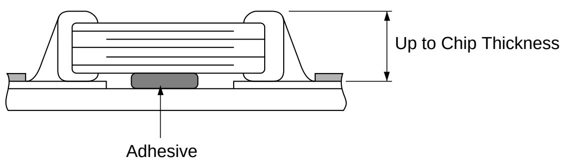


[Allowable Soldering Temperature and Time]



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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7. Correction with a Soldering Iron

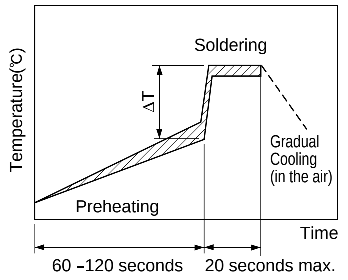
(1) For Chip Type Capacitors <Except GJ2 Series>

- 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.

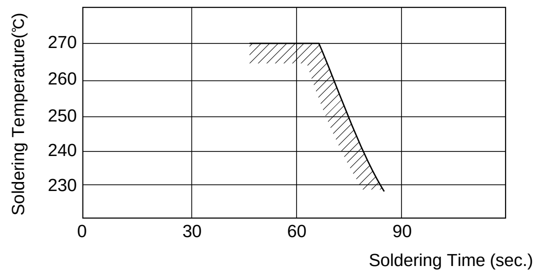
Table 3

Part Number	Temperature Differential
GRP15, GRM15/18/21/31 **GJ615** **LLL18/21/31** **GQM18/21** **ERA11/21, ERF1D**	ΔT≦190℃
GRM32/43/55 **GNM31** **ERA32, ERF22**	ΔT≦130℃

[Standard Conditions for Soldering Iron Temperature]

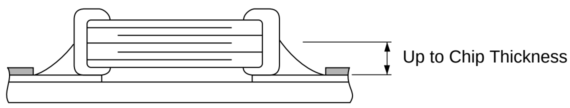


[Allowable Time and Temperature for Making Corrections with a Soldering Iron]



The accumulated soldering Time / temperature including reflow / flow soldering must be within the range shown above.

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



- When correcting chips with a soldering iron, no preheating is required if the chip is listed in Table 7 and the following conditions (Table 4) are met.
  Preheating should be performed on chips not listed in Table 4.
  (Reference Data 8. Thermal shock when making a correction with a soldering iron)

Table 4 Correction with a Soldering Iron

Part Number	Temperature of Iron Tip	Soldering Iron Wattage	Diameter of Iron Tip	Restriction
GRP15, GRM15/18/21 **GJ615** **LLL18/21** **GQM18/21** **ERA11/21, ERF1D**	300℃ max.	20W max.	ϕ 3mm max.	Do not allow the iron tip to directly touch the ceramic element.
GRM31 **LLL31** **GNM31**	270℃ max.			

Continued on the following page.

⚠Caution

Continued from the preceding page.

(2) For GJ2 Series

- When solder GJ2 series chip capacitor, keep the following conditions.

<Soldering iron method>

Part Number	Pre-heating	Temperature of iron tip	Soldering iron wattage	Diameter of iron tip	Soldering time	Soldering amount	Restriction
GJ221/31/32/43	Δ≦130℃	300℃ max.	20W max.	ϕ 3mm max.	5 sec. max.	≦1/2 of chip thickness	Do not allow the iron tip to directly touch the ceramic element.

(3) 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 products is used.

■ Rating

Die Bonding/Wire Bonding (GMA Series)

1. Die Bonding of Capacitors
- •Use the following materials
  Braze alloy : Au-Si (98/2) 400 to 420degree C in N2 atmosphere
  Au-Sn (80/20) 300 to 320degree C in N2 atmosphere
  Au-Ge (88/12) 380 to 400degree 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 : 20mm (0.0008 inch), 25mm (0.001 inch) diameter
- •Bonding
  (1) Thermocompression, ultrasonic ball bonding.
  (2) Required stage temperature : 150 to 250degree 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

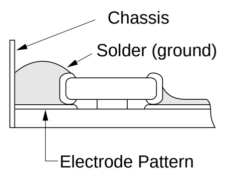
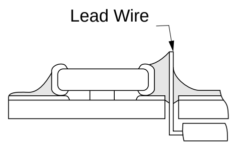
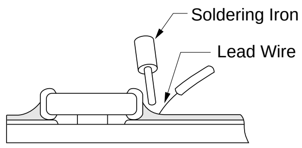
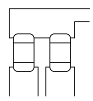
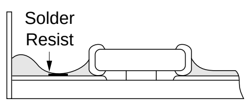
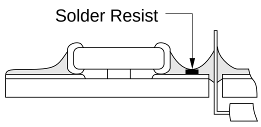
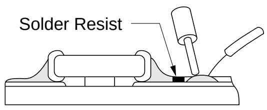
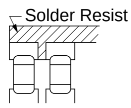
■ Soldering and Mounting

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

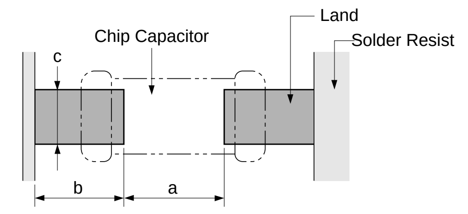

Table 1 Flow Soldering Method

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
ERA11	1.25×1.0	0.4–0.6	0.6–0.8	0.8–1.0
ERA21	2.0×1.25	1.0–1.2	0.9–1.0	0.8–1.0
ERF1D	1.4×1.4	0.5–0.8	0.8–0.9	1.0–1.2

(in mm)

Table 2 Reflow Soldering Method

Part Number \ Dimensions	Dimensions (L×W)	a	b	c
GRP03	0.6×0.3	0.2–0.3	0.2–0.35	0.2–0.4
GRP15 **GRM15** **GJ615**	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** **GJ221**	2.0×1.25	1.0–1.2	0.6–0.7	0.8–1.1
GRM31 **GJ231**	3.2×1.6	2.2–2.4	0.8–0.9	1.0–1.4
GRM32 **GJ232**	3.2×2.5	2.0–2.4	1.0–1.2	1.8–2.3
GRM43 **GJ243**	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
ERA11	1.25×1.0	0.4–0.6	0.6–0.8	0.8–1.0
ERA21	2.0×1.25	1.0–1.2	0.6–0.8	0.8–1.0
ERA32	3.2×2.5	2.2–2.5	0.8–1.0	1.9–2.3
ERF1D	1.4×1.4	0.4–0.8	0.6–0.8	1.0–1.2
ERF22	2.8×2.8	1.8–2.1	0.7–0.9	2.2–2.6

(in mm)

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Notice

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● GNM Series for reflow soldering method

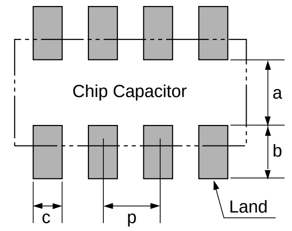
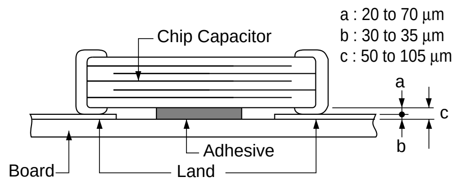


Table 3

Part Number	Dimensions (mm)					
	L	W	a	b	c	p
GNM31	3.2	1.6	0.8–1.0	0.7–0.9	0.3–0.4	0.8

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 **GQM21**	0.1mg Min.
GRM31	0.15mg Min.

*Nominal Value

3. Adhesive Curing

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

Inverting the PCB

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

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 strongly acidix flux.
Wash thoroughly because water soluble flux causes deteriorated insulation resistance between outer electrodes unless sufficiently cleaned.

Continued on the following page.

Notice

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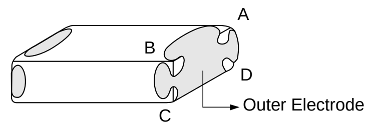
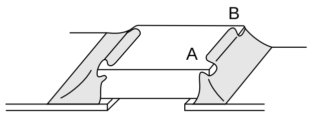
5. Flow Soldering

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

[As a Single Chip]



[As Mounted on Substrate]



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

Notice

■ 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.

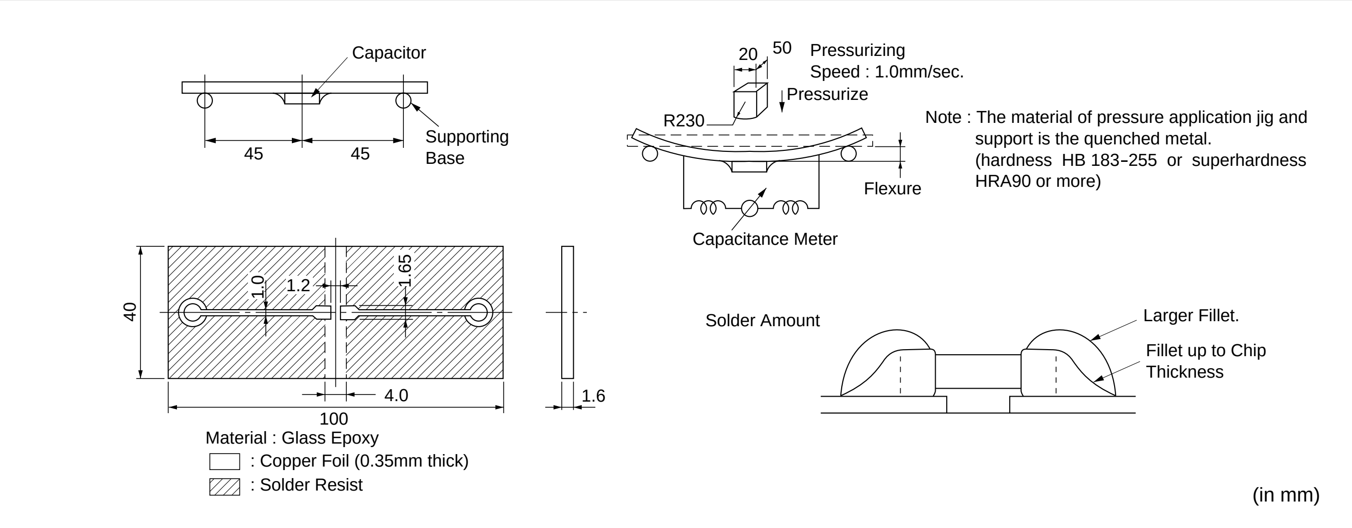
Table 1

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 C0G/X7R/Y5V 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
C0G	Within ±5% or ±0.5pF, whichever is greater
X7R	Within ±12.5%
Y5V	Within ±20%

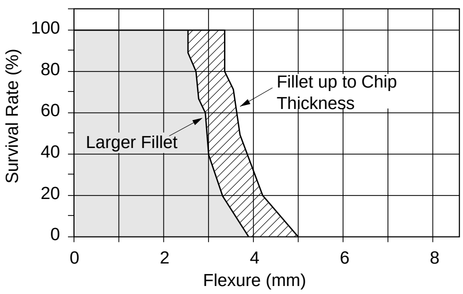
Continued on the following page.

Reference Data

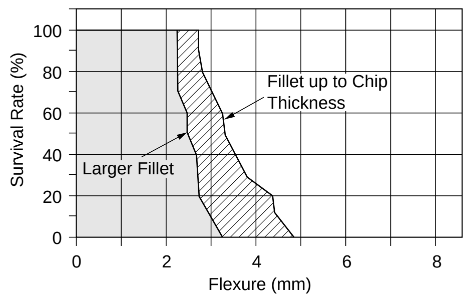
Continued from the preceding page.

(4) Results

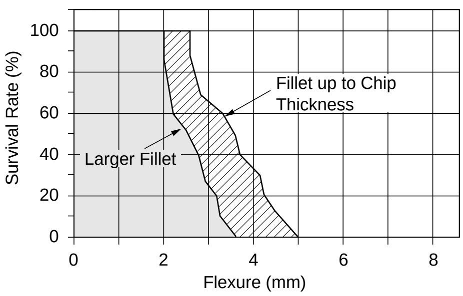
GRM21 C0G (T=0.6)



GRM21 X7R (T=0.6)



GRM21 Y5V (T=0.6)

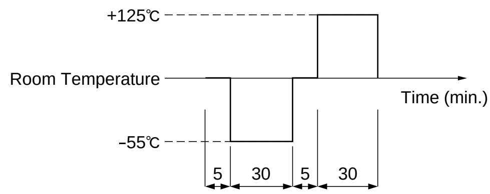


3. Temperature Cycling for Solder Fillet Height

(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

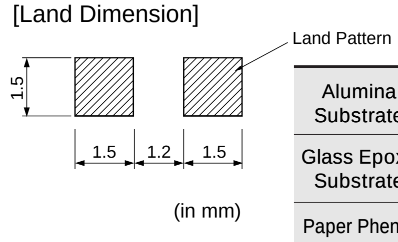
Alumina (Thickness : 0.64mm)
Glass epoxy (Thickness : 1.6 mm)
Paper phenol (Thickness : 1.6 mm)

[Solder Amount]

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

③ Land Dimension

[Land Dimension]



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

Continued on the following page.

Reference Data

Continued from the preceding page.

