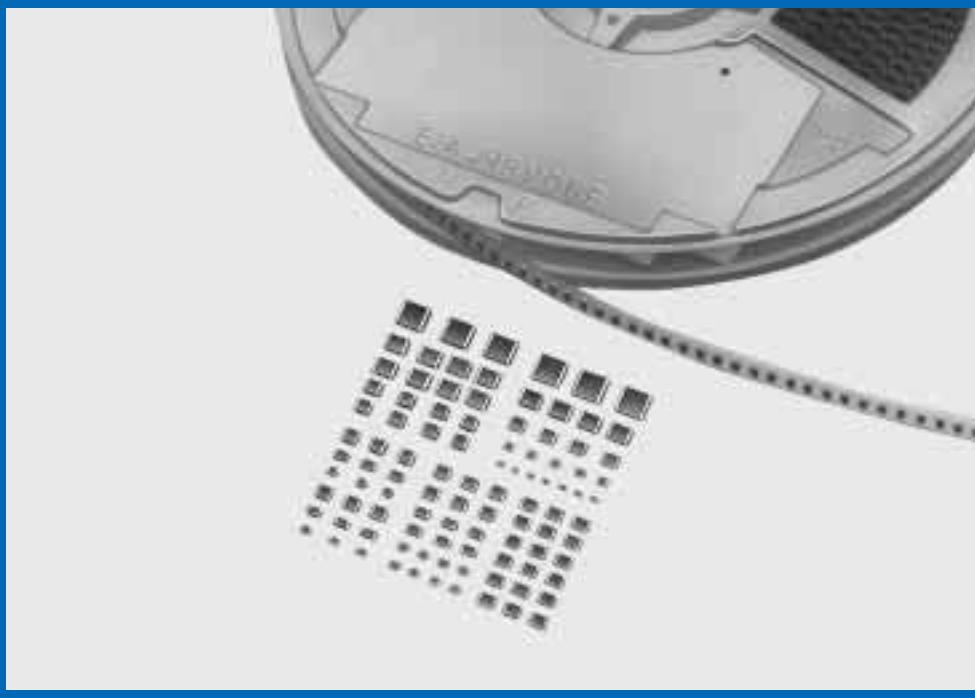
Chip Monolithic Ceramic Capacitor

CHIP MONOLITHIC CERAMIC CAPACITOR

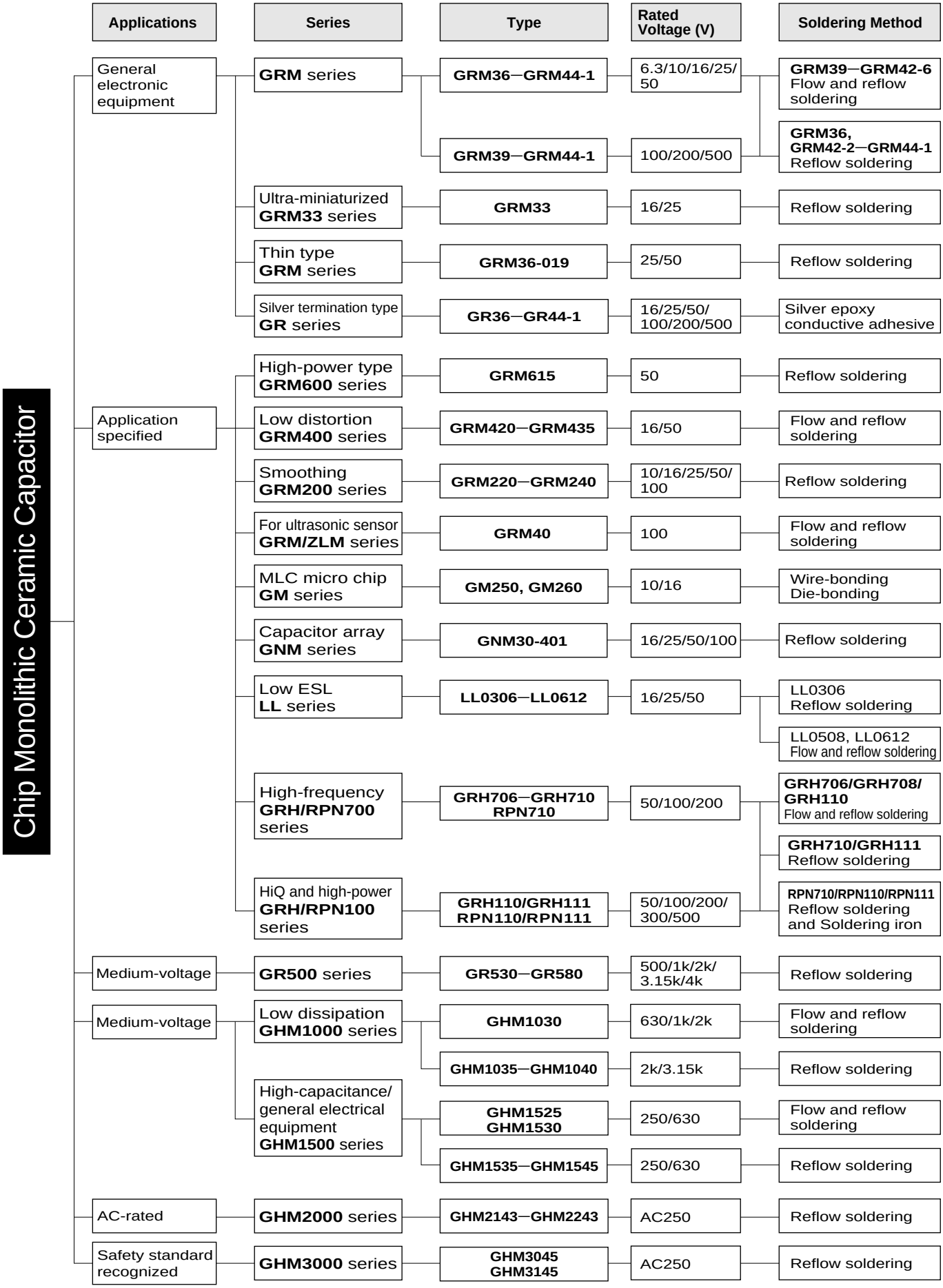


muRata Innovator in Electronics

Murata
Manufacturing Co., Ltd.

Cat.No.C02E-5

Chip Monolithic Ceramic Capacitor Product Guide



Chip Monolithic Ceramic Capacitor
CONTENTS

MONOLITHIC CERAMIC CAPACITOR

GRM Series for General Electronic Equipment

1

■FEATURES

1. Terminations are made of metal highly resistant to migration.
2. The GRM series is a complete line of chip ceramic capacitors in 6.3V, 10V, 16V, 25V, 50V, 100V, 200V and 500V ratings. These capacitors have temperature characteristics ranging from C0Δ to Y5V.
3. A wide selection of sizes is available, from the miniature GRM36 (LXWXT : 1.0X0.5X0.5mm) to the larger sized GRM44-1 (LXWXT : 5.7X5.0X2.0mm).
   GRM39, GRM40 and GRM42-6 types are suited to flow and reflow soldering.
   GRM36, GRM42-2 and larger types are suited to reflow soldering.
4. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placements on PCBs.
5. The GRM series is available in both paper and plastic embossed tape and reel packaging for automatic placement. Bulk case packaging is also available. (GRM 36, GRM39, GRM40 (T : 0.6, 1.25))

■APPLICATION

General electronic equipment.

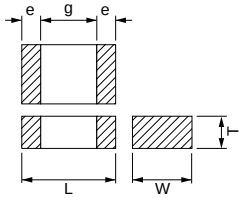
■PART NUMBERING

(*Please specify the part number when ordering)

(Ex.)	GRM40	X7R	102	K	50		PT
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

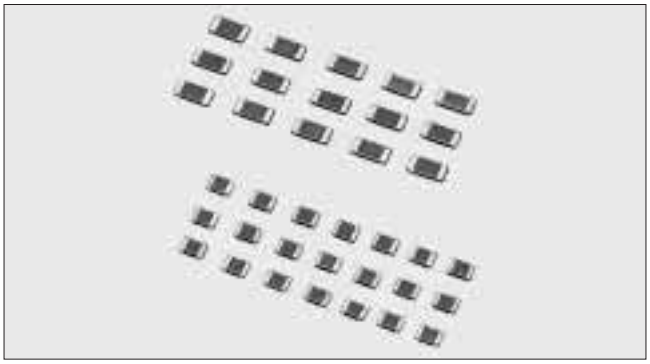
❶TYPE AND DIMENSIONS



(in mm)

Type (EIA Code)	L	W	T	e	g min.
GRM36 (0402)	1.0±0.05	0.5±0.05	0.5±0.05	0.15 to 0.3	0.4
GRM39* (0603)	1.6±0.1	0.8±0.1	0.8±0.1	0.2 to 0.5	0.5
GRM40 (0805)	2.0±0.1	1.25±0.1	0.6±0.1	0.2 to 0.7	0.7
			0.85±0.1		
			1.25±0.1		
GRM42-6 (1206)	3.2±0.15	1.6±0.15	0.85±0.1	0.3 to 0.8	1.5
			1.15±0.1		
	3.2±0.2	1.6±0.2	1.6±0.2		
GRM42-2 (1210)	3.2±0.3	2.5±0.2	0.85±0.1	0.3 min.	1.0
			1.15±0.1		
			1.35±0.15		
			1.8±0.2		
			2.5±0.2		
GRM43-2 (1812)	4.5±0.4	3.2±0.3	2.0 max.	0.3 min.	2.0
GRM44-1 (2220)	5.7±0.4	5.0±0.4	2.0 max.	0.3 min.	2.0

*Bulk case packaging is L=1.6±0.07, W,T=0.8±0.07



❷TEMPERATURE CHARACTERISTICS

• Temperature Compensating Type

Code	C0G	C0H	P2H	R2H	S2H	T2H	U2J	SL
Temp. range	−55 to +125℃		−55 to +85℃					
Temp. coeff. (ppm/℃)	0±30	0±60	−150±60	−220±60	−330±60	−470±60	−750±120	+350 to −1000

• High Dielectric Constant Type

Code	X5R	X7R	Z5U	Y5V
Temp. range	−55 to +85℃	−55 to +125℃	+10 to +85℃	−30 to +85℃
Cap. change (%)	±15	±15	+22 −56	+22 −82

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
0R5	0.5	100	10
R75	0.75	101	100
010	1	103	10,000

❹CAPACITANCE TOLERANCE

Code	Tol.	Capacitance range
C	±0.25pF	10pF and below
D	±0.5 pF	
J	±5%	More than 10pF
K	±10%	
M	±20%	
Z	+80, −20%	

❺RATED VOLTAGE

Code	DC Rated voltage (V)
6.3	6.3
10	10
16	16
25	25
50	50
100	100
200	200
500	500

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging
PC	Bulk case packaging

■CAPACITANCE RANGE TABLE

FOR FLOW AND REFLOW SOLDERING

Temperature Compensating Type 50V/25V

Type (EIA Code)	GRM36* (0402)				GRM39 (0603)								
Char.	C0G	C0H	SL		C0G	C0H	P2H	R2H	S2H	T2H	U2J	SL	
Volt. / Cap. (pF)	50	25	50	25	50	25	50	50	50	50	50	50	25
0.5													
0.75													
1													
1.5													
2													
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8,200													
9,100													
10,000													
11,000													
12,000													
13,000													
15,000													
16,000													

*GRM36 is suited to only reflow soldering.

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)*1	Bulk Case (pcs./case)
GRM36	: 0.5±0.05	1,000	10,000	50,000
GRM39	: 0.8±0.1*2	1,000	4,000	15,000

*1 φ330mm reel is available on request.
*2 Bulk case packaging is T=0.8±0.07

■CAPACITANCE TOLERANCE

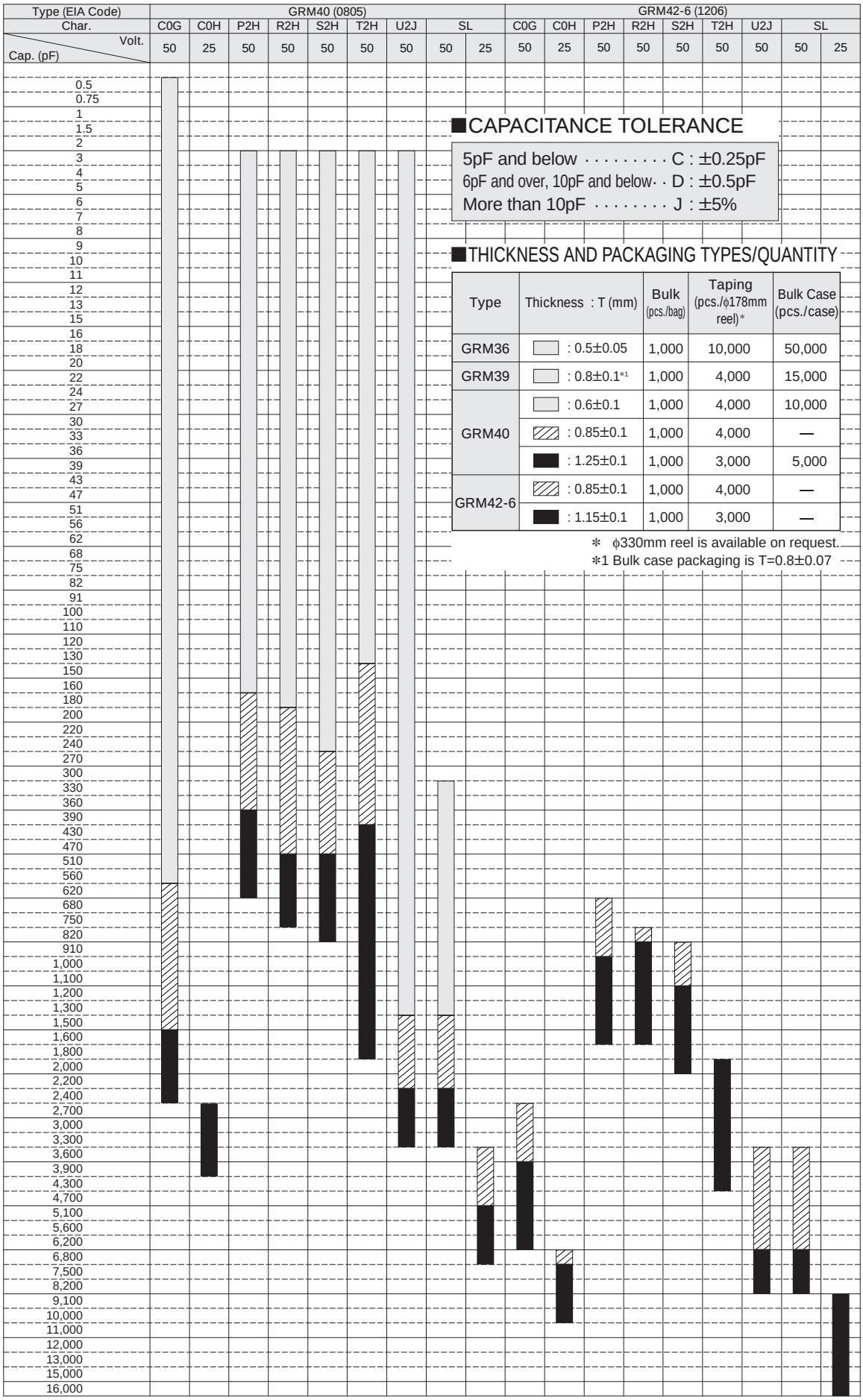
5pF and below · · · · · · · · · C : ±0.25pF
6pF and over, 10pF and below · · D : ±0.5pF
More than 10pF · · · · · · · · J : ±5%

■CAPACITANCE RANGE TABLE

FOR FLOW AND REFLOW SOLDERING

Temperature Compensating Type 50V/25V

1



■CAPACITANCE TOLERANCE

5pF and below ····· C : ±0.25pF
6pF and over, 10pF and below·· D : ±0.5pF
More than 10pF ····· J : ±5%

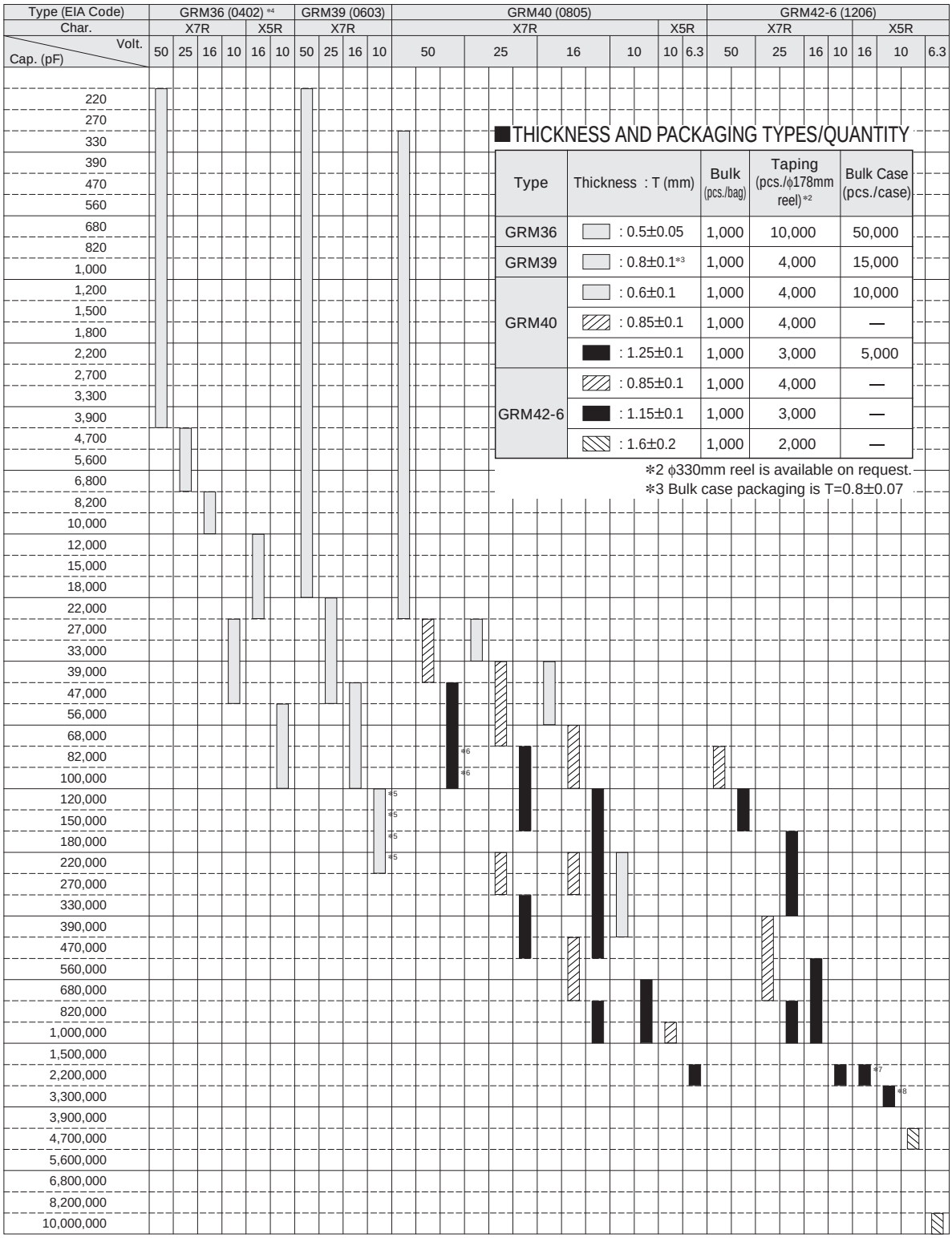
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)*	Bulk Case (pcs./case)
GRM36	: 0.5±0.05	1,000	10,000	50,000
GRM39	: 0.8±0.1*1	1,000	4,000	15,000
GRM40	: 0.6±0.1	1,000	4,000	10,000
	: 0.85±0.1	1,000	4,000	—
	: 1.25±0.1	1,000	3,000	5,000
GRM42-6	: 0.85±0.1	1,000	4,000	—
	: 1.15±0.1	1,000	3,000	—

* φ330mm reel is available on request.
*1 Bulk case packaging is T=0.8±0.07

FOR FLOW AND REFLOW SOLDERING

High Dielectric Constant Type 50V/25V/16V/10V/6.3V Char. X7R/X5R



■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)*2	Bulk Case (pcs./case)
GRM36	: 0.5±0.05	1,000	10,000	50,000
GRM39	: 0.8±0.1*3	1,000	4,000	15,000
GRM40	: 0.6±0.1	1,000	4,000	10,000
	: 0.85±0.1	1,000	4,000	—
	: 1.25±0.1	1,000	3,000	5,000
GRM42-6	: 0.85±0.1	1,000	4,000	—
	: 1.15±0.1	1,000	3,000	—
	: 1.6±0.2	1,000	2,000	—

*2 φ330mm reel is available on request.
*3 Bulk case packaging is T=0.8±0.07

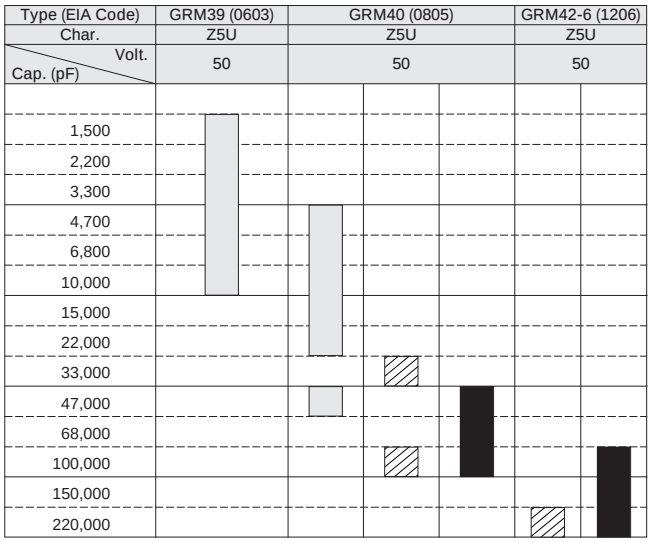
*4 GRM36 series is suited to only reflow soldering.
*5 Only for taping
*6 Type : GRM40-034 (L : 2±0.15, W : 1.25±0.15, T : 1.25±0.15)
*7 L : 3.2±0.2, W : 1.6±0.2, T : 1.15±0.15
*8 Type : GRM42-631 (L : 3.2±0.2, W : 1.6±0.2, T : $1.3^{+0}_{-0.2}$)

■CAPACITANCE TOLERANCE

X7R/X5R Characteristics
K : ±10% (E12 Series)
M : ±20% (E6 Series)

FOR FLOW AND REFLOW SOLDERING

High Dielectric Constant Type 50V Char. Z5U



✻ T : 0.85mm is also available.

■CAPACITANCE TOLERANCE

Z5U Characteristics
M : ±20% (E6 Series)
Z : $^{+80}_{-20}$% (E6 Series)

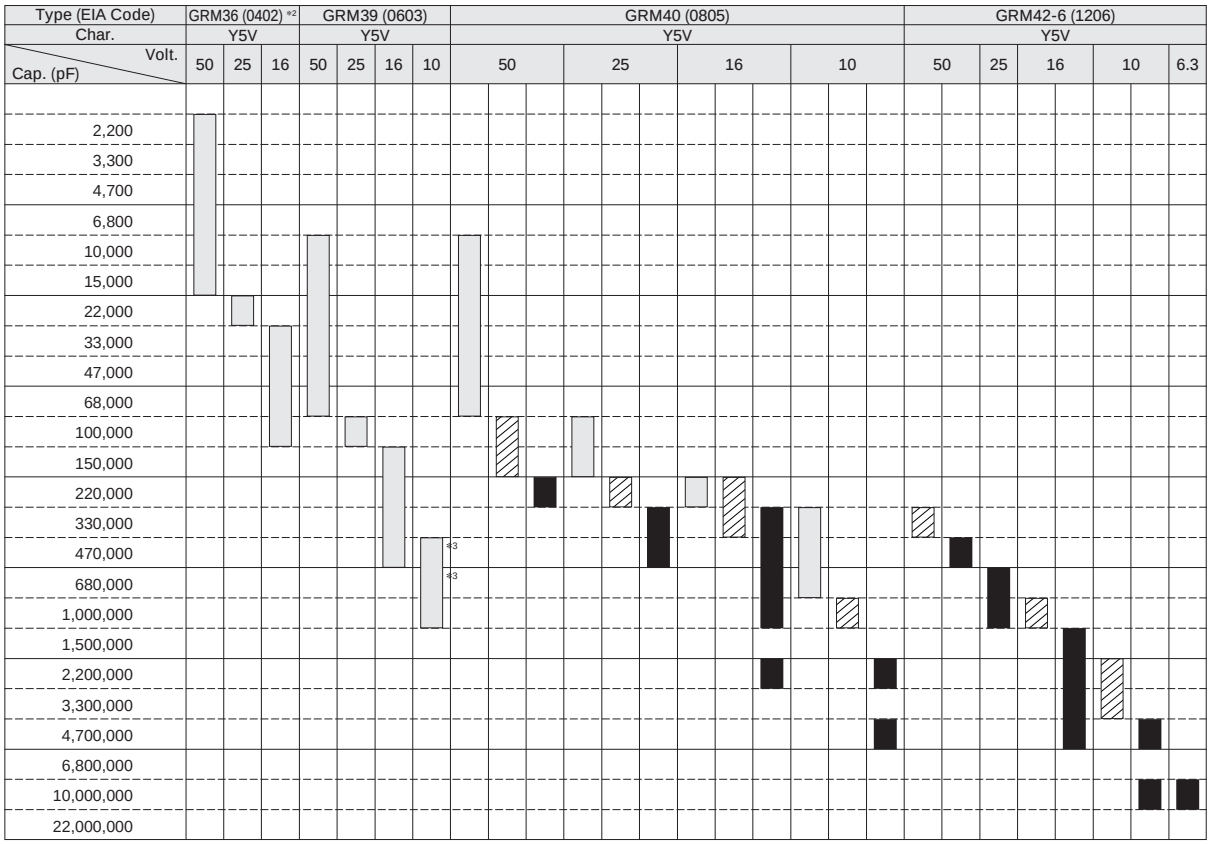
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)*	Bulk Case (pcs./case)
GRM39	: 0.8±0.1*1	1,000	4,000	15,000
GRM40	: 0.6±0.1	1,000	4,000	10,000
	: 0.85±0.1	1,000	4,000	—
	: 1.25±0.1	1,000	3,000	5,000
GRM42-6	: 0.85±0.1	1,000	4,000	—
	: 1.15±0.1	1,000	3,000	—

✻ φ330mm reel is available on request.
✻1 Bulk case packaging is T=0.8±0.07

FOR FLOW AND REFLOW SOLDERING

High Dielectric Constant Type 50V/25V/16V/10V/6.3V Char. Y5V



*2 GRM36 series is suited to only reflow soldering.
*3 Only for taping

■CAPACITANCE TOLERANCE

Y5V Characteristics
Z : $^{+80}_{-20}$% (E6 Series)

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel) *4	Bulk Case (pcs./case)
GRM36	: 0.5±0.05	1,000	10,000	50,000
GRM39	: 0.8±0.1 *5	1,000	4,000	15,000
GRM40	: 0.6±0.1	1,000	4,000	10,000
	: 0.85±0.1	1,000	4,000	—
	: 1.25±0.1	1,000	3,000	5,000
GRM42-6	: 0.85±0.1	1,000	4,000	—
	: 1.15±0.1	1,000	3,000	—

*4 φ330mm reel is available on request.
*5 Bulk case packaging is T=0.8±0.07

FOR FLOW AND REFLOW SOLDERING

Temperature Compensating Type 500V/200V/100V

Type (EIA Code)	GRM39 (0603)				GRM40 (0805)				GRM42-6 (1206)				
Char.	C0G		SL		C0G		SL		C0G			SL	
Volt. / Cap. (pF)	200	100	200	100	200	100	200	100	500	200	100	200	100
1													
1.5													
2													
3													
4													
5													
6													
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2,200													
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2,700													
3,000													
3,300													
3,600													
3,900													
4,300													
4,700													

■CAPACITANCE TOLERANCE

C0G/SL Characteristics

C : ±0.25pF · · · · 5pF and below

D : ±0.5pF · · · · · 6pF ≦cap.≦10pF

J : ±5% · · · · · · · More than 10pF

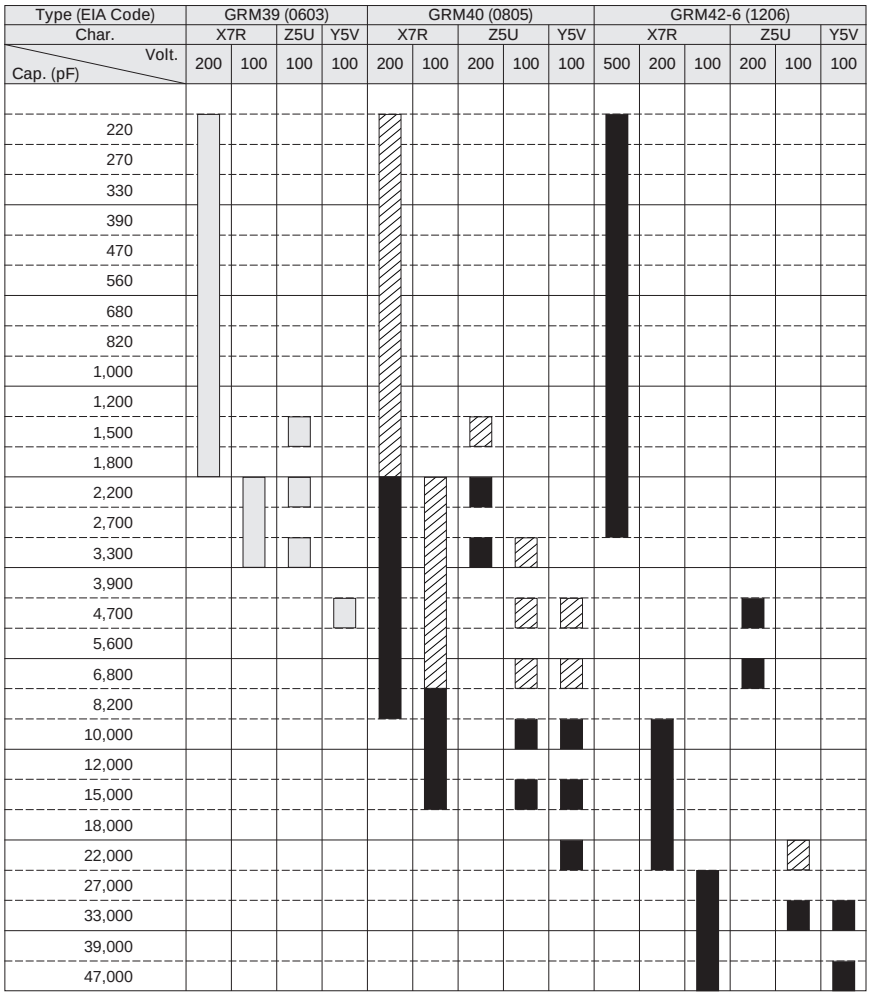
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)*
GRM39	: 0.8±0.1	1,000	4,000
GRM40	: 0.85±0.1	1,000	4,000
	: 1.25±0.1	1,000	3,000
GRM42-6	: 0.85±0.1	1,000	4,000
	: 1.15±0.1	1,000	3,000

* φ330mm reel is available on request.

FOR FLOW AND REFLOW SOLDERING

High Dielectric Constant Type 500V/200V/100V



■CAPACITANCE TOLERANCE

X7R Characteristics
K : ±10% (E12 Series)
M : ±20% (E6 Series)
Z5U Characteristics
M : ±20% (E6 Series)
Z : $^{+80}_{-20}$% (E6 Series)
Y5V Characteristics
Z : $^{+80}_{-20}$% (E6 Series)

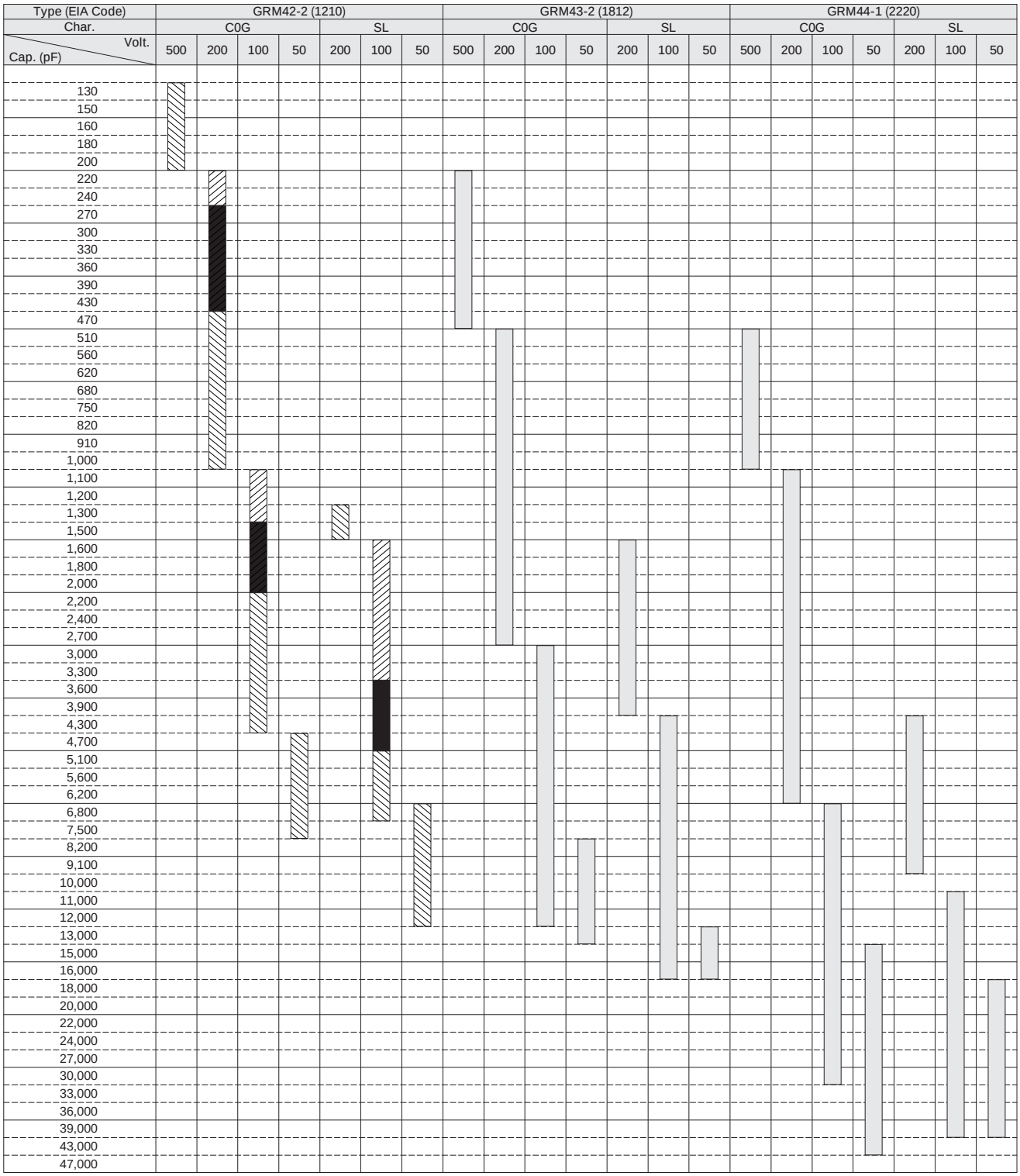
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel) *1
GRM39	: 0.8±0.1	1,000	4,000
GRM40	: 0.85±0.1	1,000	4,000
	: 1.25±0.1	1,000	3,000
GRM42-6	: 0.85±0.1	1,000	4,000
	: 1.15±0.1	1,000	3,000

*1 φ330mm reel is available on request.

FOR REFLOW SOLDERING

Temperature Compensating Type 500V/200V/100V/50V



■CAPACITANCE TOLERANCE

C0G/SL Characteristics
J : ±5% (E24 Series)

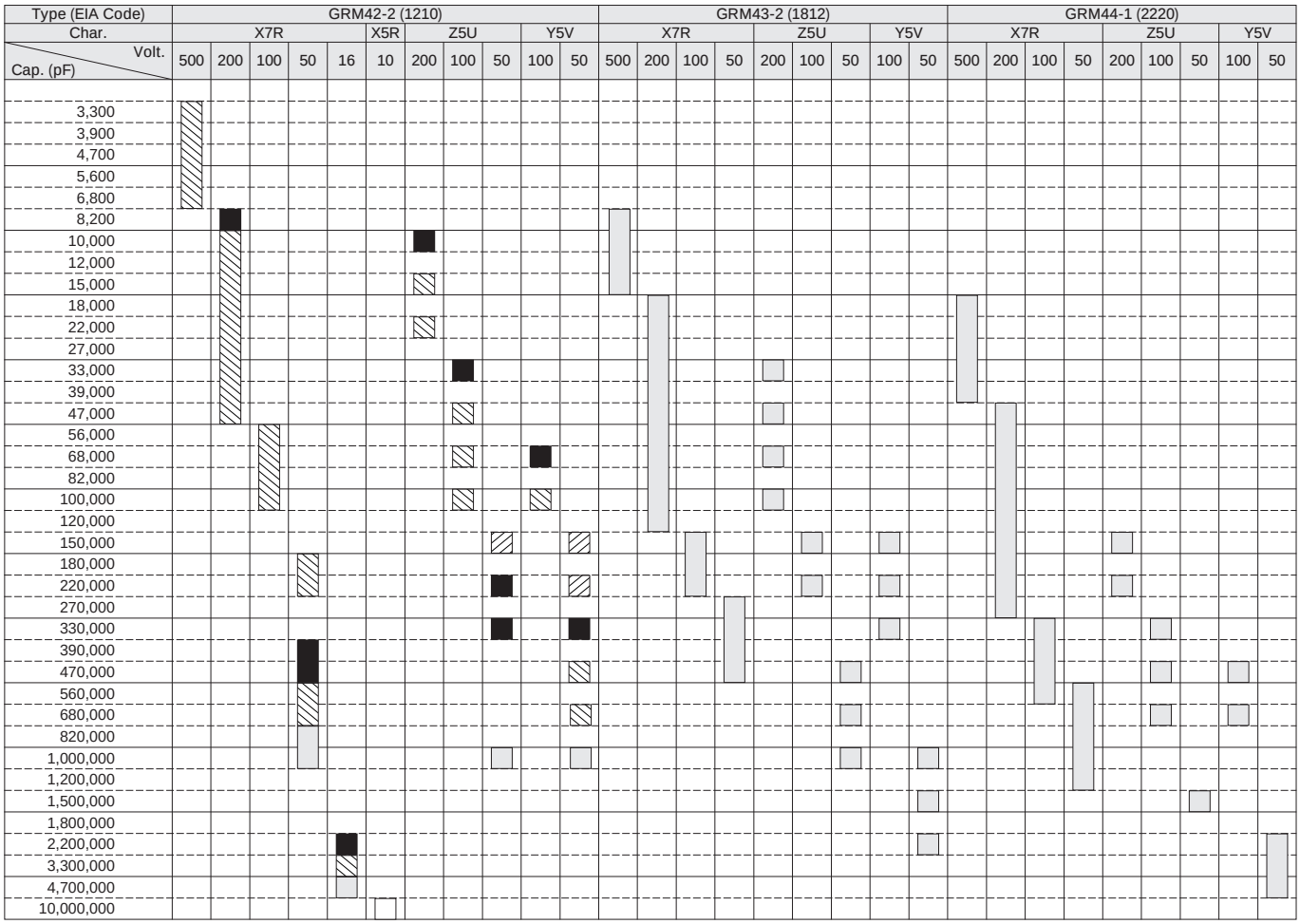
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)*
GRM42-2	▨: 0.85±0.1	1,000	4,000
	■: 1.15±0.1	1,000	3,000
	▨: 1.35±0.15	1,000	2,000
GRM43-2	□: 2.0 max.	1,000	1,000
GRM44-1	□: 2.0 max.	1,000	1,000

* φ330mm reel is available on request.

FOR REFLOW SOLDERING

High Dielectric Constant Type 500V/200V/100V/50V/16V/10V



■CAPACITANCE TOLERANCE

X7R/X5R Characteristics
K : ±10% (E12 Series)
M : ±20% (E6 Series)
Z5U Characteristics
M : ±20% (E6 Series)
Z : $^{+80}_{-20}$% (E6 Series)
Y5V Characteristics
Z : $^{+80}_{-20}$% (E6 Series)

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)*1
GRM42-2	: 0.85±0.1	1,000	4,000
	: 1.15±0.1	1,000	3,000
	: 1.35±0.15	1,000	2,000
	: 1.8±0.2	1,000	1,000
	: 2.5±0.2	1,000	1,000
GRM43-2	: 2.0 max.	1,000	1,000
GRM44-1	: 2.0 max.	1,000	1,000

*1 φ330mm reel is available on request.

