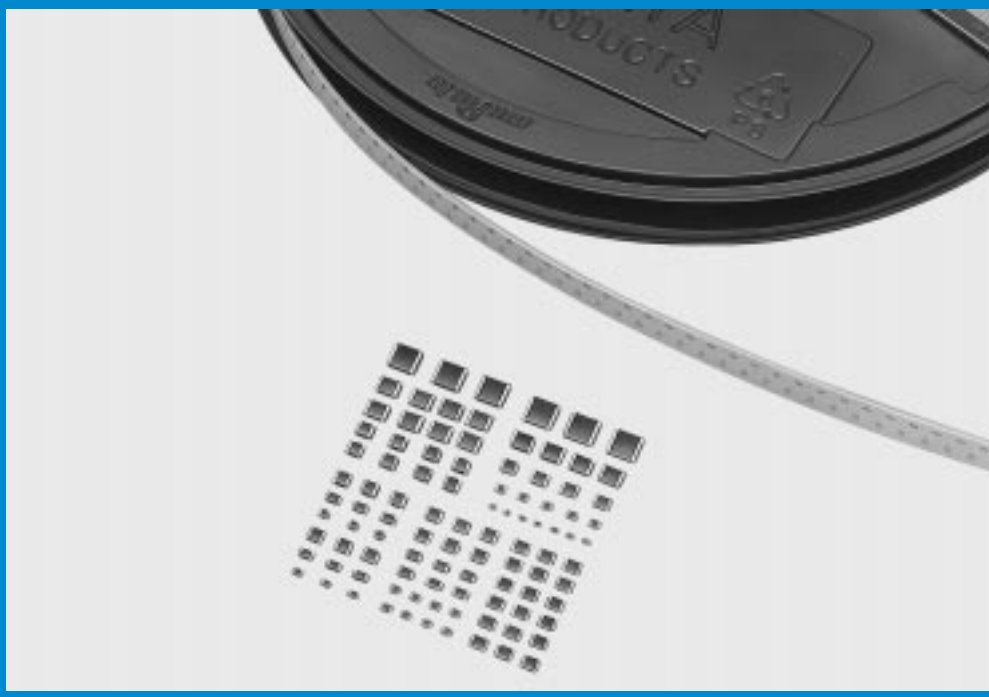
Chip Monolithic Ceramic Capacitor

CHIP MONOLITHIC CERAMIC CAPACITOR



muRata Innovator in Electronics

Murata
Manufacturing Co., Ltd.