(2) Test Samples

GRM40 C0G/X7R/Y5V Characteristics T=0.6mm

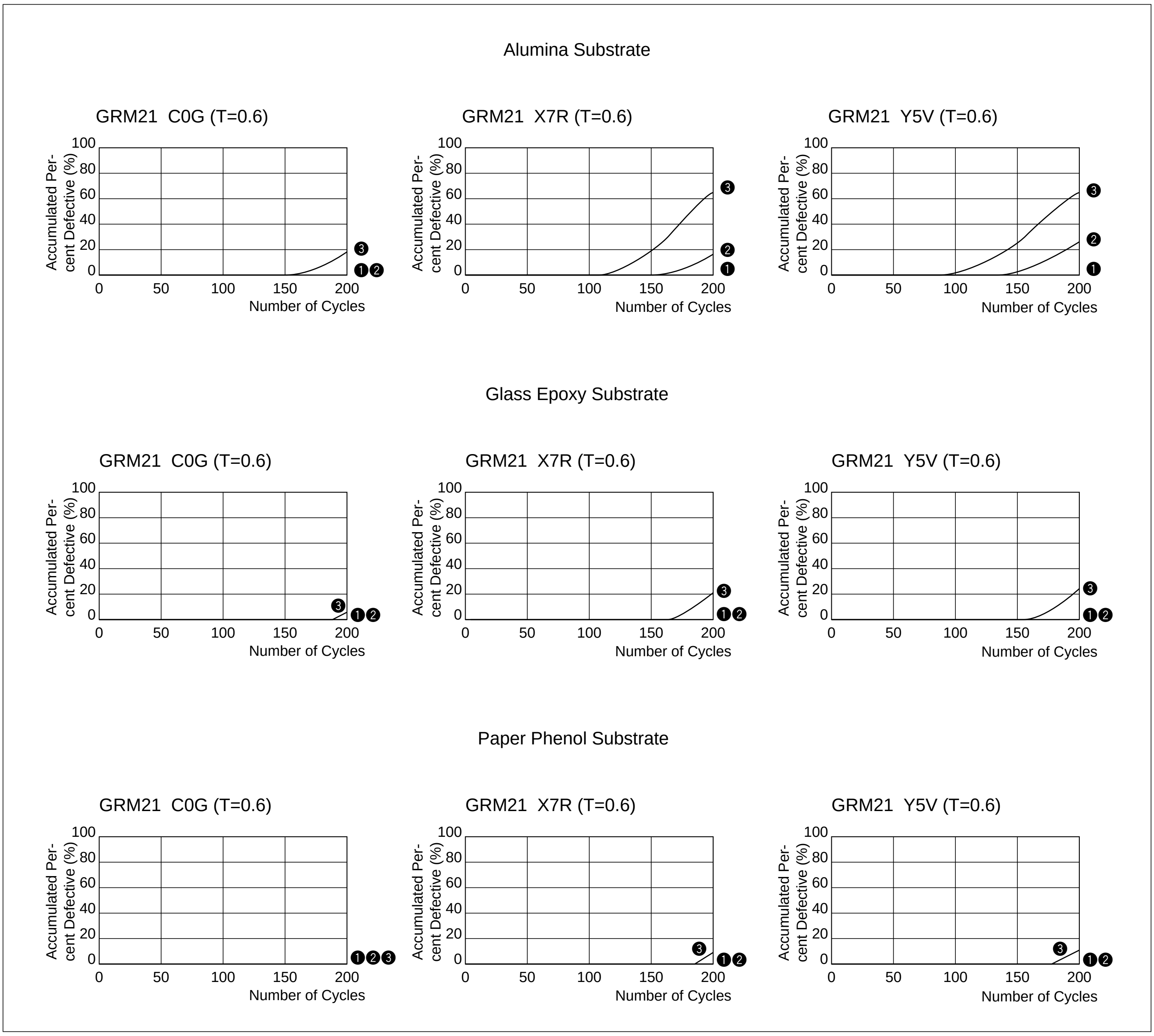
(3) Acceptance Criteria

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

Table 3

Characteristics	Change in Capacitance
C0G	Within ±2.5% or ±0.25pF, whichever is greater
X7R	Within ±7.5%
Y5V	Within ±20%

(4) Results



Continued on the following page.

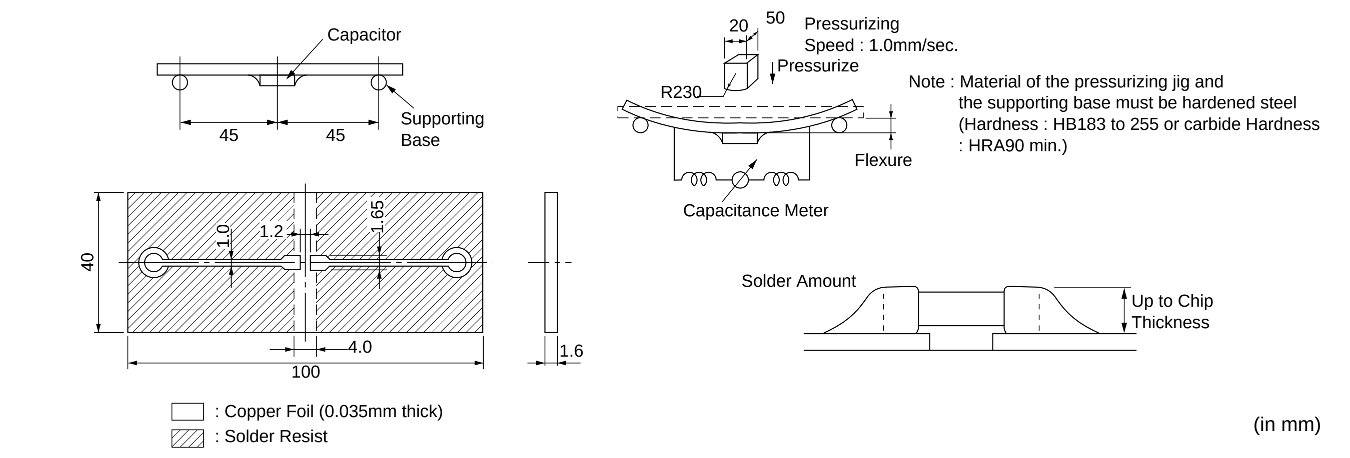
Reference Data

Continued from the preceding page.

4. Board Bending Strength for Board Material

(1) Test Method

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



(2) Test Samples

GRM21 C0G/X7R/Y5V Characteristics T=0.6mm typical

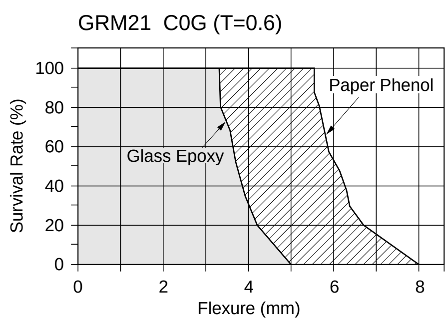
(3) Acceptance Criteria

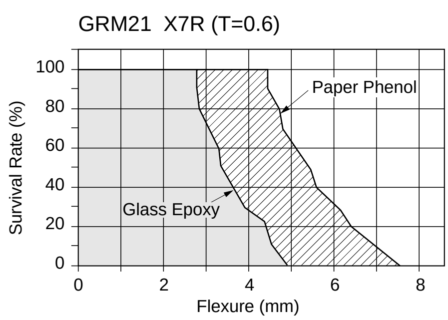
Products shall be determined to be defective if the change in capacitance has exceeded the values specified in Table 4.

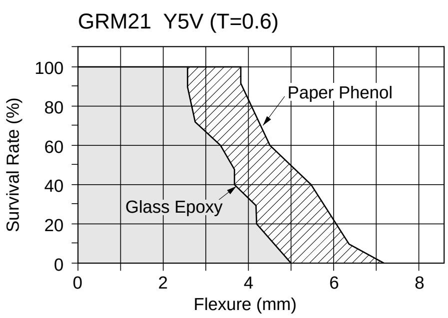
Table 4

Characteristics	Change in Capacitance
C0G	Within ±5% or ±0.5pF, whichever is greater
X7R	Within ±12.5%
Y5V	Within ±20%

(4) Results







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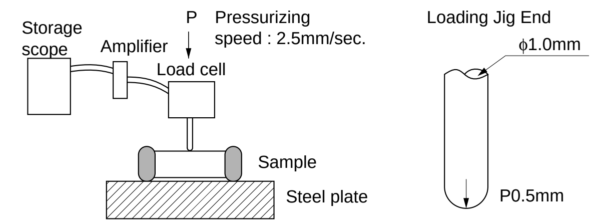
5. Break Strength

(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.

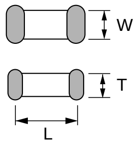


(2) Test Samples

GRM21 C0G/X7R/Y5V Characteristics
GRM31 C0G/X7R/Y5V 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		
			C0G Charac-teristics	X7R Charac-teristics	Y5V Charac-teristics
GRM21	1.5	1.2	300	180	160
GRM31	2.7	1.5			

(in mm)

(4) Explanation

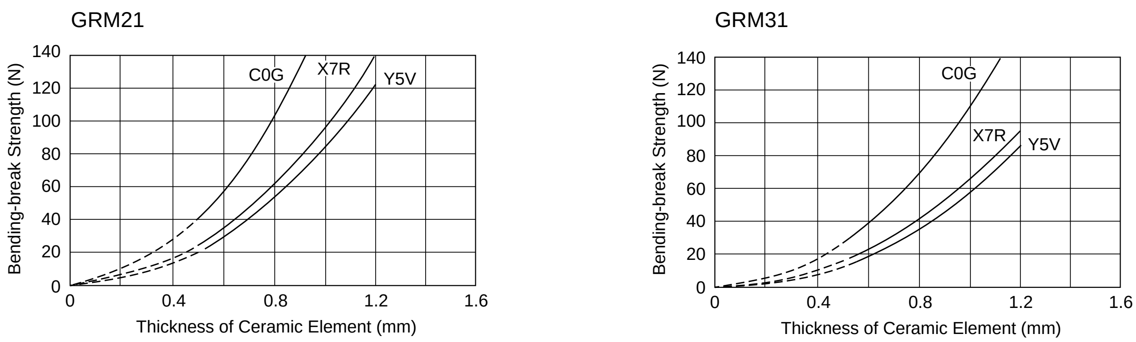
Break strength, P, is proportionate to the square of the thickness of the ceramic element and is expressed as a curve of secondary degree.

The formula is :

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

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

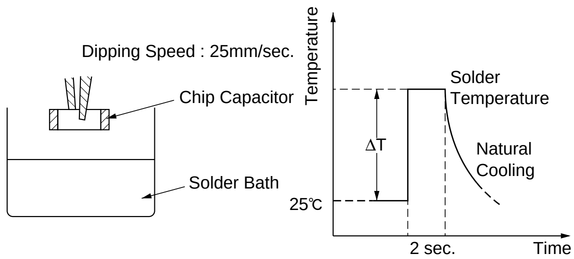
(5) Results



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 C0G/X7R/Y5V Characteristics T=0.6mm typical

(3) Acceptance criteria

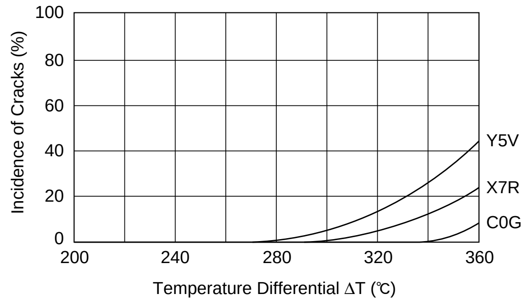
Visually inspect the test sample with a 60-power optical microscope. Chips exhibiting breaks or cracks shall be determined to be defective.

Continued on the following page.

Reference Data

Continued from the preceding page.

(4) Results



7. Solder Heat Resistance

(1) Test Method

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

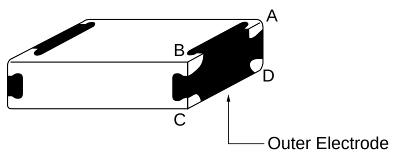
② Flow soldering :
After dipping the test sample with a pair of tweezers in wave solder (eutectic solder), check for leaching that may have occurred on the outer electrode.

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

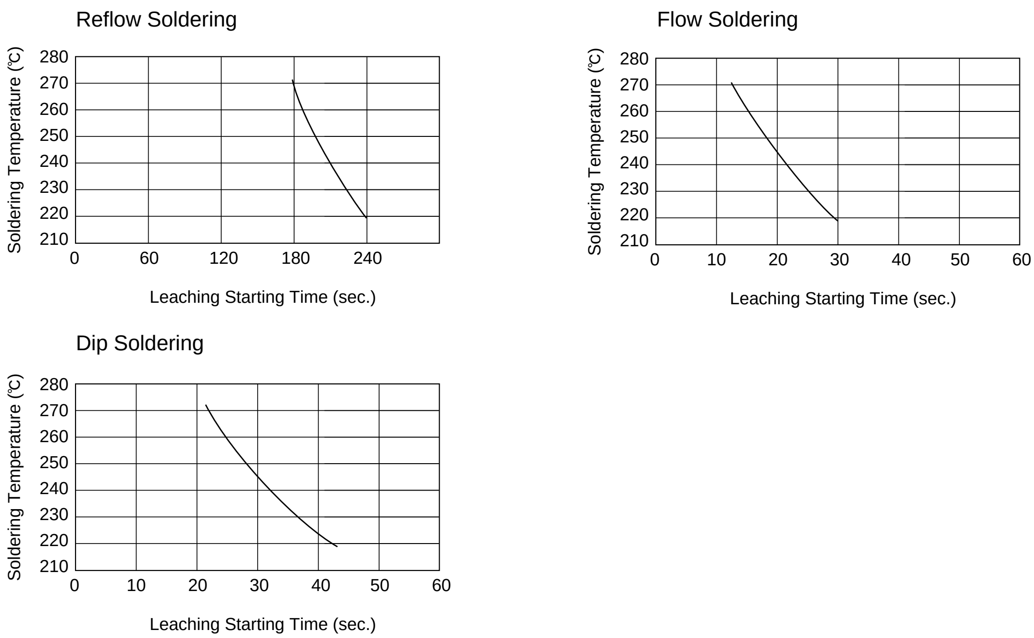
④ Flux to be used : An ethanol solution of 25 % rosin.