1

■SPECIFICATIONS AND TEST METHODS

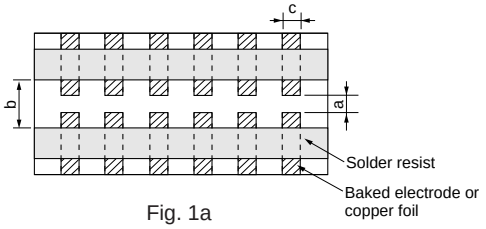
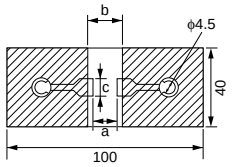
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Constant Type</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>−55 to +125℃</td><td>X5R : −55 to + 85℃
X7R : −55 to +125℃
Z5U : +10 to + 85℃
Y5V : −30 to + 85℃</td><td></td></tr>
<tr><td>2</td><td>Rated Voltage</td><td colspan="2">See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td colspan="2">No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td>Dimensions</td><td colspan="2">Within the specified dimension.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td colspan="2">No defects or abnormalities.</td><td>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</td></tr>
<tr><td>6</td><td>Insulation Resistance (I.R.)</td><td colspan="2">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>Capacitance</td><td colspan="2">Within the specified tolerance.</td><td rowspan="2">The capacitance/Q/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table
<table><tr><th>Item \ Char.</th><th>C0Δ to U2J, SL (1000pF and below)</th><th>C0Δ to U2J, SL (more than 1000pF) X5R, X7R, Y5V</th><th>Z5U</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</td><td>1±0.2Vr.m.s.</td><td>0.5±0.05Vr.m.s.</td></tr></table></td></tr>
<tr><td>8</td><td>Q/Dissipation Factor (D.F.)</td><td>30pF min. : Q≧1,000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X5R
X7R</td><td>0.025 max.</td><td>0.035 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max. (C<1.0μF)
0.09 max. (C≧1.0μF)</td><td>0.125 max.</td><td>0.125 max.</td></tr></table></td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Capacitance Temperature Characteristics</td><td>Capacitance Change</td><td>Within the specified tolerance. (Table A-1)</td><td><table><tr><th>Char.</th><th>Temp. Range.</th><th>Reference Temp.</th><th>Cap. Change</th></tr><tr><td>X5R</td><td>−55 to + 85℃</td><td rowspan="4">25℃</td><td>Within±15%</td></tr><tr><td>X7R</td><td>−55 to +125℃</td><td rowspan="2">Within $^{+22}_{-56}$%</td></tr><tr><td>Z5U</td><td>+10 to + 85℃</td></tr><tr><td>Y5V</td><td>−30 to + 85℃</td><td>Within $^{+22}_{-82}$%</td></tr></table></td><td rowspan="3">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-1. The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the step 1, 3 and 5 by the cap. value in step 3.
<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 (for C0Δ)/85±3 (for other TC)</td></tr><tr><td>5</td><td>25±2</td></tr></table>
(2) High Dielectric Constant Type
The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table shall be within the specified ranges.</td></tr>
<tr><td>Temperature Coefficient</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)
*Not apply to SL/25V</td></tr>
<tr><td>10</td><td>Adhesive Strength of Termination</td><td colspan="2">No removal of the terminations or other defects shall occur.
 

Fig. 1a</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1a using a eutectic solder. Then apply 10N* 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. *5N (GRM36, GRM39)
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM36</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM39</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM40</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM42-6</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM42-2</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43-2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM44-1</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table>(in mm)</td></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≧1,000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X5R
X7R</td><td>0.025 max.</td><td>0.035 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max. (C<1.0μF)
0.09 max. (C≧1.0μF)</td><td>0.125 max.</td><td>0.125 max.</td></tr></table></td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="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>12</td><td>Deflection</td><td colspan="2">No cracking or marking defects shall occur.</td><td>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2a using a eutectic solder. Then apply a force in the direction shown in Fig.3a. 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.
 

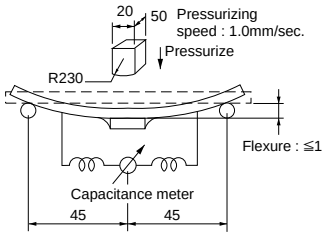
t : 1.6mm (GRM36 : 0.8mm)
Fig. 2a
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM36</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM39</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM40</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM42-6</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM42-2</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43-2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM44-1</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table>(in mm)</td></tr>
<tr><td></td><td></td><td colspan="2"> 

Fig. 3a</td><td></td></tr>
<tr><td>13</td><td>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="4">14</td><td>Resistance to Soldering Heat</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="4">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 GRM42-2/43-2/44-1
<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>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>X5R, X7R ····· Within ±7.5%
Z5U, Y5V ····· 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><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X5R
X7R</td><td>0.025 max.</td><td>0.035 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max. (C<1.0μF)
0.09 max. (C≧1.0μF)</td><td>0.125 max.</td><td>0.125 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="5">15</td><td>Temperature Cycle</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (℃)</td><td>Min. Operating Temp. $^{+0}_{-3}$</td><td>Room Temp.</td><td>Max. Operating Temp. $^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>• Initial measurement for high dielectric constant type
Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then 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>X5R, X7R ····· Within ±7.5%
Z5U, Y5V ····· 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><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X5R
X7R</td><td>0.025 max.</td><td>0.035 max.</td><td>0.035 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max. (C<1.0μF)
0.09 max. (C≧1.0μF)</td><td>0.125 max.</td><td>0.125 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="5">16</td><td>Humidity, Steady State</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td><td>X5R, X7R ····· Within ±12.5%
Z5U, Y5V ····· Within ±30%</td></tr>
<tr><td>Q/D.F.</td><td>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)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X5R
X7R</td><td>0.05 max.</td><td>0.05 max.</td><td>0.05 max.</td><td>0.075 max.</td></tr><tr><td>Z5U</td><td>0.05 max.</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Y5V</td><td>0.075 max.</td><td>0.1 max. (C<1.0μF)
0.125 max. (C≧1.0μF)</td><td>0.15 max.</td><td>0.15 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
</table>

<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="5">17</td><td colspan="2">Humidity Load</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</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 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 Y5V/10V max.
Apply the rated DC voltage for 1 hour at 40±20℃.
Remove and let sit for 48±4 hours at room temperature.
Perform initial measurement.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5% or ±0.75pF (Whichever is larger)</td><td>X5R, X7R ····Within ±12.5%
Z5U ·····Within ±30%
Y5V ·····{Within $^{+30}_{-40}$ % (10V max.)
Within ±30% (others)</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over. : Q≧200
30pF and below :
Q≧100+$\frac{10}{3}$C
C : Nominal Capacitance (pF)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X5R
X7R</td><td>0.05 max.</td><td>0.05 max.</td><td>0.05 max.</td><td>0.075 max.</td></tr><tr><td>Z5U</td><td>0.05 max.</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Y5V</td><td>0.075 max.</td><td>0.1 max. (C<1.0μF)
0.125 max. (C≧1.0μF)</td><td>0.15 max.</td><td>0.15 max.</td></tr></table></td></tr>
<tr><td colspan="2">I.R.</td><td colspan="2">More than 500MΩ or 25Ω · F (Whichever is smaller)</td></tr>
<tr><td colspan="2">Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="5">18</td><td colspan="2">High Temperature Load</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">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.

*150% for 500V</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3% or ±0.3pF (Whichever is larger)</td><td>X5R, X7R ····Within ±12.5%
Z5U ·····Within ±30%
Y5V ·····{Within ±30% (cap.<1.0μF)
Within $^{+30}_{-40}$ % (cap.≧1.0μF)</td></tr>
<tr><td>Q/D.F.</td><td>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)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V</th><th>6.3V</th></tr><tr><td>X5R
X7R</td><td>0.04 max.</td><td>0.05 max.</td><td>0.05 max.</td><td>0.075 max.</td></tr><tr><td>Z5U</td><td>0.04 max.</td><td>—</td><td>—</td><td>—</td></tr><tr><td>Y5V</td><td>0.075 max.</td><td>0.1 max. (C<1.0μF)
0.125 max. (C≧1.0μF)</td><td>0.15 max.</td><td>0.15 max.</td></tr></table></td></tr>
<tr><td colspan="2">I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td colspan="2">Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td>19</td><td colspan="2">Notice</td><td colspan="3">When mounting capacitor of 500V rated voltage, perform the epoxy resin coating (min. 1.0mm thickness)</td></tr>
</table>

Table A-1

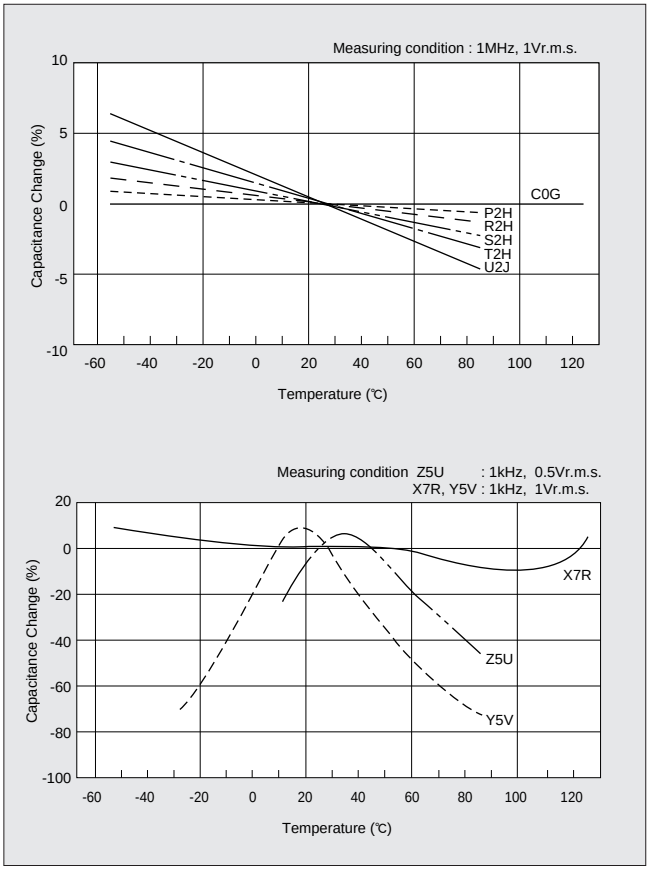
Char.	Temp. Coeff. (ppm/℃) Note 1	Capacitance Change from 25℃ (%)					
		−55℃		−30℃		−10℃	
		Max.	Min.	Max.	Min.	Max.	Min.
C0G	0± 30	0.58	−0.24	0.40	−0.17	0.25	−0.11
C0H	0± 60	0.87	−0.48	0.59	−0.33	0.38	−0.21
P2H	−150± 60	2.33	0.72	1.61	0.50	1.02	0.32
R2H	−220± 60	3.02	1.28	2.08	0.88	1.32	0.56
S2H	−330± 60	4.09	2.16	2.81	1.49	1.79	0.95
T2H	−470± 60	5.46	3.28	3.75	2.26	2.39	1.44
U2J	−750±120	8.78	5.04	6.04	3.47	3.84	2.21
SL	−350 to 1,000	—	—	—	—	—	—

Note 1 : Nominal values denote the temperature coefficient within a range of 25 to 125℃ (for C0Δ)/85℃ (for other TC).

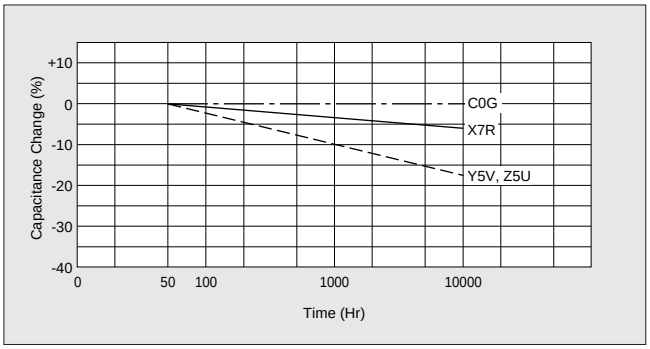
■CHARACTERISTICS (REFERENCE DATA)

- SELECTION OF CERAMIC CAPACITORS
  When selecting capacitors, consider the voltage characteristics (AC & DC) and aging characteristics.

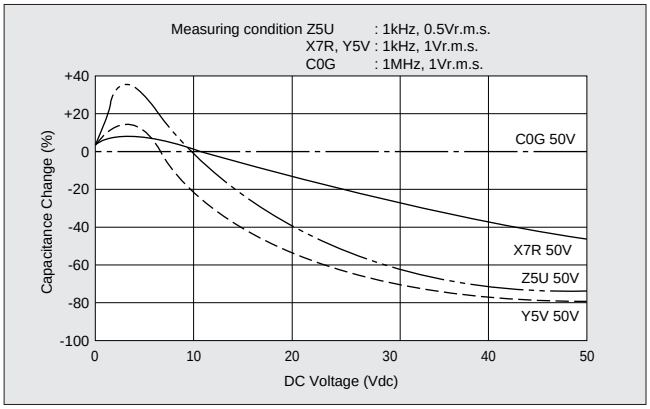
- Capacitance-Temperature Characteristics



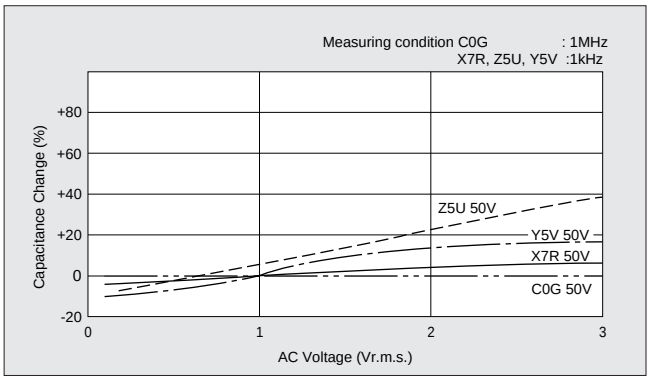
- Capacitance Change- Aging



- Capacitance- DC Voltage Characteristics

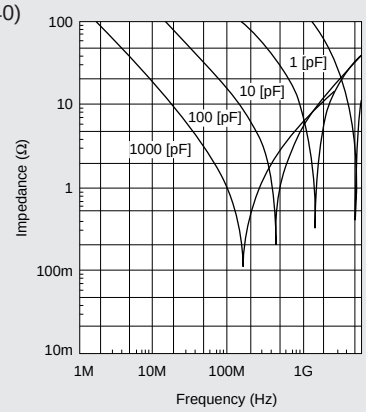


- Capacitance- AC Voltage Characteristics

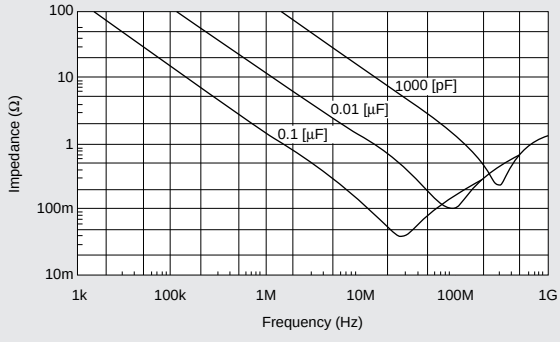


- Impedance- Frequency Characteristics

C0G (GRM40)



X7R, Y5V (GRM40)



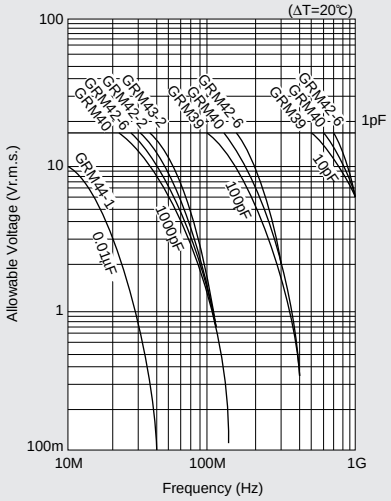
1

- High Frequency-Power Capacity
  The monolithic ceramic capacitor has a small dielectric loss. When high frequency current is applied to the capacitor, the capacitor generates heat (power consumption) by its E.S.R. Temperature rise of the capacitor (ΔT) should be kept below 20℃ (ΔT≦20℃) in the actual circuit.
  Therefore, when selecting capacitors, the applicable voltage, power and current should be considered within the following limits.

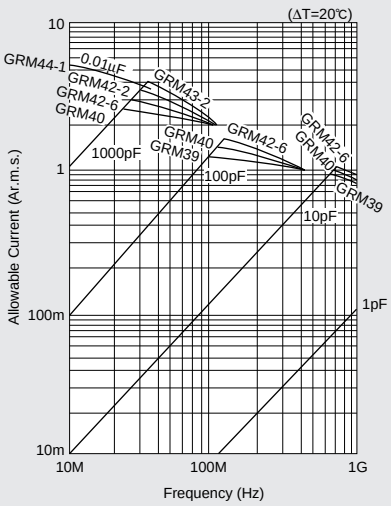
1

Temperature Compensating Type (C0G 50V)

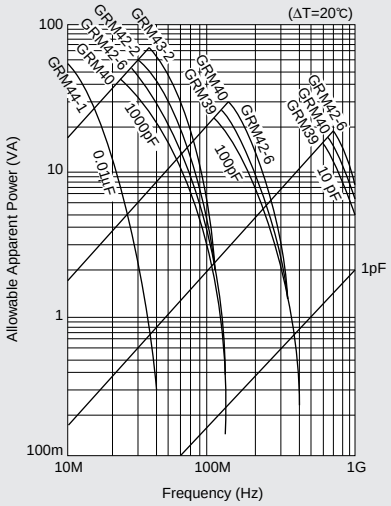
Allowable Voltage



Allowable Current

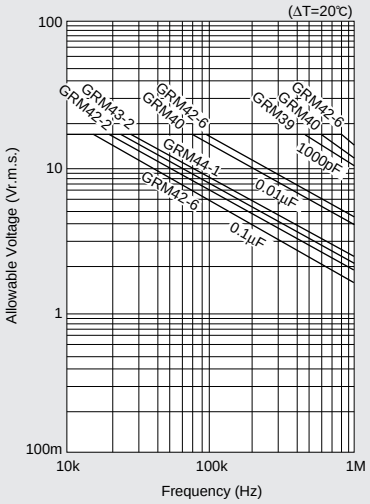


Allowable Apparent Power

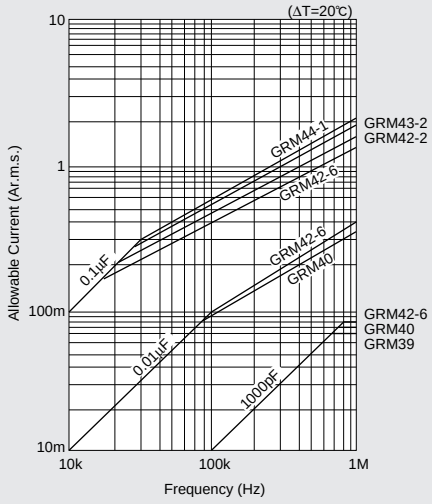


High Dielectric Constant Type (X7R 50V)

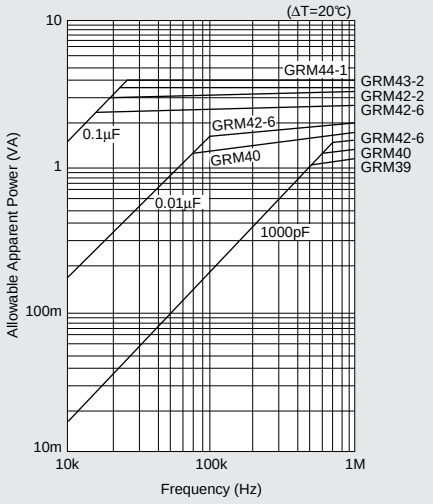
Allowable Voltage



Allowable Current



Allowable Apparent Power



MONOLITHIC CERAMIC CAPACITOR

Ultra-miniaturized **GRM33** Series

■FEATURES

1. Small chip size (L×W×T : 0.6×0.3×0.3mm).
2. Terminations are made of metal highly resistant to migration.
3. GRM33 type is suited to only reflow soldering.
4. Stringent dimensional tolerances allow highly reliable, high speed automatic chip placements on PCBs.
5. GRM33 series are suited to miniature micro wave module, portable equipment and high-frequency circuit.

■APPLICATION

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

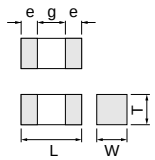
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GRM33	X7R	102	K	16		PT
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS



Type (EIA Code)	Dimensions (mm)				
	L	W	T	e	g min.
GRM33 (0201)	0.6±0.03	0.3±0.03	0.3±0.03	0.1 to 0.2	0.2

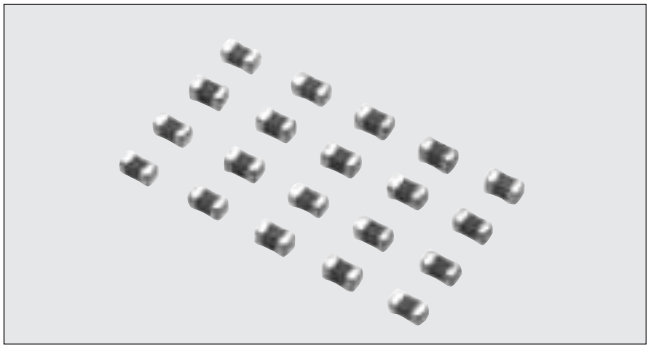
❷TEMPERATURE CHARACTERISTICS

- Temperature Compensating Type

Code	Temp. Coeff.	Temp. Range	Reference Temp.
C0G	0±30ppm/℃	−55 to +125℃	25℃

- High Dielectric Constant Type

Code	Cap. Change	Temp. Range	Reference Temp.
X7R	±15%	−55 to +125℃	25℃



❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
010	1	561	560
100	10	102	1,000

❹CAPACITANCE TOLERANCE

Code	Tol.	Capacitance range
C	±0.25pF	C0G, Cap.≦5pF
D	±0.5 pF	C0G, 6pF≦Cap.≦10pF
J	±5%	C0G, Cap.>10pF
K	±10%	X7R (E12 Series)
M	±20%	X7R (E6 Series)

✻Severe tolerance for C0G is available on request.

❺RATED VOLTAGE

Code	DC Rated voltage (V)
16	16
25	25

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging

■CAPACITANCE RANGE TABLE

(in pF)

Type	DC Rated Voltage (V)	Temp. Char.	
		C0G	X7R
GRM33	25	1 to 15	–
	16	–	100 to 1,000

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)
GRM33	0.3±0.03	1,000	15,000

■SPECIFICATIONS AND TEST METHODS

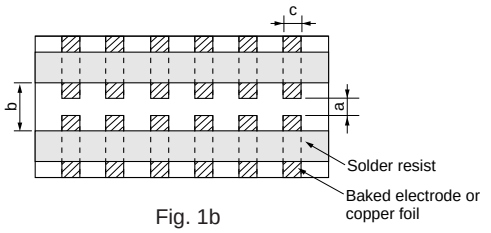
<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Constant Type</th></tr>
<tr><td>1</td><td colspan="2">Operating Temperature Range</td><td>C0G : −55 to +125℃</td><td>X7R : −55 to +125℃</td><td></td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td colspan="2">See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td colspan="2">No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td colspan="2">Within the specified dimension.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td colspan="2">No defects or abnormalities.</td><td>No failure shall be observed when 300% of the rated voltage (C0G) or 250% of the rated voltage (X7R) 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 colspan="2">More than 10,000MΩ</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 colspan="2">Within the specified tolerance.</td><td rowspan="2">The capacitance/Q/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table.
<table><tr><th>Item \ Char.</th><th>C0G</th><th>X7R</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</td><td>1±0.2Vr.m.s.</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Q/Dissipation Factor (D.F.)</td><td>Q≧400+20C
C : Nominal Capacitance (pF)</td><td>0.035 max.</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-2)</td><td rowspan="3"><table><tr><th>Char.</th><th>Temp. Range.</th><th>Reference Temp.</th><th>Cap. Change</th></tr><tr><td>X7R</td><td>−55 to +125℃</td><td>25℃</td><td>Within±15%</td></tr></table></td><td rowspan="3">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-2. 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>(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.</td></tr>
<tr><td>Temperature Coefficient</td><td>Within the specified tolerance. (Table A-2)</td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF (Whichever is larger)</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td colspan="2">No removal of the terminations or other defects shall occur.
 

Fig. 1b</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1b using a eutectic solder. Then apply 2N 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.
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM33</td><td>0.3</td><td>0.9</td><td>0.3</td></tr></table>(in mm)</td></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>Q≧400+20C
C : Nominal Capacitance (pF)</td><td>0.035 max.</td></tr>
</table>

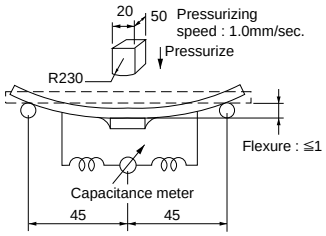
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="3">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th colspan="2">Temperature Compensating Type</th><th>High Dielectric Constant Type</th></tr>
<tr><td>12</td><td>Deflection</td><td colspan="2">No cracking or marking defects shall occur.</td><td>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2b using a eutectic solder. Then apply a force in the direction shown in Fig.3b. 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.
 

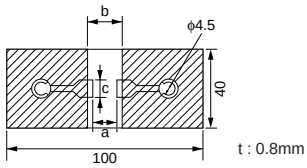
Fig. 3b
 

Fig. 2b
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM33</td><td>0.3</td><td>0.9</td><td>0.3</td></tr></table>(in mm)</td></tr>
<tr><td>13</td><td>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="5">14</td><td colspan="2">Resistance to Soldering Heat</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</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 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>Within ±7.5%</td></tr>
<tr><td>Q/D.F.</td><td>Q≧400+20C
C : Nominal Capacitance (pF)</td><td>0.035 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ</td></tr>
<tr><td rowspan="5">15</td><td colspan="2">Temperature Cycle</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (℃)</td><td>Min. Operating Temp. $^{+0}_{-3}$</td><td>Room Temp.</td><td>Max. Operating Temp. $^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>• Initial measurement for high dielectric constant type
Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then 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>Within ±7.5%</td></tr>
<tr><td>Q/D.F.</td><td>Q≧400+20C
C : Nominal Capacitance (pF)</td><td>0.035 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ</td></tr>
<tr><td rowspan="5">16</td><td colspan="2">Humidity, Steady State</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td><td>Within ±12.5%</td></tr>
<tr><td>Q/D.F.</td><td>10pF and over,
30pF and below :
$Q \geqq 275 + \frac{5}{2}C$
10pF and below :
Q≧200+10C
C : Nominal Capacitance (pF)</td><td>0.05 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ</td></tr>
</table>

No.	Item		Specification		Test Method
			Temperature Compensating Type	High Dielectric Constant Type	
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)	Within ±12.5%	
		Q/D.F.	$Q \geqq 100+\frac{10}{3}C$ C : Nominal Capacitance (pF)	0.05 max.	
		I.R.	More than 500MΩ		
		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)	Within ±12.5%	
		Q/D.F.	10pF and over, 30pF and below : $Q \geqq 275+\frac{5}{2}C$ 10pF and below : $Q \geqq 200+10C$ C : Nominal Capacitance (pF)	0.05 max.	
		I.R.	More than 1,000MΩ		
		Dielectric Strength	No failure		

Table A-2

Char.	Temp. Coeff. (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℃.

MONOLITHIC CERAMIC CAPACITOR

GRM Series for Thin Equipment

■FEATURES

1. This series is suited to 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.

■APPLICATION

Thin equipment such as IC cards.

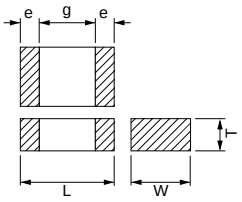
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GRM36-019	C0G	330	J	50		PT
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Nominal Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS



(in mm)

Type	L	W	T	e min.	g min.
GRM36-019	1.0±0.05	0.5±0.05	0.25±0.05	0.15	0.4

❷TEMPERATURE CHARACTERISTICS

• Temperature Compensating Type

Code	C0G
Temp. range	−55 to +125℃
Temp. coeff. (ppm/℃)	0±30

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)
0R5	0.5
030	3
101	100

❹CAPACITANCE TOLERANCE

Code	Tol.	Capacitance range
C	±0.25pF	10pF and below
D	±0.5 pF	
J	± 5%	More than 10pF

❺RATED VOLTAGE

Code	DC Rated voltage (V)
25	25
50	50

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging

■CAPACITANCE RANGE TABLE

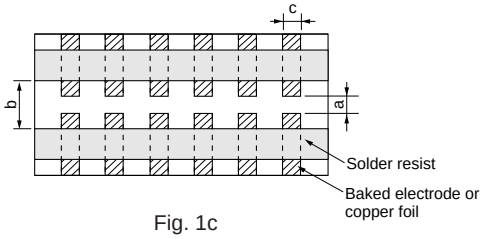
Type	DC Rated Voltage (V)	Temp. Char.
		C0G
GRM36-019	50	0.5 to 100
	25	110 to 220

■PACKAGING TYPES/QUANTITY

Bulk (pcs/bag)	Taping (pcs/reel)
1,000	10,000

1

■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 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. 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/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table
<table><tr><th>Char. / Item</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/Dissipation Factor (D.F.)</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-3)</td><td rowspan="3">The capacitance change shall be measured after 5 min. at each specified temperature stage.
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℃) the capacitance shall be within the specified tolerance for the temperature coefficient and capacitance change as Table A-3.
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 Coefficient</td><td>Within the specified tolerance. (Table A-3)</td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF
(Whichever is larger)</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defects shall occur.</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1c using a eutectic solder. Then apply a 10N* 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 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>GRM36-019</td><td>0.4</td><td>1.5</td><td>0.5</td></tr></table>(in mm)
 
Fig. 1c</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/D.F.</td><td>30pF min. : Q≧1,000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td></tr>
</table>

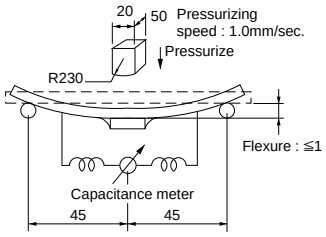
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th colspan="2">Temperature Compensating Type</th></tr>
<tr><td>12</td><td>Deflection</td><td colspan="2">No cracking or marking defects shall occur.
 

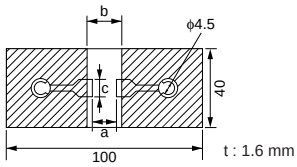
Fig. 3c</td><td>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2c using a eutectic solder. Then apply a force in the direction shown in Fig.3c for 5±1 sec. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering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

Fig. 2c
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM36-019</td><td>0.4</td><td>1.5</td><td>0.5</td></tr></table>(in mm)</td></tr>
<tr><td>13</td><td>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="5">14</td><td colspan="2">Resistance to Soldering Heat</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.</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 24±2 hours, then measure.</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/D.F.</td><td>30pF and over : Q≧1,000
30pF and below : Q≧400+20C
C : Nominal Capacitance (pF)</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td rowspan="5">15</td><td colspan="2">Temperature Cycle</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (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/D.F.</td><td>30pF and over : Q≧1,000
30pF and below : Q≧400+20C
C : Nominal Capacitance (pF)</td></tr>
<tr><td>I.R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td rowspan="5">16</td><td colspan="2">Humidity, Steady State</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>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/D.F.</td><td>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)</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 colspan="2">Humidity Load</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.</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 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/D.F.</td><td>30pF and over : Q≧200
30pF and below : Q≧100+$\frac{10}{3}$C
C : Nominal Capacitance (pF)</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 colspan="2">No failure</td></tr>
</table>

No.	Item		Specification Temperature Compensating 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 maximum operating temperature ±3℃. 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 ±3% or ±0.3pF (Whichever is larger)	
		Q/D.F.	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	

Table A-3

Char.	Temp. Coeff. (ppm/℃) Note 1	Capacitance Change from 25℃ Value (%)					
		−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℃.

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR Series for General Electronic Equipment

■FEATURES

1. The GR series is suited to silver epoxy conductive adhesive.
2. This series is a complete line of chip monolithic ceramic capacitors in 16V, 25V, 50V, 100V, 200V and 500V ratings. These capacitors have temperature characteristics ranging from C0G to Y5V.
3. A wide selection of sizes is available, from the miniature GR36 (L×W×T : 1.0×0.5×0.5mm) to the larger sized GR44-1 (L×W×T : 5.7×5.0×2.0mm).
4. Stringent dimensional tolerances allow highly reliable, high-speed automatic chip placement on PCBs.
5. The GR series is available in both paper and plastic embossed tape and reel packaging for automatic placement.

■APPLICATION

General electronic equipment.

■PART NUMBERING

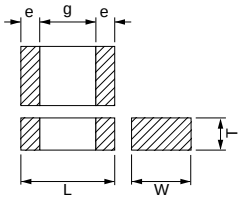
(✻Please specify the part number when ordering)

(Ex.) GR40 | X7R | 102 | K | 50 | | PT

❶ ❷ ❸ ❹ ❺ ❻ ❼

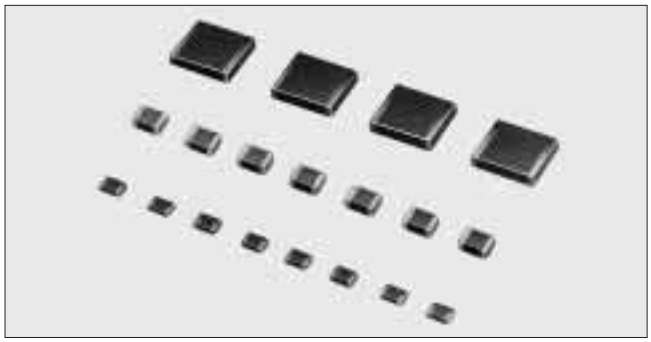
❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS



(in mm)

Type (EIA Code)	L	W	T	e min.	g min.
GR36 (0402)	1.0±0.05	0.5±0.05	0.5 ±0.05	0.15	0.4
GR39 (0603)	1.6±0.1	0.8±0.1	0.8 ±0.1	0.15	0.5
GR40 (0805)	2.0±0.15	1.25±0.15	0.7 $^{+0}_{-0.2}$	0.2	0.7
			1.0 $^{+0}_{-0.2}$		
			1.25±0.15		
GR42-6 (1206)	3.2±0.15	1.6±0.15	1.0 $^{+0}_{-0.2}$	0.25	1.5
			1.25 $^{+0}_{-0.2}$		
GR42-2 (1210)	3.2±0.3	2.5±0.2	1.25 $^{+0}_{-0.2}$	0.3	1.0
			1.5 $^{+0}_{-0.3}$		
GR43-2 (1812)	4.5±0.4	3.2±0.3	2.0 max.	0.3	2.0
GR44-1 (2220)	5.7±0.4	5.0±0.4	2.0 max.	0.3	2.0



❷TEMPERATURE CHARACTERISTICS

• Temperature Compensating Type

Code	C0G	R2H	U2J	SL
Temp. range	−55 to +125℃	−55 to +85℃		
Temp. coeff. (ppm/℃)	0±30	−220±60	−750±120	+350 to −1,000

• High Dielectric Constant Type

Code	X7R	Z5U	Y5V
Temp. range	−55 to +125℃	+10 to +85℃	−30 to +85℃
Cap. change (%)	±15	+22 −56	+22 −56

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
0R5	0.5	100	10
R75	0.75	101	100
010	1	103	10,000

❹CAPACITANCE TOLERANCE

Code	Tol.	Capacitance range
C	±0.25pF	10pF and below
D	±0.5 pF	
J	± 5%	More than 10pF
K	±10%	
M	±20%	
Z	$^{+80}_{-20}$%	

❺RATED VOLTAGE

Code	DC Rated voltage (V)
16	16
25	25
50	50
100	100
200	200
500	500

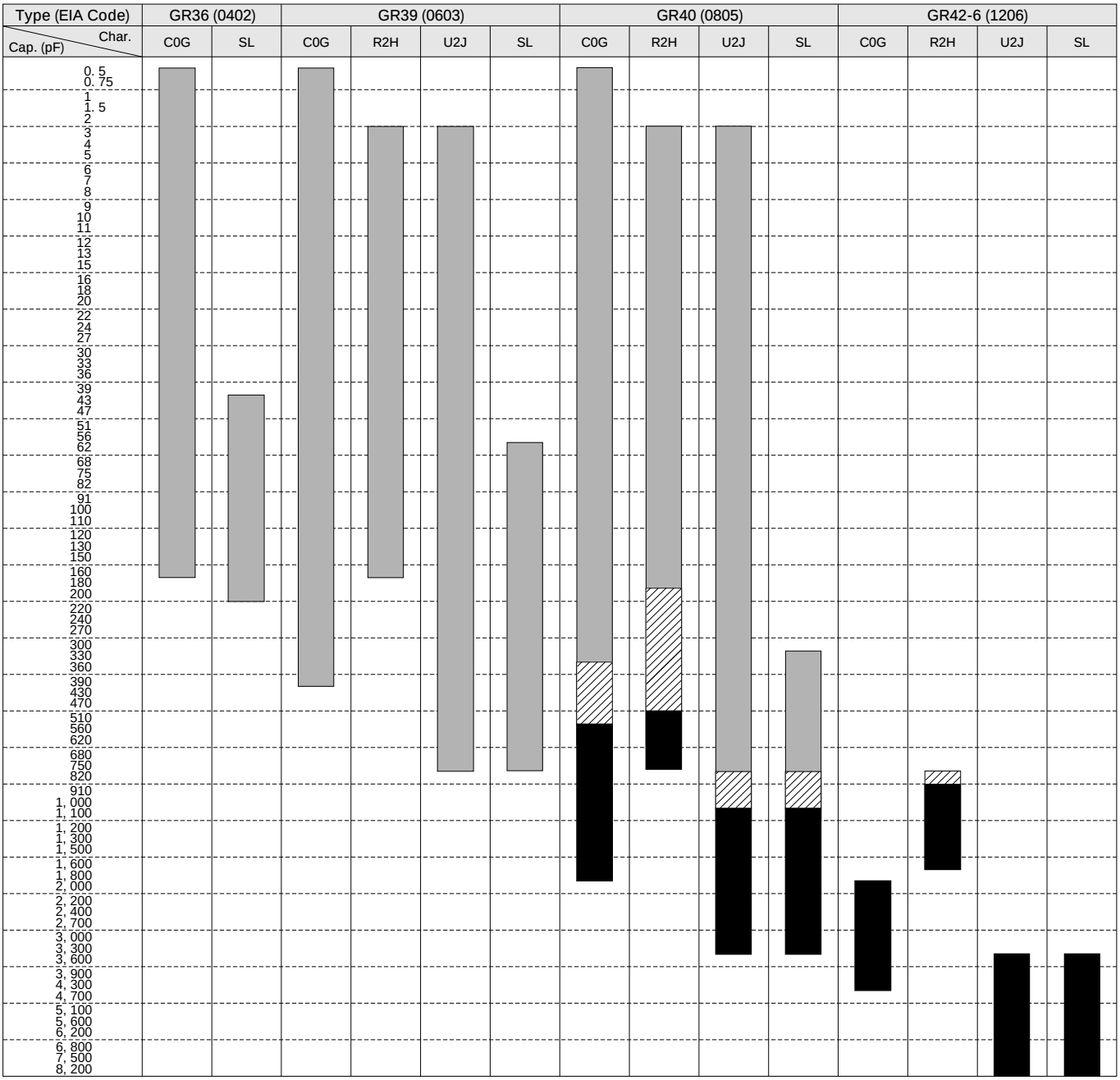
❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging

■CAPACITANCE RANGE TABLE

FOR SILVER EPOXY CONDUCTIVE ADHESIVE

Temperature Compensating Type 50V



■CAPACITANCE TOLERANCE

5pF and below · · · · · · · · · · C : ±0.25pF
6pF and over, 10pF and below · · · D : ±0.5pF
More than 10pF · · · · · · · · · J : ±5% (E24 Series)

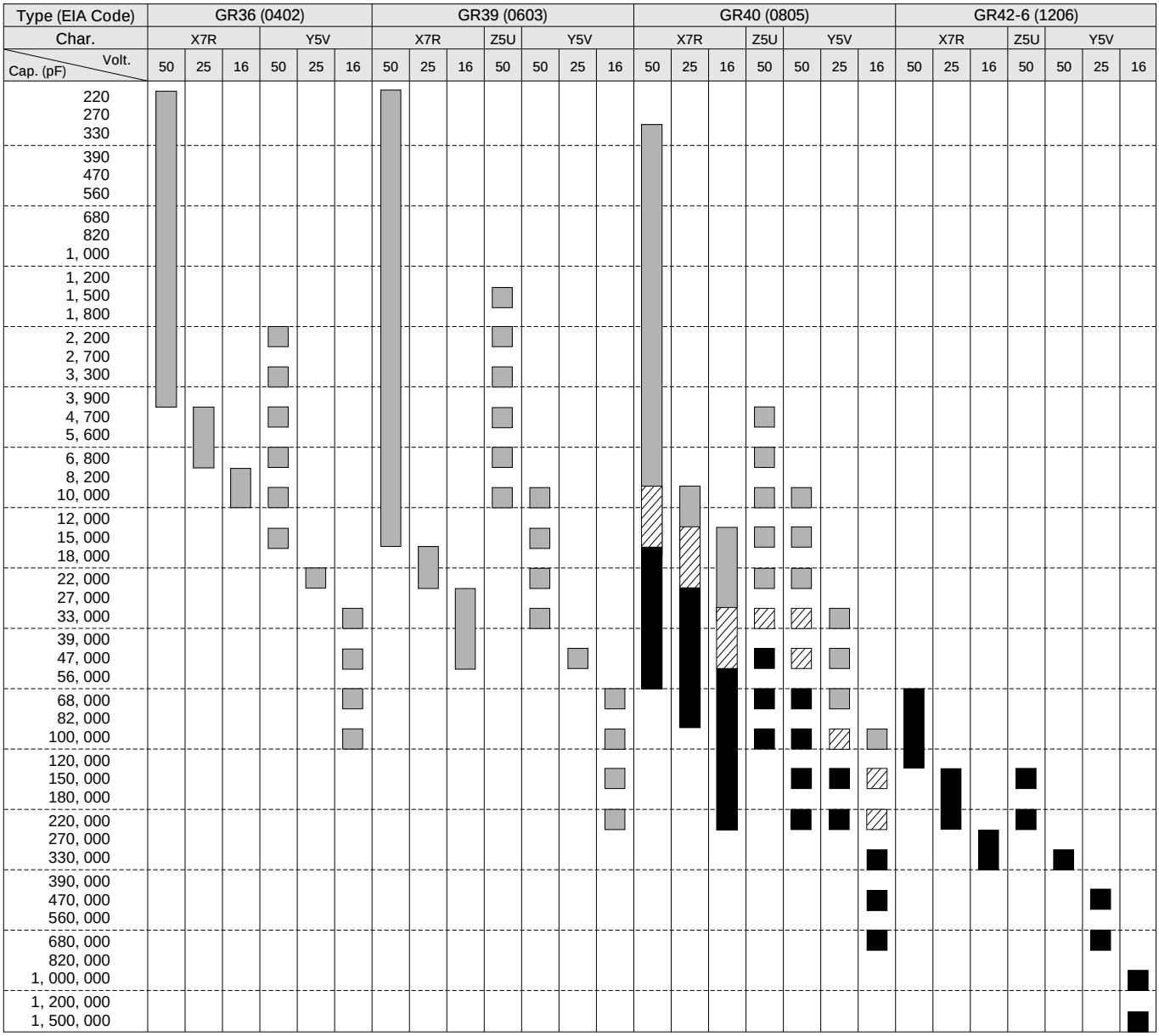
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)*
GR36	: 0.5 ±0.05	1,000	10,000
GR39	: 0.8 ±0.1	1,000	4,000
GR40	: 0.7 $^{+0}_{-0.2}$	1,000	4,000
	: 1.0 $^{+0}_{-0.2}$	1,000	4,000
	: 1.25±0.15	1,000	3,000
GR42-6	: 1.0 $^{+0}_{-0.2}$	1,000	4,000
	: 1.25 $^{+0}_{-0.2}$	1,000	3,000

* φ330mm reel is available on request.