Cat.No.C02E-3

Chip Monolithic Ceramic Capacitor
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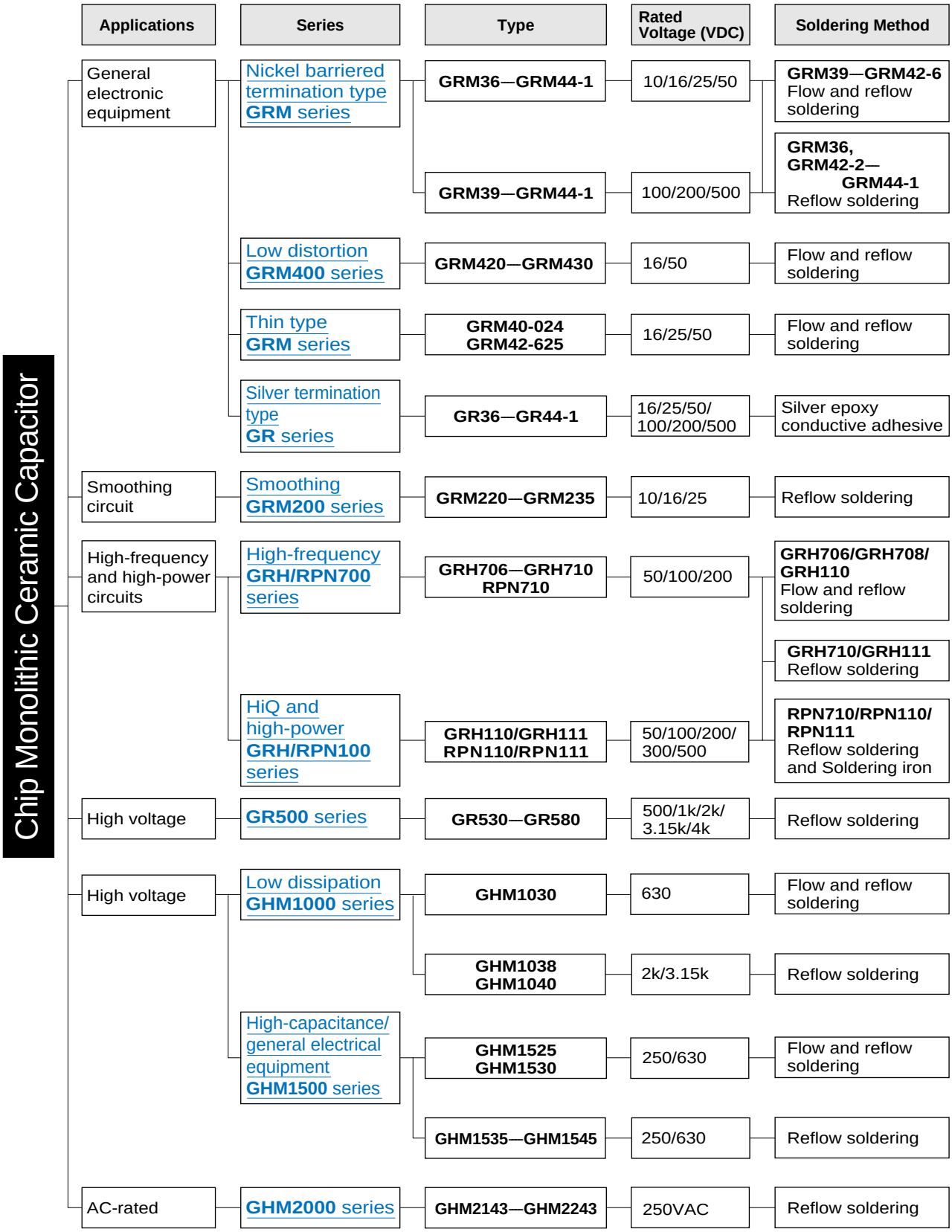


MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

■FEATURES

1. Terminations are made of metal highly resistant to migration.
2. The GRM series is a complete line of chip ceramic capacitors in 10V, 16V, 25V, 50V, 100V, 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 avairable 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

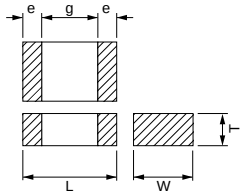
(*Please specify the part number when ordering)

(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

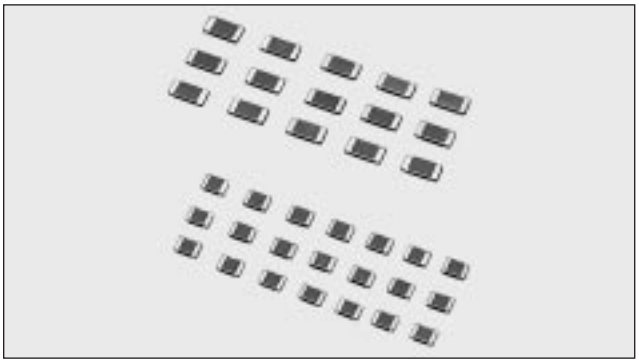
❶TYPE AND DIMENSIONS



(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	1.15±0.1	0.3min.	1.0
			1.35±0.15		
GRM43-2 (1812)	4.5±0.4	3.2 ±0.3	2.0 max.	0.3min.	2.0
GRM44-1 (2220)	5.7±0.4	5.0 ±0.4	2.0 max.	0.3min.	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˚C		-55 to 85˚C					
Temp. coeff. (ppm/˚C)	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˚C	-55 to 125˚C	+10 to 85˚C	-30 to 85˚C
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	10000

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	Rated voltage (VDC)
10	10
16	16
25	25
50	50
100	100
200	200
500	500