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

(3) Acceptance criteria
The starting time of leaching shall 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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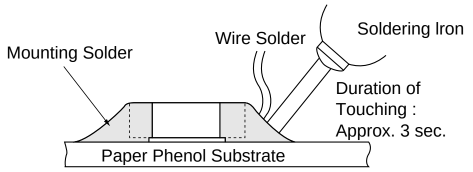
8. Thermal Shock when Making Corrections with a Soldering Iron

(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 shall not directly touch the ceramic element of the chip.)



Soldering Iron	Tip diameter
Ceramic heater 20W	ϕ3mm

(2) Test Samples

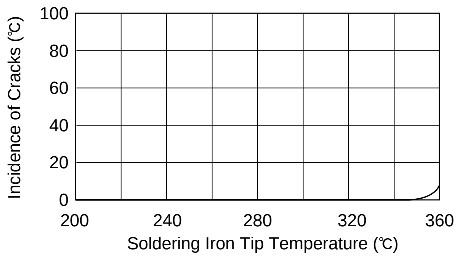
GRM21 C0G/X7R/Y5V Characteristics T=0.6mm

(3) Acceptance Criteria for Defects

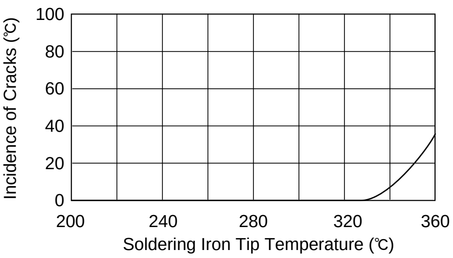
Observe the appearance of the test sample with a 60-power optical microscope. Those units displaying any breaks cracks shall be determined to be defective.

(4) Results

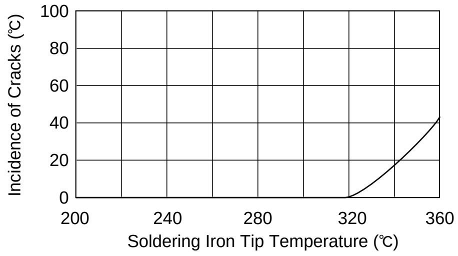
GRM21 C0G (T=0.6)



GRM21 X7R (T=0.6)



GRM21 Y5V (T=0.6)

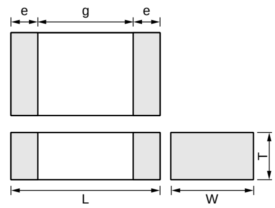


Chip Monolithic Ceramic Capacitors

Medium-voltage Low Dissipation Factor

■ 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. The GRM31 type for flow and reflow soldering, and other types for reflow soldering.
5. Low-loss and suitable for high-frequency circuits.
6. The temperature characteristics C0G and SL are temperature compensating type, and R is high dielectric constant type.



Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GRM31A	3.2 ±0.2	1.6 ±0.2	1.0 +0/-0.3	0.3	1.5*
GRM31B			1.25 +0/-0.3		
GRM32Q	3.2 ±0.2	2.5 ±0.2	1.5 +0/-0.3		1.8
GRM42D	4.5 ±0.3	2.0 ±0.2	2.0 ±0.3		2.9
GRM43D	4.5 ±0.3	3.2 ±0.3	2.0 +0/-0.3		
GRM43E			2.5 +0/-0.3		

* GRM31B1X3D : 1.8mm min.

■ Applications

- Ideal use on high-frequency pulse circuit such as snubber circuit for switching power supply, DC-DC converter, ballast(inverter fluorescent lamp), and so on. (C0G and R Char.)
- Ideal for use as the ballast in liquid crystal back lighting inverters. (SL Char.)

Part Number	Rated Voltage (V)	TC Code	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g (mm)	Electrode e (mm)
GRM31A5C2J101JW01D	DC630	C0G	100 +5,-5%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR32J101KY01D	DC630	R	100 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31A5C2J151JW01D	DC630	C0G	150 +5,-5%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR32J151KY01D	DC630	R	150 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31A5C2J221JW01D	DC630	C0G	220 +5,-5%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR32J221KY01D	DC630	R	220 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31A5C2J331JW01D	DC630	C0G	330 +5,-5%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR32J331KY01D	DC630	R	330 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31A5C2J471JW01D	DC630	C0G	470 +5,-5%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31BR32J471KY01L	DC630	R	470 +10,-10%	3.2	1.6	1.25	1.5 min.	0.3 min.
GRM31BR32J681KY01L	DC630	R	680 +10,-10%	3.2	1.6	1.25	1.5 min.	0.3 min.
GRM31B5C2J102JW01L	DC630	C0G	1000 +5,-5%	3.2	1.6	1.25	1.5 min.	0.3 min.
GRM31BR32J102KY01L	DC630	R	1000 +10,-10%	3.2	1.6	1.25	1.5 min.	0.3 min.
GRM31AR33A470KY01D	DC1000	R	47 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR33A680KY01D	DC1000	R	68 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR33A101KY01D	DC1000	R	100 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR33A151KY01D	DC1000	R	150 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR33A221KY01D	DC1000	R	220 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31AR33A331KY01D	DC1000	R	330 +10,-10%	3.2	1.6	1.0	1.5 min.	0.3 min.
GRM31BR33A471KY01L	DC1000	R	470 +10,-10%	3.2	1.6	1.25	1.5 min.	0.3 min.
GRM31B1X3D100JY01L	DC2000	SL	10 +5,-5%	3.2	1.6	1.25	1.8 min.	0.3 min.
GRM31B1X3D120JY01L	DC2000	SL	12 +5,-5%	3.2	1.6	1.25	1.8 min.	0.3 min.
GRM31B1X3D150JY01L	DC2000	SL	15 +5,-5%	3.2	1.6	1.25	1.8 min.	0.3 min.
GRM31B1X3D180JY01L	DC2000	SL	18 +5,-5%	3.2	1.6	1.25	1.8 min.	0.3 min.
GRM31B1X3D220JY01L	DC2000	SL	22 +5,-5%	3.2	1.6	1.25	1.8 min.	0.3 min.
GRM32Q1X3D270JY01L	DC2000	SL	27 +5,-5%	3.2	2.5	1.5	1.8 min.	0.3 min.
GRM32Q1X3D330JY01L	DC2000	SL	33 +5,-5%	3.2	2.5	1.5	1.8 min.	0.3 min.

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Part Number	Rated Voltage (V)	TC Code	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g (mm)	Electrode e (mm)
GRM32Q1X3D390JY01L	DC2000	SL	39 +5,-5%	3.2	2.5	1.5	1.8 min.	0.3 min.
GRM32Q1X3D470JY01L	DC2000	SL	47 +5,-5%	3.2	2.5	1.5	1.8 min.	0.3 min.
GRM32Q1X3D560JY01L	DC2000	SL	56 +5,-5%	3.2	2.5	1.5	1.8 min.	0.3 min.
GRM32Q1X3D680JY01L	DC2000	SL	68 +5,-5%	3.2	2.5	1.5	1.8 min.	0.3 min.
GRM32Q1X3D820JY01L	DC2000	SL	82 +5,-5%	3.2	2.5	1.5	1.8 min.	0.3 min.
GRM43D1X3D121JY01L	DC2000	SL	120 +5,-5%	4.5	3.2	2.0	2.9 min.	0.3 min.
GRM43D1X3D151JY01L	DC2000	SL	150 +5,-5%	4.5	3.2	2.0	2.9 min.	0.3 min.
GRM43D1X3D181JY01L	DC2000	SL	180 +5,-5%	4.5	3.2	2.0	2.9 min.	0.3 min.
GRM43D1X3D221JY01L	DC2000	SL	220 +5,-5%	4.5	3.2	2.0	2.9 min.	0.3 min.
GRM42D1X3F100JY02L	DC3150	SL	10 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F120JY02L	DC3150	SL	12 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F150JY02L	DC3150	SL	15 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F180JY02L	DC3150	SL	18 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F220JY02L	DC3150	SL	22 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F270JY02L	DC3150	SL	27 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F330JY02L	DC3150	SL	33 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F390JY02L	DC3150	SL	39 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F470JY02L	DC3150	SL	47 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F560JY02L	DC3150	SL	56 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F680JY02L	DC3150	SL	68 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM42D1X3F820JY02L	DC3150	SL	82 +5,-5%	4.5	2.0	2.0	2.9 min.	0.3 min.
GRM43E1X3F101JY01L	DC3150	SL	100 +5,-5%	4.5	3.2	2.5	2.9 min.	0.3 min.

Specifications and Test Methods

No.	Item	Specification: Temperature Compensating Type (C0G, SL Char.)	Specification: High Dielectric Constant Type (R Char.)	Test Method
1	Operating Temperature Range	−55 to +125℃		
2	Appearance	No defects or abnormalities.		Visual inspection.
3	Dimensions	Within the specified dimension.		Using calipers.
4	Dielectric Strength	No defects or abnormalities.		No failure shall be observed when voltage in Table is applied between the terminations for 1 to 5 s, provided the charge/discharge current is less than 50mA. Rated voltage / Test voltage More than DC 1kV / 120% of the rated voltage Less than DC 1kV / 150% of the rated voltage
5	Insulation Resistance (I.R.)	More than 10,000MΩ		The insulation resistance shall be measured with 500±50V and within 60±5 s of charging.
6	Capacitance	Within the specified tolerance.		The capacitance/Q/D.F. shall be measured at 20℃ at the frequency and voltage shown as follows. (1) Temperature Compensating Type Frequency : 1±0.2MHz Voltage : 0.5 to 5V (r.m.s.) (2) High Dielectric Constant Type Frequency : 1±0.2kHz Voltage : 1±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 h at room condition.
7	Q/ Dissipation Factor (D.F.)	C≧30pF : Q≧1,000 C<30pF : Q≧400+20C C : Nominal Capacitance (pF)	D.F.≦0.01	
8	Capacitance Temperature Characteristics	Temp. Coefficient C0G char. : 0±30ppm/°C (Temp. Range : -55 to +125°C) SL char. : +350 to −1,000 ppm/℃ (Temp. Range : +20 to +85℃)	Cap. Change Within ±15%	(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 (SL : +20 to +85 ℃) the capacitance shall be within the specified tolerance for the temperature coefficient. Step / Temperature(℃) 1 / 20±2 (25±2 for C0G char.) 2 / Min. Operating Temp.±3 3 / 20±2 (25±2 for C0G char.) 4 / Max. Operating Temp.±2 5 / 20±2 (25±2 for C0G char.) (2) High Dielectric Constant Type The range of capacitance change compared to the 20℃ value within −55 to +125℃ shall 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 h at room condition.
9	Adhesive Strength of Termination	No removal of the terminations or other defect shall 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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock. (see Fig.1 below)

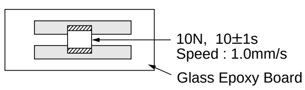


Fig.1

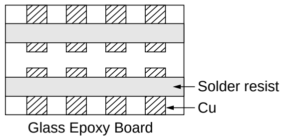
"Room condition" Temperature : 15 to 35℃, Relative humidity : 45 to 75%, Atmosphere pressure : 86 to 106kPa

Continued on the following page.

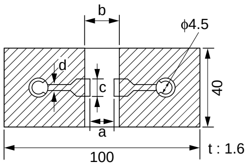
Specifications and Test Methods

Continued from the preceding page.

No.	Item		Specification: Temperature Compensating Type (C0G, SL Char.)	Specification: High Dielectric Constant Type (R Char.)	Test Method
10	Vibration Resistance	Appearance	No defects or abnormalities.		Solder the capacitor to the test jig (glass epoxy board). The capacitor shall 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, shall be traversed in approximately 1 min. This motion shall be applied for a period of 2 h in each 3 mutually perpendicular directions (total of 6 h).
		Capacitance	Within the specified tolerance.		
		Q/D.F.	C≧30pF : Q≧1,000 C<30pF : Q≧400+20C C : Nominal Capacitance (pF)	D.F.≦0.01	

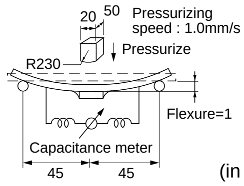


No.	Item		Specification: Temperature Compensating Type (C0G, SL Char.)	Specification: High Dielectric Constant Type (R Char.)	Test Method
11	Deflection		No cracking or marking defects shall occur.		Solder the capacitor to the testing jig (glass epoxy board) shown in Fig.2 using a eutectic solder. Then apply a force in the direction shown in Fig.3. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.



L×W (mm)	Dimension (mm) a	b	c	d
3.2×1.6	2.2	5.0	2.0	1.0
3.2×2.5	2.2	5.0	2.9	
4.5×2.0	3.5	7.0	2.4	
4.5×3.2	3.5	7.0	3.7	

Fig.2



(in mm)

Fig.3

No.	Item		Specification: Temperature Compensating Type (C0G, SL Char.)	Specification: High Dielectric Constant Type (R Char.)	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 eutectic solder solution for 2±0.5 s at 235±5℃. Immersing speed : 25±2.5mm/s
13	Resistance to Soldering Heat	Appearance	No marking defects.		Preheat the capacitor at 120 to 150℃* for 1 min. Immerse the capacitor in eutectic solder solution at 260±5℃ for 10±1 s. Let sit at room condition for 24±2 h, then measure. •Immersing speed : 25±2.5mm/s •Pretreatment for high dielectric constant type Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min and then let sit for 24±2 h at room condition.
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10%	
		Q/D.F.	C≧30pF : Q≧1,000 C<30pF : Q≧400+20C C : Nominal Capacitance (pF)	D.F.≦0.01	
		I.R.	More than 10,000MΩ		
		Dielectric Strength	Pass the item No.4.		

*Preheating for more than 3.2×2.5mm

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

No.	Item		Specification: Temperature Compensating Type (C0G, SL Char.)	Specification: High Dielectric Constant Type (R Char.)	Test Method
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 five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 h at room condition, then measure.
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10%	
		Q/D.F.	C≧30pF : Q≧1,000 C<30pF : Q≧400+20C C : Nominal Capacitance (pF)	D.F.≦0.01	
		I.R.	More than 10,000MΩ		
		Dielectric Strength	Pass the item No.4.		