FOR SILVER EPOXY CONDUCTIVE ADHESIVE

High Dielectric Constant Type 50V/25V/16V



■CAPACITANCE TOLERANCE

X7R Characteristics
K : ±10% (E12 Series)
M : ±20% (E6 Series)
Z5U Characteristics
M : ±20% (E6 Series)
Z : $^{+80}_{-20}$% (E6 Series)
Y5V Characteristics
Z : $^{+80}_{-20}$% (E6 Series)

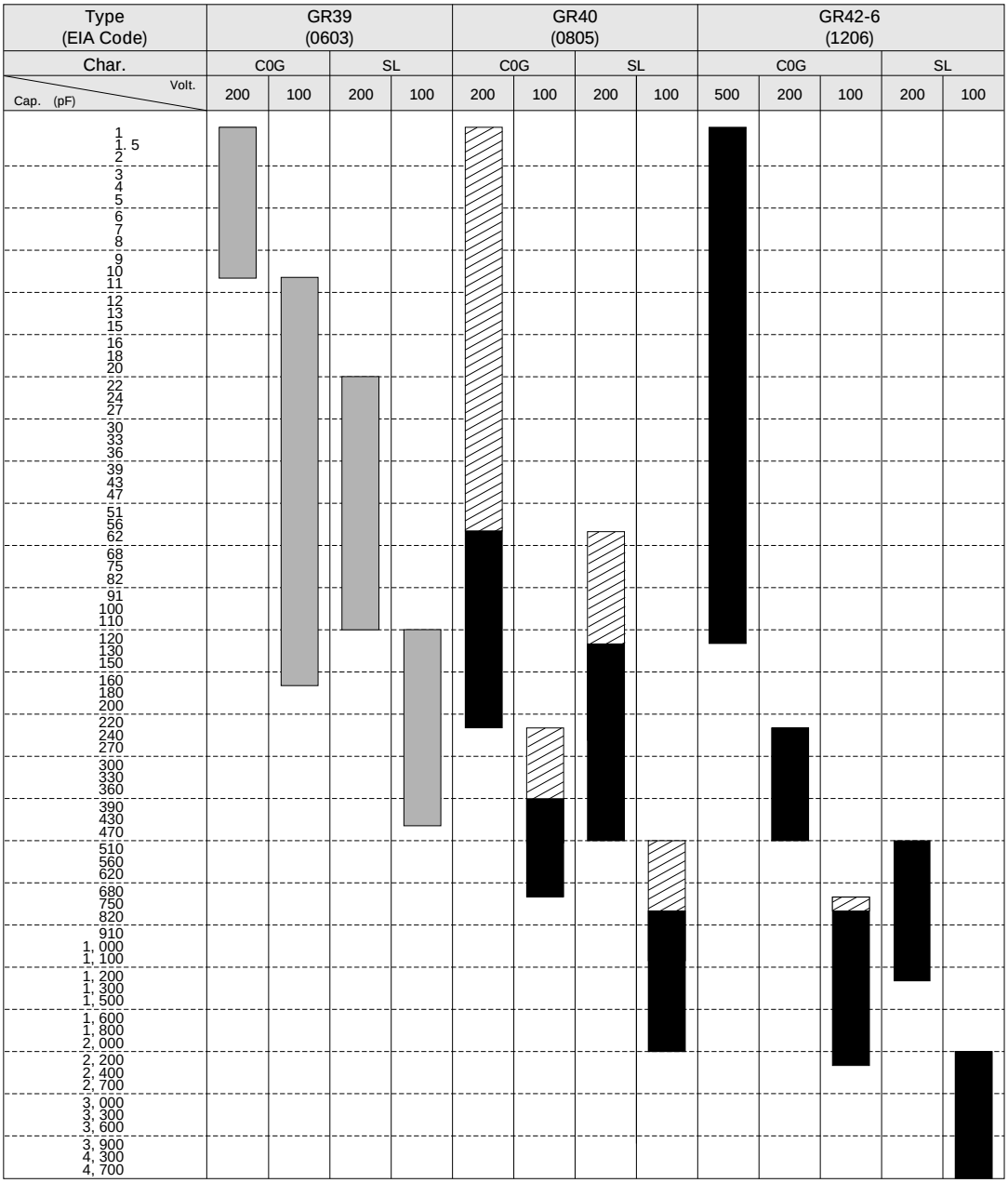
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)*1
GR36	: 0.5 ±0.05	1,000	10,000
GR39	: 0.8 ±0.1	1,000	4,000
GR40	: 0.7 $^{+0}_{-0.2}$	1,000	4,000
	: 1.0 $^{+0}_{-0.2}$	1,000	4,000
	: 1.25±0.15	1,000	3,000
GR42-6	: 1.25$^{+0}_{-0.2}$	1,000	3,000

*1 φ330mm reel is available on request.

FOR SILVER EPOXY CONDUCTIVE ADHESIVE

Temperature Compensating Type 500V/200V/100V



■CAPACITANCE TOLERANCE

C0G/SL Characteristics
C : ±0.25pF · · · · · 5pF and below
D : ±0.5pF · · · · · · 6pF≦cap.≦10pF
J : ±5% · · · · · · · · More than 10pF

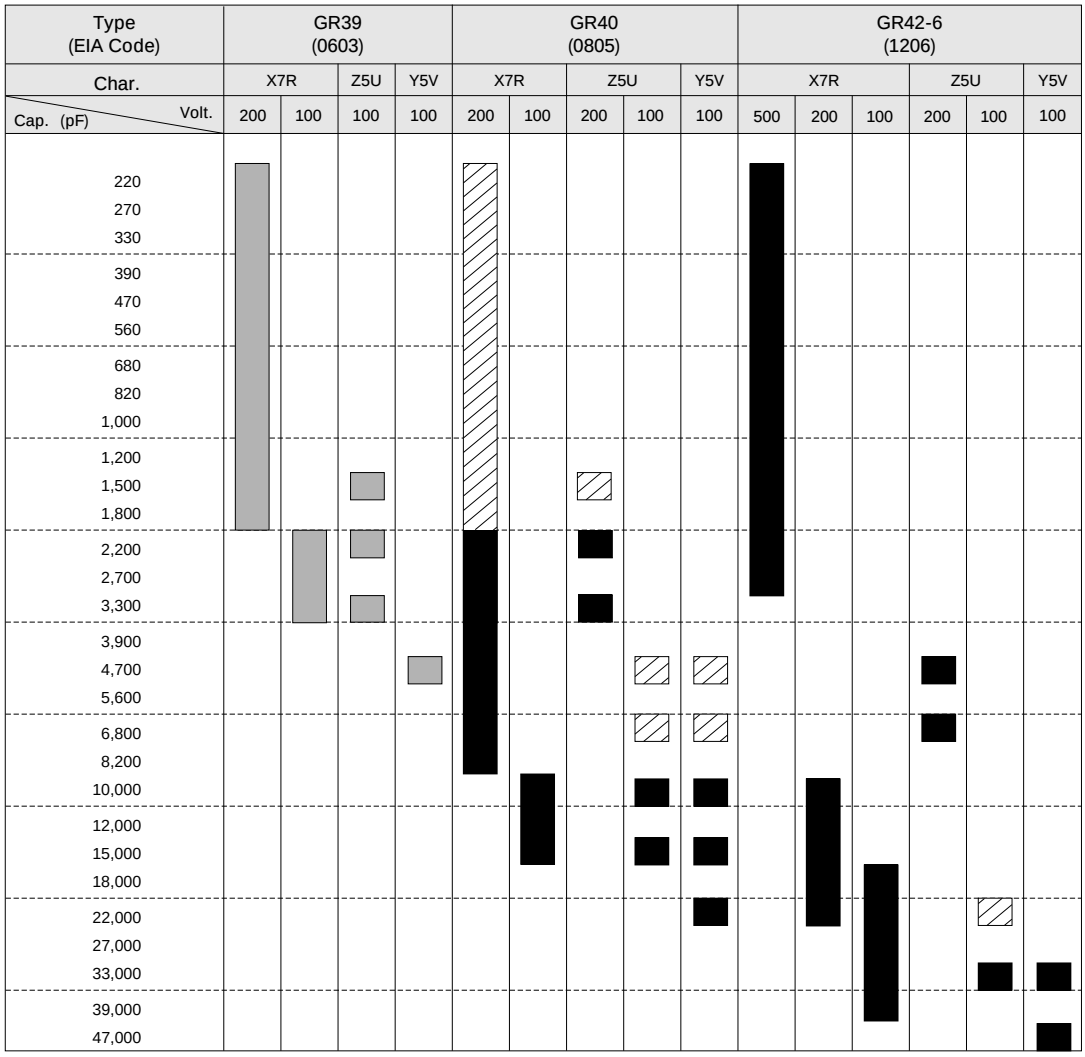
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)*
GR39	□ : 0.8 ±0.1	1,000	4,000
GR40	▨ : 1.0 $^{+0}_{-0.2}$	1,000	4,000
	■ : 1.25±0.15	1,000	3,000
GR42-6	▨ : 1.0 $^{+0}_{-0.2}$	1,000	4,000
	■ : 1.25$^{+0}_{-0.2}$	1,000	3,000

* φ330mm reel is available on request.

FOR SILVER EPOXY CONDUCTIVE ADHESIVE

High Dielectric Constant Type 500V/200V/100V



■CAPACITANCE TOLERANCE

X7R Characteristics
K : ±10% (E12 Series)
M : ±20% (E6 Series)
Z5U Characteristics
M : ±20% (E6 Series)
Z : $^{+80}_{-20}$% (E6 Series)
Y5V Characteristics
Z : $^{+80}_{-20}$% (E6 Series)

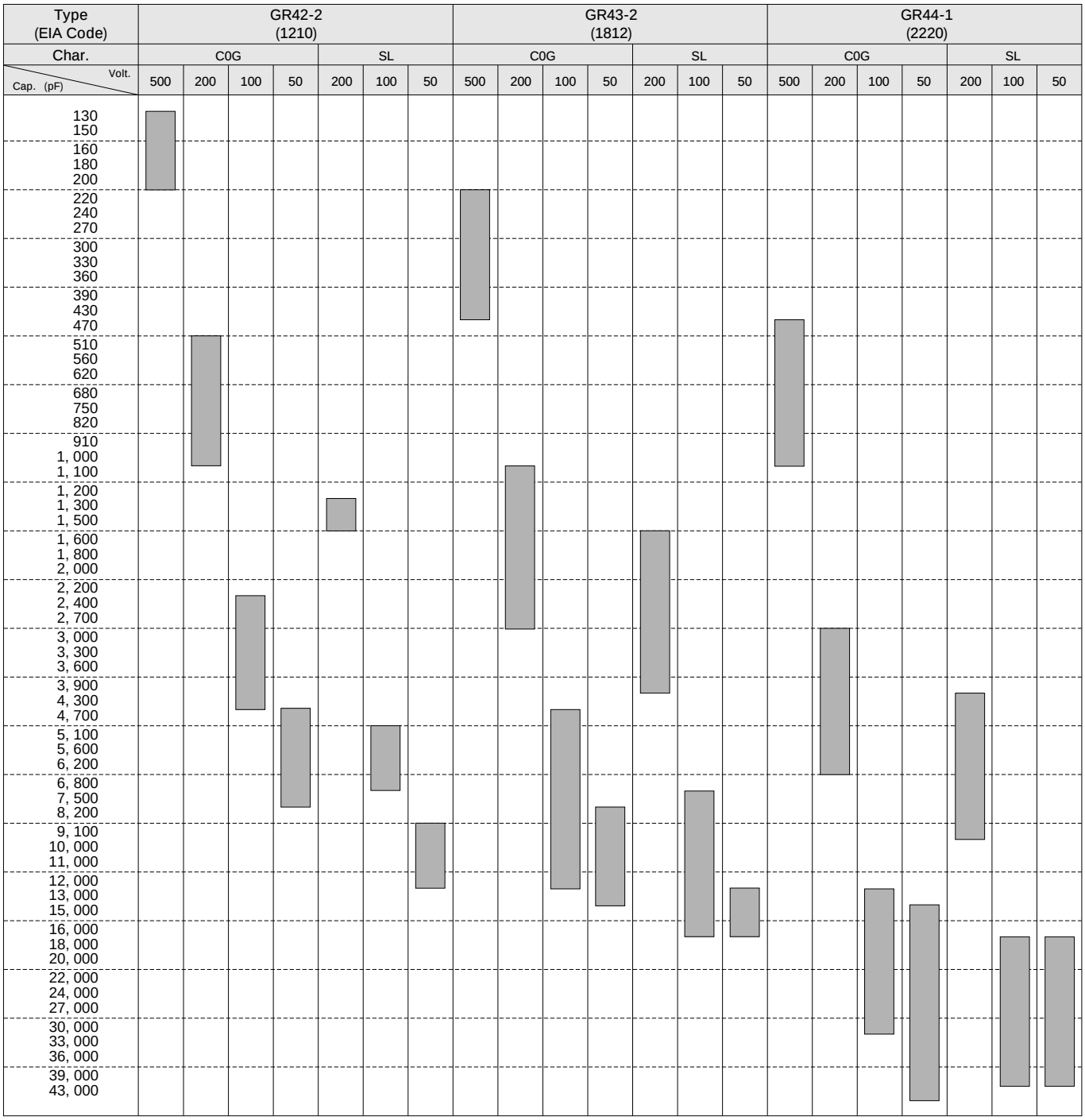
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)*1
GR39	: 0.8 ±0.1	1,000	4,000
GR40	: 1.0 $^{+0}_{-0.2}$	1,000	4,000
	: 1.25±0.15	1,000	3,000
GR42-6	: 1.0 $^{+0}_{-0.2}$	1,000	4,000
	: 1.25$^{+0}_{-0.2}$	1,000	3,000

*1 φ330mm reel is available on request.

FOR SILVER EPOXY CONDUCTIVE ADHESIVE

Temperature Compensating Type 500V/200V/100V/50V



■CAPACITANCE TOLERANCE

C0G/SL Characteristics
J : ±5% (E24 Series)

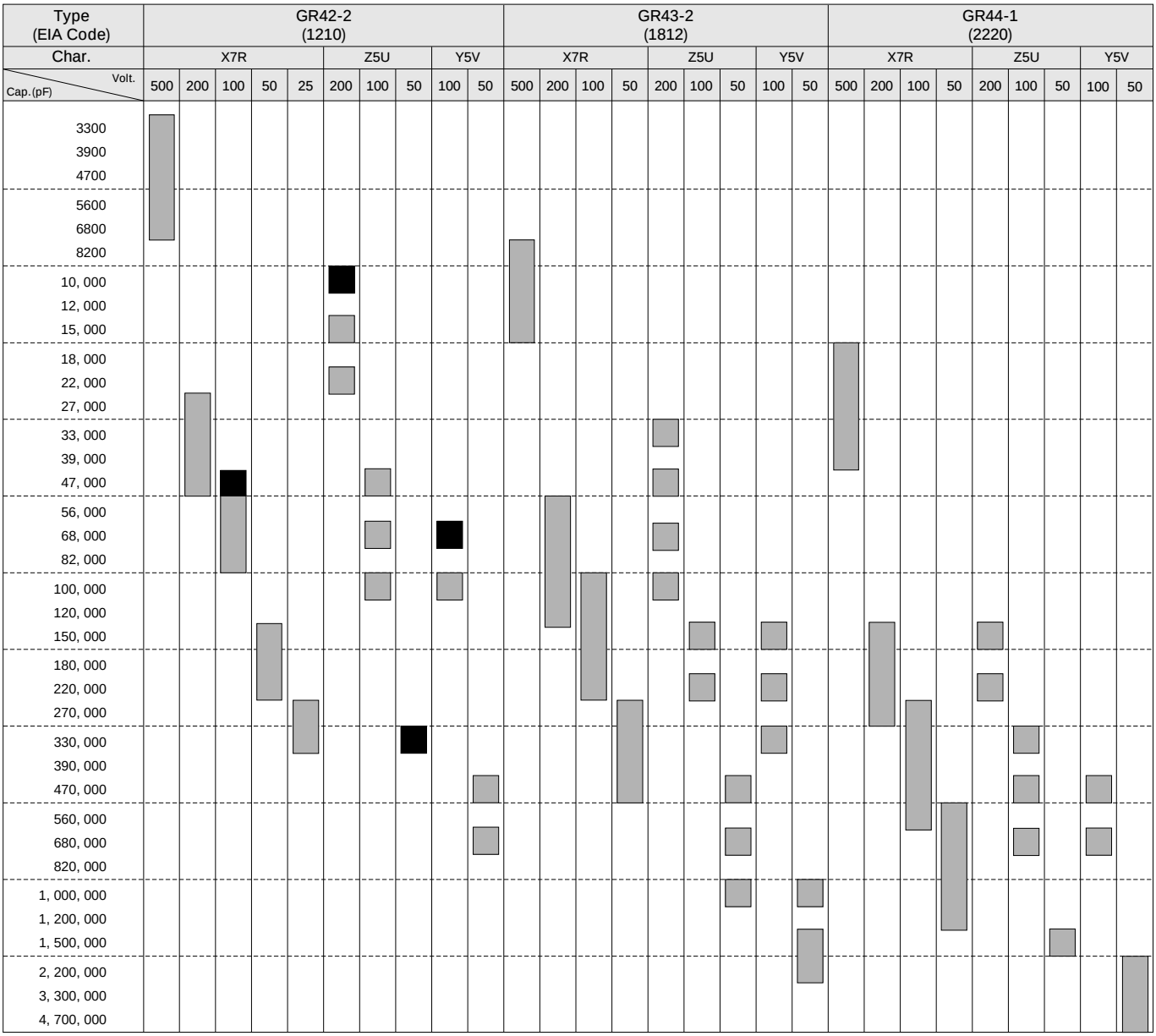
■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)*
GR42-2	: $1.5^{+0}_{-0.3}$	1,000	2,000
GR43-2	: 2.0 max.	1,000	1,000
GR44-1	: 2.0 max.	1,000	1,000

* φ330mm reel is available on request.

FOR SILVER EPOXY CONDUCTIVE ADHESIVE

High Dielectric Constant Type 500V/200V/100V/50V/25V



■CAPACITANCE TOLERANCE

X7R Characteristics
K : ±10% (E12 Series)
M : ±20% (E6 Series)
Z5U Characteristics
M : ±20% (E6 Series)
Z : $^{+80}_{-20}$% (E6 Series)
Y5V Characteristics
Z : $^{+80}_{-20}$% (E6 Series)

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)*1
GR42-2	■ : $1.25^{+0}_{-0.2}$	1,000	3,000
	□ : $1.5^{+0}_{-0.3}$	1,000	2,000
GR43-2	□ : 2.0 max.	1,000	1,000
GR44-1	□ : 2.0 max.	1,000	1,000

*1 φ330mm reel is available on request.

■SPECIFICATIONS AND TEST METHODS

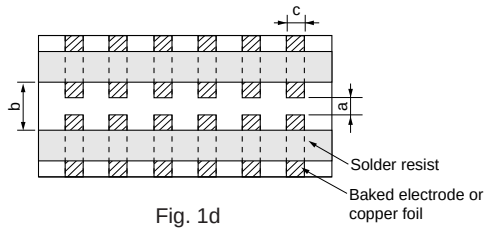
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Constant Type</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>−55 to +125℃</td><td>X7R : −55 to +125℃
Z5U : +10 to + 85℃
Y5V : −30 to + 85℃</td><td></td></tr>
<tr><td>2</td><td>Rated Voltage</td><td colspan="2">See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td colspan="2">No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td>Dimensions</td><td colspan="2">Within the specified dimension.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td colspan="2">No defects or abnormalities.</td><td>No failure shall be observed when *300% of the rated voltage (C0G to U2J and SL) or *250% of the rated voltage (X7R, Z5U, Y5V) is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
*200% for 500V</td></tr>
<tr><td>6</td><td>Insulation Resistance (I.R.)</td><td colspan="2">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>Capacitance</td><td colspan="2">Within the specified tolerance.</td><td rowspan="2">The capacitance/Q/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table.
<table><tr><th>Item \ Char.</th><th>C0G to U2J, SL (1,000pF and below)</th><th>C0G to U2J, SL (more than 1,000pF) X7R, Y5V</th><th>Z5U</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</td><td>1±0.2Vr.m.s.</td><td>0.5±0.05Vr.m.s.</td></tr></table></td></tr>
<tr><td>8</td><td>Q/Dissipation Factor (D.F.)</td><td>30pF min. : Q≧1,000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max.</td></tr></table></td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Capacitance Temperature Characteristics</td><td>Capacitance Change</td><td>Within the specified tolerance. (Table A-4)</td><td><table><tr><th>Char.</th><th>Temp. Range.</th><th>Reference Temp.</th><th>Cap. Change</th></tr><tr><td>X7R</td><td>−55 to +125℃</td><td rowspan="3">25℃</td><td>Within±15%</td></tr><tr><td>Z5U</td><td>+10 to + 85℃</td><td>Within $^{+22}_{-56}$%</td></tr><tr><td>Y5V</td><td>−30 to + 85℃</td><td>Within $^{+22}_{-82}$%</td></tr></table></td><td rowspan="3">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, (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-4. 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 (for C0G)/85±3 (for other TC)</td></tr><tr><td>5</td><td>25±2</td></tr></table>
(2) High Dielectric Constant Type
The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table shall be within the specified ranges.</td></tr>
<tr><td>Temperature Coefficient</td><td>Within the specified tolerance. (Table A-4)</td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF (Whichever is larger)</td></tr>
<tr><td rowspan="4">10</td><td rowspan="4">Vibration Resistance (No apply for GR36)</td><td>Appearance</td><td colspan="2">No defects or abnormalities.</td><td rowspan="4">Fix the capacitor to the test jig (glass epoxy boards) shown in Fig.1d using silver epoxy conductive adhesive. 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).
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GR36</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GR39</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GR40</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GR42-6</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GR42-2</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GR43-2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GR44-1</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table>(in mm)</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≧1,000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max.</td></tr></table></td></tr>
<tr><td colspan="2"></td><td colspan="2"> 

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

<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="6">11</td><td colspan="2">Temperature Cycle (Not apply for GR36)</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.
<table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Temp. (℃)</td><td>Min. Operating Temp. $^{+0}_{-3}$</td><td>Room Temp.</td><td>Max. Operating Temp. $^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>
• Initial measurement for high dielectric constant type
Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then 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>X7R ·····Within ±7.5%
Z5U, Y5V ·····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><table><tr><td>Char.</td><td>25V min.</td><td>16V</td></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="5">12</td><td colspan="2">Humidity, Steady State</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) then measure.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td><td>X7R ·····Within ±12.5%
Z5U, Y5V ·····Within ±30%</td></tr>
<tr><td>Q/D.F.</td><td>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)</td><td><table><tr><td>Char.</td><td>25V min.</td><td>16V</td></tr><tr><td>X7R</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.05 max.</td><td>—</td></tr><tr><td>Y5V</td><td>0.075 max.</td><td>0.1 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td rowspan="6">13</td><td colspan="2">High Temperature Load</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="6">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.

*150% for 500V</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3% or ±0.3pF (Whichever is larger)</td><td>X7R ·····Within ±12.5%
Z5U, Y5V ·····Within ±30%</td></tr>
<tr><td>Q/D.F.</td><td>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)</td><td><table><tr><td>Char.</td><td>25V min.</td><td>16V</td></tr><tr><td>X7R</td><td>0.04 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.04 max.</td><td>—</td></tr><tr><td>Y5V</td><td>0.075 max.</td><td>0.1 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td>14</td><td colspan="3">Notice</td><td colspan="2">When mounting capacitor of 500V rated voltage, perform the epoxy resin coating (min. 1.0mm thickness).</td></tr>
</table>

Table A-4

Char.	Temp. Coeff. (ppm/℃) Note 1	Capacitance Change from 25℃ Value (%)					
		−55℃		−30℃		−10℃	
		Max.	Min.	Max.	Min.	Max.	Min.
C0G	0± 30	0.58	−0.24	0.40	−0.17	0.25	−0.11
R2H	−220± 60	3.02	1.28	2.08	0.88	1.32	0.56
U2J	−750±120	8.78	5.04	6.04	3.47	3.84	2.21
SL	−350 to 1,000	—	—	—	—	—	—

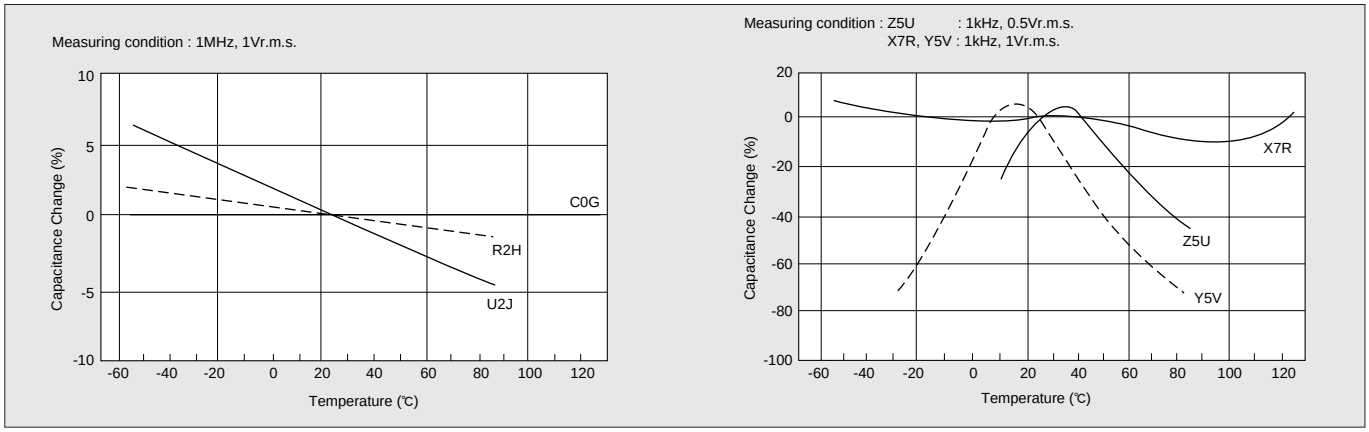
Note 1 : Nominal values denote the temperature coefficient within a range of 25 to 125℃ (for C0G)/85℃ (for other TC).

■CHARACTERISTICS (REFERENCE DATA)

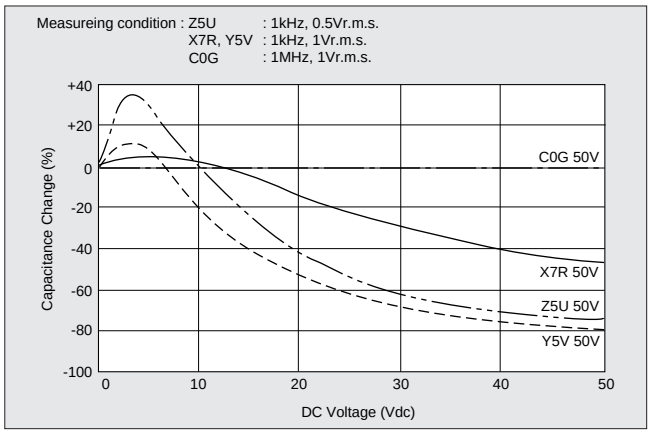
- SELECTION OF CERAMIC CAPACITORS
  When selecting capacitors, consider the voltage characteristics (AC & DC) and aging characteristics.

2

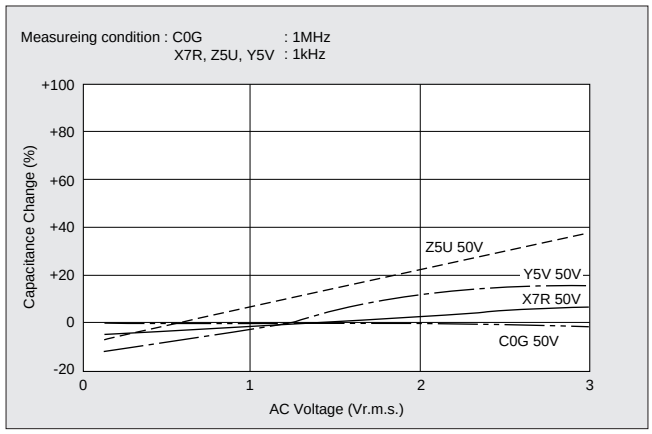
• Capacitance-Temperature Characteristics



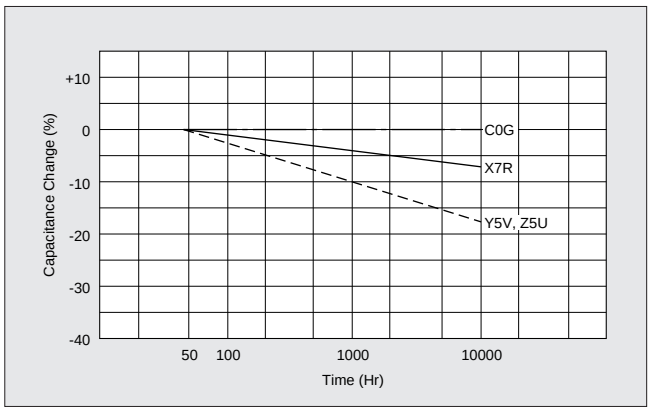
• Capacitance-DC Voltage Characteristics



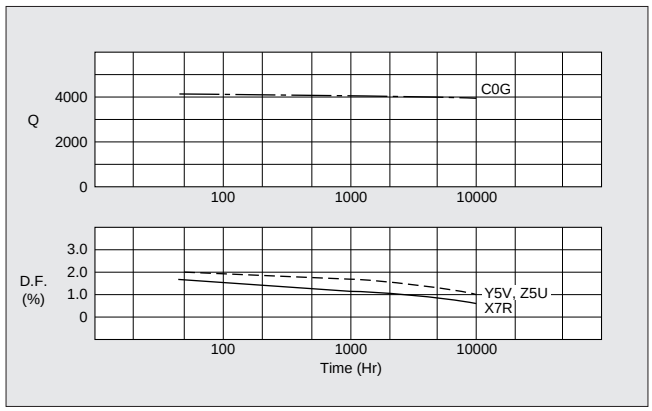
• Capacitance-AC Voltage Characteristics



• Capacitance Change-Aging



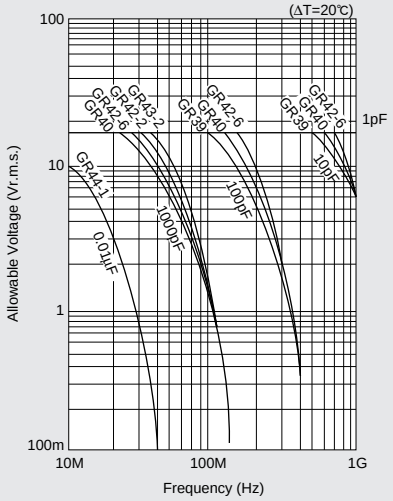
• Q/D.F. Change-Aging



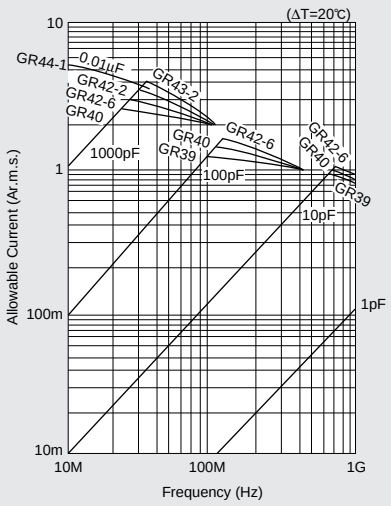
- High Frequency-Power Capacity
  The monolithic ceramic capacitor has a small dielectric loss. When high frequency current is applied to the capacitor, the capacitor generates heat (power consumption) by its E.S.R. Temperature rise of the capacitor (ΔT) should be kept below 20℃ (ΔT≦20℃) in the actual circuit.
  Therefore, when selecting capacitors, the applicable voltage, power and current should be considered within the following limits.

Temperature Compensating Type (C0G 50V)

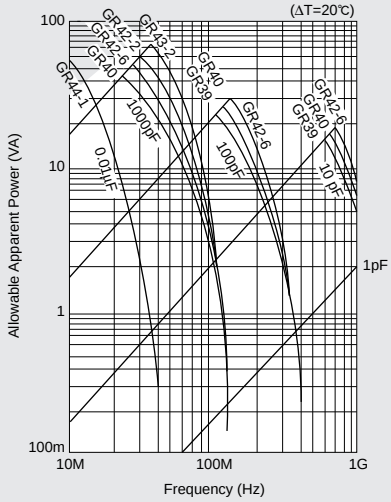
Allowable Voltage



Allowable Current

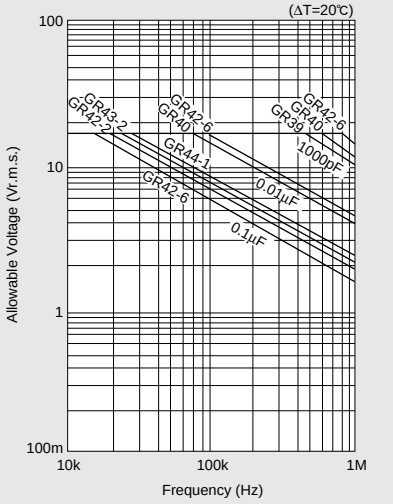


Allowable Apparent Power

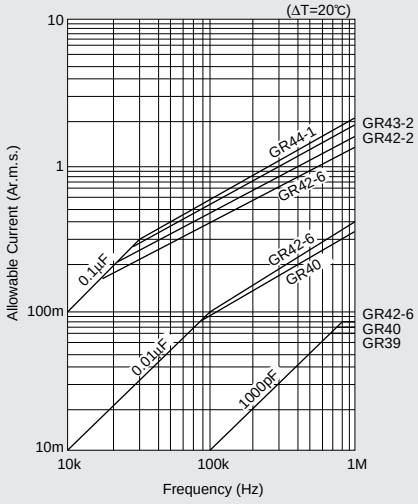


High Dielectric Constant Type (X7R 50V)

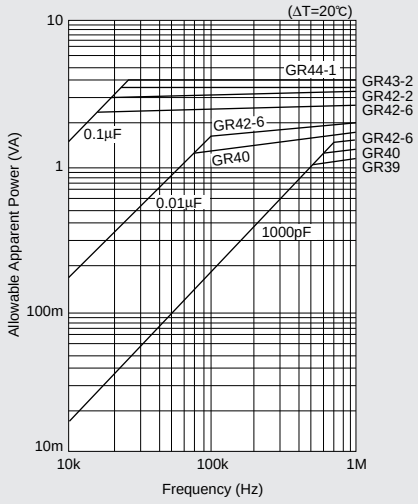
Allowable Voltage



Allowable Current



Allowable Apparent Power



MONOLITHIC CERAMIC CAPACITOR

High-power Type

Temperature Compensating Type **GRM 600** Series

3

■FEATURES

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

■APPLICATION

• VCO, PA, Mobile Telecommunication

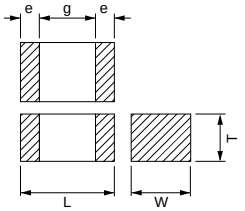
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GRM615	C0G	100	D	50		PT
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

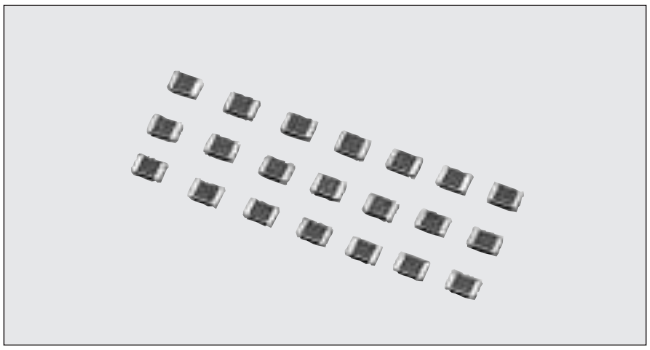
❶TYPE AND DIMENSIONS



Type (EIA Code)	Dimensions (mm)				
	L	W	T	e	g
GRM615 (0402)	1.0±0.05	0.5±0.05	0.5±0.05	0.15 to 0.3	0.4 min.

❷TEMPERATURE CHARACTERISTICS

Code	Temp. Coeff.	Temp. Range	Reference Temp.
C0G	0±30ppm/℃	−55℃ to +125℃	25℃



❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
0R5	0.5	100	10

❹CAPACITANCE TOLERANCE

Code	Tol.	Capacitance range
C	±0.25pF	Cap.≦5pF
D	±0.5pF	6pF≦Cap.≦10pF
J	±5pF	Cap.>10pF

❺RATED VOLTAGE

Code	DC Rated voltage
50	50V

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging
PC	Bulk case

■CAPACITANCE RANGE TABLE

(in pF)

Type	DC Rated Voltage (V)	Temp. Char.
		C0G
GRM615	50	0.5 to 20

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)	Bulk Case (pcs./case)
GRM615	1,000	10,000	50,000

■SPECIFICATIONS AND TEST METHODS

No.	Item		Specification: Temperature Compensating Type	Test Method
1	Operating Temperature Range		−55 to +125℃	
2	Rated Voltage		See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{p-p} or V^{o-p}, whichever is larger, 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 is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance (I.R.)		10,000MΩ min. or 500Ω · F min. (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 shall be measured at 25℃ at the frequency and voltage shown in the table
8	Q		30pF min. : Q≧1,000 30pF max. : Q≧400+20C C : Nominal Capacitance (pF)	
9	Capacitance Temperature Characteristics	Capacitance Change	Within the specified tolerance. (Table A-1)	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-1. The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the step 1, 3 and 5 by the cap value in step 3.
		Temperature Coefficient	Within the specified tolerance. (Table A-1)	
		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. 1a using a eutectic solder. Then apply a 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.
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)	

Char. / Item	C0G (1,000pF and below)
Frequency	1±0.1MHz
Voltage	0.5 to 5Vr.m.s.

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

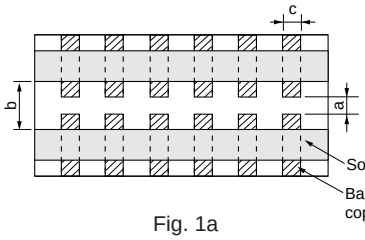
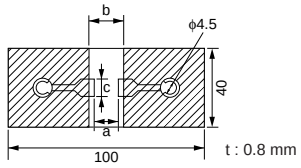
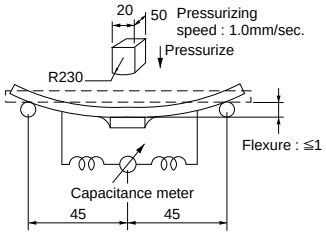


Fig. 1a

Type	a	b	c
GRM615	0.4	1.5	0.5

(in mm)

3

No.	Item	Specification Temperature Compensating Type	Test Method
12	Deflection	No cracking or marking defects shall occur.  Fig. 2a  Fig. 3a	Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2a using a eutectic solder. Then apply a force in the direction shown in Fig.3a. 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 GRM615 / 0.4 / 1.5 / 0.5 (in mm)
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. 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
	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	
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 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 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	

No.	Item		Specification Temperature Compensating 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 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 :$Q \geqq 275 + \frac{5}{2}C$ 10pF and below :Q≧200+10C C : Nominal Capacitance (pF)	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)	
		Dielectric Strength	No failure	
19	ESR		0.5pF ≦C≦1pF : 350Ω · pF below 1pF <C≦5pF : 300Ω below 5pF <C≦10pF : 250Ω below	The ESR shall be measured at room Temp. and frequency 1±0.2GHz with the equivalent of BOONTON Model 34A.
			10pF <C≦20pF : 400Ω below	The ESR shall be measured at room Temp. and frequency 500±50MHz with the equivalent of HP8753B.

Table A-1

Char.	Temp. Coeff. (ppm/℃) Note 1	Capacitance Change from 25℃ Value (%)					
		−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 C0Δ)

MONOLITHIC CERAMIC CAPACITOR

GRM400 Series ; Low Distorition

3

■FEATURES

1. This series features a low dissipation factor and low distortion.
2. Low shock noise* is realized without piezoelectric effects.
3. This series is suited to both flow and reflow soldering techniques without the need for silver.
4. This series is suitable for most automatic placement equipment.

✻ Noise resulting from mechanical stress.

■APPLICATION

Low distortion in general electronic equipment

■PART NUMBERING

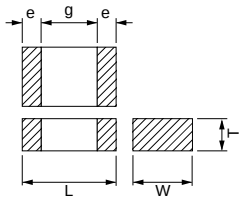
(✻Please specify the part number when ordering)

(Ex.) GRM425 | B | 103 | K | 50 | | PT

❶ ❷ ❸ ❹ ❺ ❻ ❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS



(in mm)

Type (EIA Code)	L	W	T*	e	g
GRM420 (0603)	1.6±0.1	0.8 ±0.1	Varies	0.2 to 0.5	0.5 min.
GRM425 (0805)	2.0±0.1	1.25±0.1	depending on	0.2 to 0.7	0.7 min.
GRM430 (1206)	3.2±0.15	1.6 ±0.15	capacitance	0.3 to 0.8	1.5 min.
GRM435 (1210)	3.2±0.3	2.5 ±0.2	value	0.3 min.	1.0 min.