❻PACKAGING CODE

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

MONOLITHIC CERAMIC CAPACITOR

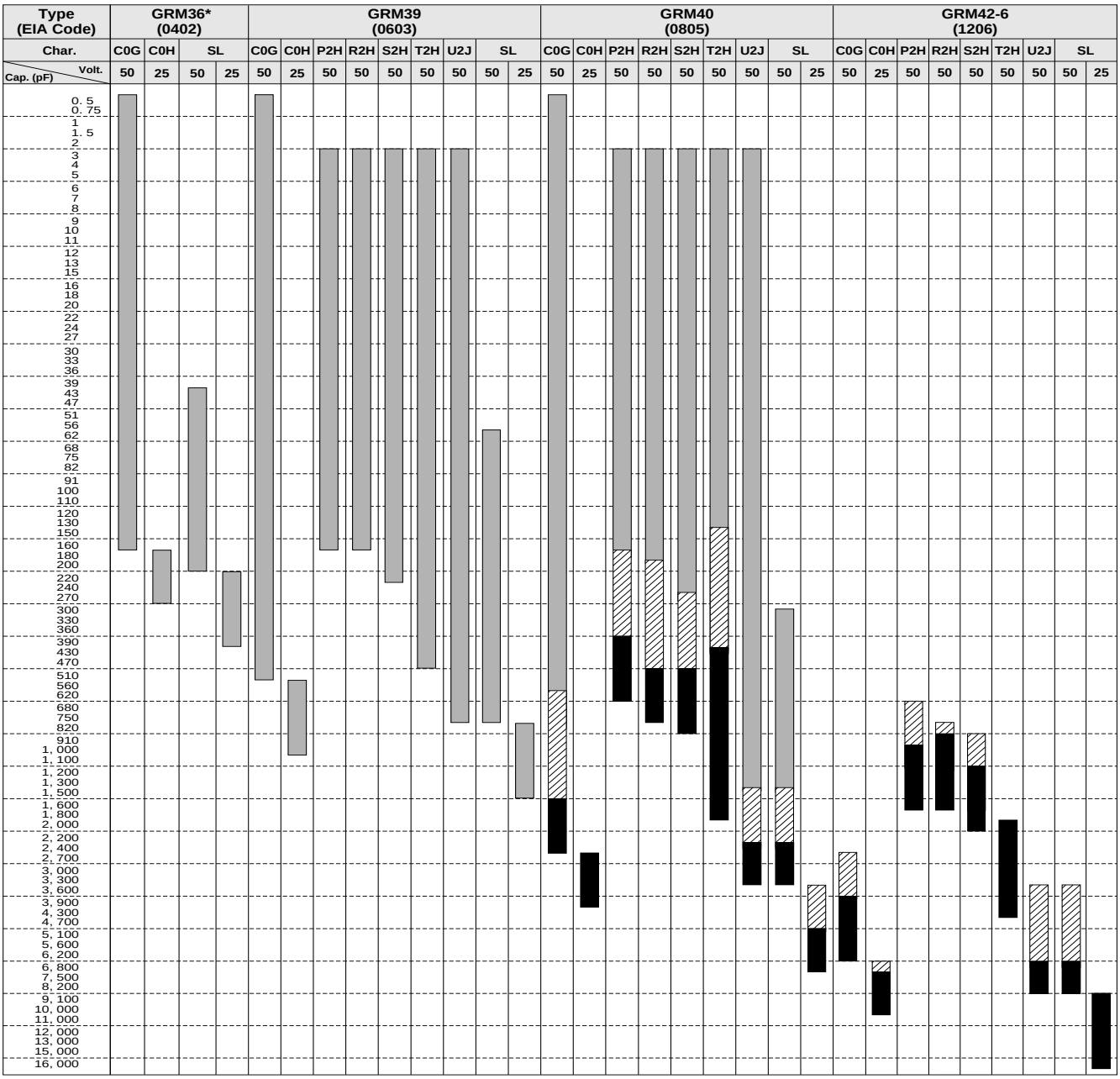
Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

■CAPACITANCE RANGE TABLE

FOR FLOW AND REFLOW SOLDERING

Temperature Compensating Type 50V/25V



*GRM36 is suited to only reflow soldering.

■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) *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
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 φ330mm reel is available on request.