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

•Pretreatment for high dielectric constant type
Perform a heat treatment at 150$^{+0}_{-10}$℃ for 60±5 min and then let sit for 24±2 h at room condition.

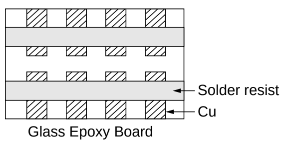


Fig.4

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

Continued on the following page.

15

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">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type (C0G, SL Char.)</th><th>High Dielectric Constant Type (R Char.)</th></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Humidity (Steady State)</td><td>Appearance</td><td colspan="2">No marking defects.</td><td rowspan="5">Sit the capacitor at 40±2℃ and relative humidity 90 to 95% for 500^{+24}_{-0} h.
Remove and let sit for 24±2 h at room condition, then measure.
•Pretreatment for high dielectric constant type
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min and then let sit for 24±2 h at room condition.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5.0% or ±0.5pF (Whichever is larger)</td><td>Within ±10%</td></tr>
<tr><td>Q/D.F.</td><td>C≧30pF : Q≧350
C<30pF : Q≧275+ $\frac{5}{2}$ C
C : Nominal Capacitance (pF)</td><td>D.F.≦0.01</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">Pass the item No.4.</td></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Life</td><td>Appearance</td><td colspan="2">No marking defects.</td><td rowspan="5">Apply the voltage in following table for $1,000^{+48}_{-0}$ at maximum operating temperature±3℃.
Remove and let sit for 24±2 h at room condition, then measure.
The charge/discharge current is less than 50mA.
•Pretreatment for high dielectric constant type
Apply test voltage for 60±5 min at test temperature.
Remove and let sit for 24±2 h at room condition.
<table><tr><th>Rated voltage</th><th>Test voltage</th></tr><tr><td>More than DC 1kV</td><td>Rated voltage</td></tr><tr><td>Less than DC 1kV</td><td>120% of the rated voltage</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td>Within ±3.0% or ±0.3pF (Whichever is larger)</td><td>Within ±10%</td></tr>
<tr><td>Q/D.F.</td><td>C≧30pF : Q≧350
C<30pF : Q≧275+ $\frac{5}{2}$ C
C : Nominal Capacitance (pF)</td><td>D.F.≦0.02</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">Pass the item No.4.</td></tr>
</table>

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

Chip Monolithic Ceramic Capacitors

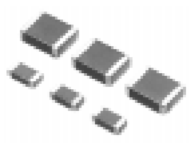
Medium-voltage High-Capacitance for General-Use

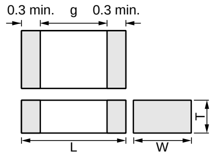
■ Features

1. A new monolithic structure for small, high-capacitance capable of operating at high-voltage levels.
2. Sn-plated external electrodes realize good solderability.
3. The GRM21/31 type for flow and reflow soldering, and other types for reflow soldering.

■ Applications

- Ideal use as hot-cold coupling for DC-DC converter.
- Ideal use on line filter and ringer detector for telephone, facsimile and modem.
- Ideal use on diode-snubber circuit for switching power supply.

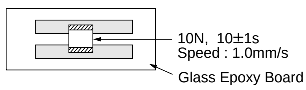
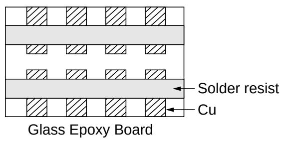
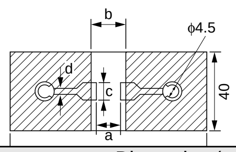
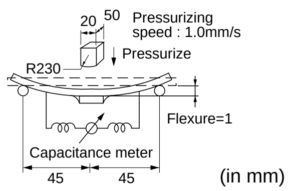




Part Number	Dimensions (mm)			
	L	W	T	g min.
GRM21A	2.0 ±0.2	1.25 ±0.2	1.0 +0,-0.3	0.7
GRM21B			1.25 ±0.2	
GRM31B	3.2 ±0.2	1.6 ±0.2	1.25 +0,-0.3	1.2
GRM31C			1.6 ±0.2	
GRM32Q	3.2 ±0.3	2.5 ±0.2	1.5 +0,-0.3	
GRM32D			2.0 +0,-0.3	
GRM43Q	4.5 ±0.4	3.2 ±0.3	1.5 +0,-0.3	2.2
GRM43D			2.0 +0,-0.3	
GRM55D	5.7 ±0.4	5.0 ±0.4	2.0 +0,-0.3	3.2
GRM55X			2.7 +0,-0.3	

Part Number	Rated Voltage (V)	TC Code	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g (mm)	Electrode e (mm)
GRM21AR72E102KW01D	DC250	X7R	1000pF +10,-10%	2.0	1.25	1.0	0.7 min.	0.3 min.
GRM21AR72E152KW01D	DC250	X7R	1500pF +10,-10%	2.0	1.25	1.0	0.7 min.	0.3 min.
GRM21AR72E222KW01D	DC250	X7R	2200pF +10,-10%	2.0	1.25	1.0	0.7 min.	0.3 min.
GRM21AR72E332KW01D	DC250	X7R	3300pF +10,-10%	2.0	1.25	1.0	0.7 min.	0.3 min.
GRM21AR72E472KW01D	DC250	X7R	4700pF +10,-10%	2.0	1.25	1.0	0.7 min.	0.3 min.
GRM21AR72E682KW01D	DC250	X7R	6800pF +10,-10%	2.0	1.25	1.0	0.7 min.	0.3 min.
GRM21BR72E103KW03L	DC250	X7R	10000pF +10,-10%	2.0	1.25	1.25	0.7 min.	0.3 min.
GRM31BR72E153KW01L	DC250	X7R	15000pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31BR72E223KW01L	DC250	X7R	22000pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31CR72E333KW03L	DC250	X7R	33000pF +10,-10%	3.2	1.6	1.6	1.2 min.	0.3 min.
GRM31CR72E473KW03L	DC250	X7R	47000pF +10,-10%	3.2	1.6	1.6	1.2 min.	0.3 min.
GRM32QR72E683KW01L	DC250	X7R	68000pF +10,-10%	3.2	2.5	1.5	1.2 min.	0.3 min.
GRM32DR72E104KW01L	DC250	X7R	0.1µF +10,-10%	3.2	2.5	2.0	1.2 min.	0.3 min.
GRM43QR72E154KW01L	DC250	X7R	0.15µF +10,-10%	4.5	3.2	1.5	2.2 min.	0.3 min.
GRM43DR72E224KW01L	DC250	X7R	0.22µF +10,-10%	4.5	3.2	2.0	2.2 min.	0.3 min.
GRM55DR72E334KW01L	DC250	X7R	0.33µF +10,-10%	5.7	5.0	2.0	3.2 min.	0.3 min.
GRM55DR72E474KW01L	DC250	X7R	0.47µF +10,-10%	5.7	5.0	2.0	3.2 min.	0.3 min.
GRM31BR72J102KW01L	DC630	X7R	1000pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31BR72J152KW01L	DC630	X7R	1500pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31BR72J222KW01L	DC630	X7R	2200pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31BR72J332KW01L	DC630	X7R	3300pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31BR72J472KW01L	DC630	X7R	4700pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31BR72J682KW01L	DC630	X7R	6800pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31BR72J103KW01L	DC630	X7R	10000pF +10,-10%	3.2	1.6	1.25	1.2 min.	0.3 min.
GRM31CR72J153KW03L	DC630	X7R	15000pF +10,-10%	3.2	1.6	1.6	1.2 min.	0.3 min.
GRM32QR72J223KW01L	DC630	X7R	22000pF +10,-10%	3.2	2.5	1.5	1.2 min.	0.3 min.
GRM32DR72J333KW01L	DC630	X7R	33000pF +10,-10%	3.2	2.5	2.0	1.2 min.	0.3 min.
GRM32DR72J473KW01L	DC630	X7R	47000pF +10,-10%	3.2	2.5	2.0	1.2 min.	0.3 min.
GRM43QR72J683KW01L	DC630	X7R	68000pF +10,-10%	4.5	3.2	1.5	2.2 min.	0.3 min.
GRM43DR72J104KW01L	DC630	X7R	0.1µF +10,-10%	4.5	3.2	2.0	2.2 min.	0.3 min.
GRM55DR72J154KW01L	DC630	X7R	0.15µF +10,-10%	5.7	5.0	2.0	3.2 min.	0.3 min.
GRM55XB32J224KY05L	DC630	B	0.22µF +10,-10%	5.7	5.0	2.7	3.5 min.	0.3 min.

Specifications and Test Methods

No.	Item	Specification	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 shall be observed when 150% of the rated voltage (200% of the rated voltage in case of rated voltage: DC 250V) is applied between the terminations for 1 to 5 s, 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 shall be measured with 500±50V (250±50V in case of rated voltage: DC 250V) and within 60±5 s of charging.
6	Capacitance	Within the specified tolerance.	The capacitance/D.F. shall be measured at 20℃ at a frequency of 1±0.2kHz and a voltage of 1±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 h at room condition.
7	Dissipation Factor (D.F.)	0.025 max.	
8	Capacitance Temperature Characteristics	Cap. Change Within ±10% (B) (Temp. Range : −25 to +85℃) Within ±15% (X7R) (Temp. Range : −55 to +125℃)	The range of capacitance change compared with the 20℃ (B), 25℃ (X7R) value within −25 to +85℃ shall 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 h at room condition.
9	Adhesive Strength of Termination	No removal of the terminations or other defect shall 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 shall be done either with an iron or using the reflow method and shall 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 shall 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, shall be traversed in approximately 1 min. This motion shall be applied for a period of 2 h in each 3 mutually perpendicular directions (total of 6 h). 
	Vibration Resistance — Capacitance	Within the specified tolerance.	
	Vibration Resistance — D.F.	0.025 max.	
11	Deflection	No cracking or marking defects shall 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 shall be done either with an iron or using the reflow method and shall 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
2.0×1.25	1.2	4.0	1.65	1.0
3.2×1.6	2.2	5.0	2.0	
3.2×2.5	2.2	5.0	2.9	
4.5×3.2	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%, Atmosphere pressure : 86 to 106kPa

Continued on the following page.

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Specifications and Test Methods

Continued from the preceding page.

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>12</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).
Immerse in eutectic solder solution for 2±0.5 s at 235±5℃.
Immersing speed : 25±2.5mm/s</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 eutectic solder solution at 260±5℃ for 10±1 s. Let sit at room condition for 24±2 h, 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 h 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℃</td><td>1 min.</td></tr><tr><td>2</td><td>170℃ to 200℃</td><td>1 min.</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>C≧0.01μF : More than 100MΩ • μF
C<0.01μF : More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>Pass the 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 five cycles according to the four heat treatments listed in the following table.
Let sit for 24±2 h at room condition, then measure.<table><tr><th>Step</th><th>Temperature (℃)</th><th>Time (min)</th></tr><tr><td>1</td><td>Min. Operating Temp.±3</td><td>30±3</td></tr><tr><td>2</td><td>Room Temp.</td><td>2 to 3</td></tr><tr><td>3</td><td>Max. Operating Temp.±2</td><td>30±3</td></tr><tr><td>4</td><td>Room Temp.</td><td>2 to 3</td></tr></table>•Pretreatment
Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min and then let sit for 24±2 h at room condition.

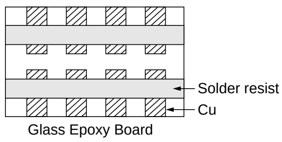



Fig.4</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td>I.R.</td><td>C≧0.01μF : More than 100MΩ • μF
C<0.01μF : More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Humidity (Steady State)</td><td>Appearance</td><td>No marking defects.</td><td rowspan="5">Sit the capacitor at 40±2℃ and relative humidity 90 to 95% for 500^{+24}_{-0} h.
Remove and let sit for 24±2 h 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 h 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>Pass the 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 (150% of the rated voltage in case of rated voltage: DC250V) for $1{,}000^{+48}_{-0}$ h at maximum operating temperature±3℃. Remove and let sit for 24 ±2 h 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 h 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>Pass the 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℃ and relative humidity 90 to 95% for 500^{+24}_{-0} h.
Remove and let sit for 24±2 h at room condition, then measure.
•Pretreatment
Apply test voltage for 60±5 min at test temperature.
Remove and let sit for 24±2 h 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>Pass the item No.4.</td></tr>
</table>

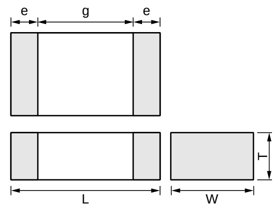
"Room condition" Temperature : 15 to 35℃, Relative humidity : 45 to 75%, Atmosphere pressure : 86 to 106kPa

Chip Monolithic Ceramic Capacitors

AC250V Type (Which Meet Japanese Low)

■ Features

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



Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GA252D	5.7 ±0.4	2.8 ±0.3	2.0 ±0.3	0.3	3.5
GA255D		5.0 ±0.4			

■ Applications

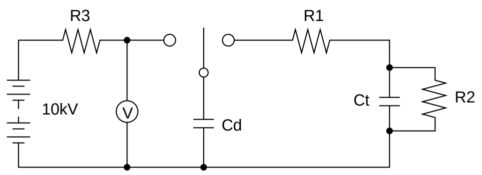
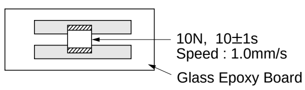
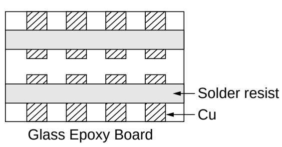
Noise suppression filters for switching power supplies, telephones, facsimiles, modems.

■ Refference srandard

JIS C 5102
JIS C 5150
The standards of the electrical appliance and material safety law of Japan, separated table 4.