✻ T : Please refer to the capacitance range table.

❷TEMPERATURE CHARACTERISTICS

Code	Capacitance Change	Temp. Range	Reference Temp.
B	Within±10%	−25 to +85℃	20℃
R	Within±15%		

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)
102	1,000
103	10,000
104	100,000

❹CAPACITANCE TOLERANCE

Code	Cap. Tolerance (%)
K	±10
M	±20

❺RATED VOLTAGE

Code	DC Rated Voltage (V)
16	16
50	50
100	100

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging

■CAPACITANCE RANGE TABLE

Type (EIA Code)	GRM420 (0603)		GRM425 (0805)		GRM430 (1206)			GRM435 (1210)
Char.	B	R	B	R	B	R		R
Cap. (pF) \ Volt.	50	16	50	16	50	50	16	100
1, 000 1, 200 1, 500								
1, 800 2, 200 2, 700								
3, 300 3, 900 4, 700								
5, 600 6, 800 8, 200								
10, 000 12, 000 15, 000								
18, 000 22, 000 27, 000								
33, 000 39, 000 47, 000								
56, 000 68, 000 82, 000								
100, 000								

■CAPACITANCE TOLERANCE

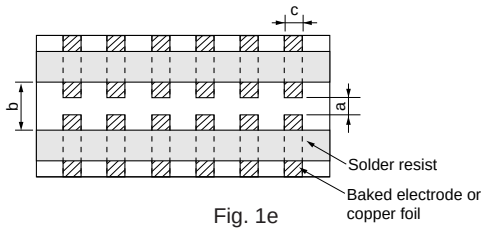
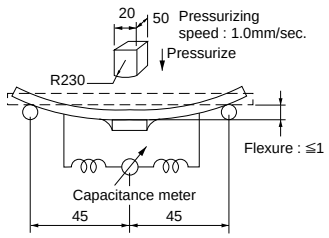
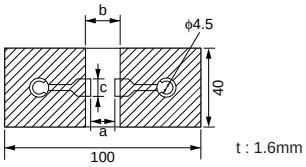
K : ±10% (E12 Series)
M : ±20% (E 6 Series)

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)*
GRM420	: 0.8 ±0.1	1,000	4,000
GRM425	: 0.7 $^{+0}_{-0.2}$	1,000	4,000
	: 1.0 $^{+0}_{-0.2}$	1,000	4,000
GRM430	: 0.7 $^{+0}_{-0.2}$	1,000	4,000
	: 1.0 $^{+0}_{-0.2}$	1,000	4,000
	: 1.25 $^{+0}_{-0.2}$	1,000	3,000
GRM435	: 2.0 $^{+0}_{-0.2}$	1,000	2,000

* φ330mm reel is available on request.

■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>B, R : −25℃ to +85℃</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 terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td>Insulation Resistance (I. R.)</td><td>C≦0.047μF : 10,000MΩ min.
C>0.047μF : 500Ω · F min.
C : Nominal Capacitance (μF)</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>Capacitance</td><td>Within the specified tolerance.</td><td>The capacitance shall be measured at 20℃ at a frequency of 1±0.1kHz and a voltage of 1±0.2Vr.m.s..</td></tr>
<tr><td>8</td><td>Dissipation Factor (D.F.)</td><td>B, R : 0.01 max.</td><td>D.F. shall be measured under the same conditions as the capacitance.</td></tr>
<tr><td>9</td><td>Capacitance Temperature Characteristics</td><td><table><tr><th rowspan="2">Char.</th><th rowspan="2">Temp. Range</th><th colspan="2">Capacitance Change</th></tr><tr><th>Without Voltage</th><th>With 50% Rated Voltage</th></tr><tr><td>B</td><td rowspan="2">−25℃ to +85℃</td><td>Within ±10%</td><td>Within $^{+10}_{-20}$ %</td></tr><tr><td>R</td><td>Within ±15%</td><td>Within $^{+15}_{-20}$ %</td></tr></table></td><td>The ranges of capacitance change compared with the 20℃ 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.
In case of applying voltage, the capacitance change shall be measured after 1 more min.with applying voltage in equilibration of each temp. stage.</td></tr>
<tr><td>10</td><td>Distortion</td><td>B : −90dB max.
R : −80dB max.</td><td>The distortion shall be measured using the third harmonic distortion, 10±1kHz in frequency and 1±0.2Vr.m.s. in voltage.</td></tr>
<tr><td>11</td><td>Adhesive Strength of Termination</td><td>No removal of the terminations or other defects shall occur.
 
Fig. 1e</td><td>Solder the capacitor to the test jig shown in Fig.1e 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 defect such as heat shock.
*5N (GRM420)<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM420</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM425</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM430</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM435</td><td>2.2</td><td>5.0</td><td>2.9</td></tr></table>(in mm)</td></tr>
<tr><td>12</td><td>Vibration Resistance</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</td><td>Within the specified tolerance.</td></tr><tr><td>D.F.</td><td>0.01 max.</td></tr></table></td><td>Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (11).
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>13</td><td>Deflection</td><td>No cracks or marking defects shall occur.
 
Fig. 3e</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 2e using a eutectic solder. Then apply force in the direction shown in Fig.3e 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. 2e<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM420</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM425</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM430</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM435</td><td>2.2</td><td>5.0</td><td>2.9</td></tr></table>(in mm)</td></tr>
</table>

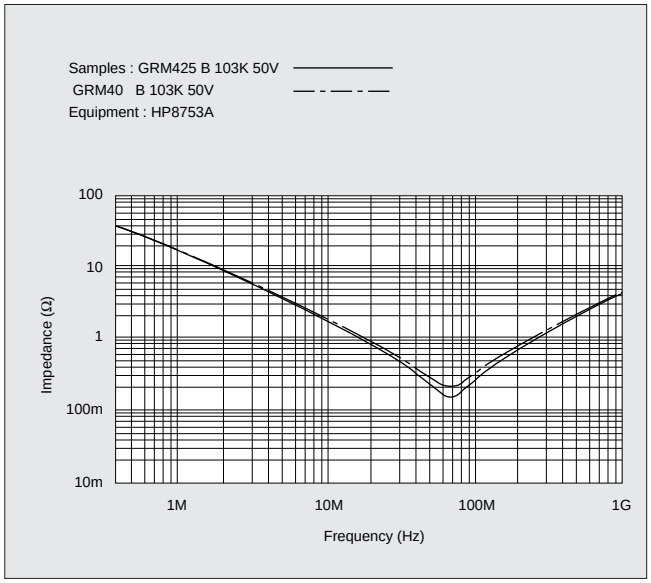
<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>14</td><td>Solderability of Termination</td><td>75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% 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>15</td><td>Resistance to Soldering Heat</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><td>Item</td><td>Specification</td></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td>I. R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>0.01 max.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table></td><td>Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature. Measure initial values.
Preheat the capacitor for 1 minute at 120 to 150℃*. Immerse the capacitor in a eutectic solder solution at 270±5℃ for 10±0.5 seconds. Let sit for 48±4 hours at room temperature, then measure values of items in table.
*Preheating for GRM435
<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>16</td><td>Temperature Cycle</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><td>Item</td><td>Specification</td></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td>I. R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>0.01 max.</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table></td><td>Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then let sit for 48±4 hours at room temperature. Measure initial values of items in table. Fix capacitor to the supporting jig in the same manner and under the same conditions as in (11).
Perform the five cycles according to the four heat treatments shown in the following table. Let sit for 48±4 hours at room temperature, then measure final values of items in table.
<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>17</td><td>Humidity Steady State</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><td>Item</td><td>Specification</td></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>I. R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>0.015 max.</td></tr>
</table></td><td>Set 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 values of items in table.</td></tr>
<tr><td>18</td><td>Humidity Load</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><td>Item</td><td>Specification</td></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>I. R.</td><td>More than 500MΩ or 25Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>0.015 max.</td></tr>
</table></td><td>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 values of items in table. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>19</td><td>High Temperature Load</td><td>The measured and observed characteristics shall satisfy the specifications in the following table.
<table>
<tr><td>Item</td><td>Specification</td></tr>
<tr><td>Appearance</td><td>No marked defect</td></tr>
<tr><td>Capacitance Change</td><td>Within ±12.5%</td></tr>
<tr><td>I. R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td>D.F.</td><td>0.015 max.</td></tr>
</table></td><td>Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3℃. Let sit for 48±4 hours at room temperature, then measure initial values of items in table. Apply 200% of the rated DC voltage for 1,000±12 hours at maximum operating temperature ±3℃. Remove and let sit for 48±4 hours at room temperature, then measure final values of items in table. The charge/discharge current is less than 50mA.</td></tr>
</table>

■CHARACTERISTICS

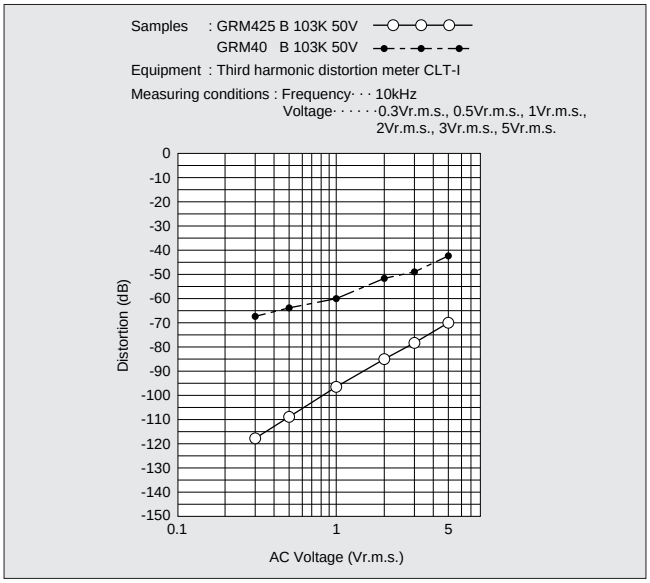
• SELECTION OF CERAMIC CAPACITORS

When selecting capacitors, consider the voltage characteristics (AC & DC) and aging characteristics.

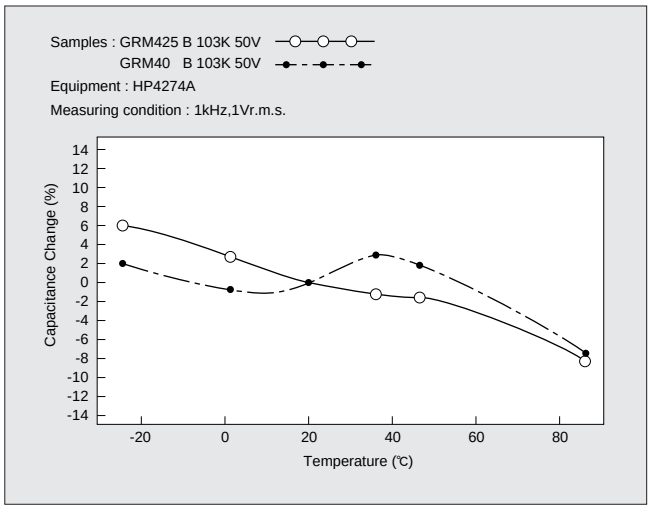
• Impedance-Frequency Characteristics



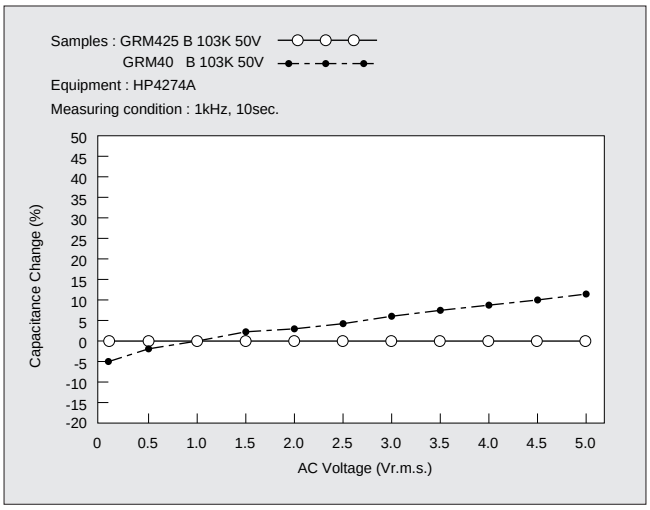
• Third Harmonic Distortion



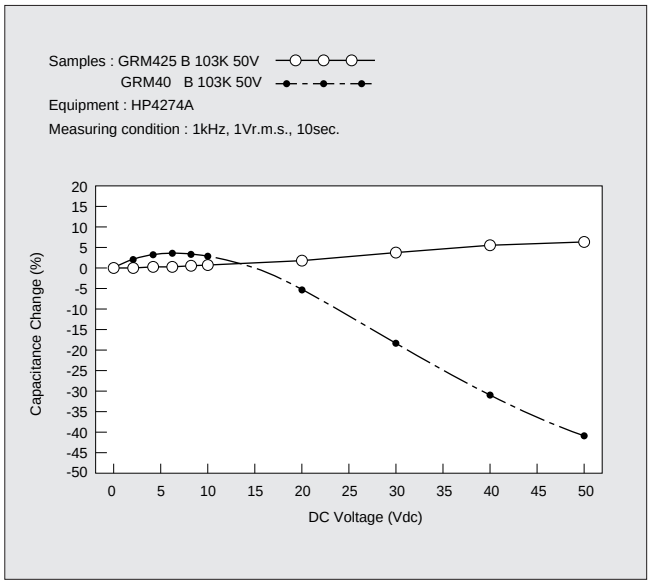
• Capacitance-Temperature Characteristics



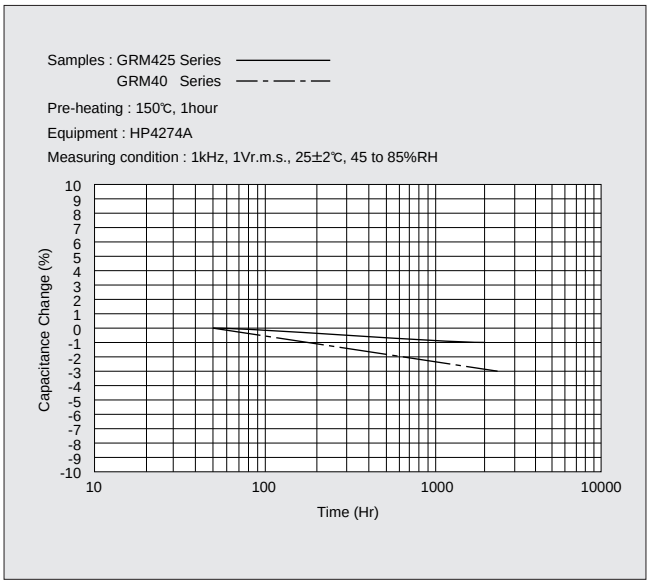
• Capacitance-AC Voltage Characteristics



• Capacitance-DC Voltage Characteristics



• Capacitance Change-Aging



MONOLITHIC CERAMIC CAPACITOR

Reflow Soldering Nickel Barriered Termination Type

GRM200 Series ; 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.

■APPLICATION

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

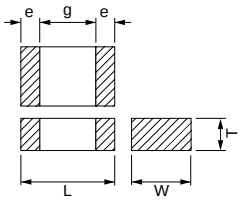
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GRM230	Y5V	106	Z	10		PT
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS

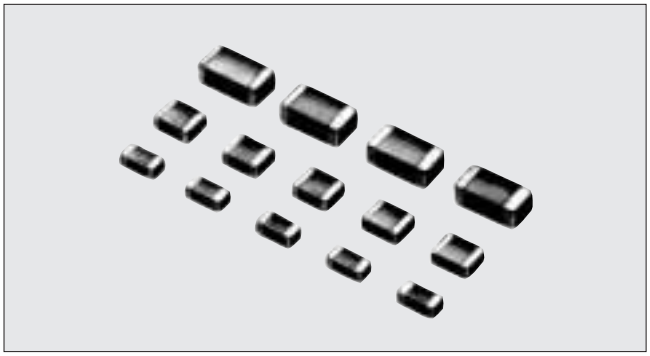


(in mm)

Type (EIA Code)	Dimensions (mm)				
	L	W	T	e	g
GRM220 (0603)	1.6±0.1	0.8 ±0.1	Please refer to the capacitance range table.	0.2–0.5	0.5 min.
GRM225 (0805)	2.0±0.1	1.25±0.1		0.2–0.7	0.7 min.
GRM230 (1206)	3.2±0.15	1.6 ±0.15		0.3–0.8	1.5 min.
GRM235 (1210)	3.2±0.3	2.5 ±0.2		0.3 min.	1.0 min.
GRM240-02 (1812)	4.5±0.4	3.2 ±0.3		0.3 min.	2.0 min.

❷TEMPERATURE CHARACTERISTICS

Code	Capacitance Change Rate	Temp. Range	Reference Temp.
Y5V	Within $^{+22}_{-82}$ %	−30 to +85℃	25℃



❸CAPACITANCE (Ex.)

Code	Capacitance (μF)
105	1
226	22

❹CAPACITANCE TOLERANCE

Z : $^{+80}_{-20}$ %

❺RATED VOLTAGE

Code	DC Rated voltage (V)
6.3	6.3
10	10
16	16
25	25
50	50
100	100

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag (only for GRM220)
PT	Tape carrier packaging

■CAPACITANCE RANGE TABLE

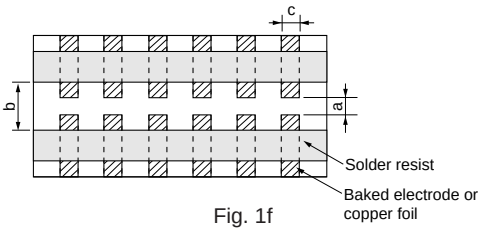
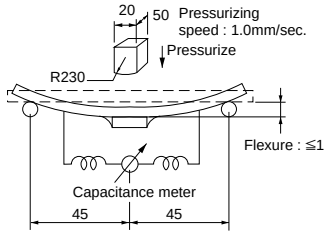
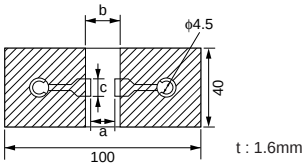
(in μF)

Type (EIA Code)	Thickness T (mm)	DC Rated Voltage					
		100V	50V	25V	16V	10V	6.3V
GRM220 (0603)	0.8 ±0.1	–	–	–	–	1	–
GRM225 (0805)	1.25±0.1	–	–	–	–	–	10
GRM230 (1206)	1.15±0.1	–	–	–	4.7	10	–
GRM235 (1210)	1.35±0.15	–	–	6.8	6.8, 10	22	–
	1.8 ±0.2	1	4.7	10	–	–	–
GRM240-02 (1812)	2.5 max.	–	10	–	–	–	–
Capacitance Tolerance	Z : $^{+80}_{-20}$ %						

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type (EIA Code)	Thickness T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178 mm reel)
GRM220 (0603)	0.8 ±0.1	1,000	4,000
GRM225 (0805)	1.25±0.1	–	3,000
GRM230 (1206)	1.15±0.1	–	3,000
GRM235 (1210)	1.35±0.15	–	2,000
	1.8 ±0.2	–	1,000
GRM240-02 (1812)	2.5 max.	–	500

■SPECIFICATIONS AND TEST METHODS

No.	Item	Specification	Test Method
1	Operating Temperature Range	Y5V : −30℃ to +85℃	
2	Rated Voltage	See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, 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 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance (I. R.)	10,000MΩ min. or 500Ω · F min. (Whichever is smaller)	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.
7	Capacitance	Within the specified tolerance.	The capacitance/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table.
8	Dissipation Factor (D.F.)	Y5V : 0.07 max. (50/100V) 0.09 max. (10/16/25V) 0.15 max. (6.3V)	Capacitance / Frequency / Voltage C≦10μF : 1±0.1kHz : 1±0.2Vr.m.s. C>10μF : 120±24Hz : 0.5±0.1Vr.m.s.
9	Capacitance Temperature Characteristics	Char. / Temp. Range / Reference Temp. / Cap. Change Rate Y5V / −30 to +85℃ / 25℃ / Within $^{+22}_{-82}$ %	The ranges of capacitance change reference to 25℃ within 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.
10	Adhesive Strength of Termination	No removal of the terminations or other defects shall occur.  Fig. 1f	Solder the capacitor on the testing jig (glass epoxy board) shown in Fig. 1f by a eutectic solder. Then apply *10N of force in parallel with the test jig for 10±1 sec. The soldering shall be done either by iron or reflow and be conducted with care so that the soldering is uniform and free of defect such as heat shock. *5N (GRM220 only) Type / a / b / c GRM220 / 1.0 / 3.0 / 1.2 GRM225 / 1.2 / 4.0 / 1.65 GRM230 / 2.2 / 5.0 / 2.0 GRM235 / 2.2 / 5.0 / 2.9 GRM240 / 3.5 / 7.0 / 3.7 (in mm)
11	Vibration Resistance	Appearance : No defects or abnormalities. Capacitance : Within the specified tolerance. Dissipation Factor (D.F.) : Y5V : 0.07 max. (50/100V) 0.09 max. (10/16/25V) 0.15 max. (6.3V)	Solder the capacitor to 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).
12	Deflection	No cracks or marking defects shall occur.  Fig. 3f	Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2f using a eutectic solder. Then apply a force in the direction shown in Fig.3f. 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. 2f Type / a / b / c GRM220 / 1.0 / 3.0 / 1.2 GRM225 / 1.2 / 4.0 / 1.65 GRM230 / 2.2 / 5.0 / 2.0 GRM235 / 2.2 / 5.0 / 2.9 GRM240 / 3.5 / 7.0 / 3.7 (in mm)

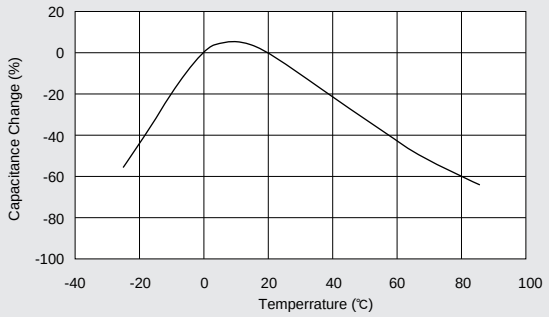
<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>13</td><td>Solderability of Termination</td><td>75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor first an ethanol (JIS-K-8101) solution of rosin (JIS-K-5902) (25% rosin in weight proportion), then in a eutectic solder solution for 2±0.5 seconds at 230±5℃ after preheating for 10 to 30seconds at 80 to 120℃.</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><td>Item</td><td>Specification</td></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±20%</td></tr><tr><td>I. R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.07 max.(50, 100V)
0.09 max.(10, 16, 25V)
0.15 max.(6.3V)</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℃ $^{+}_{-10}{}^{0}$ ℃.
Immerse the capacitor in a eutectic solder solution at 270± 5℃ for 10±0.5 seconds after preheating in the flowing table. Then set it for 48±4 hours at room temperature and measure.<table><tr><th>Chip Size</th><th>Conditions</th></tr><tr><td>3.2×1.6 mm max.</td><td>1 minute at 120 to 150℃</td></tr><tr><td>3.2×2.5 mm min.</td><td>Each 1 minute at 100 to 120℃ and then 170 to 200℃</td></tr></table></td></tr>
<tr><td>15</td><td>Temperature Cycle</td><td>The measured values shall satisfy the values in the following table.<table><tr><td>Item</td><td>Specification</td></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±20%</td></tr><tr><td>I. R.</td><td>More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.07 max.(50, 100V)
0.09 max.(10, 16, 25V)
0.15 max.(6.3V)</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℃ $^{+}_{-10}{}^{0}$ ℃, 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. (℃)</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>16</td><td>Humidity Steady State</td><td>The measured values shall satisfy the values in the following table.<table><tr><td>Item</td><td>Specification</td></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±30%</td></tr><tr><td>I. R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.1 max.(50, 100V)
0.125 max.(10, 16, 25V)
0.2 max.(6.3V)</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table></td><td>Set the capacitor for 500±12 hours at 40±2℃ and 90 to 95% humidity. Take it out and set it for 48±4 hours at room temperature, then measure.</td></tr>
<tr><td>17</td><td>Humidity Load</td><td>The measured values shall satisfy the values in the following table.<table><tr><td>Item</td><td>Specification</td></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±30%</td></tr><tr><td>I. R.</td><td>More than 500MΩ or 25Ω · F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.1 max.(50, 100V)
0.125 max.(10, 16, 25V)
0.2 max.(6.3V)</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±2℃ 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>
<tr><td>18</td><td>High Temperature Load</td><td>The measured values shall satisfy the values in the following table.<table><tr><td>Item</td><td>Specification</td></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±30%</td></tr><tr><td>I. R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.1 max.(50, 100V)
0.125 max.(10, 16, 25V)
0.2 max.(6.3V)</td></tr><tr><td>Dielectric Strength</td><td>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℃ 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 (REFERENCE DATA)

• SELECTION OF CERAMIC CAPACITORS
When selecting capacitors, consider the DC voltage characteristics (AC & DC) and aging characteristics.

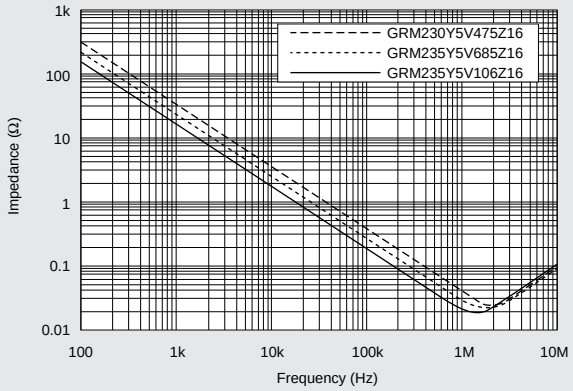
• Capacitance-Temperature Characteristics

Samples : GRM230 Y5V 106Z 10
Equipment : HP4284A
Measuring conditions : 1kHz, 1Vr.m.s.



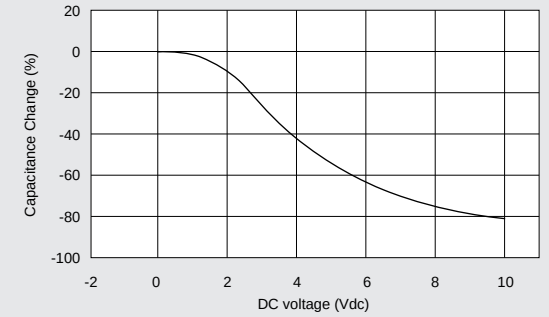
• Impedance-Frequency Characteristics

Equipment : HP4192A



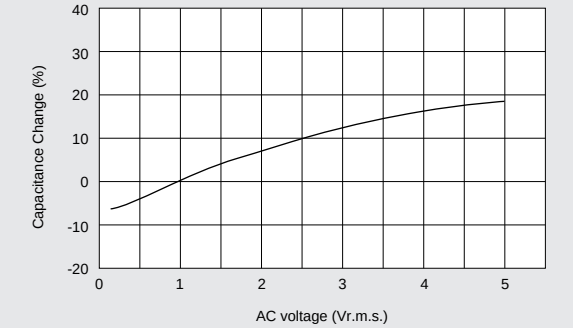
• Capacitance-DC Voltage Characteristics

Samples : GRM230 Y5V 106Z 10
Equipment : HP4284A
Measuring conditions : 1kHz, 1Vr.m.s.
Applied DC voltage per 30 sec.



• Capacitance-AC Voltage Characteristics

Samples : GRM230 Y5V 106Z 10
Equipment : HP4284A
Measuring conditions : 1kHz, 1Vr.m.s.
Applied AC voltage per 30 sec.



■ALLOWABLE RIPPLE CURRENT (GRM200 SERIES)

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℃.
When AC and DC voltage are superimposed, keep the peak value of the voltage within the rated voltage.

• Allowable Ripple Current Value

Rated Voltage : 6.3V

Chip Size	100kHz≦f <300kHz	300kHz≦f <500kHz	500kHz≦f ≦1MHz
GRM225	1.4 Ar.m.s.	1.5 Ar.m.s.	1.6 Ar.m.s.

Rated Voltage : 10V

Chip Size	100kHz≦f <300kHz	300kHz≦f <500kHz	500kHz≦f ≦1MHz
GRM220	1.4 Ar.m.s.	1.5 Ar.m.s.	1.6 Ar.m.s.
GRM230	1.5 Ar.m.s.	1.6 Ar.m.s.	1.6 Ar.m.s.
GRM235	1.7 Ar.m.s.	1.8 Ar.m.s.	2.0 Ar.m.s.

Rated Voltage : 16V

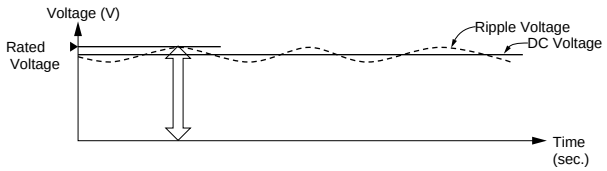
Chip Size	100kHz≦f <300kHz	300kHz≦f <500kHz	500kHz≦f ≦1MHz
GRM230	1.5 Ar.m.s.	1.6 Ar.m.s.	1.6 Ar.m.s.
GRM235	1.7 Ar.m.s.	1.8 Ar.m.s.	2.0 Ar.m.s.

Rated Voltage : 25V/50V

Chip Size	100kHz≦f <300kHz	300kHz≦f <500kHz	500kHz≦f ≦1MHz
GRM235	2.0 Ar.m.s.	2.2 Ar.m.s.	2.2 Ar.m.s.
GRM240	2.0 Ar.m.s.	2.2 Ar.m.s.	2.2 Ar.m.s.

Rated Voltage : 100V

Chip Size	100kHz≦f <300kHz	300kHz≦f <500kHz	500kHz≦f ≦1MHz
GRM235	1.6 Ar.m.s.	1.7 Ar.m.s.	1.8 Ar.m.s.



3

MONOLITHIC CERAMIC CAPACITOR

For Ultrasonic Sensor

Temperature Compensating Type **GRM ZLM** Series

4

■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.)

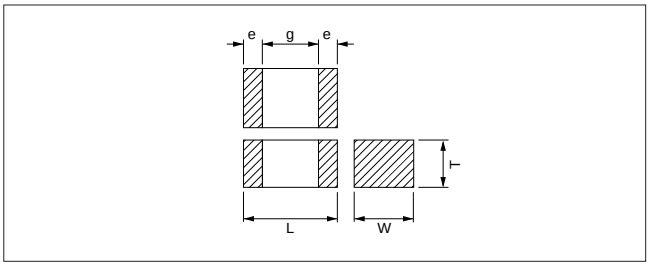
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GRM40	ZLM	102	K	100		PT
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS

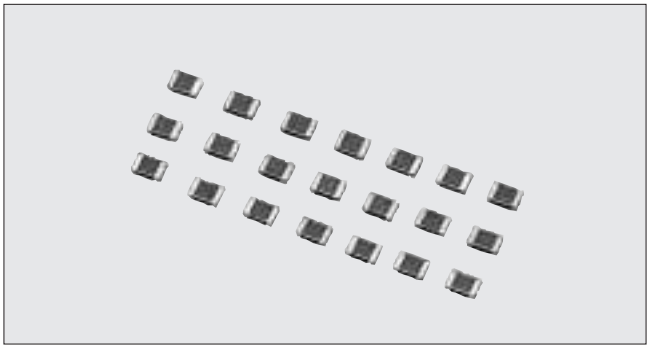


Type (EIA Code)	Dimensions (mm)				
	L	W	T	e	g
GRM40 (0805)	2.0±0.1	1.25±0.1	0.85±0.1	0.2 to 0.7	0.7 min.

❷TEMPERATURE CHARACTERISTICS

Code	Temp. Coeff.*	Temp. Range	Reference Temp.
ZLM	−4700ppm/℃	−25℃ to +85℃	20℃

✻Please refer to the specifications on next page.



❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
102	1,000	152	1,500

❹CAPACITANCE TOLERANCE

Code	Cap. tolerance
K	±10%

❺RATED VOLTAGE

Code	DC Rated voltage
100	100V

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging

■CAPACITANCE RANGE TABLE

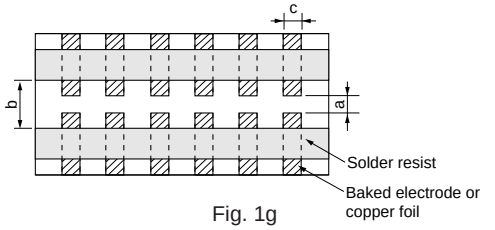
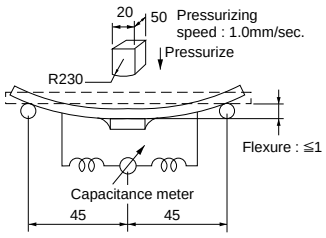
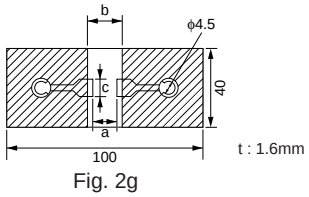
(in pF)

Type	DC Rated Voltage (V)	Temp. Char.
		ZLM
GRM40	100	1,000, 1,500

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)
GRM40	0.85±0.1	1,000	4,000

■SPECIFICATIONS AND TEST METHODS

No.	Item	Specification	Test Method
1	Operating Temperature Range	−25℃ to +85℃	
2	Rated Voltage	See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, 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 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 20℃ and 75%RH max. and within 2 minutes of charging.
7	Capacitance	Within the specified tolerance.	The capacitance/D.F. shall be measured at 20℃ with 1±0.1kHz in frequency and 1±0.2Vr.m.s. in voltage.
8	Dissipation Factor (D.F.)	0.01 max.	
9	Capacitance Temperature Characteristics	Within $-4{,}700^{+1{,}000}_{-2{,}500}$ ppm/℃ (at −25 to +20℃) Within $-4{,}700^{+500}_{-1{,}000}$ ppm/℃ (at +20 to +85℃)	The temperature coefficient is determined using the capacitance measured in step 1 as a reference. When cycling the temperature sequentially from step 1 through 5, the capacitance shall be within the specified tolerance for the temperature coefficient. The capacitance change shall be measured after 5 min. at each specified temperature stage. Step / Temperature (℃): 1: 20±2; 2: −25±3; 3: 20±2; 4: 85±3; 5: 20±2
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. 1g 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. 1g Type / a / b / c: GRM40 / 1.2 / 4.0 / 1.65 (in mm)
11	Vibration Resistance	Appearance: No defects or abnormalities. Capacitance: Within the specified tolerance. D.F.: 0.01 max.	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).
12	Deflection	No cracking or marking defects shall occur.  Fig. 3g	Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2g using a eutectic solder. Then apply a force in the direction shown in Fig.3g. 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. 2g Type / a / b / c: GRM40 / 1.2 / 4.0 / 1.65 (in mm)

4

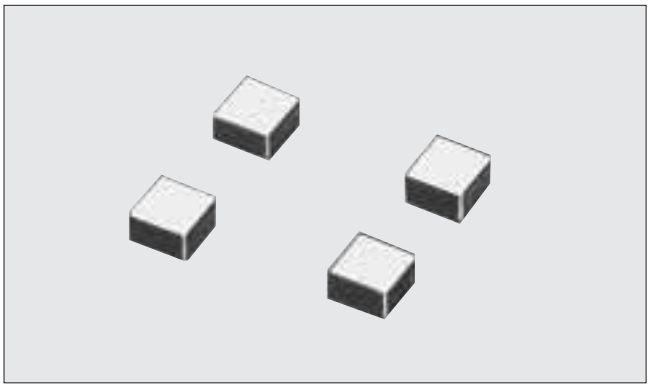
No.	Item		Specification	Test Method
13	Solderability of Termination		75% of the terminations is to be soldered evenly and continuously.	Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120℃ for 10 to 30 seconds. After 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	
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)	

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

4

MONOLITHIC CERAMIC CAPACITOR

For Wire-bonding/Die-bonding, **MLC** Micro Chip **GM250** Series



■FEATURES

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

■APPLICATION

- Optical device for telecommunication
- IC, IC package built-in
- Measuring equipment

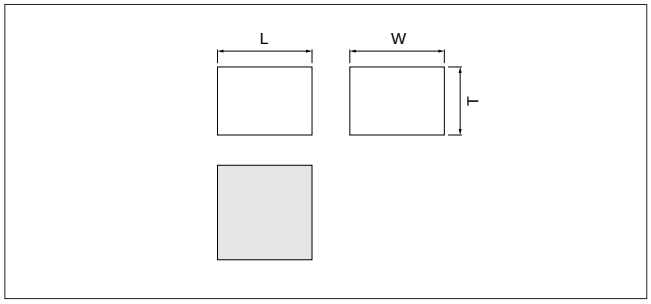
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GM250	X7R	102	M	16		PM
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS



Type	Dimensions (mm)		
	L	W	T
GM250	0.5±0.05	0.5±0.05	0.35±0.05
GM260	0.8±0.05	0.8±0.05	0.5±0.05

❷TEMPERATURE CHARACTERISTICS

Code	Cap. Change	Temp. Range	Reference Temp.
X7R	±15%	−55 to +125℃	25℃
Y5V	$\pm^{22}_{82}$%	−30 to + 85℃	25℃

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
102	1,000	103	10,000
152	1,500	104	100,000

❹CAPACITANCE TOLERANCE

Code	Tol.
M	±20%
Z	$\pm^{80}_{20}$%

❺RATED VOLTAGE

Code	DC Rated voltage (V)
50	50
16	16
10	10

❼PACKAGING CODE

Code	Packaging
PM	Bulk packaging in a tray (400 pcs./tray)

■CAPACITANCE RANGE TABLE

(in pF)

Type \ Temp. Char. / DC Rated Voltage (V)	X7R		Y5V	
	16	50	10	16
GM250	1,000, 1,500, 2,200	470	15,000	4,700, 6,800 10,000
GM260	10,000	——	100,000	47,000

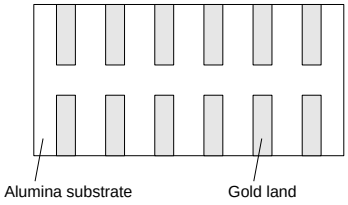
4

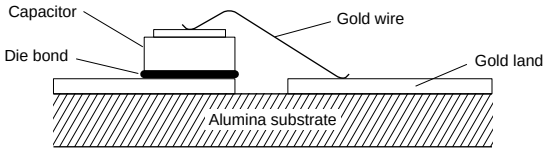
■SPECIFICATIONS AND TEST METHODS

<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>X7R : −55℃ to +125℃
Y5V : −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 abnormality.</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 abnormality.</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>X7R : 0.035 max.
Y5V : 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>X7R</td><td>−55 to +125℃</td><td>25℃</td><td>Within±15%</td></tr><tr><td>Y5V</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 defect nor abnormality.</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>X7R : 0.035 max.
Y5V : 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>X7R ····· Within±7.5%
Y5V ····· Within±20%</td></tr><tr><td>I.R.</td><td>More than 10,000MΩ</td></tr><tr><td>D.F.</td><td>X7R ····· 0.035 max.
Y5V ····· 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>X7R ····· Within±12.5%
Y5V ····· Within±30%</td></tr><tr><td>I.R.</td><td>More than 1,000MΩ</td></tr><tr><td>D.F.</td><td>X7R ····· 0.05 max.
Y5V ····· 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>
<tr><td>14</td><td colspan="2">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>X7R ····· Within±12.5%
Y5V ····· Within$\pm^{30}_{40}$%</td></tr><tr><td>I.R.</td><td>More than 500MΩ</td></tr><tr><td>D.F.</td><td>X7R ····· 0.05 max.
Y5V ····· 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>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></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>X7R ····· Within±12.5%
Y5V ····· Within$\pm^{30}_{40}$%</td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td>D.F.</td><td>X7R ····· 0.05 max.
Y5V ····· 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.