*2 Bulk case packaging is T=0.8±0.07

MONOLITHIC CERAMIC CAPACITOR

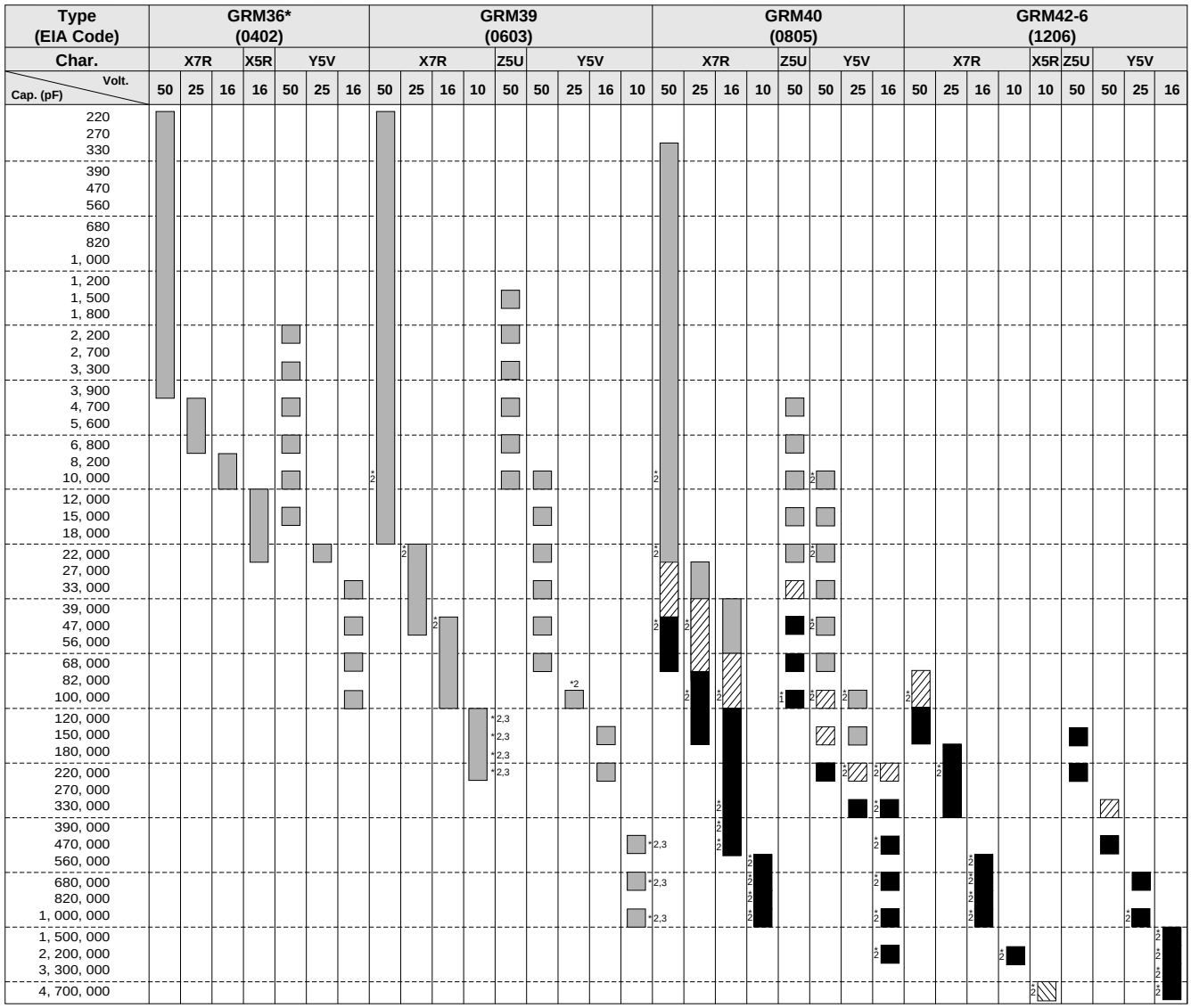
Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

FOR FLOW AND REFLOW SOLDERING

High Dielectric Constant Type

50V/25V/16V/10V



* GRM36 series is suited to only reflow soldering.
*1 Base metal inner electrode type (T : 0.85±0.1mm) is also available.
*2 Base metal inner electrode
*3 Only for taping

■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)*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	———
	: 1.6 ±0.2	1,000	2,000	———

*4 φ330mm reel is available on request.