Part Number	Rated Voltage (V)	TC Code	Capacitance	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g (mm)	Electrode e (mm)
GA252DB3E2471MY02L	AC250 (r.m.s.)	B	470pF +20,-20%	5.7	2.8	2.0	3.5 min.	0.3 min.
GA252DB3E2102MY02L	AC250 (r.m.s.)	B	1000pF +20,-20%	5.7	2.8	2.0	3.5 min.	0.3 min.
GA252DB3E2222MY02L	AC250 (r.m.s.)	B	2200pF +20,-20%	5.7	2.8	2.0	3.5 min.	0.3 min.
GA252DB3E2472MY02L	AC250 (r.m.s.)	B	4700pF +20,-20%	5.7	2.8	2.0	3.5 min.	0.3 min.
GA252DB3E2103MY02L	AC250 (r.m.s.)	B	10000pF +20,-20%	5.7	2.8	2.0	3.5 min.	0.3 min.
GA252DB3E2223MY02L	AC250 (r.m.s.)	B	22000pF +20,-20%	5.7	2.8	2.0	3.5 min.	0.3 min.
GA252DB3E2473MY02L	AC250 (r.m.s.)	B	47000pF +20,-20%	5.7	2.8	2.0	3.5 min.	0.3 min.
GA255DB3E2104MY02L	AC250 (r.m.s.)	B	0.1μF +20,-20%	5.7	5.0	2.0	3.5 min.	0.3 min.

Specifications and Test Methods

No.	Item		Specification	Test Method
1	Operating Temperature Range		−25 to +85℃	–
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 shall be observed when voltage as table is applied between the terminations for 60±1 s, 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 shall be measured with 500±50V and within 60±5 s of charging.
6	Capacitance		Within the specified tolerance.	The capacitance/D.F. shall be measured at 20℃ at a frequency of 1±0.2kHz and a voltage of 1±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 h at room condition.
7	Dissipation Factor (D.F.)		0.025 max.	
8	Capacitance Temperature Characteristics		Cap. Change Within ±10%	The range of capacitance change compared with the 20℃ value within −25 to +85℃ shall 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 h 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 s 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 shall 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 shall be done either with an iron or using the reflow method and shall 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 shall 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, shall be traversed in approximately 1 min. This motion shall be applied for a period of 2 h in each 3 mutually perpendicular directions (total of 6 h). 
		Capacitance	Within the specified tolerance.	
		D.F.	0.025 max.	

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

Continued on the following page.

Specifications and Test Methods

Continued from the preceding page.

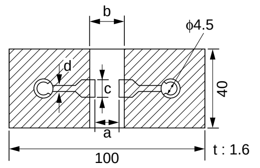
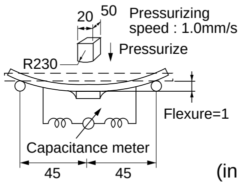
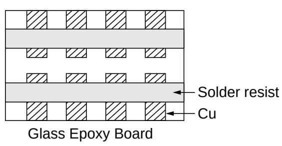
No.	Item		Specification	Test Method
12	Deflection		No cracking or marking defects shall occur.  (Dimension table below) Fig.2	Solder the capacitor to the testing jig (glass epoxy board) shown in Fig.2 using a eutectic solder. Then apply a force in the direction shown in Fig. 3. The soldering shall be done either with an iron or using the reflow method and shall 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 eutectic solder solution for 2±0.5 s at 235±5℃. Immersing speed : 25±2.5mm/s
14	Humidity Insulation	Appearance	No marking defects.	The capacitor shall be subjected to 40±2℃, relative humidity of 90 to 98% for 8 h, and then removed in room condition for 16 h until 5 cycles.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 1,000MΩ	
		Dielectric Strength	Pass the item No.4.	
15	Resistance to Soldering Heat	Appearance	No marking defects.	Preheat the capacitor as table. Immerse the capacitor in eutectic solder solution at 260±5℃ for 10±1 s. Let sit at room condition for 24±2 h, 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 h at room condition. *Preheating (table below)
		Capacitance Change	Within ±10%	
		D.F.	0.025 max.	
		I.R.	More than 2,000MΩ	
		Dielectric Strength	Pass the 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 five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 h at room condition, then measure. (Table below) •Pretreatment Perform a heat treatment at 150^{+0}_{-10}℃ for 60±5 min and then let sit for 24±2 h at room condition.  Fig.4
		Capacitance Change	Within ±7.5%	
		D.F.	0.025 max.	
		I.R.	More than 2,000MΩ	
		Dielectric Strength	Pass the item No.4.	

Fig.2 dimensions (No.12):

L×W (mm)	Dimension (mm) a	b	c	d
5.7×2.8	4.5	8.0	3.2	1.0
5.7×5.0	4.5	8.0	5.6	

*Preheating (No.15):

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

Temperature cycle (No.16):

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

"Room condition" Temperature : 15 to 35℃, Relative humidity : 45 to 75%, Atmosphere 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>Specification</th><th>Test Method</th></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">Sit the capacitor at 40±2℃ and relative humidity 90 to 95% for 500$^{+24}_{-0}$ h.
Remove and let sit for 24±2 h 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 h at room condition.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>Pass the 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">Apply voltage and time as Table at 85±2℃. Remove and let sit for 24 ±2 h at room condition, then measure. The charge / discharge current is less than 50mA.
<table><tr><th>Nominal Capacitance</th><th>Test Time</th><th>Test voltage</th></tr><tr><td>C≧10,000pF</td><td>1,000$^{+48}_{-0}$ h</td><td>AC300V (r.m.s.)</td></tr><tr><td>C<10,000pF</td><td>1,500$^{+48}_{-0}$ h</td><td>AC500V (r.m.s.) *</td></tr></table>✻ Except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1 s

•Pretreatment
Apply test voltage for 60±5 min at test temperature.
Remove and let sit for 24±2 h at room condition.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td rowspan="5">19</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℃ and relative humidity 90 to 95% for 500$^{+24}_{-0}$ h.
Remove and let sit for 24±2 h at room condition, then measure.
•Pretreatment
Apply test voltage for 60±5 min at test temperature.
Remove and let sit for 24±2 h at room condition.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
</table>

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

Chip Monolithic Ceramic Capacitors

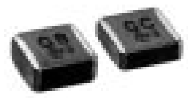
Safety Standard Recognized Type GC (UL, IEC60384-14 Class X1/Y2)

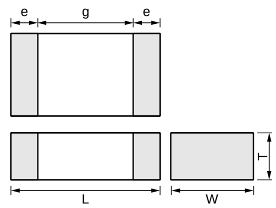
■ Features

1. Chip monolitic ceramic capacitor (certified as conforming to safety standards) for AC line.
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. The type GC can be used as an X1-class and Y2-class capacitor.
6. +125 degree C guaranteed.
7. Only for reflow soldering.

■ Applications

• Ideal use as Y capacitor or X capacitor for various switching power supply.
• Ideal use as linefilter for MODEM.





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

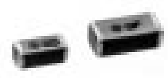
Part Number	Rated Voltage (V)	TC Code	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g (mm)	Electrode e (mm)
GA355DR7GC101KY02L	AC250 (r.m.s.)	X7R	100 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC151KY02L	AC250 (r.m.s.)	X7R	150 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC221KY02L	AC250 (r.m.s.)	X7R	220 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC331KY02L	AC250 (r.m.s.)	X7R	330 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC471KY02L	AC250 (r.m.s.)	X7R	470 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC681KY02L	AC250 (r.m.s.)	X7R	680 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC102KY02L	AC250 (r.m.s.)	X7R	1000 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC152KY02L	AC250 (r.m.s.)	X7R	1500 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC222KY02L	AC250 (r.m.s.)	X7R	2200 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC332KY02L	AC250 (r.m.s.)	X7R	3300 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GC472KY02L	AC250 (r.m.s.)	X7R	4700 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.

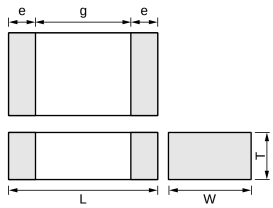
Chip Monolithic Ceramic Capacitors

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 an Y3-class capacitor, and the type GF can be used as an Y2-class capacitor.
3. Available for the equipment based on IEC/EN60950 and UL1950.
4. +125 degree C guaranteed.
5. Only for reflow soldering.





Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GA342D	4.5 ±0.3	2.0 ±0.2	2.0 ±0.3	0.3	Type GD : 2.5 Type GF : 3.5
GA343D	4.5 ±0.4	3.2 ±0.3	$2.0 \pm^{0}_{0.3}$		
GA352D	5.7 ±0.4	2.8 ±0.3	$2.0 \pm^{0}_{0.3}$		
GA355D	5.7 ±0.4	5.0 ±0.4	$2.0 \pm^{0}_{0.3}$		

■ Applications

- Ideal use on line filter and coupling for trans-former-less DAA modem.
- Ideal use on line filter for information equipment.

■ Standard Recognition

	Standard No.	Status of Recognition		Rated Voltage
		Type GD	Type GF	
SEMKO	EN132400	◎	◎	AC250V (r.m.s.)
EN132400 Class		Y3	Y2	

Part Number	Rated Voltage (V)	TC Code	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g (mm)	Electrode e (mm)
GA342DR7GD101KW02L	AC250 (r.m.s.)	X7R	100 +10,-10%	4.5	2.0	2.0	2.5 min.	0.3 min.
GA342DR7GD151KW02L	AC250 (r.m.s.)	X7R	150 +10,-10%	4.5	2.0	2.0	2.5 min.	0.3 min.
GA342DR7GD221KW02L	AC250 (r.m.s.)	X7R	220 +10,-10%	4.5	2.0	2.0	2.5 min.	0.3 min.
GA342DR7GD471KW02L	AC250 (r.m.s.)	X7R	470 +10,-10%	4.5	2.0	2.0	2.5 min.	0.3 min.
GA342DR7GD102KW02L	AC250 (r.m.s.)	X7R	1000 +10,-10%	4.5	2.0	2.0	2.5 min.	0.3 min.
GA342DR7GD152KW02L	AC250 (r.m.s.)	X7R	1500 +10,-10%	4.5	2.0	2.0	2.5 min.	0.3 min.
GA343DR7GD182KW01L	AC250 (r.m.s.)	X7R	1800 +10,-10%	4.5	3.2	2.0	2.5 min.	0.3 min.
GA343DR7GD222KW01L	AC250 (r.m.s.)	X7R	2200 +10,-10%	4.5	3.2	2.0	2.5 min.	0.3 min.

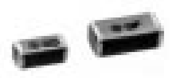
Chip Monolithic Ceramic Capacitors

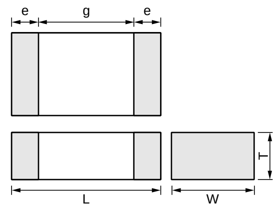
muRata

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

■ 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 an Y3-class capacitor, and the type GF can be used as an Y2-class capacitor.
3. Available for the equipment based on IEC/EN60950 and UL1950.
4. +125 degree C guaranteed.
5. Only for reflow soldering.





Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GA342D	4.5 ±0.3	2.0 ±0.2	2.0 ±0.3	0.3	Type GD : 2.5 Type GF : 3.5
GA343D	4.5 ±0.4	3.2 ±0.3	$2.0 \pm^{0}_{0.3}$		
GA352D	5.7 ±0.4	2.8 ±0.3	$2.0 \pm^{0}_{0.3}$		
GA355D	5.7 ±0.4	5.0 ±0.4	$2.0 \pm^{0}_{0.3}$		

■ Applications

- Ideal use on line filter and coupling for trans-former-less DAA modem.
- Ideal use on line filter for information equipment.

■ Standard Recognition

	Standard No.	Status of Recognition		Rated Voltage
		Type GD	Type GF	
SEMKO	EN132400	◎	◎	AC250V (r.m.s.)
EN132400 Class		Y3	Y2	

Part Number	Rated Voltage (V)	TC Code	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g (mm)	Electrode e (mm)
GA352DR7GF102KW01L	AC250 (r.m.s.)	X7R	1000 +10,-10%	5.7	2.8	2.0	3.5 min.	0.3 min.
GA355DR7GF222KW01L	AC250 (r.m.s.)	X7R	2200 +10,-10%	5.7	5.0	2.0	3.5 min.	0.3 min.

Chip Monolithic Ceramic Capacitors

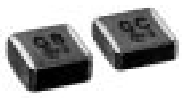
Safety Standard Recognized Type GB (IEC60384-14 Class X2)

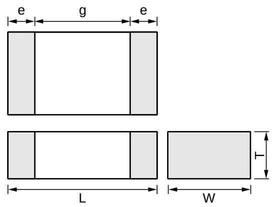
■ Features

1. Chip monolitic ceramic capacitor (certified as conforming to safety standards) for AC line.
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. The type GC can be used as an X1-class and Y2-class capacitor.
6. +125 degree C guaranteed.
7. Only for reflow soldering.

■ Applications

• Ideal use as Y capacitor or X capacitor for various switching power supply.
• Ideal use as linefilter for MODEM.





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		

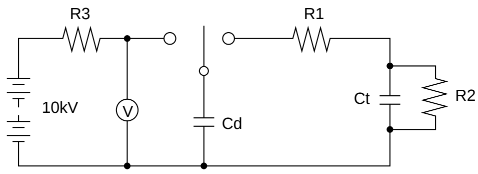
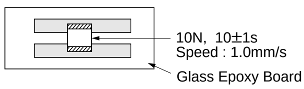
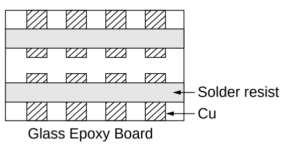
■ Standard Recognition

	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	Capacitance (pF)	Length L (mm)	Width W (mm)	Thickness T (mm)	Electrode g (mm)	Electrode e (mm)
GA355DR7GB103KY02L	AC250 (r.m.s.)	X7R	10000 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GB153KY02L	AC250 (r.m.s.)	X7R	15000 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355DR7GB223KY02L	AC250 (r.m.s.)	X7R	22000 +10,-10%	5.7	5.0	2.0	4.0 min.	0.3 min.
GA355XR7GB333KY06L	AC250 (r.m.s.)	X7R	33000 +10,-10%	5.7	5.0	2.7	4.0 min.	0.3 min.