MONOLITHIC CERAMIC CAPACITOR

Capacitor Array **GNM** Series

■FEATURES

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

■APPLICATION

• General electronic equipment

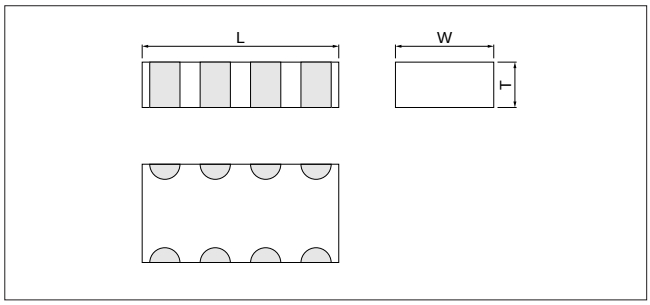
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GNM30-401	C0G	103	J	50		PT
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS



Type (EIA Code)	Dimensions (mm)		
	L	W	T
GNM30-401 (1206)	3.2±0.15	1.6±0.15	0.8±0.1

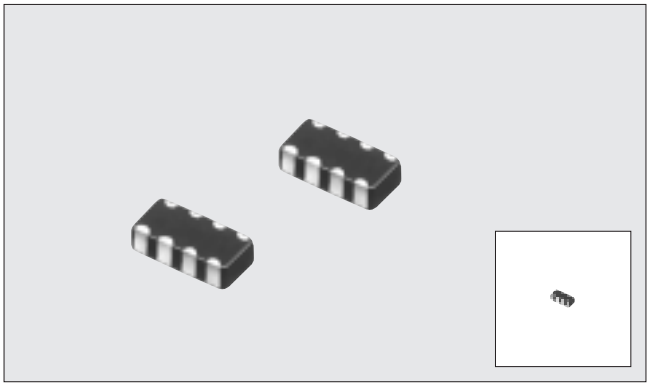
❷TEMPERATURE CHARACTERISTICS

•Temperature Compensating Type

Code	C0G	SL
Temp. range	−55 to +125℃	−55 to +85℃
Temp. coeff. (ppm/℃)	0±30	+350 to −1,000

•Temperature Compensating Type

Code	X7R	Y5V
Temp. range	−55 to +125℃	−30 to +85℃
Cap. Change (%)	±15	$\pm^{22}_{82}$



❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (μF)
100	10	103	0.01
472	4,700	154	0.15

❹CAPACITANCE TOLERANCE

Code	Tol.	Capacitance range
D	±0.5pF	C0G, 10pF
J	± 5%	C0G, Over 10pF
K	±10%	C0G/X7R, Over 10pF
M	±20%	X7R
Z	$\pm^{80}_{20}$%	Y5V

❺RATED VOLTAGE

Code	DC Rated voltage (V)
16	16
25	25
50	50
100	100

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging

■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : T (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)
GNM30-401	0.8±0.1	1,000	4,000

■CAPACITANCE RANGE TABLE

Type	GNM30-401								
Temp. Char.	C0G		X7R				Y5V		
DC Rated Voltage (V) / Cap. (pF)	50	100	100	50	25	16	100	50	16
10									
11									
12									
13									
15									
16									
18									
20									
22									
24									
27									
30									
33									
36									
39									
43									
47									
51									
56									
62									
68									
75									
82									
91									
100									
110									
120									
130									
150									
160									
180									
200									
220									
240									
270									
300									
330									
360									
390									
470									
560									
680									
820									
1,000									
1,200									
1,500									
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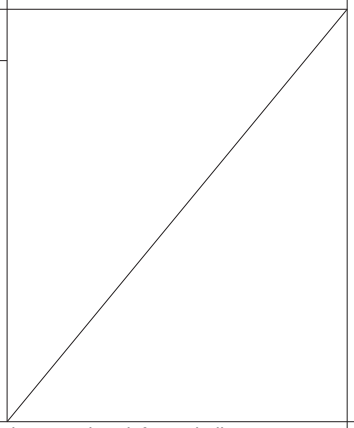
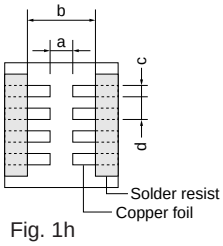
5,600									
6,800									
8,200									
10,000									
12,000									
15,000									
18,000									
22,000									
27,000									
33,000									
39,000									
47,000									
68,000									
100,000									
150,000									

■SPECIFICATIONS AND TEST METHODS

<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>1</td><td colspan="2">Operating Temperature Range</td><td>C0G : −55 to +125℃</td><td>X7R : −55 to +125℃
Y5V : −30 to + 85℃</td><td></td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td colspan="2">See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td colspan="2">Appearance</td><td colspan="2">No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td colspan="2">Dimensions</td><td colspan="2">Within the specified dimension.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td colspan="2">Dielectric Strength</td><td colspan="2">No defects or abnormalities.</td><td>No failure 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.</td></tr>
<tr><td>6</td><td colspan="2">Insulation Resistance (I.R.)</td><td colspan="2">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 colspan="2">Within the specified tolerance.</td><td>The capacitance/Q/D.F. shall be measured at 25℃ at the frequency and voltage shown in the table.
<table><tr><th>Item \ Char.</th><th>C0G</th><th>X7R, Y5V</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vr.m.s.</td><td>1±0.2Vr.m.s.</td></tr></table></td></tr>
<tr><td>8</td><td colspan="2">Q/Dissipation Factor (D.F.)</td><td>30pF min. : Q≧1,000
30pF max. : Q≧400+20C
C : Nominal Capacitance (pF)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max.</td></tr></table></td><td></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-5)</td><td><table><tr><th>Char.</th><th>Temp. Range.</th><th>Reference Temp.</th><th>Cap. Change</th></tr><tr><td>X7R</td><td>−55to +125℃</td><td rowspan="2">25℃</td><td>Within±15%</td></tr><tr><td>Y5V</td><td>−30to + 85℃</td><td>Within $^{+22}_{-82}$%</td></tr></table></td><td rowspan="3">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-5. 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>
(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.</td></tr>
<tr><td>Temperature Coefficient</td><td>Within the specified tolerance. (Table A-5)</td><td rowspan="2">  </td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF (Whichever is larger)</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td colspan="2">No removal of the terminations or other defects shall occur.
 
Fig. 1h</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1h 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.
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>GNM30-401</td><td>0.8</td><td>2.5</td><td>0.4</td><td>0.8</td></tr></table>(in mm)</td></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><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max.</td></tr></table></td></tr>
</table>

4

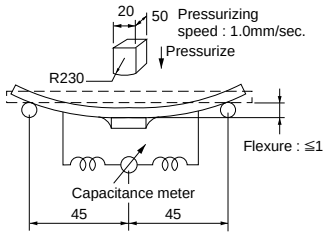
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="3">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th colspan="2">Temperature Compensating Type</th><th>High Dielectric Constant Type</th></tr>
<tr><td>12</td><td>Deflection</td><td colspan="3">No cracking or marking defects shall occur.
 

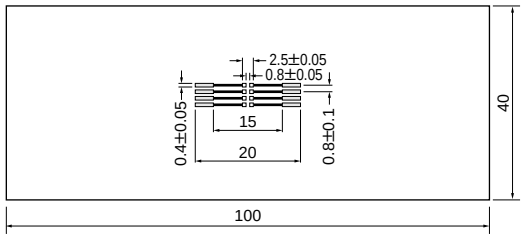
Fig. 3h</td><td>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2h using a eutectic solder. Then apply a force in the direction shown in Fig.3h. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is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

Fig. 2h</td></tr>
<tr><td>13</td><td>Solderability of Termination</td><td colspan="3">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 colspan="3">The measured and observed characteristics shall satisfy the specifications in the following table.</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 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>X7R ····· Within±7.5%
Y5V ····· 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><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="5">15</td><td rowspan="5">Temperature Cycle</td><td colspan="3">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (℃)</td><td>Min. Operating Temp. $^{+0}_{-3}$</td><td>Room Temp.</td><td>Max. Operating Temp. $^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>
• Initial measurement for high dielectric constant type
Perform a heat treatment at 150 $^{+0}_{-10}$℃ for one hour and then 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>X7R ····· Within±7.5%
Y5V ····· 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><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Y5V</td><td>0.05 max.</td><td>0.07 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="5">16</td><td rowspan="5">Humidity, Steady State</td><td colspan="3">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td><td>X7R ····· Within±12.5%
Y5V ····· Within±30%</td></tr>
<tr><td>Q/D.F.</td><td>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)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Y5V</td><td>0.075 max.</td><td>0.1 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
</table>

4

<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="6">17</td><td rowspan="6">Humidity Load</td><td>Appearance</td><td colspan="2">No marking defects</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 (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance Change</td><td>Within ±7.5% or ±0.75pF (Whichever is larger)</td><td>X7R ····· Within±12.5%
Y5V ····· Within±30%</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over : Q≧200
30pF and below : Q≧100+$\frac{10}{3}$C
C : Nominal Capacitance (pF)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Y5V</td><td>0.075 max.</td><td>0.1 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 500MΩ or 25Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
<tr><td rowspan="6">18</td><td rowspan="6">High Temperature Load</td><td colspan="3">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="6">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.</td></tr>
<tr><td>Appearance</td><td colspan="2">No marking defects</td></tr>
<tr><td>Capacitance Change</td><td>Within ±3% or ±0.3pF (Whichever is larger)</td><td>X7R ····· Within±12.5%
Y5V ····· Within±30%</td></tr>
<tr><td>Q/D.F.</td><td>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)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.04 max.</td><td>0.05 max.</td></tr><tr><td>Y5V</td><td>0.075 max.</td><td>0.1 max.</td></tr></table></td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr>
</table>

4

Table A-5

Char.	Temp. Coeff. (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℃.

MONOLITHIC CERAMIC CAPACITOR

Low **ESL** Wide Width Type **LL** Series

■FEATURES

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

■APPLICATION

- High speed micro processor
- High frequency digital equipment

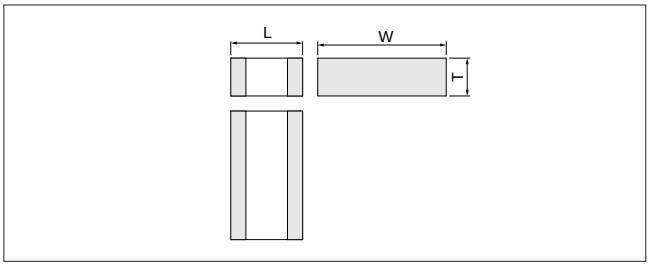
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	LL0508	X7R	103	K	50		PT
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

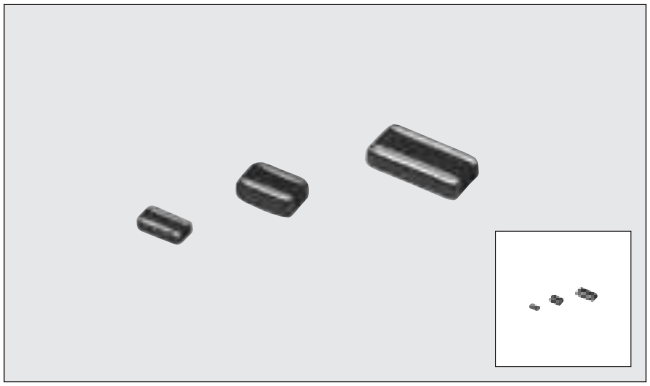
❶TYPE AND DIMENSIONS



Type	Dimensions (mm)		
	L	W	T
LL0306	0.8 ±0.1	1.6±0.1	0.6 max.
LL0508	1.25±0.1	2.0±0.1	1.0 max.
LL0612	1.6 ±0.15	3.2±0.15	0.7 ±0.1
			1.15±0.1

❷TEMPERATURE CHARACTERISTICS

Code	Cap. Change	Temp. Range	Reference Temp.
X7R	±15%	−55 to +125℃	25℃
Z5U	$\pm^{22}_{56}$%	+10 to + 85℃	
Y5V	$\pm^{22}_{82}$%	−30 to + 85℃	



❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (µF)
472	4,700	224	0.22
103	10,000	105	1

❹CAPACITANCE TOLERANCE

Code	Tol.	Applied Temp. char.
K	±10%	X7R
M	±20%	X7R, Z5U
Z	$\pm^{80}_{20}$%	Z5U, Y5V

❺RATED VOLTAGE

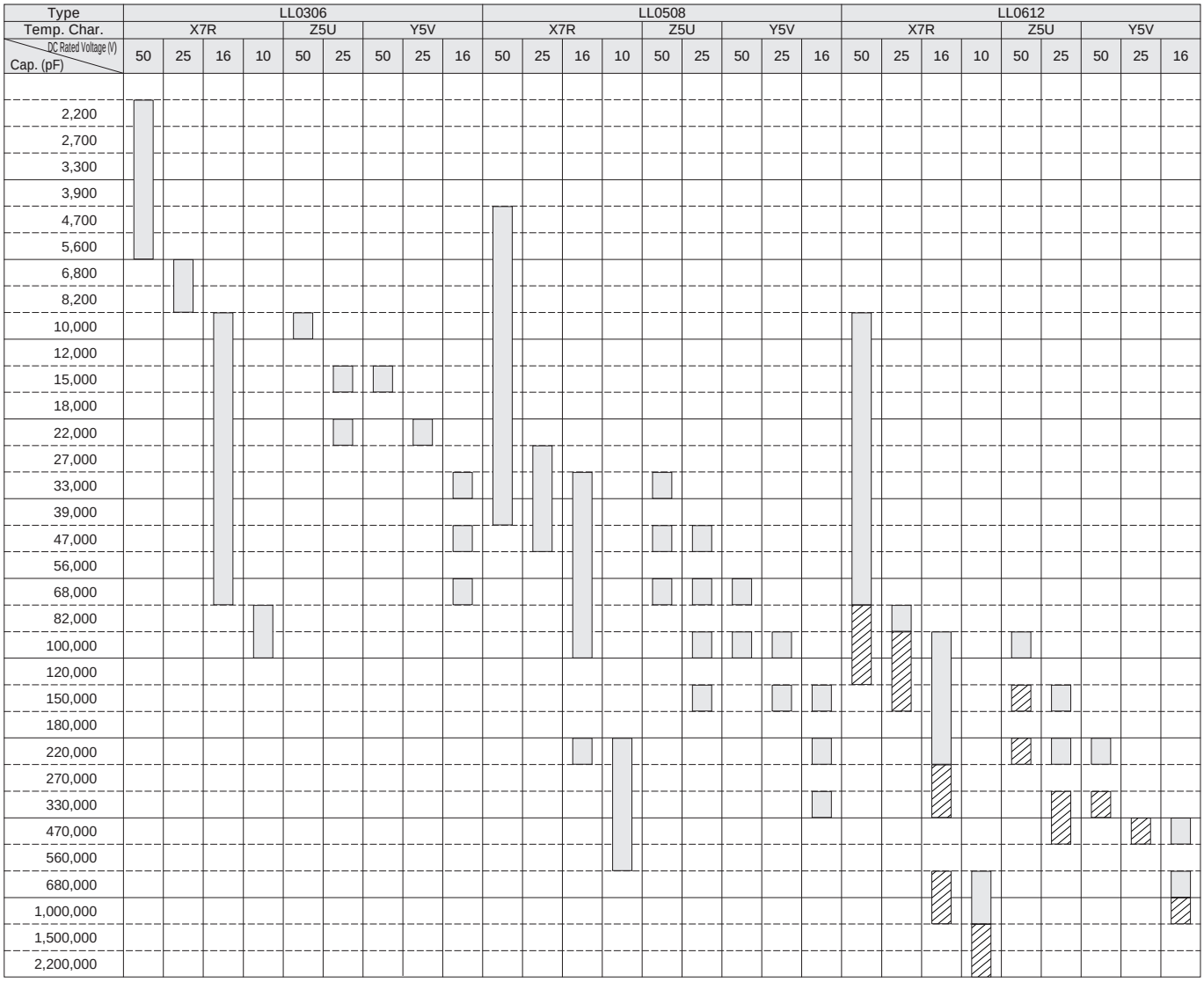
Code	DC Rated voltage (V)
16	16
25	25
50	50

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging

4

■CAPACITANCE RANGE TABLE



■THICKNESS AND PACKAGING TYPES/QUANTITY

Type	Thickness : (mm)	Bulk (pcs./bag)	Taping (pcs./φ178mm reel)
LL0306	T : 0.6 max.	1,000	4,000
LL0508	T : 1.0 max.	1,000	4,000
LL0612	T : 0.7±0.1	1,000	4,000
	T : 1.15±0.1	1,000	3,000

■SPECIFICATIONS AND TEST METHODS

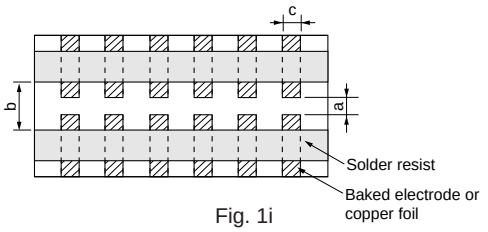
<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>X7R : −55℃ to +125℃
Z5U : +10℃ to + 85℃
Y5V : −30℃ to + 85℃</td><td></td></tr>
<tr><td>2</td><td>Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage 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 terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td>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>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>X7R · Y5V</th><th>Z5U</th></tr><tr><td>Frequency</td><td>1±0.1kHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>1±0.2Vr.m.s.</td><td>0.5±0.05Vr.m.s.</td></tr></table></td></tr>
<tr><td>8</td><td>Dissipation Factor (D.F.)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td></tr><tr><td rowspan="2">Y5V</td><td rowspan="2">0.05 max.</td><td>0.07 max. (C<1.0μF)</td></tr><tr><td>0.09 max. (C≧1.0μF)</td></tr></table></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.</th></tr><tr><td>X7R</td><td>−55 to +125</td><td rowspan="3">25℃</td><td>Within±15%</td></tr><tr><td>Z5U</td><td>+10 to + 85</td><td>Within+22%/−56%</td></tr><tr><td>Y5V</td><td>−30 to + 85</td><td>Within+22%/−82%</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>Adhesive Strength of Termination</td><td>No removal of the terminations or other defects shall occur.
 

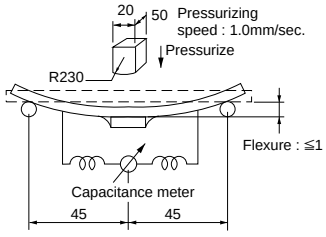
Fig. 1i</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1i using a eutectic solder. Then apply 10N* force in the direction of the arrow. *5N:LL0306
The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering 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>LL0306</td><td>0.3</td><td>1.2</td><td>2.0</td></tr><tr><td>LL0508</td><td>0.6</td><td>1.6</td><td>2.4</td></tr><tr><td>LL0612</td><td>1.0</td><td>3.0</td><td>3.7</td></tr></table>(in mm)</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>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td></tr><tr><td rowspan="2">Y5V</td><td rowspan="2">0.05 max.</td><td>0.07 max. (C<1.0μF)</td></tr><tr><td>0.09 max. (C≧1.0μF)</td></tr></table></td></tr>
<tr><td>12</td><td>Deflection</td><td colspan="2">No crack or marked defect shall occur.
 

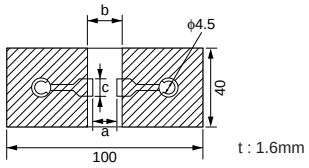
Fig. 3i</td><td>Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2i using a eutectic solder. Then apply a force in the direction shown in Fig.3i. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is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

Fig. 2i
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>LL0306</td><td>0.3</td><td>1.2</td><td>2.0</td></tr><tr><td>LL0508</td><td>0.6</td><td>1.6</td><td>2.4</td></tr><tr><td>LL0612</td><td>1.0</td><td>3.0</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 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>
</table>

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="5">Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in 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>X7R : Within±7.5%
Z5U · Y5V : Within±20%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td></tr><tr><td rowspan="2">Y5V</td><td rowspan="2">0.05 max.</td><td>0.07 max. (C<1.0μF)</td></tr><tr><td>0.09 max. (C≧1.0μF)</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>Min. 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>X7R : Within±7.5%
Z5U · Y5V : Within±20%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.025 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</td><td>—</td></tr><tr><td rowspan="2">Y5V</td><td rowspan="2">0.05 max.</td><td>0.07 max. (C<1.0μF)</td></tr><tr><td>0.09 max. (C≧1.0μF)</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">16</td><td rowspan="5">Humidity, Steady State</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="5">Sit the capacitor at 40±2℃ and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 48±4 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Change</td><td>X7R : Within±12.5%
Z5U . Y5V : Within±30%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.05 max.</td><td>—</td></tr><tr><td rowspan="2">Y5V</td><td rowspan="2">0.075 max.</td><td>0.1 max. (C<1.0μF)</td></tr><tr><td>0.125 max. (C≧1.0μF)</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>X7R : Within±12.5%
Z5U . Y5V : Within±30%</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.05 max.</td><td>—</td></tr><tr><td rowspan="2">Y5V</td><td rowspan="2">0.075 max.</td><td>0.1 max. (C<1.0μF)</td></tr><tr><td>0.125 max. (C≧1.0μF)</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>
<tr><td rowspan="6">18</td><td rowspan="6">High Temperature Load</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="6">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 hours at the maximum operating temperature ±3℃.
Remove and let sit for 48±4 hours at room temperature. Perform initial measurement.</td></tr>
<tr><td>Capacitance Change</td><td>X7R : Within±12.5%
Z5U : Within±30%
Y5V : Within±30% (C<1.0μF)
Within$^{+30}_{-40}$% (C≧1.0μF)</td></tr>
<tr><td>D.F.</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th></tr><tr><td>X7R</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.05 max.</td><td>—</td></tr><tr><td rowspan="2">Y5V</td><td rowspan="2">0.075 max.</td><td>0.1 max. (C<1.0μF)</td></tr><tr><td>0.125 max. (C≧1.0μF)</td></tr></table></td></tr>
<tr><td>I.R.</td><td>More than 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td>No failure</td></tr>
</table>

4

MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN700 Series ; High-frequency Type

■FEATURES

1. Negligible inductance is achieved by its monolithic structure so the series can be used at frequencies above 1GHz.
2. Nickel barriered terminations of GRH type improve solderability and decrease solder leaching.
3. GRH706/GRH708 type is designed for both flow and reflow soldering and GRH710 type is designed for reflow soldering.
4. RPN type capacitors withstand at high temperatures because ribbon leads are attached with silver paste.
5. RPN type 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

■PART NUMBERING

(✻Please specify the part number when ordering)

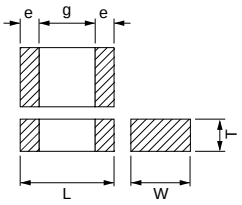
(Ex.) GRH710 | C0G | 151 | J | 200 | | PB

❶ ❷ ❸ ❹ ❺ ❻ ❼

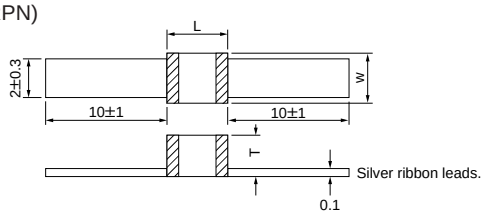
❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS

Chip Type (GRH)



Microstrip Type (RPN)



(in mm)

Type	Dimensions (mm)				
	L	W	T	e	g
GRH706	1.25 $^{+0.5}_{-0.3}$	1.0 $^{+0.5}_{-0.3}$	1.2 max.	0.15 min.	0.3 min.
GRH708	2.0 $^{+0.5}_{-0.3}$	1.25 $^{+0.5}_{-0.3}$	1.45 max.	0.2 min.	0.5 min.
GRH710	3.2 $^{+0.6}_{-0.4}$	2.5 $^{+0.5}_{-0.3}$	1.9 max.	0.3 min.	0.5 min.
RPN710	4.0 max.	3.0 max.	2.3 max.	—	—

❷TEMPERATURE CHARACTERISTICS

Code	Temp. Coeff.	Temp. Range	Reference Temp.
C0G	0±30ppm/℃	−55℃ to +125℃	25℃

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
010	1	220	22
1R5	1.5	471	470

❹CAPACITANCE TOLERANCE

Code	C	D	J
Cap. tolerance	±0.25pF	±0.5pF	±5%
Cap. range	C≦5pF	5pF<C≦10pF	10pF<C

❺RATED VOLTAGE

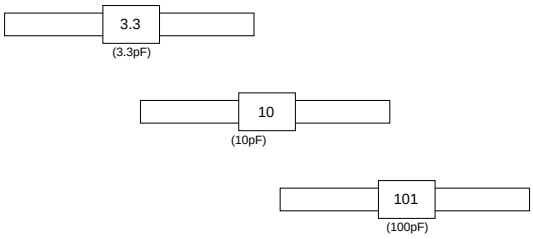
Code	DC Rated voltage (V)
50	50
100	100
200	200

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging (for only GRH type)

■MARKING

Marking is omitted from GRH706, GRH708 and GRH710. For the RPN710, the actual number is marked if less than 100pF and the three digit code is marked if 100pF or over.



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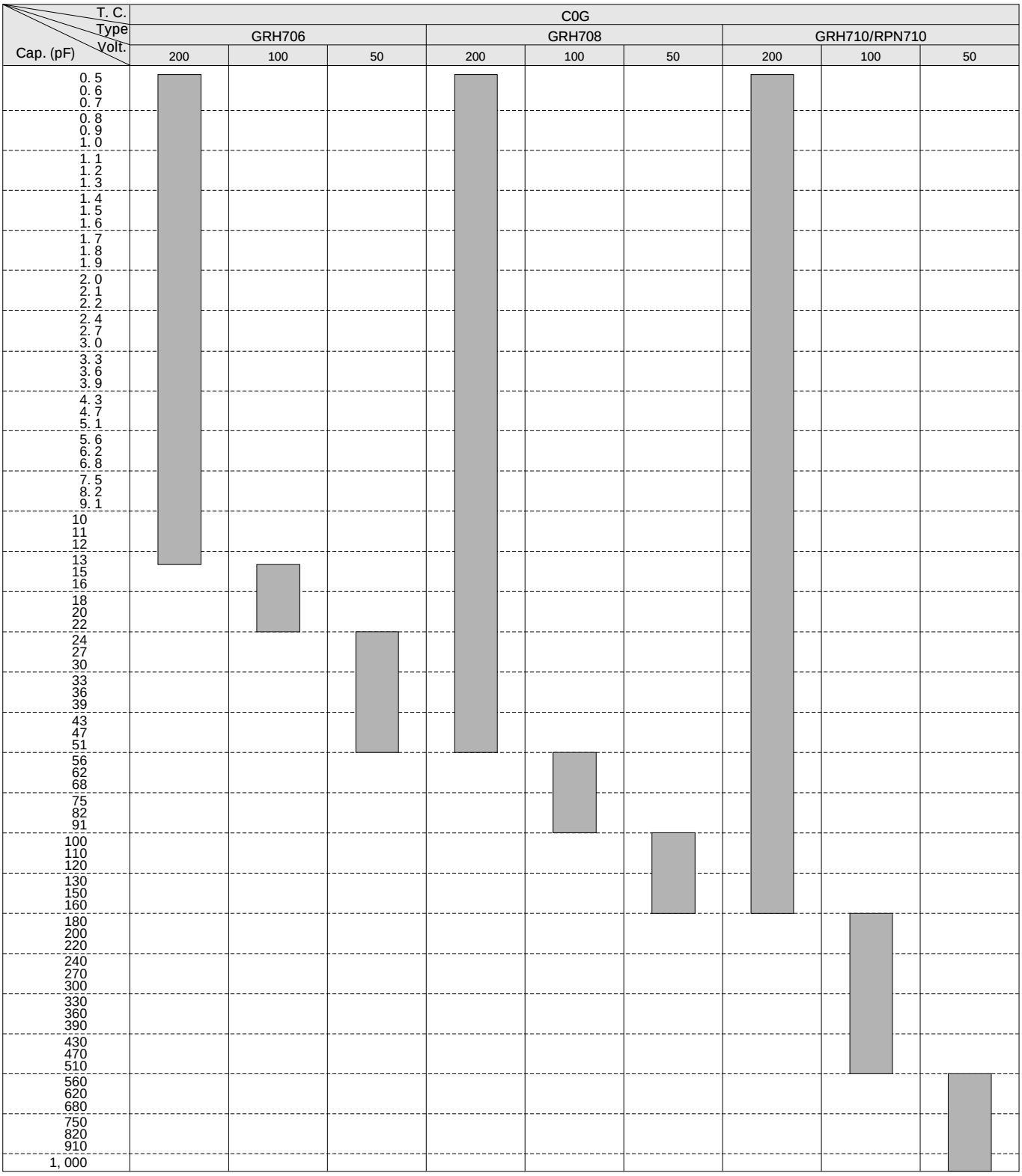
■CAPACITANCE RANGE TABLE



■CAPACITANCE TOLERANCE

5pF and below · · · · · · · · · · · · · C : ±0.25pF
Over 5pF, 10pF and below · · · · D : ±0.5pF
More than 10pF · · · · · · · · · · · · J : ±5%

■PACKAGING TYPES/QUANTITY

Type	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)
GRH706	1,000	–
GRH708	1,000	3,000
GRH710	1,000	2,000
RPN710	100	–

■SPECIFICATIONS AND TEST METHODS

Temperature Compensating Type

No.	Item		Specification	Test Method
1	Operating Temperature Range		−55℃ to +125℃	
2	Rated Voltage		See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, 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 is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance (I.R.)		10,000MΩ min.	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.
7	Capacitance		Within the specified tolerance.	The capacitance/Q shall be measured at 25℃ at the frequency and voltage shown in the table.
8	Q		C≦ 220pF : Q≧10,000 220pF<C≦ 470pF : Q≧ 5,000 470pF<C≦1,000pF : Q≧ 3,000 C : Nominal Capacitance (pF)	
9	Capacitance Temperature Characteristics	Capacitance Variation Rate	Within the specified tolerance. (Table A-6)	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-6. 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.
		Temperature Coefficient	Within the specified tolerance. (Table A-6)	
		Capacitance Drift	Within ±0.2% or ±0.05pF (Whichever is larger)	
10	Terminal Strength	Adhesive Strength of Termination (for chip type)	No removal of the terminations or other defects shall occur.	Solder the capacitor to the test jig (alumina substrate) shown in Fig. 1j 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.
		Tensile Strength (for micro-strip type)	Capacitor shall not be broken or damaged.	The capacitor body is fixed and a load is applied gradually in the axial direction until its value reaches 5N.
		Bending Strength of lead wire terminal (for micro-strip type)	Lead wire shall not be cut or broken.	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.
11	Vibration Resistance	Appearance	No defects or abnormalities.	Solder the capacitor to the test jig (alumina substrate) shown in Fig.2j 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).
		Capacitance	Within the specified tolerance.	
		Q	Satisfies the initial value. C≦ 220pF : Q≧10,000 220pF<C≦ 470pF : Q≧ 5,000 470pF<C≦1,000pF : Q≧ 3,000 C : Nominal Capacitance (pF)	

Char. / Item	C0G (1,000pF and below)
Frequency	1±0.1MHz
Voltage	0.5 to 5Vr.m.s.

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

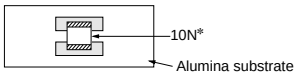


Fig. 1j

*5N (GRH 706)

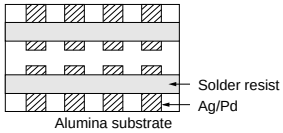


Fig. 2j

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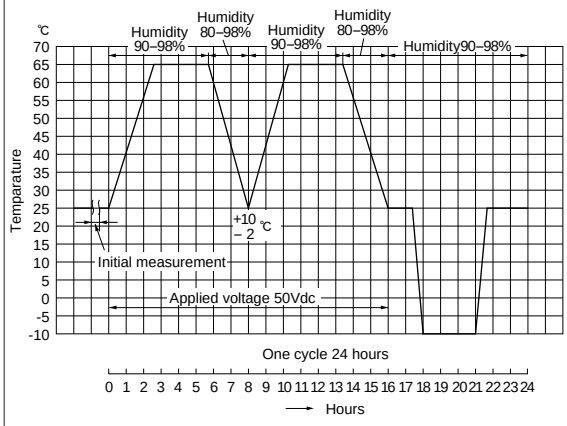
<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>12</td><td>Solderability of Termination</td><td>75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% 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>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>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>Room Temp.</td><td>+125 $^{+3}_{-0}$</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>15</td><td>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>
<tr><td>16</td><td>High Temperature Load</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 ±3% or ±0.3pF (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 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.</td></tr>
</table>

Char.	Temperature Coefficient (ppm/℃) Note 1	Capacitance Change from 25℃ Value (%)					
		−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℃.

MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN100 Series ; HiQ and High-power Type

■FEATURES

1. The dielectric is composed of low dielectric loss ceramics. This series is perfectly suited to high-frequency applications (VHF-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. GRH110 type is designed for both flow and reflow soldering and GRH111 type is designed for reflow soldering.
4. GRH type capacitors exhibit better solderability and lower solder leaching because of its nickel barriered terminations.
5. RPN type capacitors withstand high temperatures because ribbon leads are attached with silver paste.
6. RPN type capacitors are easily soldered and especially well suited in applications where only a soldering iron can be used.

■APPLICATION

High-frequency and high-power circuits

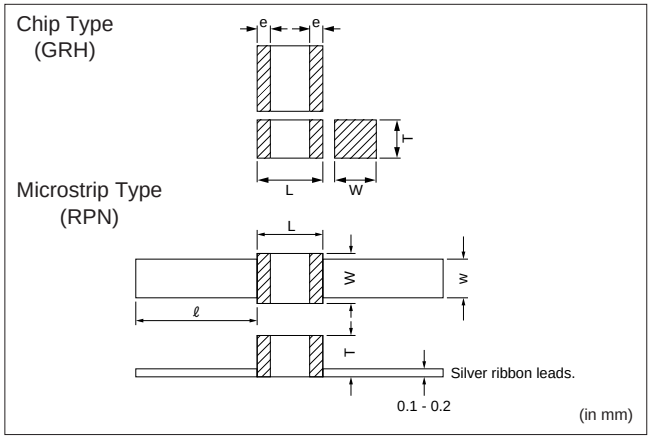
■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GRH111	C0G	151	J	300		PB
	❶	❷	❸	❹	❺	❻	❼

❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS



Type	Dimensions (mm)			
	L	W	T	e
GRH110	$1.4^{+0.6}_{-0.4}$	$1.4^{+0.6}_{-0.4}$	0.8 to 1.65	$0.25^{+0.25}_{-0.15}$
GRH111	$2.8^{+0.6}_{-0.4}$	$2.8^{+0.6}_{-0.4}$	2.0 to 2.8	$0.4^{+0.4}_{-0.3}$

Type	Dimensions (mm)				
	L	W	T	ℓ	w
RPN110	1.6±0.4	1.4±0.4	1.6 max.	5.0 min.	1.3 ±0.4
RPN111	3.2±0.4	2.8±0.4	3.0 max.	9.0±2.0	2.35±0.15

❷TEMPERATURE CHARACTERISTICS

Code	Temp. Coeff.	Temp. Range	Reference Temp.
C0G	0±30ppm/℃	−55℃ to +125℃	25℃

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
010	1	220	22
1R5	1.5	471	470

❹CAPACITANCE TOLERANCE

Code	C	D	J
Cap. tolerance	±0.25pF	±0.5pF	±5%
Applied	C≦5pF	5pF<C≦10pF	10pF<C

❺RATED VOLTAGE

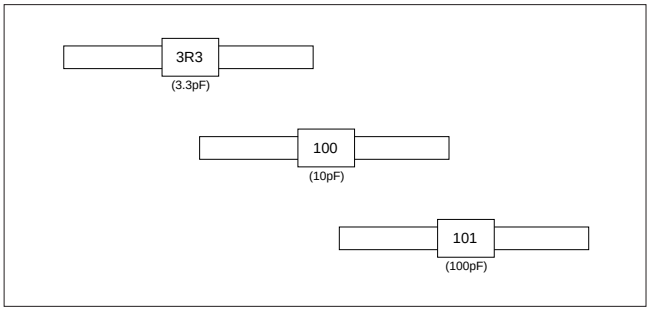
Code	DC Rated voltage (V)
50	50
100	100
200	200
300	300
500	500

❼PACKAGING CODE

Code	Packaging
PB	Bulk packaging in a bag
PT	Tape carrier packaging (for only GRH type)

■MARKING

Marking is omitted from the GRH110, GRH111 and RPN110.
The three digit code is marked on the RPN111 series.



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■CAPACITANCE RANGE TABLE

T. C.	C0G					
Type	GRH110/RPN110	GRH111/RPN111				
Cap. (pF) \ Volt.	50	500	300	200	100	50
0. 5 0. 6 0. 7						
0. 8 0. 9 1. 0						
1. 1 1. 2 1. 3						
1. 4 1. 5 1. 6						
1. 7 1. 8 1. 9						
2. 0 2. 1 2. 2						
2. 4 2. 7 3. 0						
3. 3 3. 6 3. 9						
4. 3 4. 7 5. 1						
5. 6 6. 2 6. 8						
7. 5 8. 2 9. 1						
10 11 12						
13 15 16						
18 20 22						
24 27 30						
33 36 39						
43 47 51						
56 62 68						
75 82 91						
100 110 120						
130 150 160						
180 200 220						
240 270 300						
330 360 390						
430 470 510						
560 620 680						
750 820 910						
1, 000						

■CAPACITANCE TOLERANCE

5pF and below · · · · · · · · · · · · · C : ±0.25pF
Over 5pF, 10pF and below · · · · D : ±0.5pF
More than 10pF · · · · · · · · · · · · J : ±5%

■PACKAGING TYPES/QUANTITY

Type	Bulk (pcs./bag)	Taping (pcs./φ178mm/reel)
GRH110	1,000	2,000
GRH111	1,000	1,000
RPN110	100	–
RPN111	50	–

■SPECIFICATIONS AND TEST METHODS

Temperature Compensating Type

No.	Item		Specification	Test Method
1	Operating Temperature Range		−55℃ to +125℃	
2	Rated Voltage		See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, 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 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance (I.R.)	25℃	C≦ 470pF :1,000,000MΩ min. 470pF<C≦1,000pF : 100,000MΩ min.	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.
		125℃	C≦ 470pF : 100,000MΩ min. 470pF<C≦1,000pF : 10,000MΩ min.	
7	Capacitance		Within the specified tolerance.	The capacitance/Q shall be measured at 25℃ at the frequency and voltage shown in the table.
8	Q		C≦ 220pF : Q≧10,000 220pF<C≦ 470pF : Q≧ 5,000 470pF<C≦1,000pF : Q≧ 3,000 C : Nominal Capacitance (pF)	
9	Capacitance Temperature Characteristics	Capacitance Variation Rate	Within the specified tolerance. (Table A-7)	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-7. 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.
		Temperature Coefficient	Within the specified tolerance. (Table A-7)	
		Capacitance Drift	Within ±0.2% or ±0.05pF (Whichever is larger)	
10	Terminal Strength	Adhesive Strength of Termination (for chip type)	No removal of the terminations or other defects shall occur.	Solder the capacitor to the test jig (alumina substrate) shown in Fig. 1k 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.
		Tensile Strength (for micro-strip type)	Capacitor shall not be broken or damaged.	The capacitor body is fixed and a load is applied gradually in the axial direction until its value reaches 10N (5N for RPN110).
		Bending Strength of lead wire terminal (for micro-strip type)	Lead wire shall not be cut or broken.	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.
11	Vibration Resistance	Appearance	No defects or abnormalities.	Solder the capacitor to the test jig (alumina substrate) shown in Fig.2k 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).
		Capacitance	Within the specified tolerance.	
		Q	Satisfies the initial value. C≦ 220pF : Q≧10,000 220pF<C≦ 470pF : Q≧ 5,000 470pF<C≦1,000pF : Q≧ 3,000 C : Nominal Capacitance (pF)	

Char. / Item	C0G (1,000pF and below)
Frequency	1±0.1MHz
Voltage	0.5 to 5Vr.m.s.

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

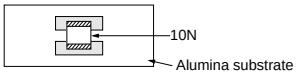


Fig. 1k

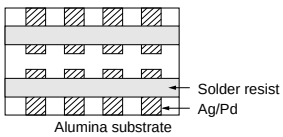
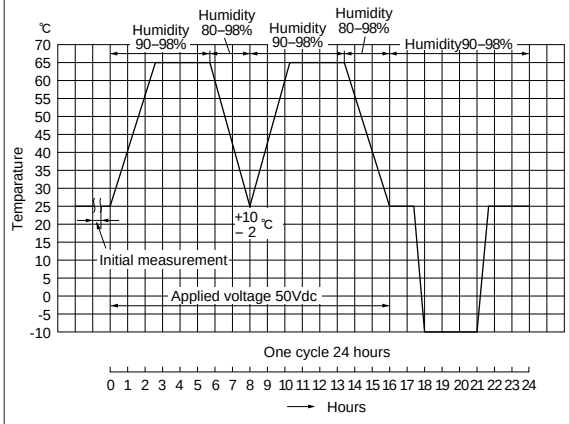


Fig. 2k

5

<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>12</td><td>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>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>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>Room Temp.</td><td>$+125^{+3}_{-0}$</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>15</td><td>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>
<tr><td>16</td><td>High Temperature Load</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></table>C : Nominal Capacitance (pF)</td><td>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.</td></tr>
</table>

5

Table A-7

Char.	Temp. Coeff. (ppm/℃) Note 1	Capacitance Change from 25℃ Value (%)					
		−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℃.

MONOLITHIC CERAMIC CAPACITOR

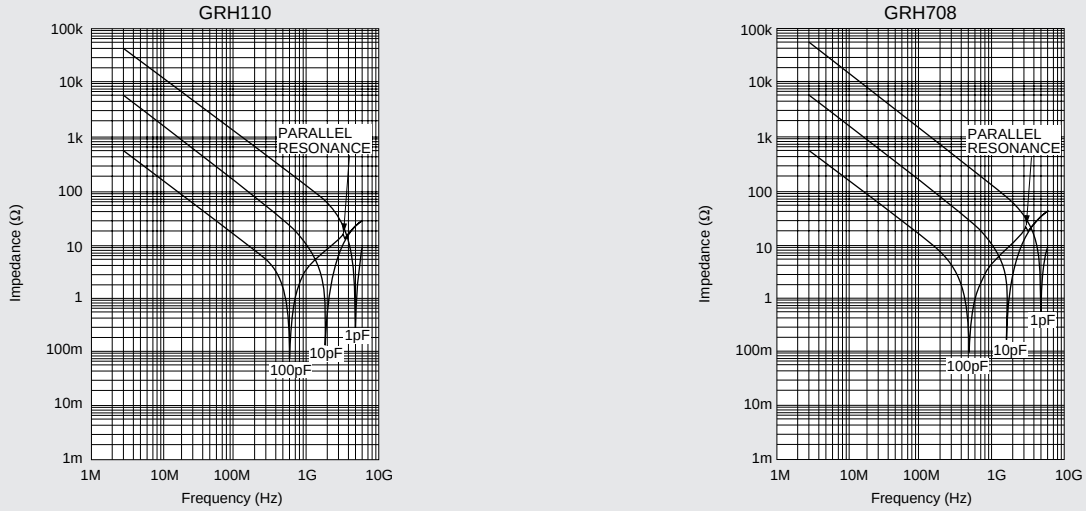
Solder Coated Type

GRH/RPN700 Series and **GRH/RPN100** Series

■CHARACTERISTICS

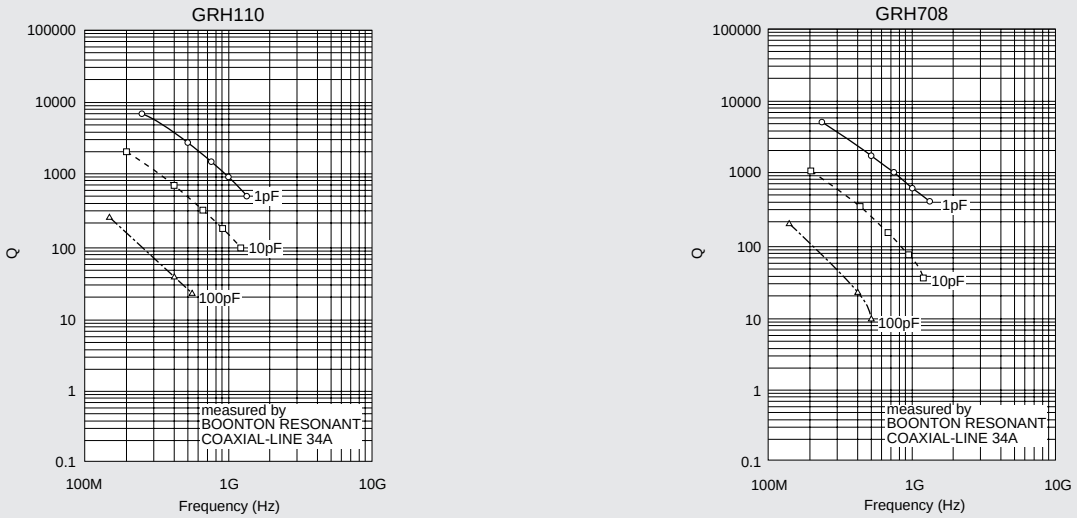
• Impedance-Frequency Characteristics

Measuring Diagram : NETWORK ANALYZER HP8753C → COAXIAL TEST FIXTURE HP16091A



• Q-Frequency Characteristics

Measuring Diagram : RF SIGNAL GENERATOR FLUKE 6062A → RESONANT COAXIAL LINE BOONTON MODEL 34A → MILLIVOLTMETER BOONTON 9200A



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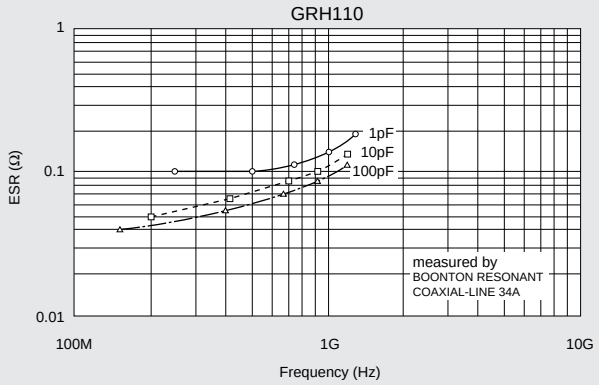
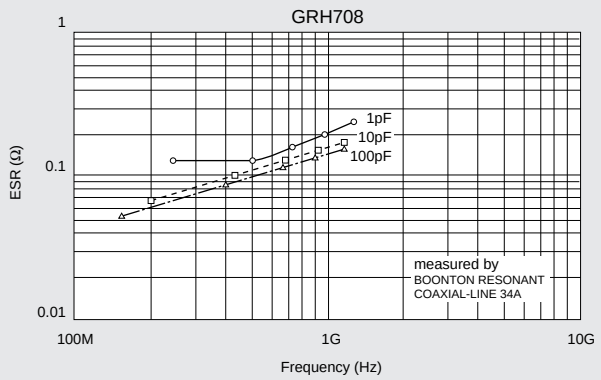
• ESR-Frequency

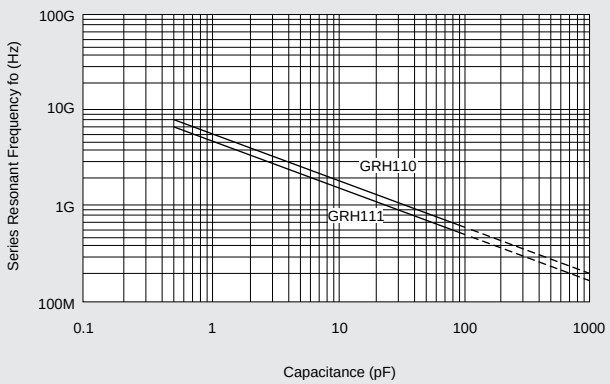
Measuring Diagram : RF SIGNAL GENERATOR FLUKE 6062A → RESONANT COAXIAL LINE BOONTON MODEL 34A → MILLIVOLTMETER BOONTON 9200A

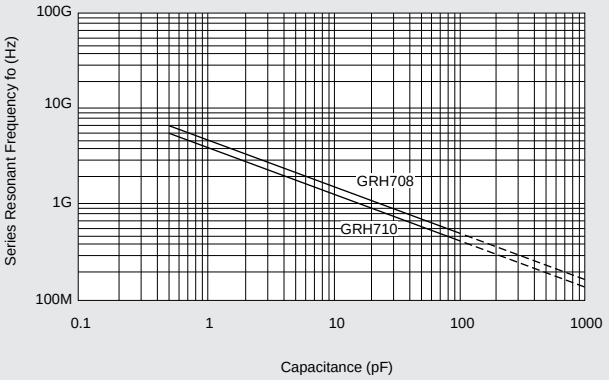




• Resonant Frequency-Capacitance

Measuring Diagram : NETWORK ANALYZER HP8753C → COAXIAL TEST FIXTURE HP16091A





5

MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN100 Series ; HiQ and High-power Type

• High Frequency-Power Capacity

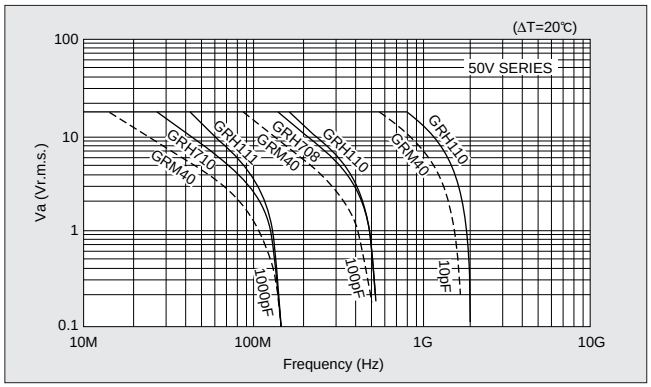
The monolithic ceramic capacitor has a small dielectric loss. When high frequency current is applied to the capacitor, the capacitor generates heat (power consumption) by its E.S.R. Temperature rise of the capacitor (ΔT) should be kept below 20℃ (ΔT≦20℃) in the actual circuit.

Therefore, when selecting capacitors, the applicable voltage, power and current should be considered within the following limits.

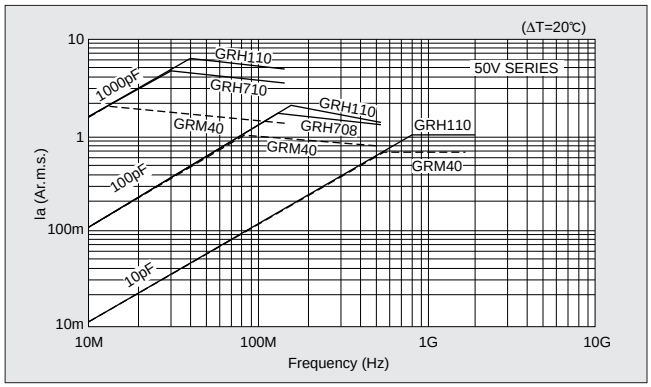
Effective power at ΔT=20℃ is as follows

Size	Effective power P. [mW]
GRH110	120
GRH111	245
GRH708	125
GRH710	225

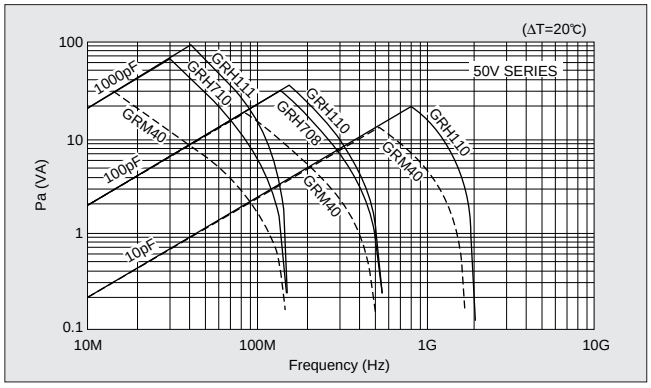
• Allowable Voltage-Frequency



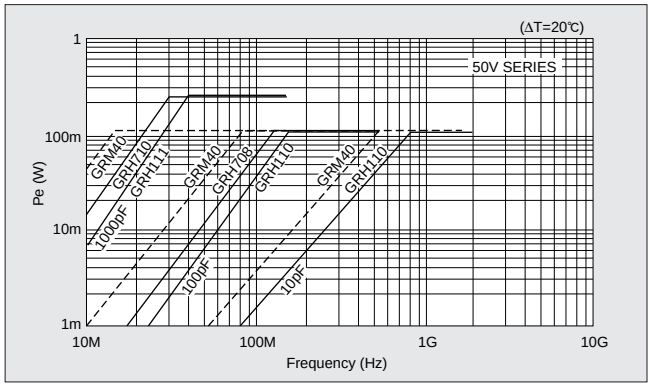
• Allowable Current-Frequency



• Allowable Apparent Power-Frequency



• Allowable Effective Power-Frequency



5

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR500 Series ; Medium voltage

■FEATURES

1. Large capacitance but of compact size due to monolithic construction.
2. Ceramic covered internal electrodes offer excellent humidity resistance.
3. Elimination of lead wires reduces inductance for high frequency application.
4. Can be soldered on to substrates with resin coating.

■APPLICATION

1. For by-pass and coupling of high voltage generation circuits of measuring instruments, medical instruments, automated office equipment, and many other types of equipment.
2. For pick-up tube related high voltage generating circuits.

■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.) GR530 | X7R | 103 | K | 500 | | PM

❶ ❷ ❸ ❹ ❺ ❻ ❼

❶Type

See the Dimensions.

❷Temperature Characteristics

Code	Characteristic
X7R	Capacitance Change Rate : ±15% max.
C0G	Capacitance Temp. Coefficient : 0±30ppm/℃

Temperature Range : −55℃ to +125℃
Standard Temperature : 25℃

❸Nominal Capacitance (Ex.)

Code	Capacitance (pF)
100	10
101	100
222	2,200
683	68,000
334	330,000 (=0.33μF)

❹Capacitance Tolerance

Code	Standards	Condition
F	± 1pF	10pF and below
K	±10%	More than 10pF

❺Rated Voltage

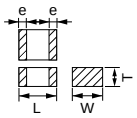
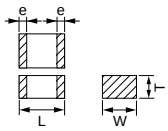
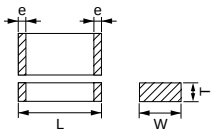
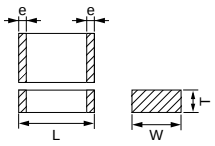
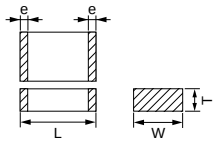
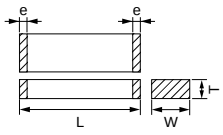
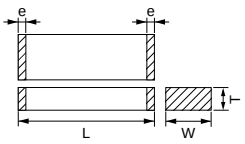
Code	DC Rated Voltage (V)
500	500
1K	1k
2K	2k
3K	3.15k
4K	4k

❻Murata's Control No.

❼Packaging Code

Bulk Packaging : PM

■DIMENSIONS

Type	Appearance	Dimensions (mm)			
		L	W	T max.	e min.
GR530		4.5±0.3	3.8±0.3	3.6	0.3
GR535		5.6±0.3	5.0±0.3	4.3	0.3
GR540		10.6±0.5	5.0±0.3	4.3	0.3
GR545		10.6±0.5	10.0±0.6	4.3	0.3
GR550		11.8±1.0	10.6±0.9	4.5	0.3
GR555		16.0±0.7	5.0±0.3	4.3	0.3
GR580		28.0±1.4	13.2±1.3	5.1	0.3

6

■CAPACITANCE RANGE TABLE

Temperature Characteristic : C0G

● 500V Tol. : ±10% (K)

Cap. \ Type	GR530	GR535
39(pF) 47		
56 68		
82 100		
120 150		
180 220		
270 330		
390 470		
560 680		
820 1000		

● 1kV Tol. : ±10% (K)

Cap. \ Type	GR530	GR535	GR550
39(pF) 47			
56 68			
82 100			
120 150			
180 220			
270 330			
390 470			
560 680			
820 1000			
1200 1500			
1800 2200			
2700			

● 2kV Tol. : ±10% (K)

Cap. \ Type	GR530	GR535	GR550
15(pF) 18			
22 27			
33 39			
47 56			
68 82			
100 120			
150 180			
220 270			
330 390			
470 560			
680 820			
1000 1200			
1500 1800			

● 3.15kV Tol. : ±10% (K) ±1pF (F) for capacitance 10pF.

Cap. \ Type	GR530	GR535	GR550	GR580
10(pF) 12				
15 18				
22 27				
33 39				
47 56				
68 82				
100 120				
150 180				
220 270				
330 390				
470 560				
680 820				
1000 1200				
1500				

● 4kV Tol. : ±10% (K) ±1pF (F) for capacitance 10pF.

Cap. \ Type	GR535	GR540	GR550	GR580
10 (pF) 12				
15 18				
22 27				
33 39				
47 56				
68 82				
100 120				
150 180				
220 270				
330 390				
470 560				
680 820				
1000 1200				

∗The standard tolerance for C0G is K%, but the tolerance J% is also available.

6

■CAPACITANCE RANGE TABLE

Temperature Characteristic : X7R

● 500V Tol. : ±10% (K)

Cap. \ Type	GR530	GR535	GR550
1200(pF) 1500			
1800 2200			
2700 3300			
3900 4700			
5600 6800			
8200 10000			
12000 15000			
18000 22000			
27000 33000			
39000 47000			
56000 68000			
82000 0.1(μF)			
0.12 0.15			
0.18 0.22			
0.27 0.33			

● 1kV Tol. : ±10% (K)

Cap. \ Type	GR530	GR535	GR550
820 (pF) 1000			
1200 1500			
1800 2200			
2700 3300			
3900 4700			
5600 6800			
8200 10000			
12000 15000			
18000 22000			
27000 33000			
39000 47000			
56000 68000			
82000 0.1(μF)			
0.12 0.15			

● 2kV Tol.: ±10% (K)

Cap. \ Type	GR540	GR545	GR580
470 (pF) 560			
680 820			
1000 1200			
1500 1800			
2200 2700			
3300 3900			
4700 5600			
6800 8200			
10000 12000			
15000 18000			
22000 27000			
33000 39000			
47000 56000			
68000 82000			
0.1 (μF) 0.12			

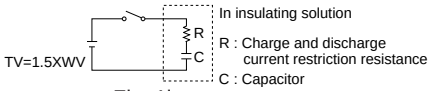
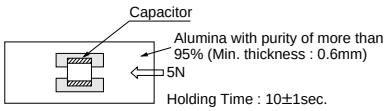
● 3.15kV Tol. : ±10% (K)

Cap. \ Type	GR545	GR555
680 (pF) 820		
1000 1200		
1500 1800		
2200 2700		
3300 3900		
4700 5600		
6800 8200		
10000		

6

■SPECIFICATIONS AND TEST METHODS

Temperature Compensating Type

No.	Item	Specification	Test Method
1	Operating Temperature Range	−25℃ to +85℃	
2	Rated Voltage	See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, 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 nor abnormality.	No failure shall be observed when a voltage of 150% of the rated voltage are applied between electrodes in a circuit as shown in Fig.1l for 1 to 5 seconds, in insulating solution, provided the charge/discharge current is less than 50mA.  Fig. 1l
6	Insulation Resistance (I.R.)	10,000MΩ min. or 100Ω · F min. (Whichever is smaller)	The insulation resistance shall be measured with the following voltage at normal temperature and humidity and within 1 minute of charging. DC Rated voltage: DC Voltage applied WV : 500V: 500V WV≧1kV: 1kV
7	Capacitance	Within the specified tolerance.	The capacitance/Q shall be measured at 25℃ with the frequency and voltage shown in the table. Char. / Item: C0G, (1,000pF and below): C0G, (more than 1,000pF) Frequency: 1±0.2MHz: 1±0.2kHz Voltage: 5Vr.m.s. max.: 5Vr.m.s. max.
8	Q	30pF min. : Q≧1,000 30pF max. : Q≧400+20C C : Nominal Capacitance (pF)	
9	Capacitance Temperature Characteristics — Capacitance Variation Rate	Within the specified tolerance. (Table A-8)	When the temperature coefficient is measured with the capacitance of step 3 as a reference which changing the capacitor temperature from step 1 to 5 in sequence, +25 to +125℃ shall be within the specified tolerance for the temperature coefficient. −55 to +25℃ shall be within the tolerance for capacitance change specified. The values of drift are obtained by dividing the differences between the maximum and minimum measured values in the step 1, 3 and 5 by the intermediate measured value (or the maximum tolerance). The capacitance change shall be measured after 5 min.at each specified temperature stage. Step: Temperature (℃) 1: 25±2 2: −55±3 3: 25±2 4: 125±3 5: 25±2
	Capacitance Temperature Characteristics — Temperature Coefficient	Within the specified tolerance. (Table A-8)	
	Capacitance Temperature Characteristics — Capacitance Drift	Within ±0.2% or ±0.05pF (Whichever is larger)	
10	Adhesive Strength of Termination	No removal of the terminations or other defect shall occur.	Solder a capacitor to test jig (alumina substrate) shown in Fig. 2l with solder containing 2.5% silver. Soldering should be done either by hand iron or in furnace so carefully as to make a uniformed finish and to avoid anything irregular such as thermal shock. No peeling or other troubles of external electrode when 5N "force" is imposed to the capacitor in the direction of the arrow.  Fig. 2l

6

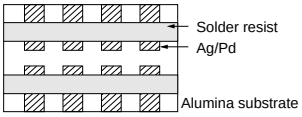
<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defects or abnormality.</td><td rowspan="3">Solder the capacitor on the testing jig (alumina substrate) shown in Fig. 3l by solder containing 2.5% silver. The soldering shall be done either by iron or reflow and be conducted with care so that the soldering is uniform and free of defect such as heat shock. The range of vibration frequency (10 to 55Hz), total amplitude (1.5 mm), and the ratio of changes in the number of vibrations shall satisfy the specified values after applying vibration which takes about 1 minute to be transmitted from 10Hz to 55Hz and back to 10Hz for a total of six hours (two hours each in three mutually perpendicular directions).
 

Fig. 3l</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance.</td></tr>
<tr><td>Q</td><td>Satisfies the initial value.
30pF min. : Q≧1,000
30pF max. : Q≧400+20C
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 first in a ethanol (JIS-K-8101) solution of rosin (JIS-K-5902) (25% rosin in weight proportion), then in solder containing 2.5% silver for 2±0.5 seconds at 235±5℃ after preheating for 5 minutes at 80 to 100℃ and then 1 to 2 minutes at 160 to 170℃.</td></tr>
<tr><td>13</td><td colspan="2">Resistance to Soldering Heat</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>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td>30pF and over : Q≧1,000
30pF and below : Q≧400+20C</td></tr><tr><td>I.R.</td><td>More than 10,000MΩ or 100Ω · F (Whichever is smaller)</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table>C : Nominal Capacitance (pF)</td><td>Immerse the capacitor in solder containing 2.5% silver of 260±5℃ for 5±0.5 seconds after preheating for 5 minutes at 80 to 100℃ and then for 1 to 2 minutes at 160 to 170℃. Set it for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>14</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>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td>30pF and over : Q≧1,000
30pF and below : Q≧400+20C</td></tr><tr><td>I.R.</td><td>More than 10,000MΩ or 100Ω · F (Whichever is smaller)</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) and conduct the five cycles according to the temperatures and time shown in the following table. Set it for 24±2 hours at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (℃)</td><td>-25^{+0}_{-3}</td><td>Room Temp.</td><td>$+85^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table></td></tr>
<tr><td>15</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>Within ±5% or ±0.5pF (Whichever is larger)</td></tr><tr><td>Q</td><td>30pF and over : Q≧350
10pF and over, 30pF and below : Q≧275+$\frac{5}{2}$C
30pF and below : Q≧200+10C</td></tr><tr><td>I.R.</td><td>More than 1,000MΩ or 10Ω · F (Whichever is smaller)</td></tr></table>C : Nominal Capacitance (pF)</td><td>Set the capacitor for 500 $^{+24}_{-0}$ hours at 40±2℃, in 90 to 95% humidity. Take it out and set it for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>16</td><td colspan="2">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>Within ±3% or ±0.3pF (Whichever is larger)</td></tr><tr><td>Q</td><td>30pF and over : Q≧350
10pF and over, 30pF and below : Q≧275+$\frac{5}{2}$C
10pF and below : Q≧200+10C</td></tr><tr><td>I.R.</td><td>More than 2,000MΩ or 20Ω · F (Whichever is smaller)</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table>C : Nominal Capacitance (pF)</td><td>Apply a voltage of 125 % of the rated voltage for 1000 $^{+48}_{-0}$ hours at 85±3℃ and set it for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>17</td><td colspan="2">Notice</td><td colspan="2">When mounting capacitor, perform the epoxy resin coating (min. 0.1mm thickness).</td></tr>
</table>

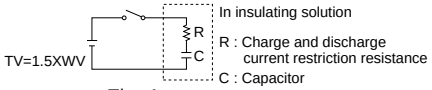
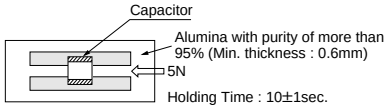
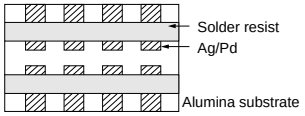
Table A-8

Char.	Temp. Coeff. (ppm/℃) Note1	Capacitance Change from 25℃ Value (%)					
		−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℃.

■SPECIFICATIONS AND TEST METHODS

High Dielectric Constant Type

No.	Item	Specification	Test Method
1	Operating Temperature Range	−25℃ to +85℃	
2	Rated Voltage	See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, 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 nor abnormality.	No failure shall be observed when a voltage of 150% of the rated voltage are applied between electrodes in a circuit as shown in Fig.1m for 1 to 5 seconds, in insulating solution, provided the charge/discharge current is less than 50mA.  Fig. 1m
6	Insulation Resistance (I.R.)	10,000MΩ min. or 100Ω · F min. (Whichever is smaller)	The insulation resistance shall be measured with the following voltage at normal temperature and humidity and within 1 minute of charging. DC Rated voltage: DC Voltage applied WV : 500V: 500V WV≧1kV: 1kV
7	Capacitance	Within the specified tolerance.	The capacitance shall be measured at 25℃ with 1±0.2kHz in frequency and 1±0.2Vr.m.s. in voltage.
8	Dissipation Factor (D.F.)	0.025 max.	D.F. shall be measured under the same conditions as the capacitance.
9	Capacitance Temperature Characteristics	Char. / Temp. Range / Reference Temp. / Cap. Change Rate X7R / −55 to +125℃ / 25℃ / Within ±15%	The range of capacitance change in reference to 25℃ within the temperature range shown in the table shall be within the specified ranges.
10	Adhesive Strength of Termination	No removal of the terminations or other defect shall occur.	Solder a capacitor to test jig (alumina substrate) shown in Fig. 2m with solder containing 2.5% silver. Soldering should be done either by hand iron or in furnace so carefully as to make a uniformed finish and to avoid anything irregular such as thermal shock. No peeling or other troubles of external electrode when 5N "force" is imposed to the capacitor in the direction of the arrow.  Fig. 2m
11	Vibration Resistance — Appearance	No defects or abnormality.	Solder the capacitor on the testing jig (alumina substrate) shown in Figs. 3m by solder containing 2.5% silver. The soldering shall be done either by iron or reflow and be conducted with care so that the soldering is uniform and free of defect such as heat shock. The range of vibration frequency (10 to 55Hz), total amplitude (1.5mm), and the ratio of changes in the number of vibrations shall satisfy the specified values after applying vibration which takes about 1 minute to be transmitted from 10Hz to 55Hz and back to 10Hz for a total of six hours (two hours each in three mutually perpendicular directions).  Fig. 3m
	Vibration Resistance — Capacitance	Within the specified tolerance.	
	Vibration Resistance — D.F.	0.025 max.	
12	Solderability of Termination	75% of the terminations is to be soldered evenly and continuously.	Immerse the capacitor first in a ethanol (JIS-K-8101) solution of rosin (JIS-K-5902) (25% rosin in weight proportion), then in solder containing 2.5% silver for 2±0.5 seconds at 235±5℃ after preheating for 5 minutes at 80 to 100℃ and then 1 to 2 minutes at 160 to 170℃.

6

<table>
<tr><th>No.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>13</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>Specification</th></tr><tr><td>Appearance</td><td>No marked defect</td></tr><tr><td>Capacitance Change</td><td>Within ±7.5%</td></tr><tr><td>I.R.</td><td>More than 10,000MΩ or 100Ω · F
(Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.025 max.</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table></td><td>The capacitor shall be set for 24±2 hours at room temperature after one hour heat of treatment at 150 $^{+}_{-}{}^{0}_{10}$℃. Immerse the capacitor in solder containing 2.5% silver of 260±5℃ for 5±0.5 seconds after preheating for 5 minutes at 80 to 100℃ and then for 1 to 2 minutes at 160 to 170℃. Then set it for 48±4 hours at room temperature and measure.</td></tr>
<tr><td>14</td><td>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>Within ±7.5%</td></tr><tr><td>I.R.</td><td>More than 10,000MΩ or 100Ω · F
(Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.025 max.</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table></td><td>The capacitor shall be set for 24±2 hours at room temperature after one hour heat of treatment at 150 $^{+}_{-}{}^{0}_{10}$ ℃ then measure for the initial measurement. Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11) and conduct the five cycles according to the temperatures and time shown in the following table. Set it for 24±2 hours at room temperature, then measure.<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (℃)</td><td>−25$^{+0}_{-3}$</td><td>Room Temp.</td><td>+85$^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table></td></tr>
<tr><td>15</td><td>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>Within ±10%</td></tr><tr><td>I.R.</td><td>More than 1,000MΩ or 10Ω · F
(Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.05 max.</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table></td><td>The capacitor shall be set for 24±2 hours at room temperature after one hour heat of treatment at150 $^{+}_{-}{}^{0}_{10}$℃, then measure for the initial measurement. Set the capacitor for 500 $^{+24}_{-0}$ ℃ hours at 40±2℃, in 90 to 95% humidity. Take it out and set it for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>16</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>Within ±12.5%</td></tr><tr><td>I.R.</td><td>More than 2,000MΩ or 20Ω · F
(Whichever is smaller)</td></tr><tr><td>D.F.</td><td>0.05 max.</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 125% the rated voltage is applied for one hour at 85±3℃ then it shall be set for 24±2 hours at room temperature and the initial measurement shall be conducted. Then apply the above mentioned voltage continuously for 1000 $^{+48}_{-0}$ hours at the same temperature, remove it from the bath, and set it for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.</td></tr>
<tr><td>17</td><td>Notice</td><td colspan="2">When mounting capacitor, perform the epoxy resin coating (min. 0.1mm thickness).</td></tr>
</table>

6

■PACKAGING

There are three types of packaging for chip monolithic ceramic capacitors. Please specify the packaging code when ordering.

1. BULK PACKAGING

Packaging code : PB (PM for GM250/GR500 Series)

Minimum Quantity*

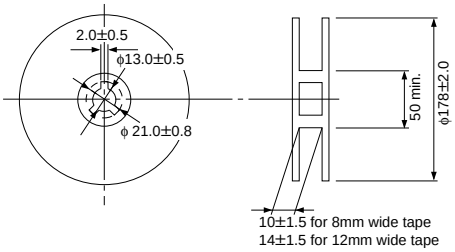
Type	Minimum Quantity (pcs./bag or tray)
GRM33, GR(M)36, GR(M)39, GR(M)40, GR(M)42-6, GR(M)42-2, GR(M)43-2, GR(M)44-1, GRM420, GRM425, GRM430, GRM435, GRM220, GRM615, GNM30-401, LL0306, LL0508, LL0612 GRH110, GRH111, GRH706, GRH708, GRH710	1,000
RPN710	100
RPN110, RPN111, GR530, GR535	50
GR540, GR545, GR550	20
GR555, GR580	40
GM250, GM260	400

* "Minimum Quantity" means the numbers of units of each delivery or order. The quantity should be an integral multiple of the "minimum quantity" (Please note that the actual delivery quantity in a package may change sometimes.)

2. TAPE CARRIER PACKAGING

Packaging code : PT

(1) Dimensions of Reel

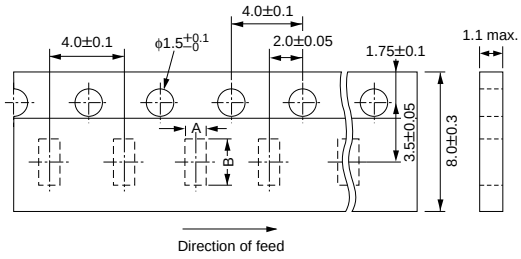


φ330mm reel is available on request. (in mm)

(2) Dimensions of Tape

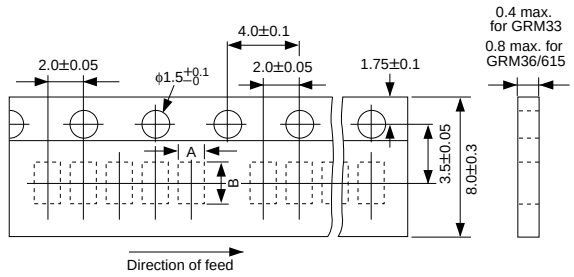
(a) Paper Tape

• 4mm Pitch Tape



	GR(M)39 GRM420 GRM220 LL0306	GR(M)40 GRM425 LL0508 (T≦1.0mm)	GR(M)42-6 GRM430 GNM30-401 LL0612 (T≦1.0mm)	GRM42-2 (T=8.5mm)
A	1.05±0.1	1.55±0.15	2.0±0.2	2.8±0.2
B	1.85±0.1	2.3 ±0.15	3.6±0.2	3.6±0.2

• 2mm Pitch Tape



	GRM33	GRM615 GR(M)36
A	0.37	0.65
B	0.67	1.15

(Nominal value)

(in mm)

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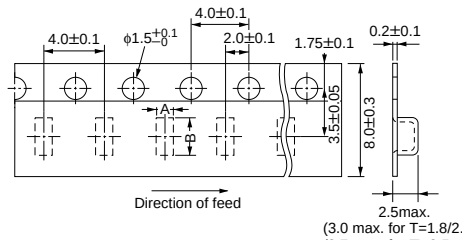
PACKAGE

(b) Plastic Tape

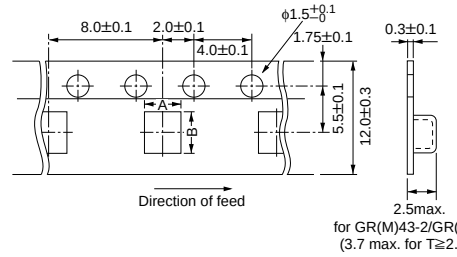
• 4mm Pitch Tape



	GR(M)40 GRM225 (T=1.25mm)	GR(M)42-6 GRM430 GRM230 LL0612 (T≧1.15mm)	GRM435 GR(M)42-2 GRM235 (T≧1.15mm)	GRH708	GRH710	GRH110	GRH111
A	1.45±0.2	1.9±0.2	2.8±0.2	1.8*	2.8*	2.0*	3.1*
B	2.25±0.2	3.5±0.2	3.5±0.2	2.6*	3.5*	2.1*	3.2*

*Nominal value

• 8mm Pitch Tape



	GRM240 GR(M)43-2	GR(M)44-1
A	3.6	5.2
B	4.9	6.1

(Nominal value)

(in mm)

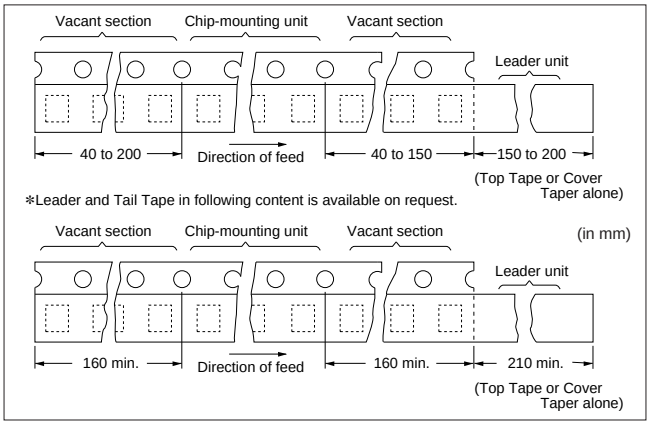
(3) Minimum Quantity*

Type	Chip Thickness	Minimum Quantity* (pcs./reel)	
		φ178 mm reel	φ330 mm reel
GRM33	All	15,000	—
GR(M)36, GRM615	All	10,000	50,000
GR(M)39, GR(M)40, GR(M)42-6, GR(M)42-2, GRM420, GRM425, GRM430, GRM220	1.0mm max.	4,000	10,000
GR(M)40, GR(M)42-6, GR(M)42-2 GRM430, GRM225, GRM230 LL0612	1.15/1.25mm	3,000	10,000
GRH708	All	3,000	—
GR(M)42-2, GRM235	1.35mm	2,000	8,000
GRH110, GRH710	All	2,000	—
GR(M)43-2, GR(M)44-1	1.25mm	1,000	5,000
GRH111	All	1,000	—
GR(M)43-2, GR(M)44-1	1.5mm 2.0mm	1.000	4,000
GRM42-2, GRM235	1.8mm	1,000	—
GRM42-6, GRM235	1.6mm	2,000	6,000
GRM42-2, GRM435	2.5mm	1,000	—
GRM240	2.5mm	500	1,000

(4) Others

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.



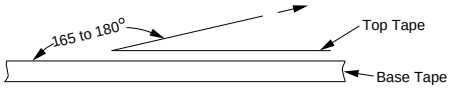
③ The top tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

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

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

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

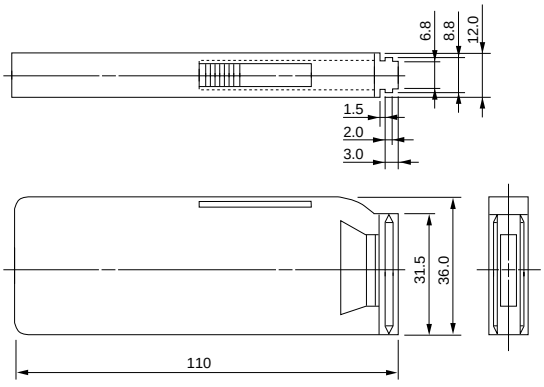
⑦ Peeling off force : 0.1 to 0.6N in the direction shown below.



3. BULK CASE PACKAGING

Packaging code : PC (Please contact Murata for details)

(1) Dimensions of Bulk case



The bulk case used antistatic materials.

(in mm)

(2) Minimum Quantity* (pcs./case)

Type / Thickness	GRM36/615	GRM39	GRM40
0.5 mm	50,000	—	—
0.8 mm	—	15,000	—
0.6 mm	—	—	10,000
1.25 mm	—	—	5,000

* "Minimum Quantity" means the numbers of units of each delivery or order. The quantity should be an integral multiple of the "minimum quantity" (Please note that the actual delivery quantity in a package may change sometimes.)

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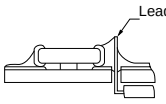
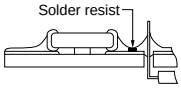
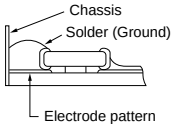
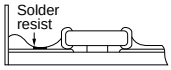
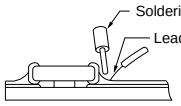
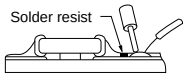
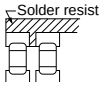
■NOTICE

Process	Cautions	Control Points	Reference Data
1. Storage of Chips	• 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℃ and an ambient humidity of 20-70% RH. Use chips within 6 months. If 6 months or more have elapsed, check solderability before use. • For GR series and GR500 series, do not unpack the minimum package until immediately before use. After unpacking, re-seal promptly or store with a desiccant. • Avoid mechanical shock (ex. falling) to the capacitor to prevent mechanical cracking inside of the ceramic dielectric due to its own weight.	Data 1 Solderability
2. Circuit Design	• These capacitors on this catalog are not safety recognized products.		
3. PCB Design	• 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]	Data 2 Board bending strength for solder fillet height Data 3 Temperature cycling for solder fillet height Data 4 Board bending strength for board material

	Incorrect	Correct
Placing of chip components and leaded components		
Placing close to chassis		
Placing of leaded components after chip components		
Lateral mounting		

[Land Dimensions]

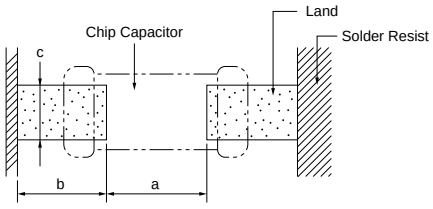


Table 1 Flow soldering method (in mm)

		GRM39 GRM420	GRM40 GRM425	GRM42-6 GRM430	LL0508	LL0612	GRH706	GRH708	GRH110
Dimen-sions	L	1.6	2.0	3.2	1.25	1.6	1.25	2.0	1.4
	W	0.8	1.25	1.6	2.0	3.2	1.0	1.25	1.4
a		0.6–1.0	1.0–1.2	2.2–2.6	0.4–0.7	0.6–1.0	0.4–0.6	1.0–1.2	0.5–0.8
b		0.8–0.9	0.9–1.0	1.0–1.1	0.5–0.7	0.8–0.9	0.6–0.8	0.9–1.0	0.8–0.9
c		0.6–0.8	0.8–1.1	1.0–1.4	1.4–1.8	2.6–2.8	0.8–1.0	0.8–1.0	1.0–1.2

NOTICE

Process	Cautions	Control Points	Reference Data

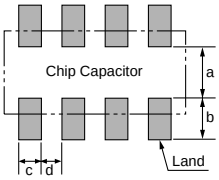
3. PCB Design

Table 2 Reflow soldering method (in mm)

		GRM33	GRM36 GRM615	GRM39 GRM420 GRM220	GRM40 GRM425 GRM225	GRM42-6 GRM430 GRM230	GRM42-2 GRM235 GRM435	GRM43-2 GRM240	GRM44-1	LL0306	LL0508	LL0612	GRH706
Dimensions	L	0.6	1.0	1.6	2.0	3.2	3.2	4.5	5.7	0.8	1.25	1.6	1.25
	W	0.3	0.5	0.8	1.25	1.6	2.5	3.2	5.0	1.6	2.0	3.2	1.0
a		0.2-0.3	0.3 -0.5	0.6-0.8	1.0-1.2	2.2-2.4	2.0-2.4	3.0-3.5	4.0-4.6	0.2-0.4	0.4-0.6	0.6-0.8	0.4-0.6
b		0.2-0.35	0.35-0.45	0.6-0.7	0.6-0.7	0.8-0.9	1.0-1.2	1.2-1.4	1.4-1.6	0.3-0.4	0.3-0.5	0.6-0.7	0.6-0.8
c		0.2-0.4	0.4 -0.6	0.6-0.8	0.8-1.1	1.0-1.4	1.8-2.3	2.3-3.0	3.5-4.8	1.0-1.4	1.4-1.8	2.6-2.8	0.8-1.0

		GRH708	GRH710	GRH110	GRH111	GR530	GR535	GR540	GR545	GR550	GR555	GR580
Dimensions	L	2.0	3.2	1.4	2.8	4.5	5.6	10.6	10.6	11.8	16.0	28.1
	W	1.25	2.5	1.4	2.8	3.8	5.0	5.0	10.0	10.6	5.0	13.2
a		1.0-1.2	2.2-2.5	0.4-0.8	1.8-2.1	3.2-3.4	4.2-4.5	8.5-9.0	8.5- 9.0	9.0-9.5	13.0-13.5	25.0-25.5
b		0.6-0.8	0.8-1.0	0.6-0.8	0.7-0.9	0.9-1.2	0.9-1.2	1.3-1.5	1.3- 1.5	1.8-2.0	1.8- 2.0	2.2- 2.4
c		0.8-1.0	1.9-2.3	1.0-1.2	2.2-2.6	3.0-3.8	4.0-5.0	4.0-5.0	8.0-10.0	8.0-10.0	4.0- 5.0	10.0-13.0

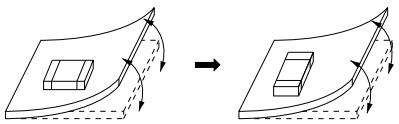
Table 3 GNM Series for reflow soldering method



Type	Dimensions (mm)					
	L	W	a	b	c	d
GNM30-401	3.2	1.6	0.8-1.0	0.7-0.9	0.3-0.4	0.4-0.5

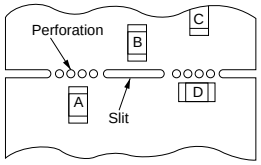
- Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[Component Direction]



Locate chip horizontal to the direction in which stress acts

[Chip Mounting Close to Board Separation point]



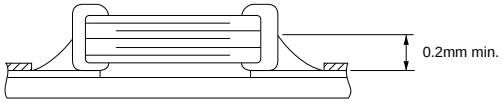
Chip arrangement
Worst A-C-(B≒D) Best

4. 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]



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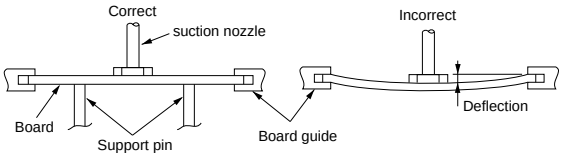
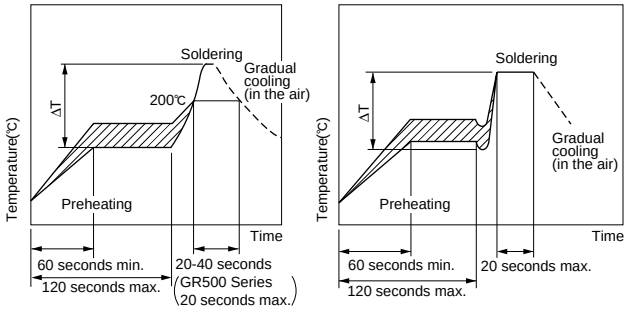
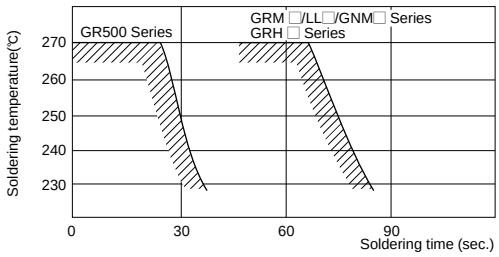
NOTICE

<table>
<tr><th>Process</th><th>Cautions</th><th>Control Points</th><th>Reference Data</th></tr>
<tr><td>5. Chip Placing</td><td>• An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips.
• 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.
• The locating claw, when worn out, imposes uneven forces on the chip when positioning, causing cracked chips.</td><td>• Adjust the suction nozzle's bottom dead point by correcting warps 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.
• The suction nozzle and the locating claw must be maintained, checked and replaced periodically.</td><td>Data 5
Break Strength</td></tr>
<tr><td>6. Reflow Soldering</td><td>• Sudden heating of the chip results in distortion due to excessive expansion and construction forces within the chip causing cracked chips.</td><td>• When preheating, keep temperature differential, ΔT, within the range shown in Table 4. The smaller the ΔT, the less stress on the chip.
Table 4
<table>
<tr><th>Chip Size</th><th>Temperature Differential</th></tr>
<tr><td>GRM33/36/39/40/42-6
GRM420/425/430/615
GRM220/225/230
LL0306/0508/0612
GRH706/708/110</td><td>ΔT≦190℃</td></tr>
<tr><td>GRM42-2/43-2/44-1/240/435
GRH710/111
GRM235/GNM30-401
GR530/535/540/545/550/555/580</td><td>ΔT≦130℃</td></tr>
</table>
• 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.