GA3 Series Specifications and Test Methods

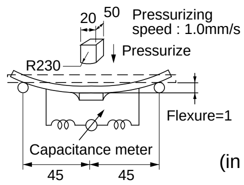
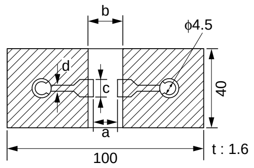
No.	Item		Specification	Test Method
1	Operating Temperature Range		−55 to +125℃	–
2	Appearance		No defects or abnormalities.	Visual inspection.
3	Dimensions		Within the specified dimensions.	Using calipers.
4	Dielectric Strength		No defects or abnormalities.	No failure shall be observed when voltage as table is applied between the terminations for 60±1 s, provided the charge/discharge current is less than 50mA. (Test voltage) Type GB: DC1075V; Type GC/GD/GF: AC1500V (r.m.s.)
5	Insulation Resistance (I.R.)		More than 6,000MΩ	The insulation resistance shall be measured with 500±50V and within 60±5 s of charging.
6	Capacitance		Within the specified tolerance.	The capacitance/D.F. shall be measured at 20℃ at a frequency of 1±0.2kHz and a voltage of 1±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 h at room condition.
7	Dissipation Factor (D.F.)		0.025 max.	
8	Capacitance Temperature Characteristics		Cap. Change Within ±15%	The range of capacitance change compared with the 25℃ value within −55 to +125℃ shall 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 h at room condition.
9	Discharge Test (Application: Type GC)	Appearance	No defects or abnormalities.	As in Fig., discharge is made 50 times at 5 s intervals from the capacitor(Cd) charged at DC voltage of specified.  Ct : Capacitor under test Cd : 0.001μF R1 : 1,000Ω R2 : 100MΩ R3 : Surge resistance
		I.R.	More than 1,000MΩ	
		Dielectric Strength	Pass the item No.4.	
10	Adhesive Strength of Termination		No removal of the terminations or other defect shall 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 shall be done either with an iron or using the reflow method and shall 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 shall 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, shall be traversed in approximately 1 min. This motion shall be applied for a period of 2 h in each 3 mutually perpendicular directions (total of 6 h). 
		Capacitance	Within the specified tolerance.	
		D.F.	0.025 max.	

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

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>Specification</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 shall 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 shall be done either with an iron or using the reflow method and shall 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>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).
Immerse in eutectic solder solution for 2±0.5 s at 235±5℃.
Immersing speed : 25±2.5mm/s</td></tr>
<tr><td rowspan="4">14</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 eutectic solder solution at 260±5℃ for 10±1 s. Let sit at room condition for 24±2 h, 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 h at room condition.

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

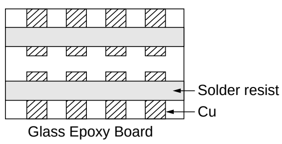



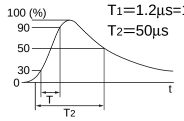
Fig.4</td></tr>
<tr><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Humidity (Steady State)</td><td>Appearance</td><td>No marking defects.</td><td rowspan="5">Sit the capacitor at 40±2℃ and relative humidity 90 to 95% for 500±12 h.
Remove and let sit for 24±2 h at room condition, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
</table>

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

Continued on the following page.

GA3 Series Specifications and Test Methods

Continued from the preceding page.

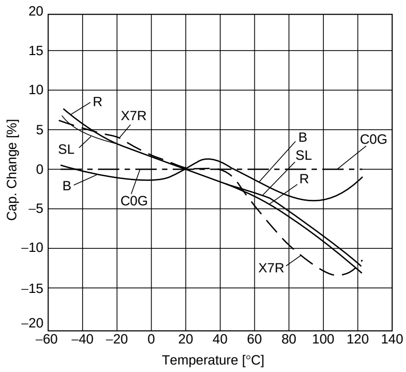
No.	Item		Specification	Test Method
17	Life	Appearance	No marking defects.	Impulse Voltage Each individual capacitor shall be subjected to a 2.5kV (Type GC/GF:5kV)Impulses (the voltage value means zero to peak) for three times. Then the capacitors are applied to life test.  T_1=1.2µs=1.67T T_2=50µs Apply voltage as Table for 1,000 h at 125^{+3}_{-0}℃, relative humidity 50% max. Type: GB — Applied voltage: AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1s. Type: GC, GD, GF — Applied voltage: AC425V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1s.
		Capacitance Change	Within ±20%	
		D.F.	0.05 max.	
		I.R.	More than 3,000MΩ	
		Dielectric Strength	Pass the item No.4.	
18	Humidity Loading	Appearance	No marking defects.	Apply the rated voltage at 40±2℃ and relative humidity 90 to 95% for 500^{+24}_{-0} h. Remove and let sit for 24±2 h at room condition, then measure.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 3,000MΩ	
		Dielectric Strength	Pass the item No.4.	

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

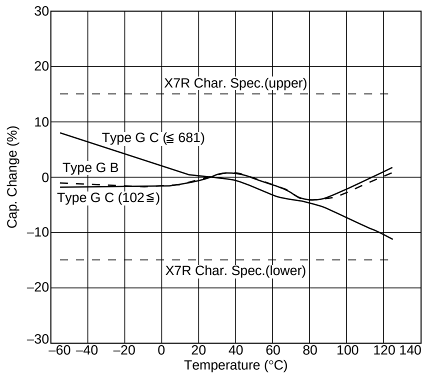
GRM/GA2/GA3 Series Data (Typical Example)

■ Capacitance-Temperature Characteristics

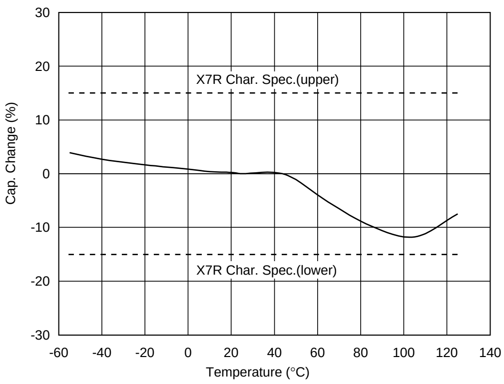
GRM/GA2 Series



GA3 Series (type GB/GC)

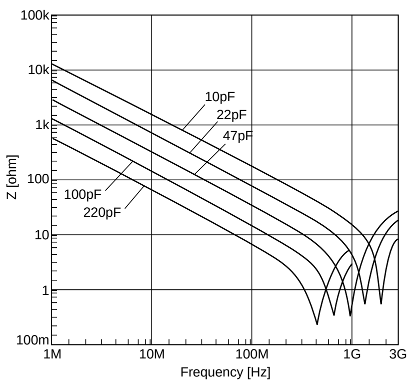


GA3 Series (type GD/GF)

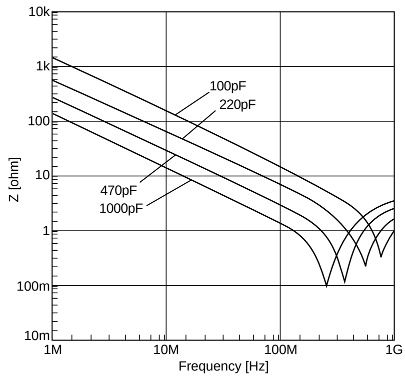


■ Impedance-Frequency Characteristics

GRM Series (SL Characteristics)



GRM Series (R Characteristics)



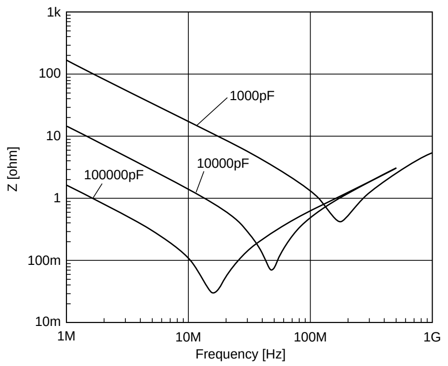
Continued on the following page.

GRM/GA2/GA3 Series Data (Typical Example)

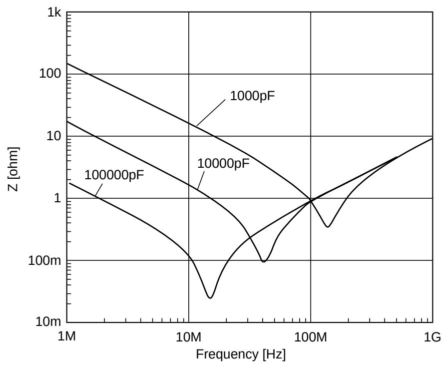
Continued from the preceding page.

■ Impedance-Frequency Characteristics

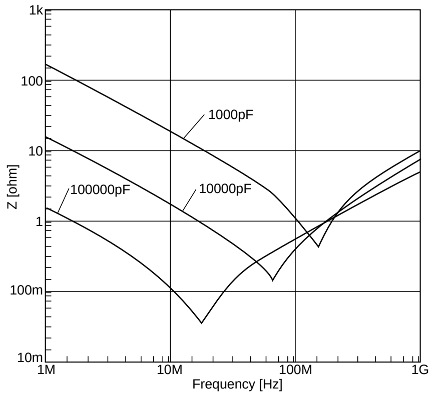
GRM Series (X7R Char. 250V)



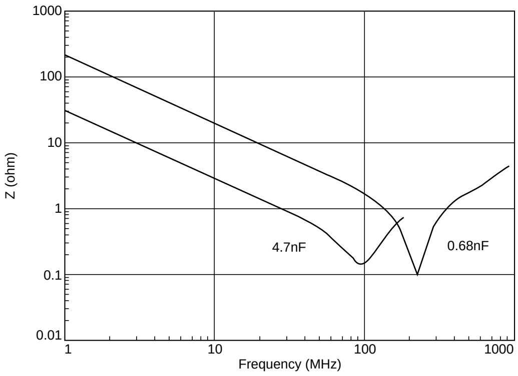
GRM Series (B/X7R Char. 630V)



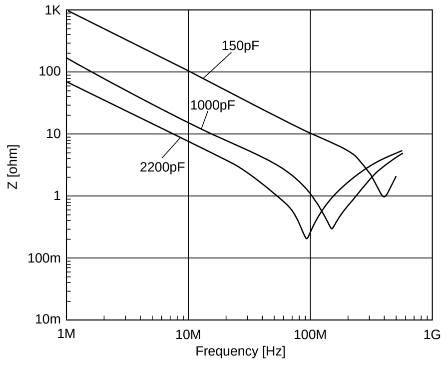
GA2 Series



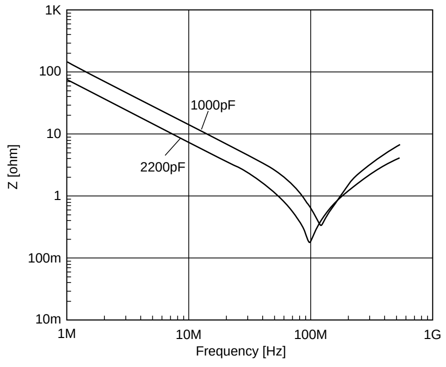
GA3 Series (Type GC)



GA3 Series (Type GD)



GA3 Series (Type GF)



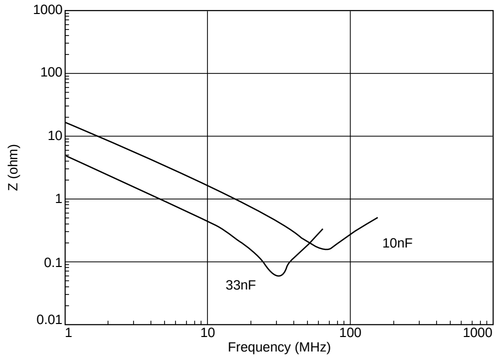
Continued on the following page.

GRM/GA2/GA3 Series Data (Typical Example)

Continued from the preceding page.

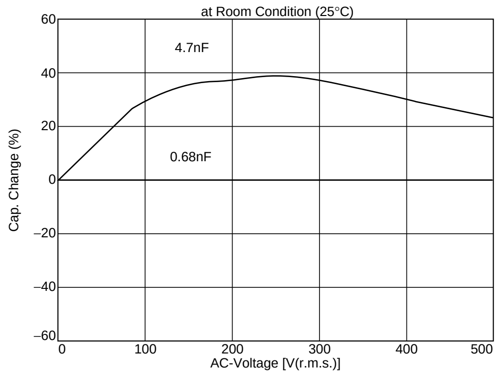
■ Impedance-Frequency Characteristics

GA3 Series (Type GB)

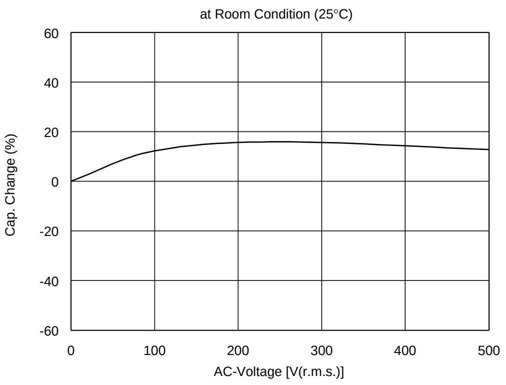


■ Capacitance-AC Voltage Characteristics

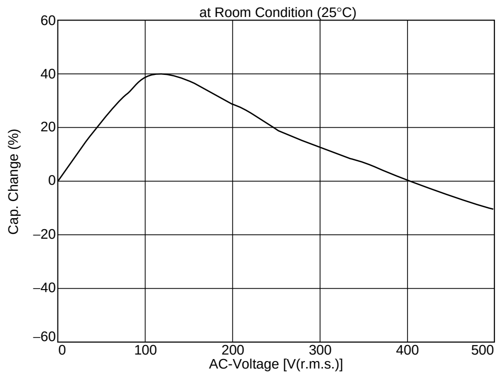
GA3 Series (Type GC)



GA3 Series (Type GD/GF)



GA3 Series (Type GB)



Package

Taping is standard packaging method.