[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.</td><td></td></tr>
<tr><td>Inverting the PCB</td><td></td><td>• Make sure not to impose an abnormal mechanical shock on the PCB.</td><td></td></tr>
</table>

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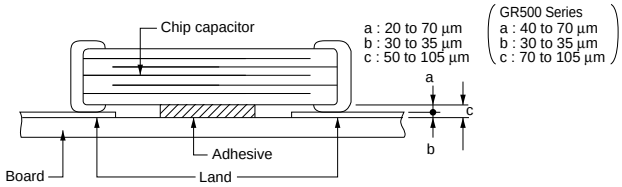
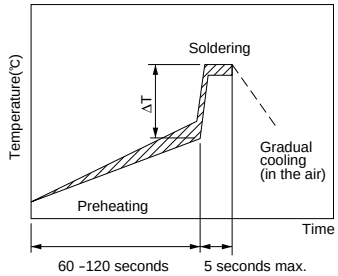
NOTICE

Process	Cautions	Control Points	Reference Data
7. Adhesive Application	• Thin or insufficient adhesive causes chips to loosen or become disconnected when flow soldered. • Low viscosity adhesive causes chips to slip after mounting.	• 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. • Adhesive must have a viscosity of 500ps (at 25℃) min. 	
8. 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 board		• Make sure not to impose an abnormal mechanical shock on the PCB..	
9. 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.	
10. Flux Application	• An excessive amount of flux generates a large quantity of flux gas, causing deteriorated solderability. • Flux containing too high a percentage of halide may cause corrosion of the outer electrodes unless sufficiently cleaned.	• Apply flux thinly and evenly throughout. (A foaming system is generally used for flow soldering). • 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.	
11. Flow Soldering	• Sudden heating of the chip results in thermal distortion causing cracked chips. • 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 5. 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 5. • Do not apply flow soldering to chips not listed in Table 5. Table 5 Chip Size: GRM39/40/42-6, GRM420/425/430, LL0508/0612, GRH706/708/110 — Temperature Differential: ΔT≦150℃ [Standard Conditions for Flow Soldering] 	Data 6 Thermal shock Data 7 Solder heat resistance

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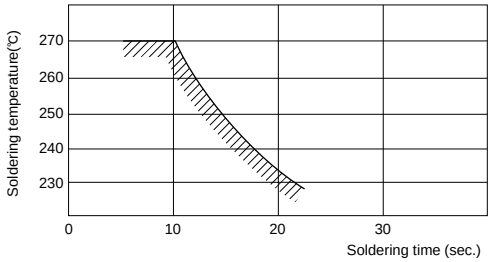
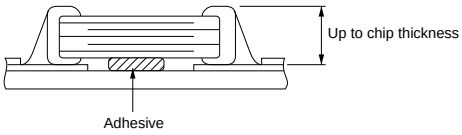
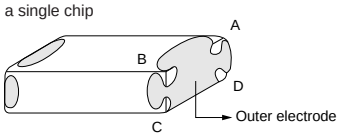
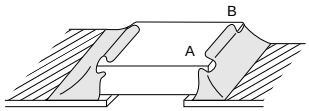
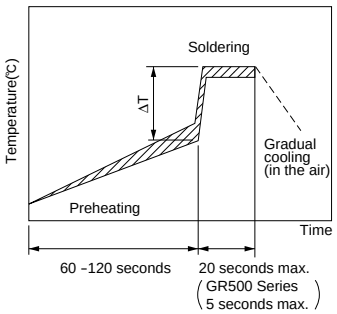
NOTICE

Process	Cautions	Control Points	Reference Data
11. 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]  • 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  	
12. Correction with a Soldering iron	<For chip type capacitors except GRM200 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 6. The smaller theΔT, the less stress on the chip. Table 6 Chip Size / Temperature Differential GRM36/39/40/42-6, GRM420/425/430/615, LL0306/0508/0612, GRH706/708/110: ΔT≦190℃ GRM42-2/43-2/44-1/435, GNM30-401, GRH710/111, GR530/535/540/545/550/555/580: ΔT≦130℃ [Standard Conditions for Soldering Iron Temperature]  	Data 8 Thermal shock when making a correction with a soldering iron

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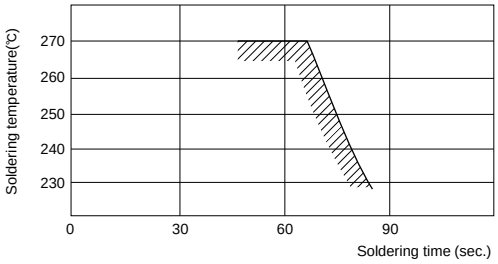
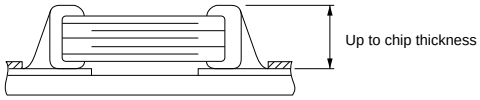
NOTICE

<table>
<tr><th>Process</th><th>Cautions</th><th>Control Points</th><th>Reference Data</th></tr>
<tr><td>12. Correction with a Soldering iron</td><td></td><td>[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 below :
 

[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 7) are met.
Preheating should be performed on chips not listed in Table 7.
Table 7
<table>
<tr><th>Item</th><th colspan="2">Conditions</th></tr>
<tr><td>Chip Size</td><td>GRM36/39/40
GRM420/425/615
LL0306/0508
GRH706/708/110</td><td>GRM42-6
GRM430
LL0612
GNM30-401</td></tr>
<tr><td>Temperature of iron tip</td><td>300℃ max.</td><td>270℃ max.</td></tr>
<tr><td>Soldering iron wattage</td><td colspan="2">20W max.</td></tr>
<tr><td>Diameter of iron tip</td><td colspan="2">ϕ 3mm max.</td></tr>
<tr><td>Restriction</td><td colspan="2">Do not allow the iron tip to directly touch the ceramic element.</td></tr>
</table></td><td>Data 8
Thermal shock when making a correction with a soldering iron</td></tr>
<tr><td></td><td><For GRM200 series></td><td>• When solder GRM200 series chip capacitor, keep the following conditions.
<Soldering iron method>
<table>
<tr><th>Item</th><th colspan="2">Conditions</th></tr>
<tr><td>Chip type</td><td>GRM220</td><td>GRM225/230/235/240</td></tr>
<tr><td>Pre-heating</td><td>no pre-heating is possible</td><td>Δ≦130℃</td></tr>
<tr><td>Temperature of iron tip</td><td colspan="2">300℃ max.</td></tr>
<tr><td>Soldering iron wattage</td><td colspan="2">20W max.</td></tr>
<tr><td>Diameter of iron tip</td><td colspan="2">ϕ 3mm max.</td></tr>
<tr><td>Soldering time</td><td colspan="2">5 sec. max.</td></tr>
<tr><td>Solder amount</td><td>≦Chip thickness</td><td>≦1/2 of chip thickness</td></tr>
<tr><td>Restriction</td><td colspan="2">Do not allow the iron tip to directly touch the ceramic element.</td></tr>
</table></td><td></td></tr>
<tr><td></td><td><For Microstrip types></td><td>• 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℃ in temperature.</td><td></td></tr>
<tr><td>13. Washing</td><td>• Excessive output of ultrasonic oscillation during cleaning causes PCBs to resonate, resulting in cracked chips or broken solder.</td><td>• Take note not to vibrate PCBs.</td><td></td></tr>
<tr><td>14. Inspection</td><td>• Thrusting force of the test probe can flex the PCB, resulting in cracked chips or open solder joints.</td><td>• Provide support pins on the back side of the PCB to prevent warping or flexing.</td><td></td></tr>
<tr><td>15. Resin Coating</td><td></td><td>• When selecting resin materials, select those with low contraction.</td><td></td></tr>
<tr><td>16. Board Separation (or Depanelization)</td><td>• Board flexing at the time of separation causes cracked chips or broken solder.</td><td>• 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.</td><td></td></tr>
</table>

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NOTICE

■DIE BONDING/WIRE BONDING (GM Series)

(1) Die Bonding of capacitors
- Use the following materials
  Braze alloy :
  Au-Si (98/2) 400 to 420℃ in N_2 atmosphere
  Au-Sn (80/20) 300 to 320℃ in N_2 atmosphere
  Au-Ge (88/12) 380 to 400℃ in N_2 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 : 20μm (0.0008 inch), 25μm (0.001 inch) diameter
- Bonding
  ① Thermocompression, ultrasonic wedge or ball bonding. Required stage temperature : 150 to 250℃.
  ② Required wedge or capillary weight : 0.2N to 0.5N.
  ③ Bond the capacitor and base substrate or other devices with gold wire.

■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.

GRM SERIES REFERENCE DATA

■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

GRM40 : 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

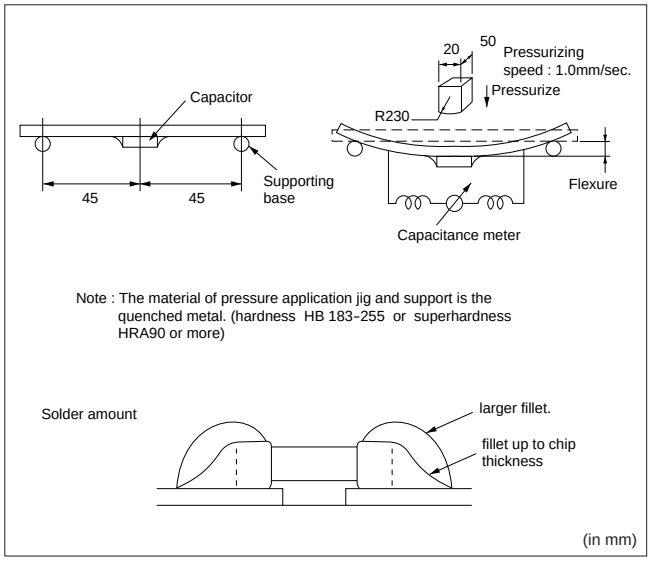
Table 1

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		
GRM40 for flow/reflow soldering	95 to 100%	95 to 100%	95%	95 to 95%	95%

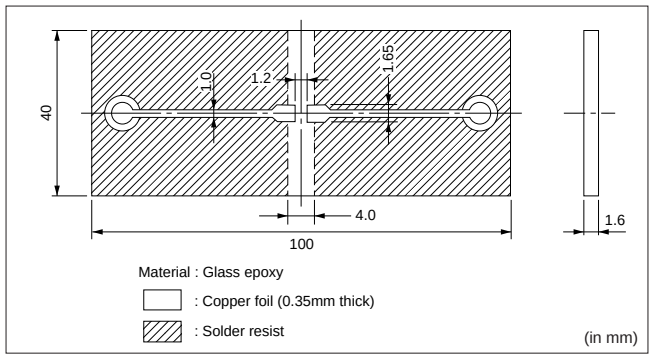
2. Board Bending Strength for Solder Fillet Height

(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 board



(3) Test samples

GRM40 C0G/X7R/Y5V Characteristics T=0.6mm

(4) Acceptance criteria

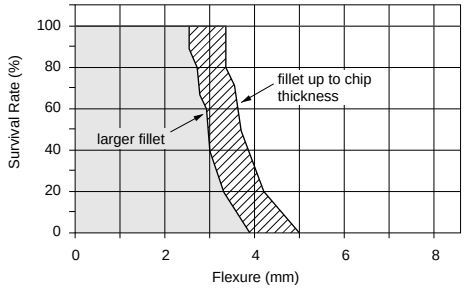
Products shall be determined to be defective if the change in capacitance has exceeded the values specified in Table 2.

Table 2

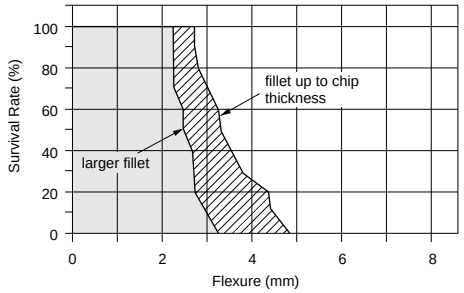
Characteristics	Change in Capacitance
C0G	Within ±5% or ±0.5pF, whichever is greater
X7R	Within ±12.5%
Y5V	Within ±20%

(5) Results

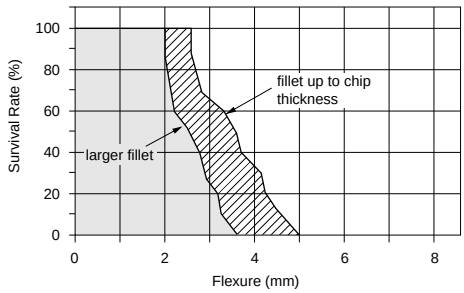
GRM40 C0G (T=0.6)



GRM40 X7R (T=0.6)



GRM40 Y5V (T=0.6)



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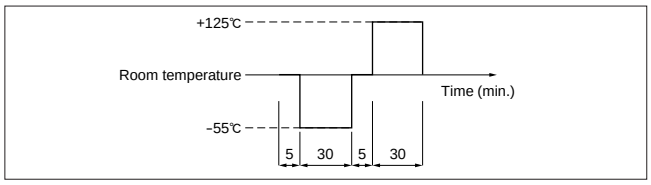
3. Temperature Cycling for Solder Fillet Height

(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.



Solder Amount :

Substrate		Alumina*1	Glass Epoxy*2 or Paper Phenol
Solder Amount	①	0.5T	T
	②	0.7T	1.3T
	③	T	1.6T
Solder to be used		6×4 Eutectic solder	

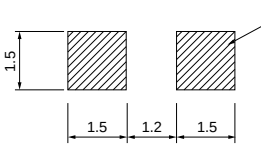
∗1 : Alumina substrates are typically designed for reflow soldering.

∗2 : Glass epoxy or paper phenol substrates are typically used for flow soldering.

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

(4) Results

Land Dimension :



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

(2) Test samples

GRM40 C0G/X7R/Y5V Characteristics T=0.6mm

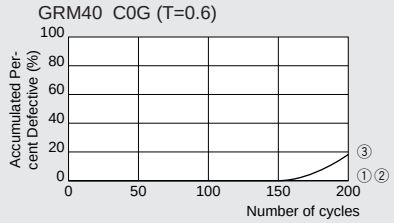
(3) Acceptance criteria

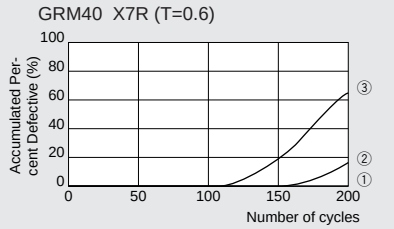
Products shall be determined to be defective if the change in capacitance has exceeded the values specified in Table 3.

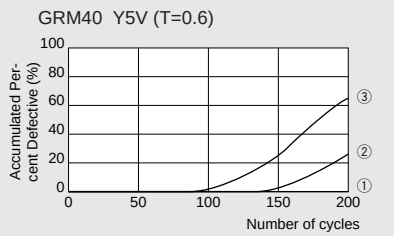
Table 3

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

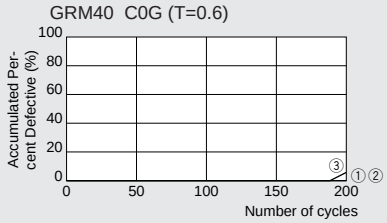
Alumina substrate

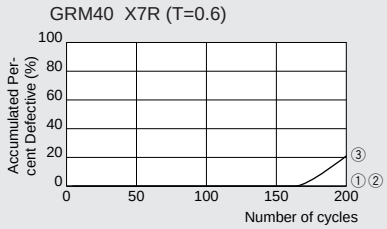


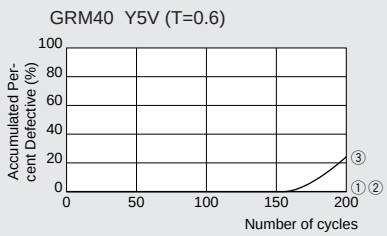




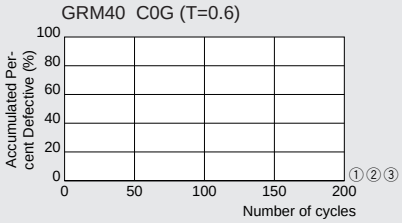
Glass epoxy substrate

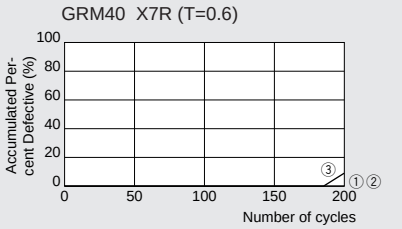


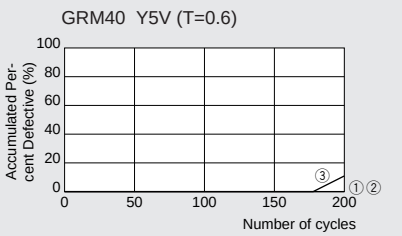




Paper phenol substrate







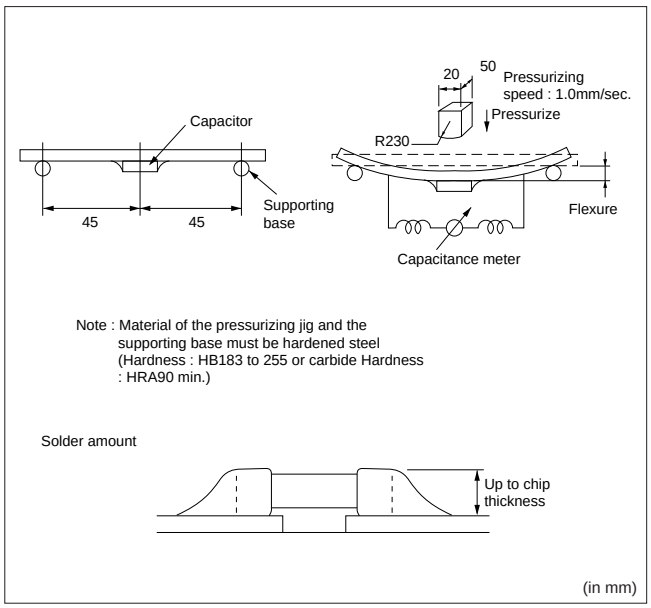
8

GRM SERIES REFERENCE DATA

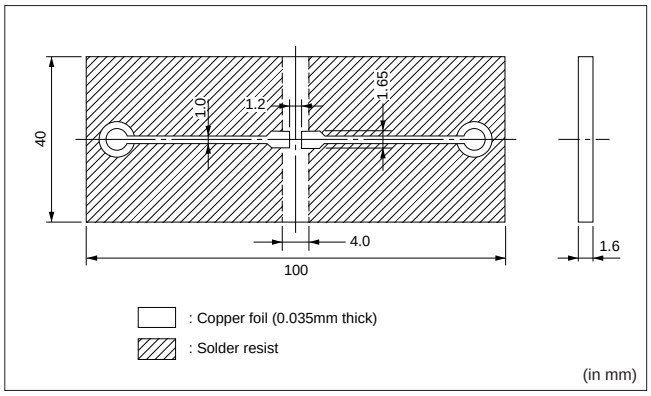
4. Board Bending Strength for Board Material

(1) Test method

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



(2) Test board



(3) Test samples

GRM40 C0G/X7R/Y5V Characteristics T=0.6mm typical

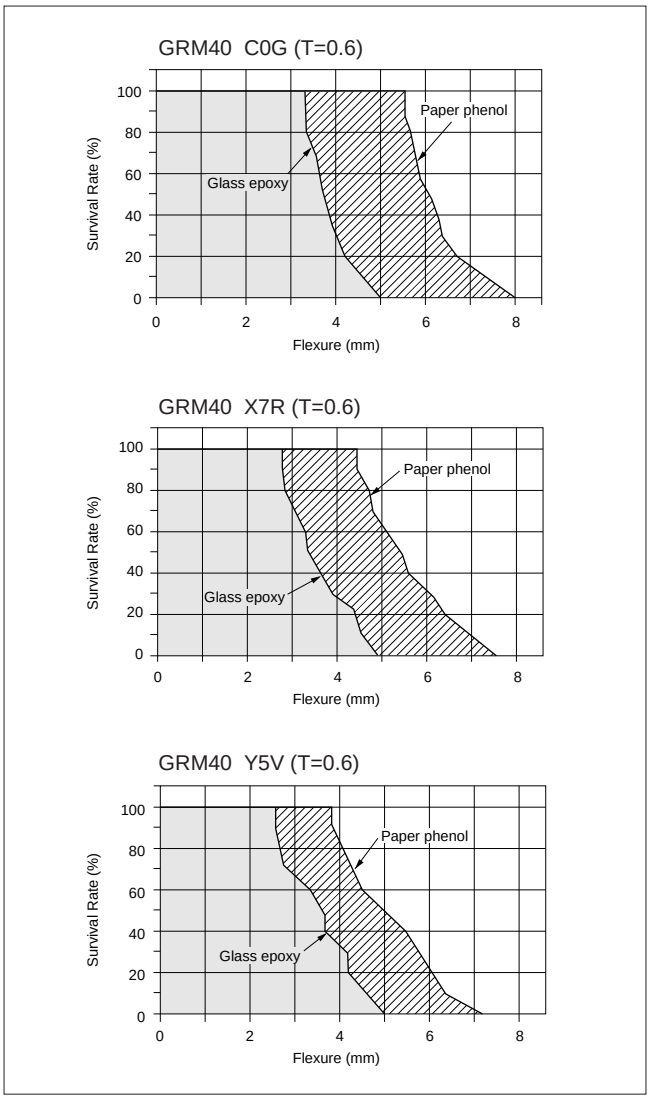
(4) Acceptance criteria

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%

(5) Results



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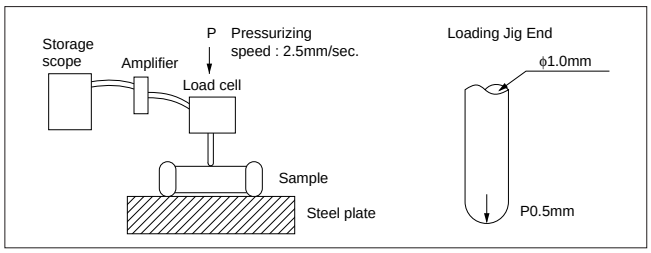
5. Break Strength

(1) Test method

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



(2) Test samples

GRM40 C0G/X7R/Y5V Characteristics
GRM42-6 C0G/X7R/Y5V Characteristics

(3) Acceptance criteria

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

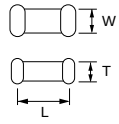
(4) Explanation

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 :

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

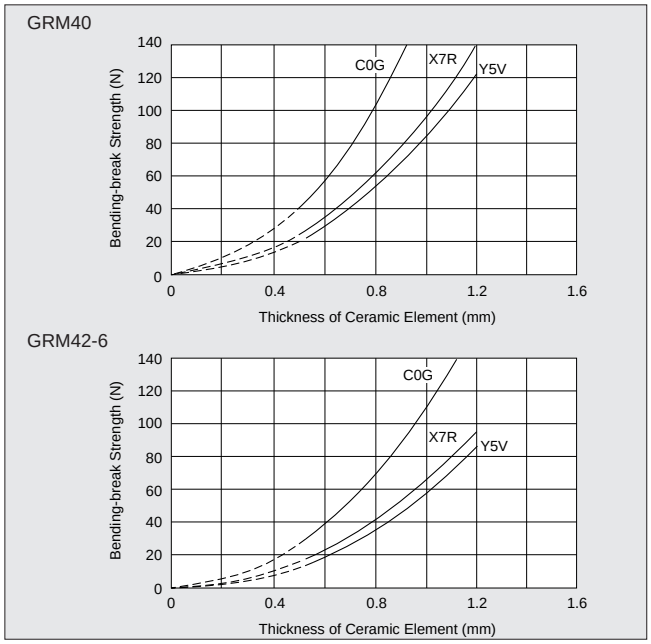
W : Width of ceramic element (mm)
T : Thickness of element (mm)
L : Distance between fulcrums (mm)
γ : Bending stress (N/mm²)



Chip size		GRM40	GRM42-6
L		1.5	2.7
W		1.2	1.5
γ	C0G Characteristics	300	
	X7R Characteristics	180	
	Y5V Characteristics	160	

(in mm)

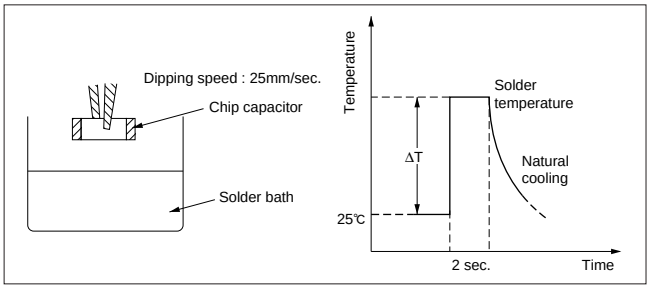
(5) Results



6. Thermal Shock

(1) Test method

After applying flux (an ethanol solution of 25% rosin), dip the chip in a solder bath (6X4 eutectic solder) in accordance with the following conditions :



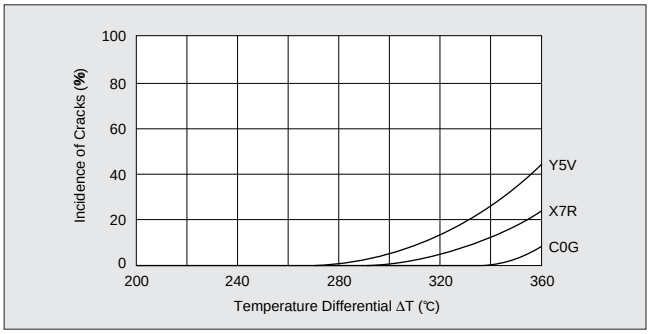
(2) Test samples

GRM40 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.

(4) Results



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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.

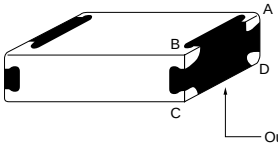
③ Flux to be used : An ethanol solution of 25 % rosin.

④ 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.

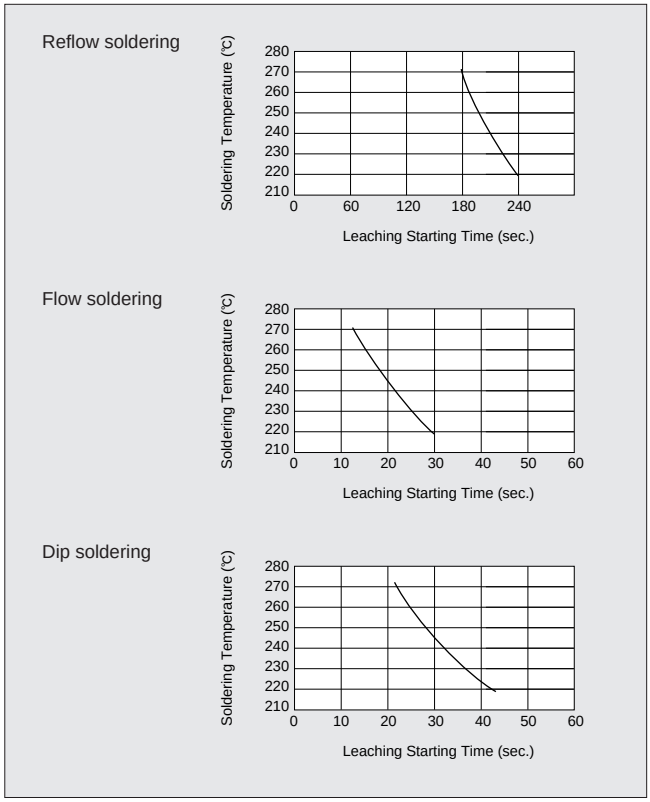
⑤ Flux to be used : An ethanol solution of 25 % rosin.

(2) Test samples
GRM40 : 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 :

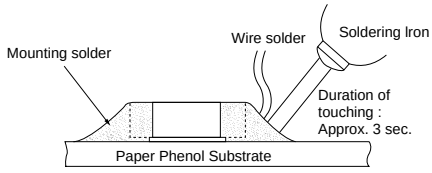


(4) Results



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.)

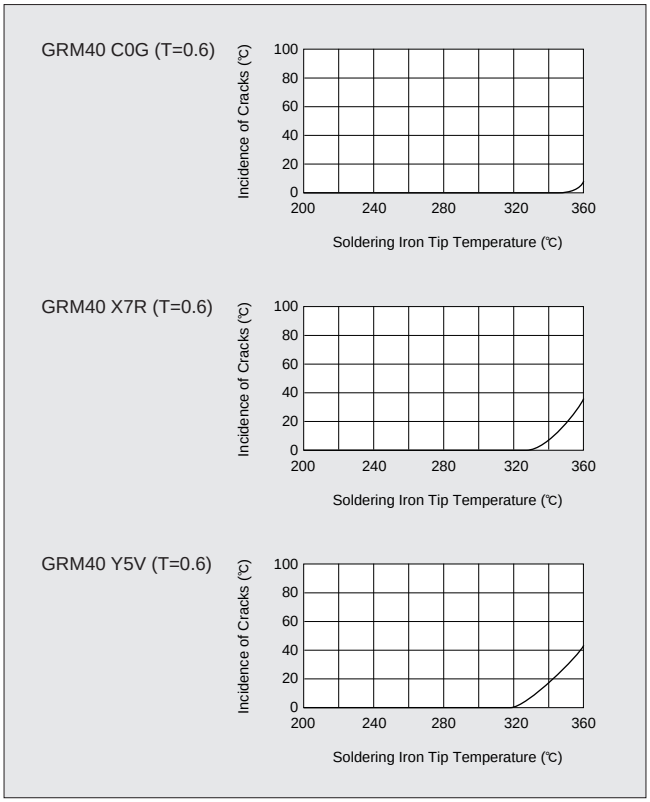


Soldering Iron	Tip diameter
Ceramic heater 20W	ϕ3mm

(2) Test samples
GRM40 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



8

■PART NUMBERING

(✻Please specify the part number when ordering)

(Ex.)	GHM10	40	SL	101	J	3K	
	❶	❷	❸	❹	❺	❻	❼

❶Type

GHM××

GHM plus two digits denote the series.

Code	Series	Feature
GHM10	GHM1000	Low dissipation
GHM15	GHM1500	High-capacitance General electrical equipment
GHM21	GHM2000	AC-rated capacitor
GHM22	GHM2000	AC-rated capacitor
GHM30	GHM3000	Safety standard recognized Y capacitor
GHM31	GHM3000	Safety standard recognized X capacitor

❷Dimension

Code (EIA Code)	Dimension (mm)	Code (EIA Code)	Dimension (mm)
25 (0805)	2.0×1.25	40 (1812)	4.5×3.2
30 (1206)	3.2×1.6	43 (2211)	5.7×2.8
35 (1210)	3.2×2.5	45 (2220)	5.7×5.0
38 (1808)	4.5×2.0		

❸Temperature Characteristics

Code	Temp. Coeff./Cap. Change	Temp. Range (℃)	Remarks
SL	+350 to −1000ppm/℃	+20 to + 85	
B	±10%	−25 to + 85	Equivalent to X7R✻
R	±15%	−55 to +125	Equivalent to X7R✻
X7R	±15%	−55 to +125	

✻ Except GHM2000 series

❹Nominal Capacitance

The first two digits represent significant figures ;
the last digit represents the multiplier of 10 in pF.

Code (Ex.)	Value (pF)	Code (Ex.)	Value (pF)
100	10	223	22,000
121	120	104	100,000
472	4,700	–	–

❺Capacitance Tolerance

Code	Tolerance
D	±0.5pF
J	± 5%
K	± 10%
M	± 20%

❻Rated Voltage

Code	Voltage
250	DC250V
630	DC630V
1K	DC1kV
2K	DC2kV
3K	DC3.15kV
AC250	AC250V (r.m.s.)

✻ Not apply to GHM3000 series [Rated Voltage : AC250V (r.m.s.)]

❼Type Designation

Code	Type Designation
-GC	Type GC
-GB	Type GB

✻ Apply to GHM3000 series.

■CAPACITANCE RANGE TABLE

Type	Temp. Char.	Rated Voltage	Nominal Capacitance Range (pF)
			10 50 100 500 1,000 5,000 10,000 50,000 100,000 500,000
GHM1030	R	DC630V	100—1,000
		DC1kV	47—470
GHM1030	SL	DC2kV	10—22
GHM1035	SL	DC2kV	27—82
GHM1040	SL	DC2kV	120—220
GHM1038	SL	DC3.15kV	10—82
GHM1040	SL	DC3.15kV	100
GHM1525	B	DC250V	1,000—10,000
GHM1530	B	DC250V	15,000—47,000
		DC630V	1,000—10,000
GHM1535	B	DC250V	68,000 • 100,000
		DC630V	15,000 • 22,000
GHM1540	B	DC250V	150,000 • 220,000
		DC630V	33,000—100,000
GHM1545	B	DC250V	330,000 • 470,000
		DC630V	150,000 • 220,000
GHM2143	B	AC250V (r.m.s.)	10,000—47,000
GHM2145	B	AC250V (r.m.s.)	100,000
GHM2243	B	AC250V (r.m.s.)	470—4,700
GHM3045	X7R	AC250V (r.m.s.)	100—4,700
GHM3145	X7R	AC250V (r.m.s.)	10,000—33,000

9

MONOLITHIC CERAMIC CAPACITOR

Medium voltage Low Dissipation **GHM1000** Series

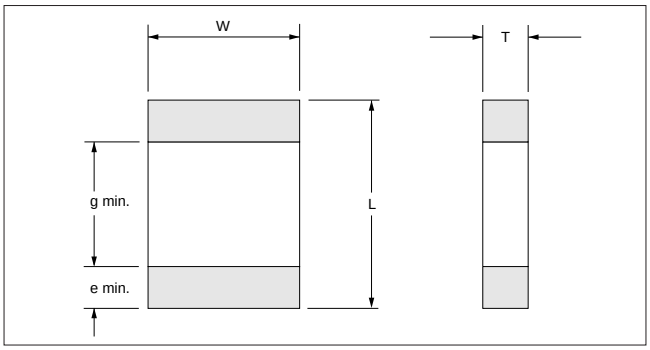
■FEATURES

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 allow mounting without silver compound solder.
4. The GHM1030 type for flow and reflow soldering, and other types for reflow soldering.
5. Low-loss and suitable for high-frequency circuits.

■APPLICATIONS

1. 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. (R Characteristics)
2. Ideal for use as the ballast in liquid crystal back-lighting inverters. (SL Characteristics)

■DIMENSIONS



Type (EIA Code)	Dimensions (mm)				
	L	W	T	g	e
GHM1030 (1206)	3.2±0.2	1.6±0.2	See "STANDARD LIST"	1.5*	0.3
GHM1035 (1210)	3.2±0.2	2.5±0.2		1.8	
GHM1038 (1808)	4.5±0.3	2.0±0.2		2.9	
GHM1040 (1812)	4.5±0.3	3.2±0.6			

* 1.8mm for SL 2kV

■STANDARD LIST

Temperature Compensating Type SL Characteristic (+350 to −1000ppm/℃)

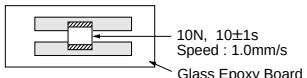
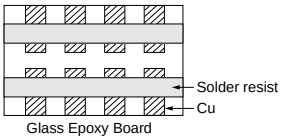
Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	DC Rated Volt. (V)	Packaging Qty. (pcs./reel)
	L	W	T				
GHM1030 SL 100 D 2K	3.2±0.2	1.6±0.2	$1.25^{+0}_{-0.3}$	10	±0.5pF	2k	3,000
GHM1030 SL 120 J 2K				12	±5%		
GHM1030 SL 150 J 2K				15			
GHM1030 SL 180 J 2K				18			
GHM1030 SL 220 J 2K				22			
GHM1035 SL 270 J 2K		2.5±0.2	$1.5^{+0}_{-0.3}$	27			2,000
GHM1035 SL 330 J 2K				33			
GHM1035 SL 390 J 2K				39			
GHM1035 SL 470 J 2K				47			
GHM1035 SL 560 J 2K				56			
GHM1035 SL 680 J 2K				68			
GHM1035 SL 820 J 2K				82			
GHM1040 SL 121 J 2K	4.5±0.3	3.2±0.3	$2.0^{+0}_{-0.3}$	120	±5%	2k	1,000
GHM1040 SL 151 J 2K				150			
GHM1040 SL 181 J 2K				180			
GHM1040 SL 221 J 2K				220			
GHM1038 SL 100 D 3K	4.5±0.3	2.0±0.2	2.0 ±0.3	10	±0.5pF	3.15k	2,000
GHM1038 SL 120 J 3K				12	±5%		
GHM1038 SL 150 J 3K				15			
GHM1038 SL 180 J 3K				18			
GHM1038 SL 220 J 3K				22			
GHM1038 SL 270 J 3K				27			
GHM1038 SL 330 J 3K				33			
GHM1038 SL 390 J 3K				39			
GHM1038 SL 470 J 3K				47			
GHM1038 SL 560 J 3K				56			
GHM1038 SL 680 J 3K				68			
GHM1038 SL 820 J 3K				82			
GHM1040 SL 101 J 3K	4.5±0.3	3.2±0.3	$2.5^{+0}_{-0.3}$	100			500

High Dielectric Constant Type R Characteristic (±15%)

Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	DC Rated Volt. (V)	Packaging Qty. (pcs./reel)
	L	W	T				
GHM1030 R 101 K 630	3.2±0.2	1.6±0.2	$1.0^{+0}_{-0.3}$	100	±10%	630	4,000
GHM1030 R 151 K 630				150			
GHM1030 R 221 K 630				220			
GHM1030 R 331 K 630				330			
GHM1030 R 471 K 630			$1.25^{+0}_{-0.3}$	470			3,000
GHM1030 R 681 K 630				680			
GHM1030 R 102 K 630				1,000			
GHM1030 R 470 K 1K	3.2±0.2	1.6±0.2	$1.0^{+0}_{-0.3}$	47	±10%	1k	4,000
GHM1030 R 680 K 1K				68			
GHM1030 R 101 K 1K				100			
GHM1030 R 151 K 1K				150			
GHM1030 R 221 K 1K				220			
GHM1030 R 331 K 1K				330			
GHM1030 R 471 K 1K			$1.25^{+0}_{-0.3}$	470			3,000

9

■SPECIFICATIONS AND TEST METHODS

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type (SL Char.)</th><th>High Dielectric Constant Type (R Char.)</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td colspan="2">−55 to +125℃</td><td>–</td></tr>
<tr><td>2</td><td>Appearance</td><td colspan="2">No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>3</td><td>Dimensions</td><td colspan="2">Within the specified dimension.</td><td>Using Calipers.</td></tr>
<tr><td>4</td><td>Dielectric Strength</td><td colspan="2">No defects or abnormalities.</td><td>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.
<table><tr><th>Rated voltage</th><th>Test voltage</th></tr><tr><td>More than DC 1kV</td><td>120% of the rated voltage</td></tr><tr><td>Less than DC 1kV</td><td>150% of the rated voltage</td></tr></table></td></tr>
<tr><td>5</td><td>Insulation Resistance (I. R.)</td><td colspan="2">More than 10,000MΩ</td><td>The insulation resistance shall be measured with 500±50V and within 60±5 s of charging.</td></tr>
<tr><td>6</td><td>Capacitance</td><td colspan="2">Within the specified tolerance.</td><td rowspan="2">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.)</td></tr>
<tr><td>7</td><td>Q/ Dissipation Factor (D.F.)</td><td>C≧30pF : Q≧1,000
C<30pF : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>D.F.≦0.01</td></tr>
<tr><td>8</td><td>Capacitance Temperature Characteristics</td><td>Temp. Coefficient
+350 to −1,000 ppm/℃
(Temp. Range : +20 to +85℃)</td><td>Cap. Change
Within ±15%</td><td>(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 (+20 to +85 ℃) the capacitance shall be within the specified tolerance for the temperature coefficient.
<table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>20±2</td></tr><tr><td>2</td><td>Min. Operating Temp.±3</td></tr><tr><td>3</td><td>20±2</td></tr><tr><td>4</td><td>Max. Operating Temp.±2</td></tr><tr><td>5</td><td>20±2</td></tr></table>(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.</td></tr>
<tr><td>9</td><td>Adhesive Strength of Termination</td><td colspan="2">No removal of the terminations or other defects shall occur.</td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig.1 using a eutectic solder.
Then apply 10N force in the direction of the arrow.
The soldering 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</td></tr>
<tr><td rowspan="3">10</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).
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).
  </td></tr>
<tr><td>Capacitance</td><td colspan="2">Within the specified tolerance.</td></tr>
<tr><td>Q/D.F.</td><td>C≧30pF : Q≧1,000
C<30pF : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>D.F.≦0.01</td></tr>
</table>

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

9

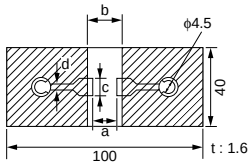
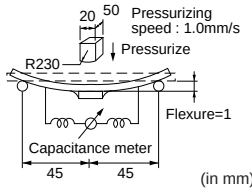
<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type (SL Char.)</th><th>High Dielectric Constant Type (R Char.)</th></tr>
<tr><td>11</td><td colspan="2">Deflection</td><td colspan="2">No cracking or marking defects shall occur.
 