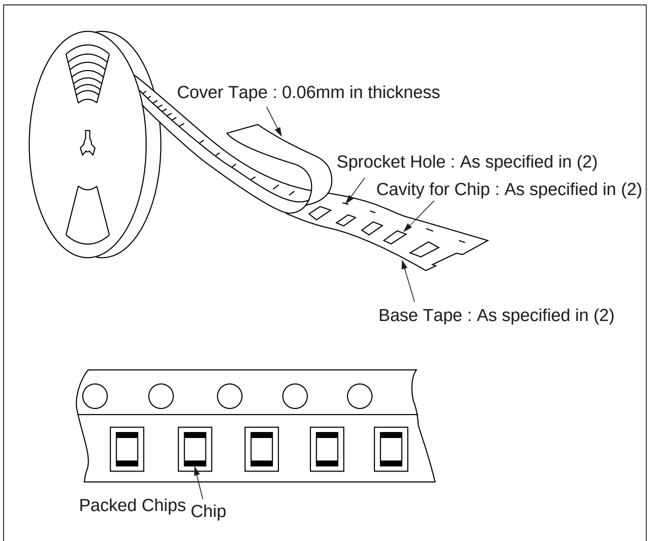
■ Minimum Quantity Guide

Part Number		Dimensions (mm)			Quantity (pcs.)	
					ϕ180mm reel	
		L	W	T	Paper Tape	Plastic Tape
Medium-voltage	**GRM21**	2.0	1.25	1.0	4,000	-
				1.25	-	3,000
	GRM31	3.2	1.6	1.0	4,000	-
				1.25	-	3,000
				1.6	-	2,000
	GRM32	3.2	2.5	1.5	-	2,000
				2.0	-	1,000
	GRM42	4.5	2.0	2.0	-	2,000
	GRM43	4.5	3.2	1.5	-	1,000
				2.0	-	1,000
				2.5	-	500
	GRM55	5.7	5.0	2.0	-	1,000
				2.7	-	500
AC250V	**GA252**	5.7	2.8	2.0	-	1,000
	GA255	5.7	5.0	2.0	-	1,000
Safety Std. Recognition	**GA342**	4.5	2.0	2.0	-	2,000
	GA343	4.5	3.2	2.0	-	1,000
	GA352	5.7	2.8	2.0	-	1,000
	GA355	5.7	5.0	2.0	-	1,000
				2.7	-	500

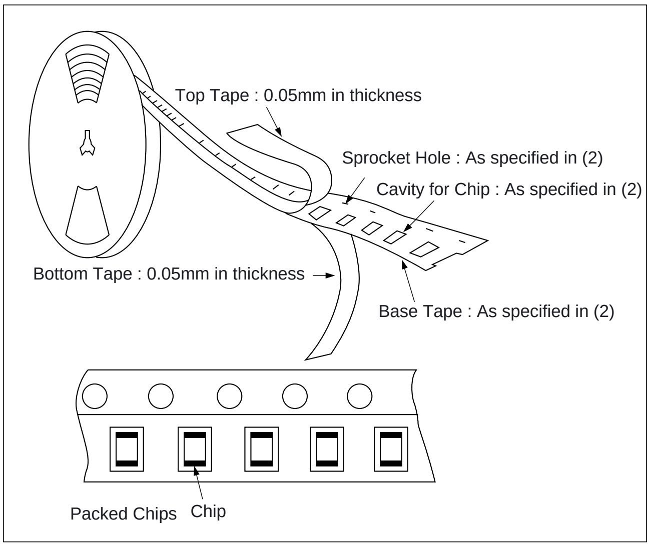
■ Tape Carrier Packaging

(1) Appearance of Taping

① Plastic Tape



② Paper Tape



Continued on the following page.

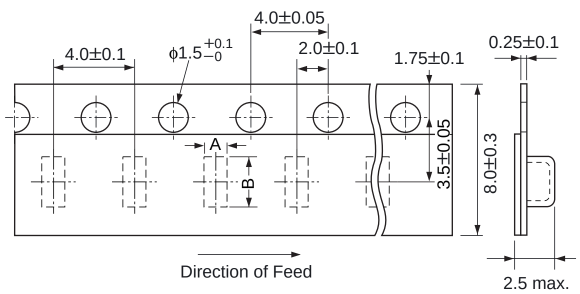
Package

Continued from the preceding page.

(2) Dimensions of Tape

① Plastic Tape

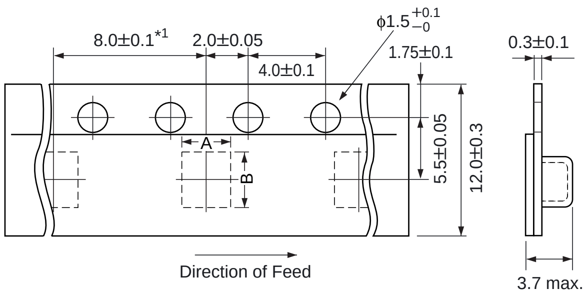
8mm width 4mm pitch Tape (T≧1.25 rank)



Part Number	A*	B*
GRM21	1.45	2.25
GRM31	2.0	3.6
GRM32	2.9	3.6

*Nominal Value

12mm width 8mm/4mm pitch Tape



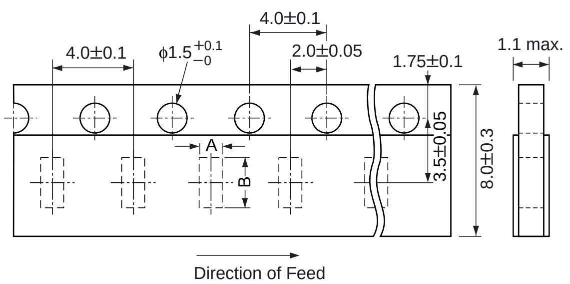
Part Number	A*	B*
GRM42/GA342	2.5	5.1
GRM43/GA343	3.6	4.9
GA252/GA352	3.2	6.1
GRM55 **GA255** **GA355**	5.4	6.1

*1 4.0±0.1mm in case of GRM42/GA342 *Nominal Value

(in mm)

② Paper Tape

8mm width 4mm pitch Tape (T=1.0 rank)

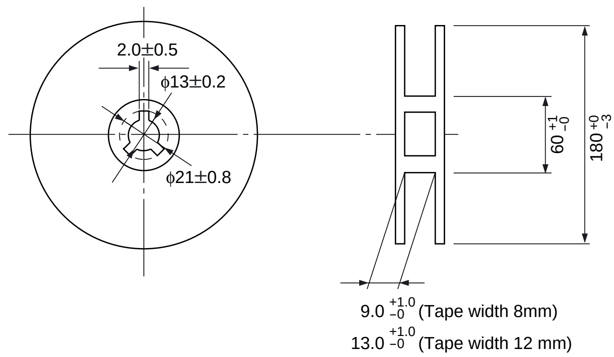


Part Number	A*	B*
GRM21	1.45	2.25
GRM31	2.0	3.6

*Nominal value

(in mm)

(3) Dimensions of Reel



(in mm)

Continued on the following page.

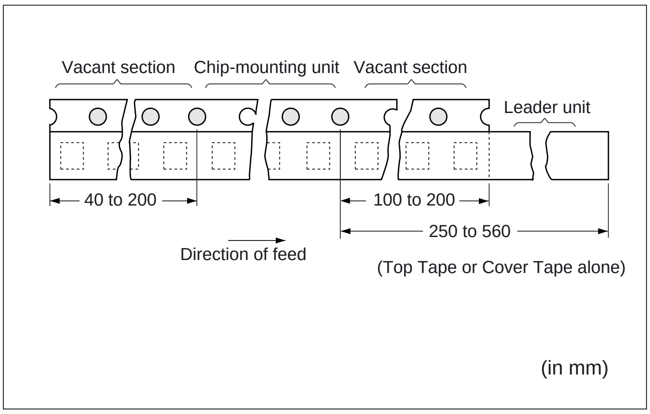
Package

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 right figure.



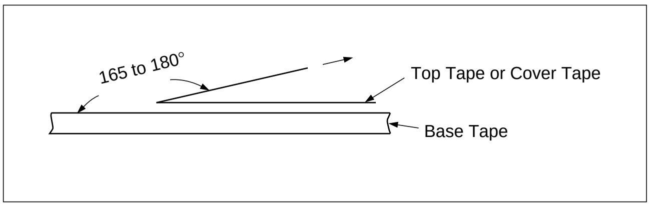
③ The top tape or cover tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

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 0.7N in the direction shown on the right.



⚠Caution

■ Storage and Operating Conditions

Operating and storage environment

Do not use or store capacitors in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present and avoid exposure to moisture. Before cleaning, bonding or molding this product, verify that these processes do not affect product quality by testing the performance of a cleaned, bonded or molded product in the intended equipment. Store the capacitors where the temperature and relative humidity do not exceed 5 to 40 degrees centigrade and 20 to 70%. Use capacitors within 6 months. Confirm the solderability in case of 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 touch the chip capacitor especially ceramic body directly. The short error on the surface might be occurred by the ion ingredient brought from human finger or hand.

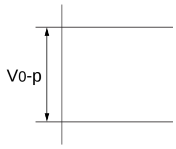
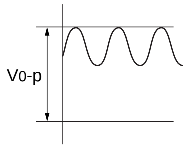
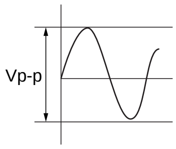
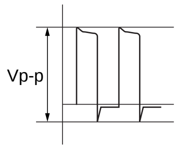
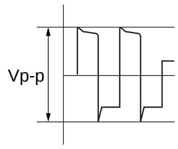
"Failure to follow the above cautions may result, worst case, in a short circuit and cause fuming or partial dispersion when the product is used."

⚠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 started to apply to the circuit or it is stopped applying, the irregular voltage may be generated for a transit period because of resonance or switching. Be sure to use a capacitor within rated voltage containing these irregular voltage.

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

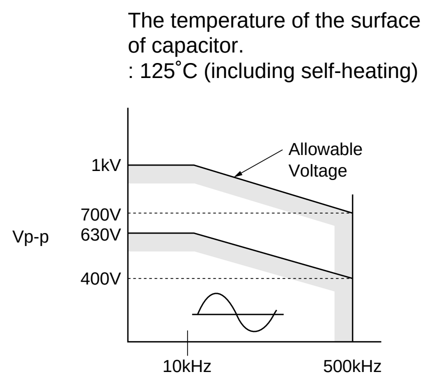
2. Operating Temperature and Self-generated Heat

(1) In case of B/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 produced by the capacitor itself. When a capacitor is used in a high-frequency current, pulse current or the like, it may produce heat due to dielectric loss. Keep such self-generated temperature below 20°C. When measuring, use a thermocouple of small thermal capacity-K of ϕ0.1 mm and be in the condition where capacitor is not affected by radiant heat of other components and wind of surroundings. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability.

(2) In case of C0G/R 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 produced by the capacitor itself. When a capacitor is used in a high-frequency current, pulse current or the like, it may produce heat due to dielectric loss. The allowable frequency should be in less than 500kHz in sine wave. The applied voltage should be limited maximum 60% of the rated voltage (400Vp-p) : rated voltage : DC630V and maximum 70% of the rated voltage (700Vp-p) : rated voltage DC1kV at 500kHz in more than 10kHz domain as right figure. While, in case of non-sine wave which include a harmonic frequency, please contact our sales representatives or product engineers. The excessive heat may occur a deterioration of the electric characteristic or the reliability on a capacitor.



The sine-wave frequency VS allowable voltage

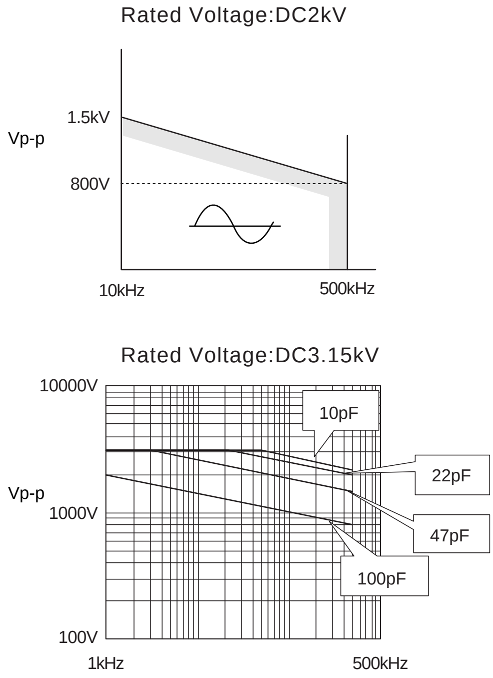
Continued on the following page.

⚠Caution

Continued from the preceding page.

(3) In case of 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 produced by the capacitor itself. When a capacitor is used in a high-frequency current, pulse current or the like, it may produce heat due to dielectric loss. The allowable frequency should be in less than 500kHz in sine wave.
The applied voltage should be less than the value as shown in right figure. While, in case of non-sine wave which include a harmonic frequency, please contact our sales representatives or product engineers.
The excessive heat may occur a deterioration of the electric characteristic or the reliability on a capacitor.

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



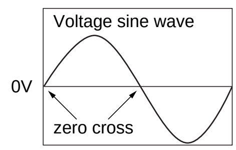
The sine-wave frequency VS allowable voltage

3. Test condition for AC withstanding Voltage

(1) Test Equipment
Test equipment for AC withstanding voltage shall be used with the performance of the wave similar to 50/60 Hz sine wave.
If the distorted sine wave or over load exceeding the specified voltage value is applied, the defective may be caused.

(2) Voltage applied method
When the withstanding voltage is applied, capacitor's lead or terminal shall be firmly connected to the out-put of the withstanding voltage test equipment, and then the voltage shall be raised from near zero to the test voltage.
If the test voltage without the raise from near zero voltage would be applied directly to capacitor, test voltage should be applied with the *zero cross. At the end of the test time, the test voltage shall be reduced to near zero, and then capacitor's lead or terminal shall be taken off the out-put of the withstanding voltage test equipment.
If the test voltage without the raise from near zero voltage would be applied directly to capacitor, the surge voltage may arise, and therefore, the defective may be caused.

*ZERO CROSS is the point where voltage sine wave pass 0V.
- See the right figure -



Continued on the following page.

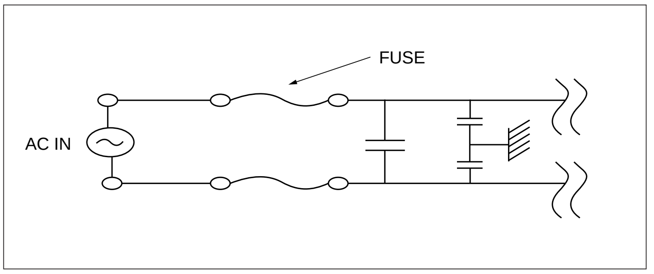
⚠Caution

Continued from the preceding page.

4. Fail-Safe

When capacitor would be broken, failure may result in a short circuit. Be sure to provide an appropriate fail-safe function like a fuse on your product if failure would follow an electric shock, fire or fume.

Please be considered to use fuses on each AC lines in case that capacitors are used between AC input line to earth (line by-pass capacitor) preparing for the worst (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

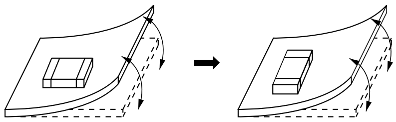
■ Caution (Soldering and Mounting)

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

2. Circuit Board Material
   Please contact our sales representatives or engineers in case that GR/GA products (size 4.5×3.2mm and over) are to be mounted upon a metal-board or metal-frame. Soldering heat causes the expansion and shrinkage of a board or frame. which may result in chip-cracking.

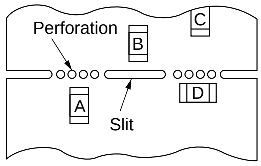
3. Land Layout for Cropping PC Board
   Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[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

Continued on the following page.

⚠Caution

Continued from the preceding page.

4. Soldering (Prevention of the thermal shock)
   If a chip component is heated or cooled abruptly during soldering, it may crack due to the thermal shock. To prevent this, adequate soldering condition should be taken following our recommendation below.

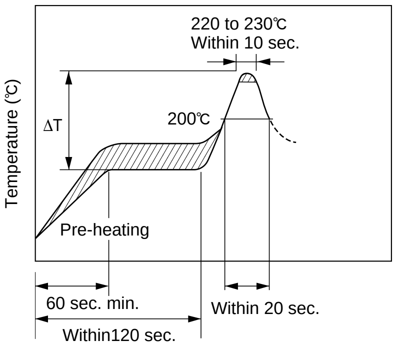
Carefully perform pre-heating so that temperature difference (ΔT) between the solder and component surface should be in the following range. When components are immersed in solvent after mounting, pay special attention to maintain the temperature difference within 100˚C.

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	——

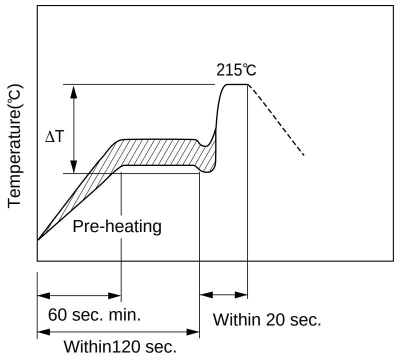
When soldering chips with a soldering iron, it should be performed in following conditions.

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.	

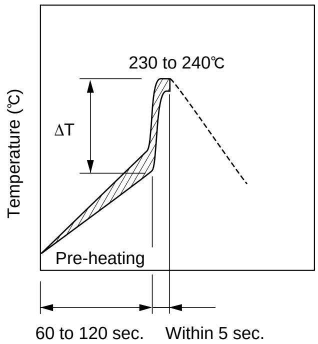
Infrared Reflow Soldering Conditions (Example)



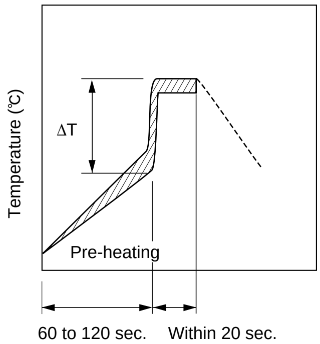
Vapor Reflow Soldering (VPS) Conditions (Example)



Flow Soldering Conditions (Example)



Dip Soldering/Soldering Iron Conditions (Example)



5. Soldering Method
   GR/GA products whose sizes are 3.2✕1.6mm and under for flow and reflow soldering, and other sizes for reflow soldering.
   Be sure to contact our sales representatives or engineers in case that GR/GA products (size 3.2✕2.5mm and over) are to be mounted with flow soldering. It may crack due to the thermal shock.

   Failure to follow the above cautions may result, worst case, in a short circuit and fuming when the product is used.

Notice

■ Notice (Soldering and Mounting)

1. Mounting of Chips

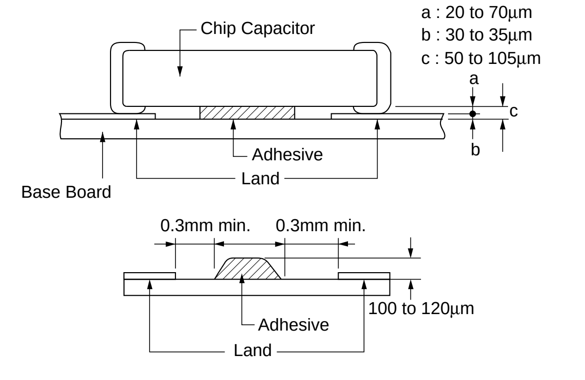
● Mechanical shock of the chip placer

When the positioning claws and pick up nozzle are worn, the load is applied to the chip while positioning is concentrated to 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.

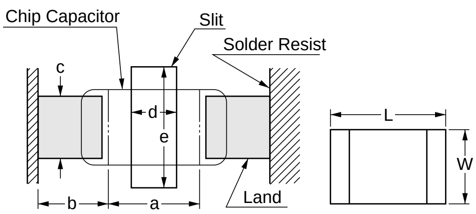
Termination Thickness of Chip Capacitor and Desirable Thickness of Adhesives Applied



2. 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 pre-vent this, be extremely careful in determining shape and dimension before designing the circuit board diagram.

Construction and Dimensions of Pattern (Example)



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

Flow Soldering

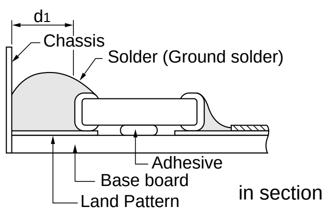
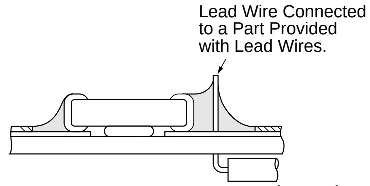
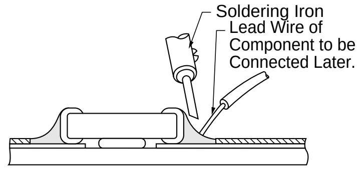
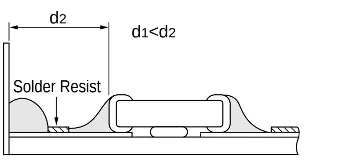
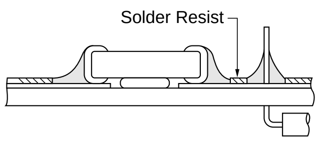
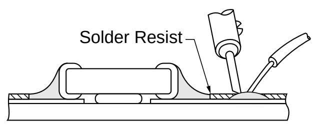
L×W	a	b	c
2.0×1.25	1.0-1.2	0.9-1.0	0.8-1.1
3.2×1.6	2.2-2.6	1.0-1.1	1.0-1.4

Reflow Soldering

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

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Notice

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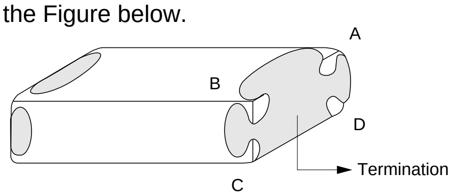
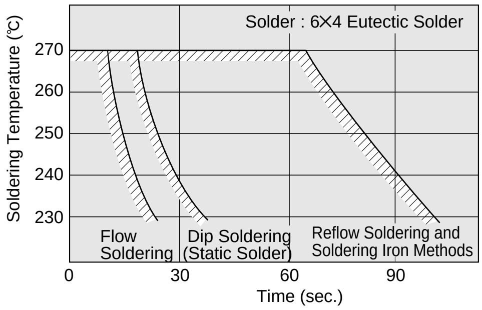
3. Soldering

(Care for minimizing loss of the terminations.)
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 minimum 25% on all edge length A-B-C-D of part with A, B, C, D, shown in the Figure below.



Soldering Allowance Time

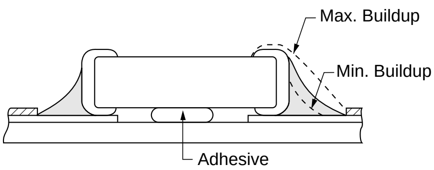


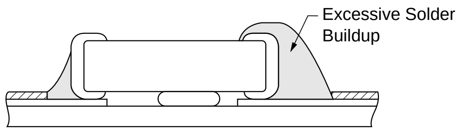
In case of repeated soldering, the accumulated soldering time must be within the range shown above.

(2) Flux
- Use rosin-type flux and do not use a highly acidic flux (any containing a minimum of 0.2wt% chlorine).

(3) Solder Buildup
① Flow soldering and iron soldering
Use as little solder as possible, and confirm that the solder is securely placed.

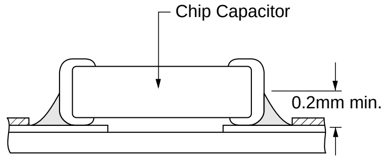
[Solder Buildup by Flow Method and Soldering Iron Method]





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

[Solder Buildup by Reflow Method]



4. Cleaning

To perform ultrasonic cleaning, observe the following conditions on the right.

Rinse bath capacity : Output of 20 watts per liter or less.
Rinsing time : 5 minutes maximum.

5. Resin Coating

- When selecting resin materials, select those with low contraction and low moisture absorption coefficient (generally epoxy resin is used).
- Buffer coat can decrease the influence of the resin shrinking (generally silicone resin).

Notice

■ Rating

Capacitance change of capacitor

1. Class 1 capacitors
   Capacitance might change a little depending on a surrounding temperature or an applied voltage. Please contact us if you use for the strict time constant circuit.
2. Class 2 and 3 capacitors
   Class 2 and 3 capacitors like temperature characteristic B, E and F have an aging characteristic, whereby the capacitor continually decreases its capacitance slightly if the capacitor leaves for a long time. Moreover, capacitance might change greatly depending on a surrounding temperature or an applied voltage. So, it is not likely to be able to use for the time constant circuit. Please contact us if you need a detail information.

ISO 9000 Certifications

Plant	Certified Date	Organization	Registration No.
Fukui Murata Manufacturing Co., Ltd.	Apr. 2, '97	UL *1 ISO9001	A5287
Izumo Murata Manufacturing Co., Ltd.	Jul. 25, '97		A5587
Murata Electronics Singapore (Pte.) Ltd.	Nov. 3, '99	PSB *2 ISO9001	99-2-1085
Murata Manufacturing (UK) Ltd.	Jun. 24, '98	BSI *3 ISO9001	FM 22169
Murata Amazonia Industria Comercio Ltda.	Jul. 28, '98	FUNDACAO VANZOLINI ISO9002	SQ-480-675/98
Murata Electronics North America State College Plant	Mar. 7, '96	UL *1 ISO9001	A1734
Beijing Murata Electronics Co., Ltd.	Dec. 10, '98	UL *1 ISO9002	A7123

*1 UL : Underwriters Laboratories Inc.
*2 PSB : Singapore Productivity and Standards Board
*3 BSI : British Standards Institution

⚠Note:

1. Export Control
   〈For customers outside Japan〉
   Murata products should not be used or sold for use in the development, production, stockpiling or utilization of any conventional weapons or mass-destructive weapons (nuclear weapons, chemical or biological weapons, or missiles), or any other weapons.
   〈For customers in Japan〉
   For products which are controlled items subject to the “Foreign Exchange and Foreign Trade Law” of Japan, the export license specified by the law is required for export.
2. Please contact our sales representatives or product engineers before using our products listed in this catalog for the applications listed below which require especially high reliability for the prevention of defects which might directly cause damage to the third party's life, body or property, or when intending to use one of our products for other applications than specified in this catalog.
   ① Aircraft equipment ② Aerospace equipment
   ③ Undersea equipment ④ Power plant equipment
   ⑤ Medical equipment ⑥ Transportation equipment (vehicles, trains, ships, etc.)
   ⑦ Traffic signal equipment ⑧ Disaster prevention / crime prevention equipment
   ⑨ Data-processing equipment ⑩ Application of similar complexity and/or reliability requirements to the applications listed in the above
3. Product specifications in this catalog are as of January 2002. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.
4. Please read rating and ⚠CAUTION (for storage and operating, rating, soldering and mounting, handling) in this catalog to prevent smoking and/or burning, etc.
5. This catalog has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specification or transact the approval sheet for product specification before ordering.
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