Fig. 2
<table>
<tr><th rowspan="2">L×W (mm)</th><th colspan="4">Dimension (mm)</th></tr>
<tr><th>a</th><th>b</th><th>c</th><th>d</th></tr>
<tr><td>3.2×1.6</td><td>2.2</td><td>5.0</td><td>2.0</td><td rowspan="4">1.0</td></tr>
<tr><td>3.2×2.5</td><td>2.2</td><td>5.0</td><td>2.9</td></tr>
<tr><td>4.5×2.0</td><td>3.5</td><td>7.0</td><td>2.4</td></tr>
<tr><td>4.5×3.2</td><td>3.5</td><td>7.0</td><td>3.7</td></tr>
</table></td><td>Solder the capacitor to the testing jig (glass epoxy board) shown in Fig.2 using a eutectic solder.
Then apply a force in the direction shown in Fig. 3.
The soldering 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.
 

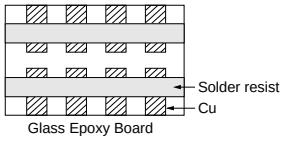
(in mm) Fig. 3</td></tr>
<tr><td>12</td><td colspan="2">Solderability of Termination</td><td colspan="2">75% of the terminations are to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse 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 colspan="2">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 for high dielectric constant type
Perform a heat treatment at 150$^{+}_{-10}{}^{0}$℃ 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 ±2.5% or ±0.25pF (Whichever is larger)</td><td>Within ±10%</td></tr>
<tr><td>Q/D.F.</td><td>C≧30pF : Q≧1,000
C<30pF : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>D.F.≦0.01</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">Pass the item No.4.</td></tr>
<tr><td rowspan="5">14</td><td rowspan="5">Temperature Cycle</td><td>Appearance</td><td colspan="2">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 for high dielectric constant type
Perform a heat treatment at 150$^{+}_{-10}{}^{0}$℃ 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 ±2.5% or ±0.25pF (Whichever is larger)</td><td>Within ±10%</td></tr>
<tr><td>Q/D.F.</td><td>C≧30pF : Q≧1,000
C<30pF : Q≧400+20C
C : Nominal Capacitance (pF)</td><td>D.F.≦0.01</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">Pass the item No.4.</td></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$^{+}_{-10}{}^{0}$℃ 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

9

MONOLITHIC CERAMIC CAPACITOR

High-capacitance for General Electrical Equipment **GHM1500** Series

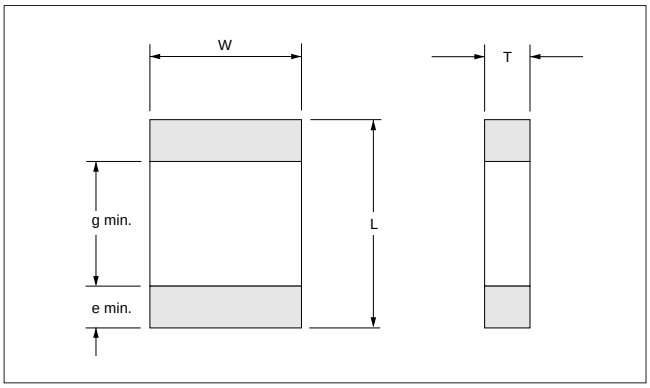
■FEATURES

1. A new monolithic structure for small, high-capacitance capable of operating at high-voltage levels.
2. Sn-plated external electrodes allow mounting without silver compound solder.
3. The GHM1525/1530 type for flow and reflow soldering, and other types for reflow soldering.

■APPLICATIONS

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

■DIMENSIONS



Type (EIA Code)	Dimensions (mm)				
	L	W	T	g	e
GHM1525 (0805)	2.0±0.2	1.25±0.2	See "STANDARD LIST"	0.7	0.3
GHM1530 (1206)	3.2±0.2	1.6±0.2		1.5	
GHM1535 (1210)	3.2±0.3	2.5±0.2			
GHM1540 (1812)	4.5±0.4	3.2±0.3		2.5	
GHM1545 (2220)	5.7±0.4	5.0±0.4		3.5	

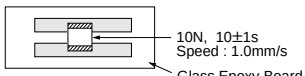
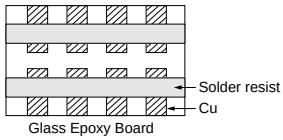
■STANDARD LIST

High Dielectric Constant Type B Characteristic (±10%)

Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	DC Rated Volt. (V)	Packaging Qty. (pcs./reel)
	L	W	T				
GHM1525 B 102 K 250	2.0±0.2	1.25±0.2	1.0 $^{+}_{-}{}^{0}_{0.3}$	1,000	±10%	250	4,000
GHM1525 B 152 K 250				1,500			
GHM1525 B 222 K 250				2,200			
GHM1525 B 332 K 250				3,300			
GHM1525 B 472 K 250				4,700			
GHM1525 B 682 K 250				6,800			
GHM1525 B 103 K 250			1.25±0.2	10,000			3,000
GHM1530 B 153 K 250	3.2±0.2	1.6±0.2	1.0 $^{+}_{-}{}^{0}_{0.3}$	15,000			4,000
GHM1530 B 223 K 250				22,000			
GHM1530 B 333 K 250			1.25$^{+}_{-}{}^{0}_{0.3}$	33,000			3,000
GHM1530 B 473 K 250			1.6 ±0.2	47,000			2,000
GHM1535 B 683 K 250	3.2±0.3	2.5±0.2	1.5 $^{+}_{-}{}^{0}_{0.3}$	68,000			
GHM1535 B 104 K 250			2.0 $^{+}_{-}{}^{0}_{0.3}$	100,000			1,000
GHM1540 B 154 K 250	4.5±0.4	3.2±0.3		150,000			
GHM1540 B 224 K 250			2.5 $^{+}_{-}{}^{0}_{0.3}$	220,000			500
GHM1545 B 334 K 250	5.7±0.4	5.0±0.4	2.0 $^{+}_{-}{}^{0}_{0.3}$	330,000			1,000
GHM1545 B 474 K 250				470,000			
GHM1530 B 102 K 630	3.2±0.2	1.6±0.2	1.25$^{+}_{-}{}^{0}_{0.3}$	1,000		630	3,000
GHM1530 B 152 K 630				1,500			
GHM1530 B 222 K 630				2,200			
GHM1530 B 332 K 630				3,300			
GHM1530 B 472 K 630				4,700			
GHM1530 B 682 K 630				6,800			
GHM1530 B 103 K 630				10,000			
GHM1535 B 153 K 630	3.2±0.3	2.5±0.2	1.5 $^{+}_{-}{}^{0}_{0.3}$	15,000			2,000
GHM1535 B 223 K 630				22,000			
GHM1540 B 333 K 630	4.5±0.4	3.2±0.3		33,000			1,000
GHM1540 B 473 K 630				47,000			
GHM1540 B 683 K 630			2.0 $^{+}_{-}{}^{0}_{0.3}$	68,000			
GHM1540 B 104 K 630			2.6 $^{+}_{-}{}^{0}_{0.3}$	100,000			500
GHM1545 B 154 K 630	5.7±0.4	5.0±0.4	2.0 $^{+}_{-}{}^{0}_{0.3}$	150,000			1,000
GHM1545 B 224 K 630			2.7 $^{+}_{-}{}^{0}_{0.3}$	220,000			500

9

■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 dimension.	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.)
7	Dissipation Factor (D.F.)		0.025 max.	
8	Capacitance Temperature Characteristics		Cap. Change Within ±10% (Temp. Range : −25 to +85℃)	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$^{+}_{-10}$℃ 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 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
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.	
		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.

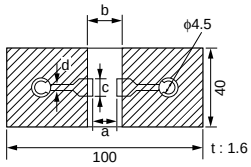
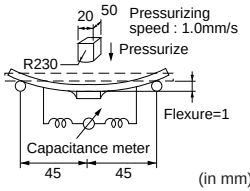


Fig. 2

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	



(in mm) Fig. 3

12	Solderability of Termination	75% of the terminations are to be soldered evenly and continuously.	Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Immerse in eutectic solder solution for 2±0.5 s at 235±5℃. Immersing speed : 25±2.5mm/s

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

9

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="5">13</td><td rowspan="5">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects.</td><td rowspan="5">Preheat the capacitor at 120 to 150℃* 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.

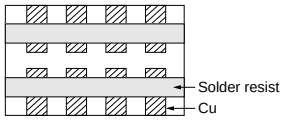
*Preheating for more than 3.2×2.5mm
<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100℃ to 120℃</td><td>1 min</td></tr><tr><td>2</td><td>170℃ to 200℃</td><td>1 min</td></tr></table></td></tr>
<tr><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td>D.F.</td><td>0.025 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

MONOLITHIC CERAMIC CAPACITOR

Ceramic Capacitor for AC250V **GHM2000** Series

Products which are based on the Standards of the Electrical Appliance And Material control Law of Japan

■FEATURES

1. Chip monolithic 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 allow mounting without silver compound solder.
4. Only for Reflow soldering.

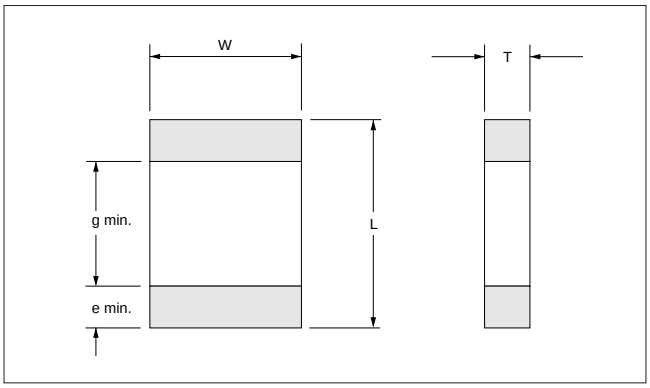
■APPLICATIONS

Noise filter for switching power supply, telephone, facsimile and modem.

■REFERENCE STANDARD

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

■DIMENSIONS



Type (EIA Code)	Dimensions (mm)				
	L	W	T	g	e
GHM2143 (2211)	5.7±0.4	2.8±0.3	2.0±0.3	3.5	0.3
GHM2145 (2220)		5.0±0.4			
GHM2243 (2211)		2.8±0.3			

■STANDARD LIST

B Characteristic (±10%)

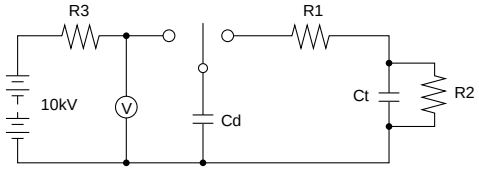
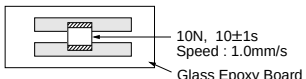
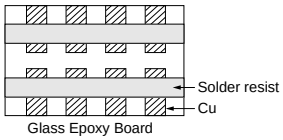
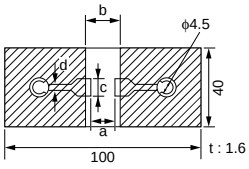
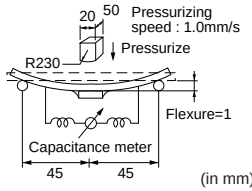
[GHM21xx (Line to line capacitor)]

Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	AC Rated Volt. [V (r.m.s.)]	Packaging Qty. (pcs./reel)
	L	W	T				
GHM2143 B 103 M AC250	5.7±0.4	2.8±0.3	2.0±0.3	10,000	±20%	250	1,000
GHM2143 B 223 M AC250				22,000			
GHM2143 B 473 M AC250				47,000			
GHM2145 B 104 M AC250		5.0±0.4		100,000			

[GHM22xx (Line to earth capacitor)]

Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	AC Rated Volt. [V (r.m.s.)]	Packaging Qty. (pcs./reel)
	L	W	T				
GHM2243 B 471 M AC250	5.7±0.4	2.8±0.3	2.0±0.3	470	±20%	250	1,000
GHM2243 B 102 M AC250				1,000			
GHM2243 B 222 M AC250				2,200			
GHM2243 B 472 M AC250				4,700			

■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 dimension.	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. GHM21xx: AC575V (r.m.s.) GHM22xx: 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.)
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 $^{+}_{-10}$ ℃ for 60±5 min and then let sit for 24±2 h at room condition.
9	Discharge Test (Application: GHM22xx)	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 detects 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.	
12	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.  Fig. 2 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 / 1.0  (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

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

9

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>14</td><td>Humidity Insulation</td><td>Appearance</td><td>No marking defects.</td><td rowspan="6">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.</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td></td><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td></td><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td>15</td><td>Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects.</td><td rowspan="6">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.

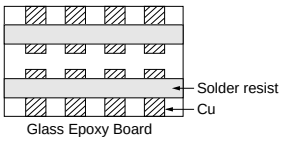
✻Preheating
<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100℃ to 120℃</td><td>1 min</td></tr><tr><td>2</td><td>170℃ to 200℃</td><td>1 min</td></tr></table></td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 2,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>16</td><td>Temperature Cycle</td><td>Appearance</td><td>No marking defects.</td><td rowspan="6">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></td><td></td><td>Capacitance Change</td><td>Within ±7.5%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.025 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 2,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>17</td><td>Humidity (Steady State)</td><td>Appearance</td><td>No marking defects.</td><td rowspan="6">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></td><td></td><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>18</td><td>Life</td><td>Appearance</td><td>No marking defects.</td><td rowspan="6">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></th><th>Test Time</th><th>Test voltage</th></tr><tr><td>GHM21xx</td><td>$1{,}000^{+48}_{0}$ h</td><td>AC300V (r.m.s.)</td></tr><tr><td>GHM22xx</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></td><td></td><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>19</td><td>Humidity Loading</td><td>Appearance</td><td>No marking defects.</td><td rowspan="6">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></td><td></td><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td></td><td></td><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

9

MONOLITHIC CERAMIC CAPACITOR

Safety Standard Recognized **GHM3000** Series

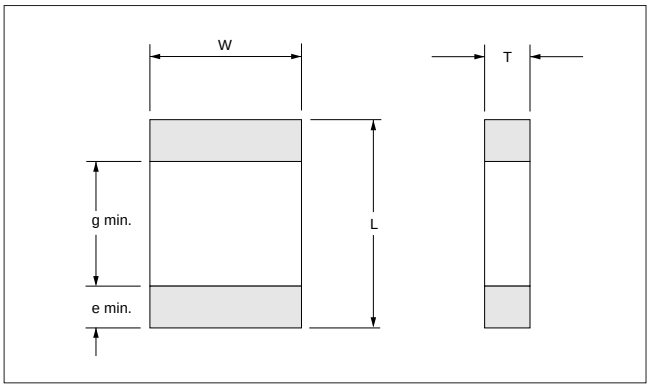
■FEATURES

1. Chip monolithic 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, line by pass capacitor in UL1414.
6. +125℃ guaranteed.
7. Only for Reflow soldering.

■APPLICATIONS

1. Ideal use as Y capacitor or X capacitor for various switching power supply.
2. Ideal use as line filter for modem.

■DIMENSIONS



Type (EIA Code)	Dimensions (mm)				
	L	W	T	g	e
GHM3045 (2220)	5.7±0.4	5.0±0.4	See "STANDARD LIST"	4.0	0.3
GHM3145 (2220)					

■STANDARD NO.

	Standard No.	Status of Recognition		AC Rated Voltage [V (r.m.s.)]
		Type GB	Type GC	
UL	UL1414	—	◎*	250
BSI	EN132400	—	◎	
VDE		◎	◎	
SEV		◎	◎	
SEMKO		◎	◎	
EN132400 Class		X2	X1, Y2	

* Line By Pass only

■STANDARD LIST

High Dielectric Constant Type X7R Characteristic (±15%)

Type GC

Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	AC Rated Volt. [V (r.m.s.)]	Packaging Qty. (pcs./reel)
	L	W	T				
GHM3045 X7R 101K -GC	5.7±0.4	5.0±0.4	2.0±0.3	100	±10%	250	1,000
GHM3045 X7R 151K -GC				150			
GHM3045 X7R 221K -GC				220			
GHM3045 X7R 331K -GC				330			
GHM3045 X7R 471K -GC				470			
GHM3045 X7R 681K -GC				680			
GHM3045 X7R 102K -GC				1,000			
GHM3045 X7R 152K -GC				1,500			
GHM3045 X7R 222K -GC				2,200			
GHM3045 X7R 332K -GC				3,300			
GHM3045 X7R 472K -GC				4,700			

Type GB

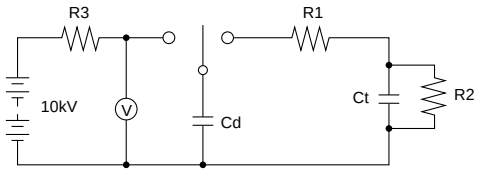
Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	AC Rated Volt. [V (r.m.s.)]	Packaging Qty. (pcs./reel)
	L	W	T				
GHM3145 X7R 103K -GB	5.7±0.4	5.0±0.4	2.0±0.3	10,000	±10%	250	1,000
GHM3145 X7R 153K -GB				15,000			
GHM3145 X7R 223K -GB				22,000			
GHM3145 X7R 333K -GB			2.7±0.3	33,000			500

9

■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 dimension.	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.
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.)
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 $^{+}_{-10}$ ℃ 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.
		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 detects 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.
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.	
12	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.
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% rin in weight proportion). Immerse in eutectic solder solution for 2±0.5 s at 235±5℃. Immersing speed : 25±2.5mm/s

Test voltage	
Type GB	DC1075V
Type GC	AC1500V (r.m.s.)



Ct : Capacitor under test Cd : 0.001μF
R1 : 1,000Ω R2 : 100MΩ R3 : Surge resistance

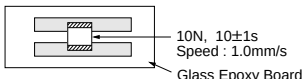
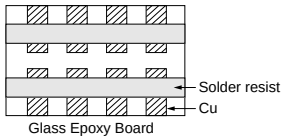


Fig. 1



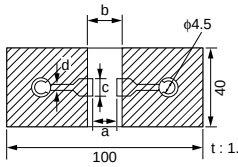
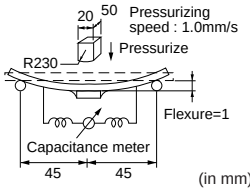


Fig. 2

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



(in mm) Fig. 3

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

9

<table>
<tr><th>No.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>14</td><td>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.

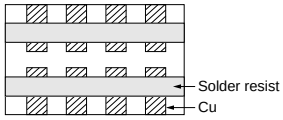
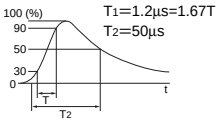
*Preheating
<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100℃ to 120℃</td><td>1 min</td></tr><tr><td>2</td><td>170℃ to 200℃</td><td>1 min</td></tr></table></td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>Within ±10%</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 1,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td>15</td><td>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></td><td></td><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td>16</td><td>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></td><td></td><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td>17</td><td>Life</td><td>Appearance</td><td>No marking defects.</td><td rowspan="5">Impulse Voltage
Each individual capacitor shall be subjected to a 2.5kV (Type GC:5kV) Impulses (the voltage value means zero to peak) for three times. Then the capacitors are applied to life test.
 

Apply voltage as Table for 1,000 h at 125$^{+2}_{0}$ ℃, relative humidity 50% max.
<table><tr><th>Type</th><th>Applied voltage</th></tr><tr><td>GB</td><td>AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1s.</td></tr><tr><td>GC</td><td>AC425V (r.m.s.), except that once each hour the voltage is increased to AC1,000V (r.m.s.) for 0.1s.</td></tr></table></td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>Within ±20%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
<tr><td>18</td><td>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.</td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>Within ±15%</td></tr>
<tr><td></td><td></td><td>D.F.</td><td>0.05 max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 3,000MΩ</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>Pass the item No.4.</td></tr>
</table>

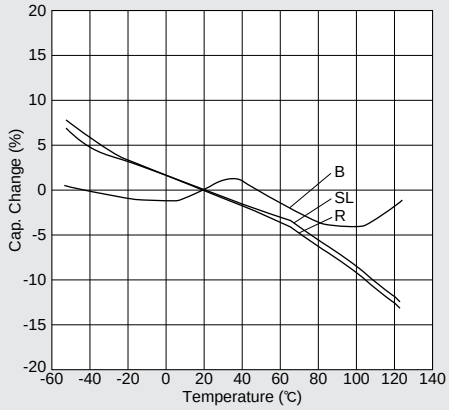
"Room condition" Temperature : 15 to 35℃, Relative humidity : 45 to 75%, Atmosphere pressure : 86 to 106kPa

9

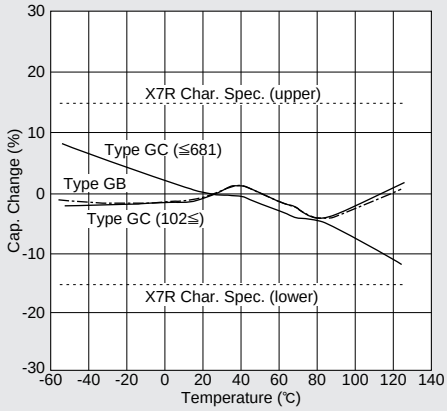
TYPICAL CHARACTERISTICS DATA

•Capacitance-Temp. Char.

GHM1000 Series · GHM2000 Series

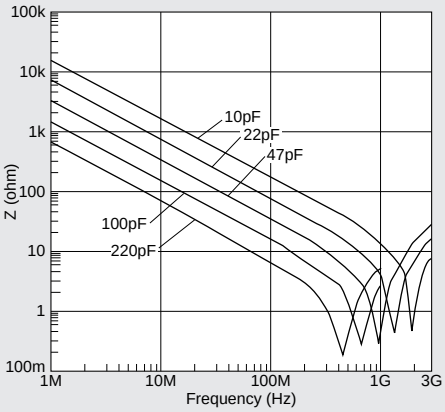


GHM3000 Series

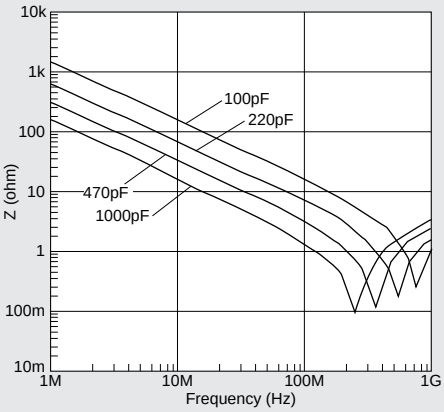


•Impedance-Freq. Char.

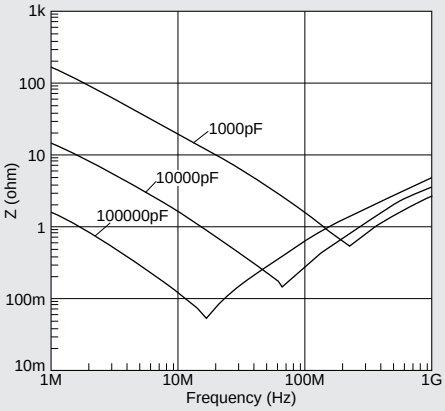
GHM1000 Series [SL Char.]



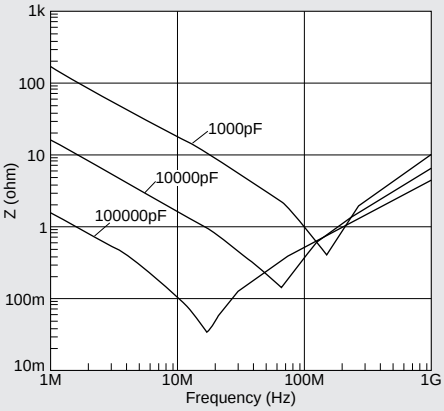
GHM1000 Series [R Char.]



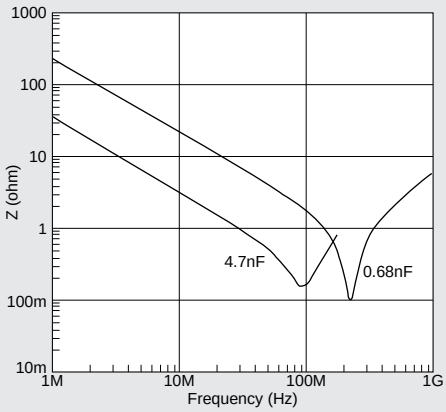
GHM1500 Series



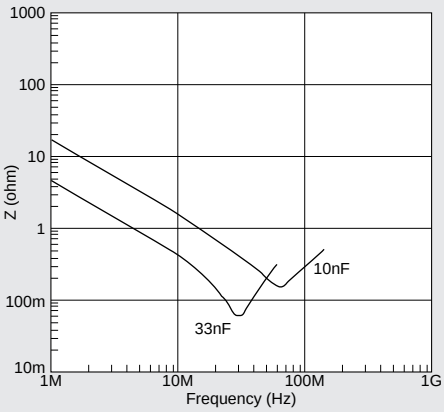
GHM2000 Series



GHM3000 Series (Type GC)



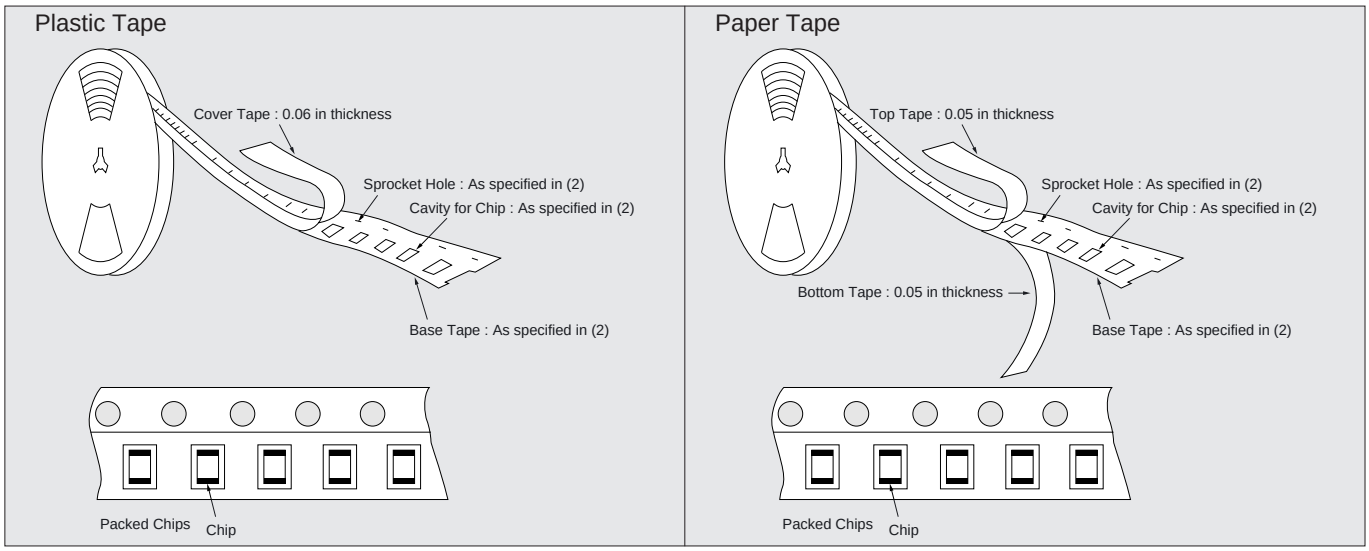
GHM3000 Series (Type GB)



9

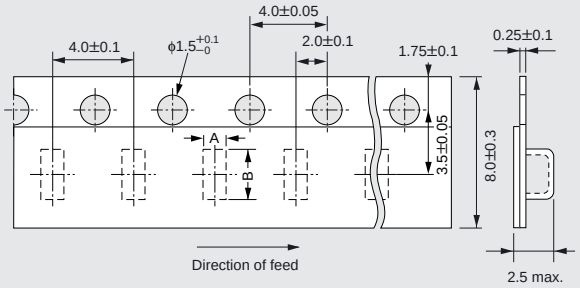
PACKAGING (Taping is standard packaging method.)

(1) Appearance of taping



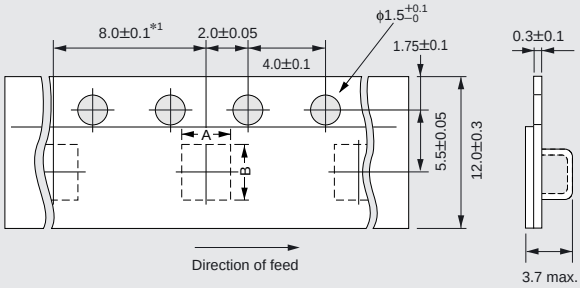
(2) Dimensions of Tape

Plastic Tape (T≧1.25 rank)



Type	*A	*B
GHMxx25	1.45	2.25
GHMxx30	2.0	3.6
GHMxx35	2.9	3.6

*Nominal value



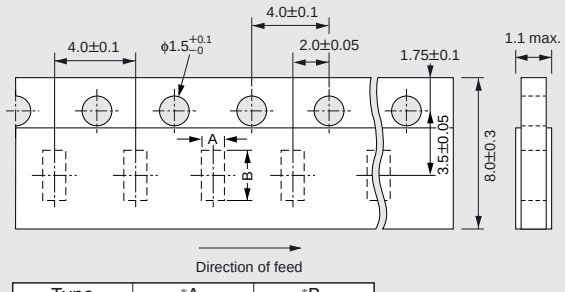
Type	*A	*B
GHMxx38	2.5	5.1
GHMxx40	3.6	4.9
GHMxx43	3.2	6.1
GHMxx45	5.4	6.1

*Nominal value

*1 4.0±0.1mm in case of GHM1038

(in mm)

Paper Tape (T=1.0 rank)

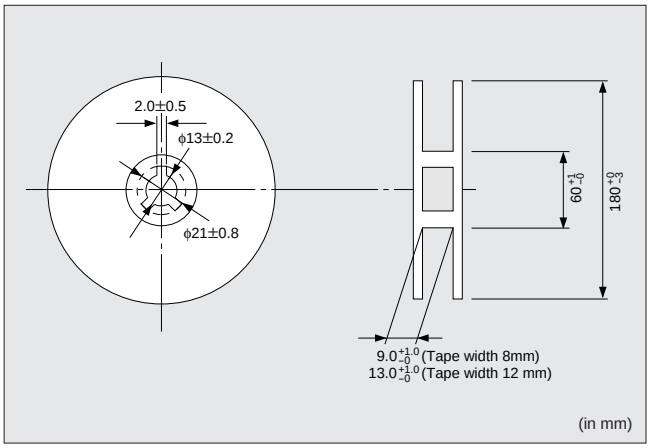


Type	*A	*B
GHMxx25	1.45	2.25
GHMxx30	2.0	3.6

*Nominal value

(in mm)

(3) Dimensions of Reel

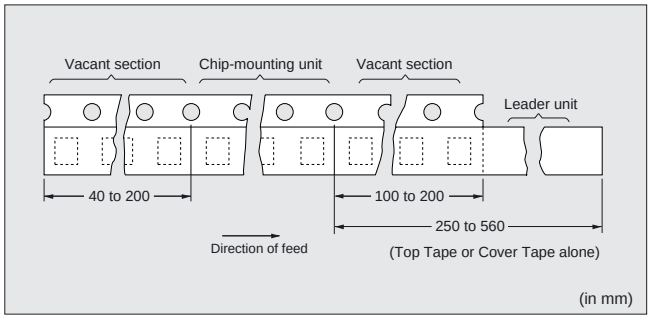


(4) Tapes for capacitors are wound clockwise. The sprocket holes are to the right as the tape is pulled toward the user.

9

PACKAGING (Taping is standard packaging method.)

(5) Part of the leader and part of the empty tape shall be attached to the end of the tape as follows.



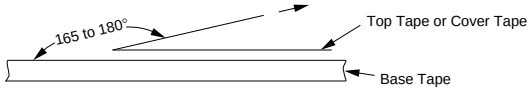
(6) The top tape or cover tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

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

(8) The top tape or cover tape and bottom tape shall not protrude beyond the edges of the tape and shall not cover sprocket holes.

(9) Cumulative tolerance of sprocket holes, 10 pitches : ±0.3mm.

(10) Peeling off force : 0.1 to 0.7N in the direction shown below.



9

⚠CAUTION

1. Operating voltage
   Be sure to use a capacitor only within its rated operating voltage range. When DC-rated capacitors are to be used in AC or ripple voltage circuits, be sure to maintain the Vp-p value of the applied voltage within the rated voltage range.

2. Operating temperature and self-generated heat
   Keep the surface temperature of a capacitor within the 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 circuit, pulse voltage circuit or the like, it may produce heat due to dielectric loss.
   Keep such self-generated temperature below 20℃.

3. 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℃ and 20 to 70%.
   Use capacitors within 6 months.

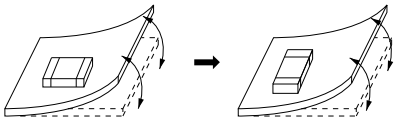
4. Vibration and impact
   Do not expose a capacitor to excessive shock or vibration during use.

5. Circuit board material
   Please contact our sales representatives or engineers in case that GHM 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.

6. Land layout for cropping PC Board

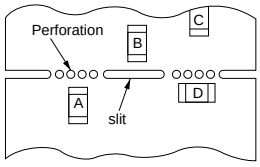
Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

[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

9

⚠CAUTION

7. 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.

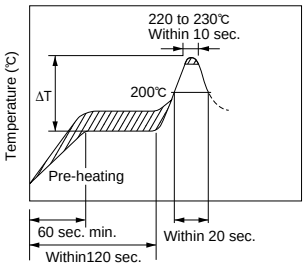
Soldering method \ Chip Size	3.2×1.6mm and under	3.2×2.5mm and over
Reflow method or Soldering iron method	ΔT≦190℃	ΔT≦130℃
Flow method or Dip Soldering method	ΔT≦150℃	——

When components are immersed in solvent after mounting, pay special attention to maintain the temperature difference within 100℃.

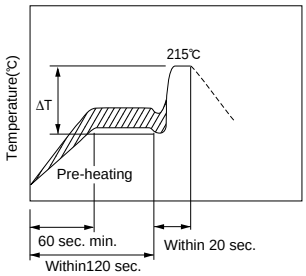
When soldering chips with a soldering iron, it should be performed in following conditions.

Item	Conditions	
Chip size	≦2.0×1.25mm	3.2×1.6mm
Temperature of iron-tip	300℃ max.	270℃ 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.	

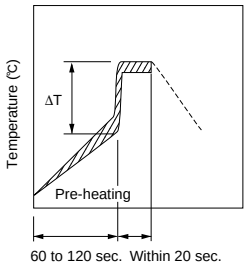
• Infrared reflow soldering conditions (Example)



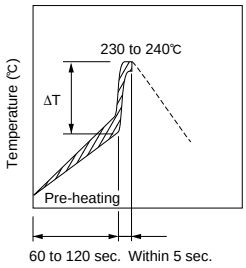
• Vapor reflow soldering (VPS) conditions (Example)



• Dip soldering/Soldering iron conditions (Example)



• Flow soldering conditions (Example)



8. Soldering method
   GHM 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 GHM products (size 3.2×2.5mm and over) are to be mounted with flow soldering. It may crack due to the thermal shock.

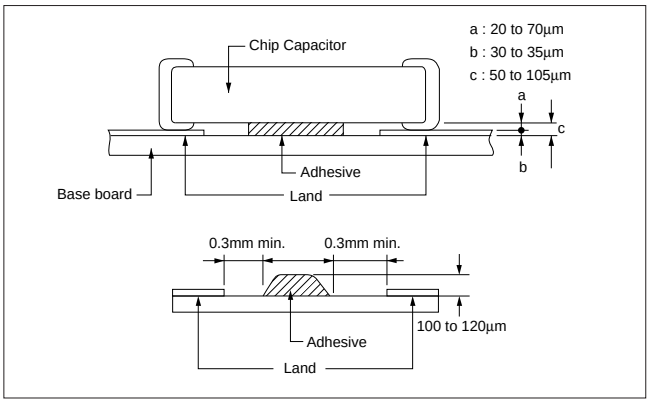
Failure to follow the above cautions may result, worst case, in a short circuit and fuming when the product is used.

9

NOTICE

1. MOUNTING OF CHIPS

● Termination thickness of chip capacitor and desirable thickness of adhesives applied



● 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.

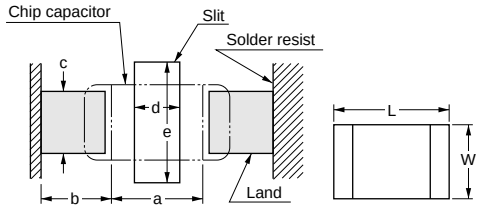
Careful checking and maintenance are necessary to prevent unexpected trouble.

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.

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 prevent 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.

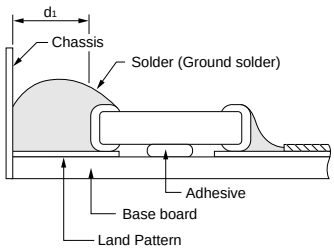
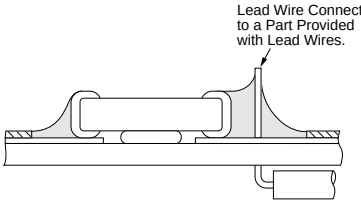
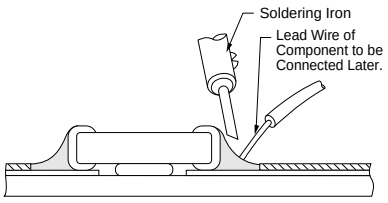
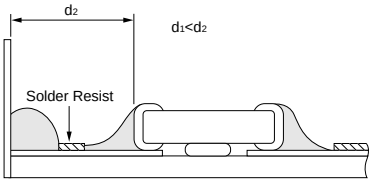
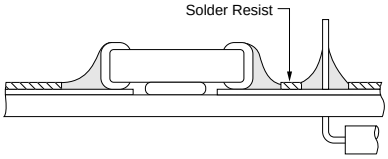
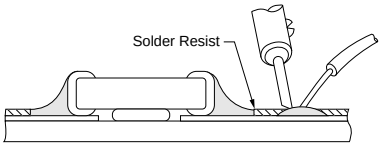
● Flow soldering (in mm)

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 (in mm)

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

● 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			
Examples of improvements by the land division			

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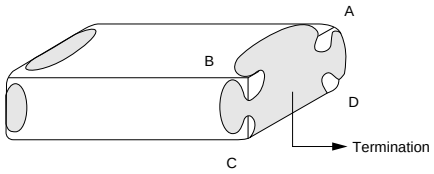
NOTICE

3. SOLDERING

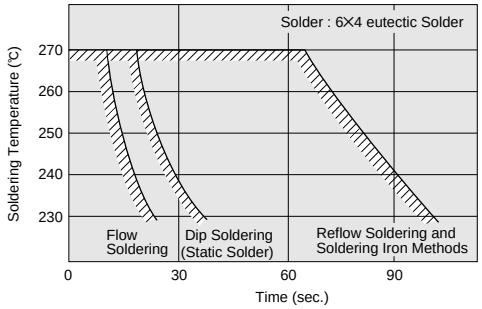
(Care for minimizing loss of the terminations)

● 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.

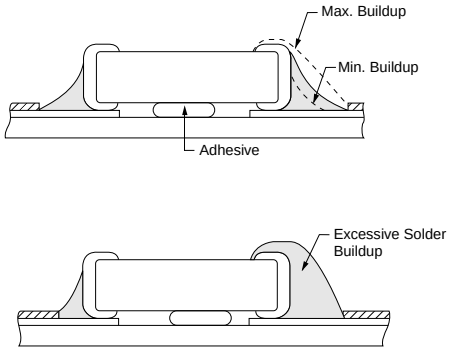
(Flux and Solder)

- Use rosin-type flux and do not use a highly acidic flux (any containing a minimum of 0.2wt% chlorine).
- Please use 6X4 eutectic solder, or 5X5 solder. (Do not use solder with silver.)

(Solder Buildup)

(i) Flow soldering and iron soldering
Use as little solder as possible (as shown in Fig.1), and confirm that the solder is securely placed.

(ii) Reflow soldering
When soldering, confirm that the solder is placed over 0.2mm of the surface of the terminations (as shown in Fig.2).



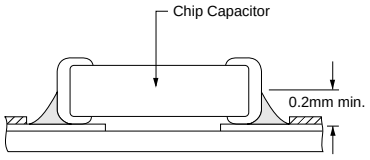
Solder buildup by flow method and soldering iron methods.

Fig.1

4. CLEANING

- To perform ultrasonic cleaning, observe the following conditions.

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



Solder buildup by reflow method.

Fig.2

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).

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■ISO9000 CERTIFICATIONS

Manufacturing plants of these products in this catalog have obtained the ISO9001 or ISO9002 certificate.

Plant	Certified Date	Organization	Registration NO.
Fukui Murata Manufacturing Co.,Ltd.	Mar. 31, '95	RCJ★ ISO9001	RCJ-85M-01C
Izumo Murata Manufacturing Co.,Ltd.	May. 11, '95		RCJ-93M-05A
Murata Electronics Singapore (Pte.) Ltd.	Aug. 13, '92	SISIR★★ ISO9002	SG MES 91M001A
Murata Manufacturing (UK) Ltd.	Nov. 18, '92	BSI★★★ ISO9002	FM 22169
Murata Amazonia Industria Comercio Ltda.	Sep. '93	RCJ★ ISO9002	RCJ-(B)-93M-01
Murata Electronics North America State College Plant	Jun. '94	UL★★★★ ISO9002	A1734

★ RCJ : Reliability Center for Electronic Components of Japan
★★ SISIR : Singapore Institute of Standards and Industrial Research
★★★ BSI : British Standards Institution
★★★★ UL : Underwriters Laboratories Inc.

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   ⑦ Disaster prevention / crime prevention equipment
   ⑧ Data-processing equipment
   ⑨ Application of similar complexity and/or reliability requirements to the applications listed in the above
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