*5 Bulk case packaging is T=0.8±0.07

MONOLITHIC CERAMIC CAPACITOR

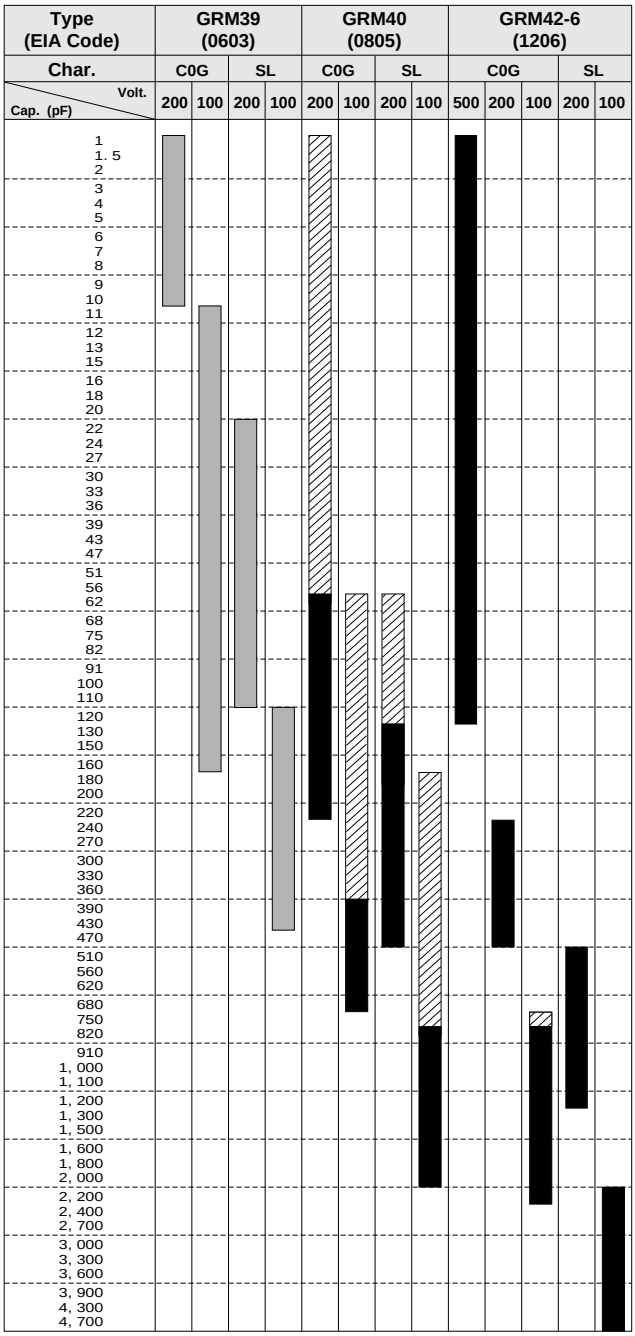
Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

FOR FLOW AND REFLOW SOLDERING

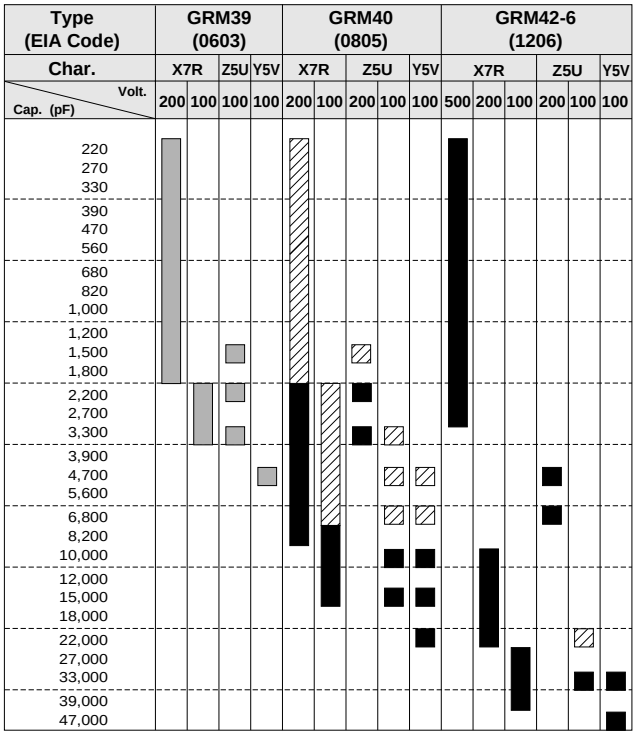
Temperature Compensating Type

500V/200V/100V



High Dielectric Constant 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

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)*
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.

MONOLITHIC CERAMIC CAPACITOR

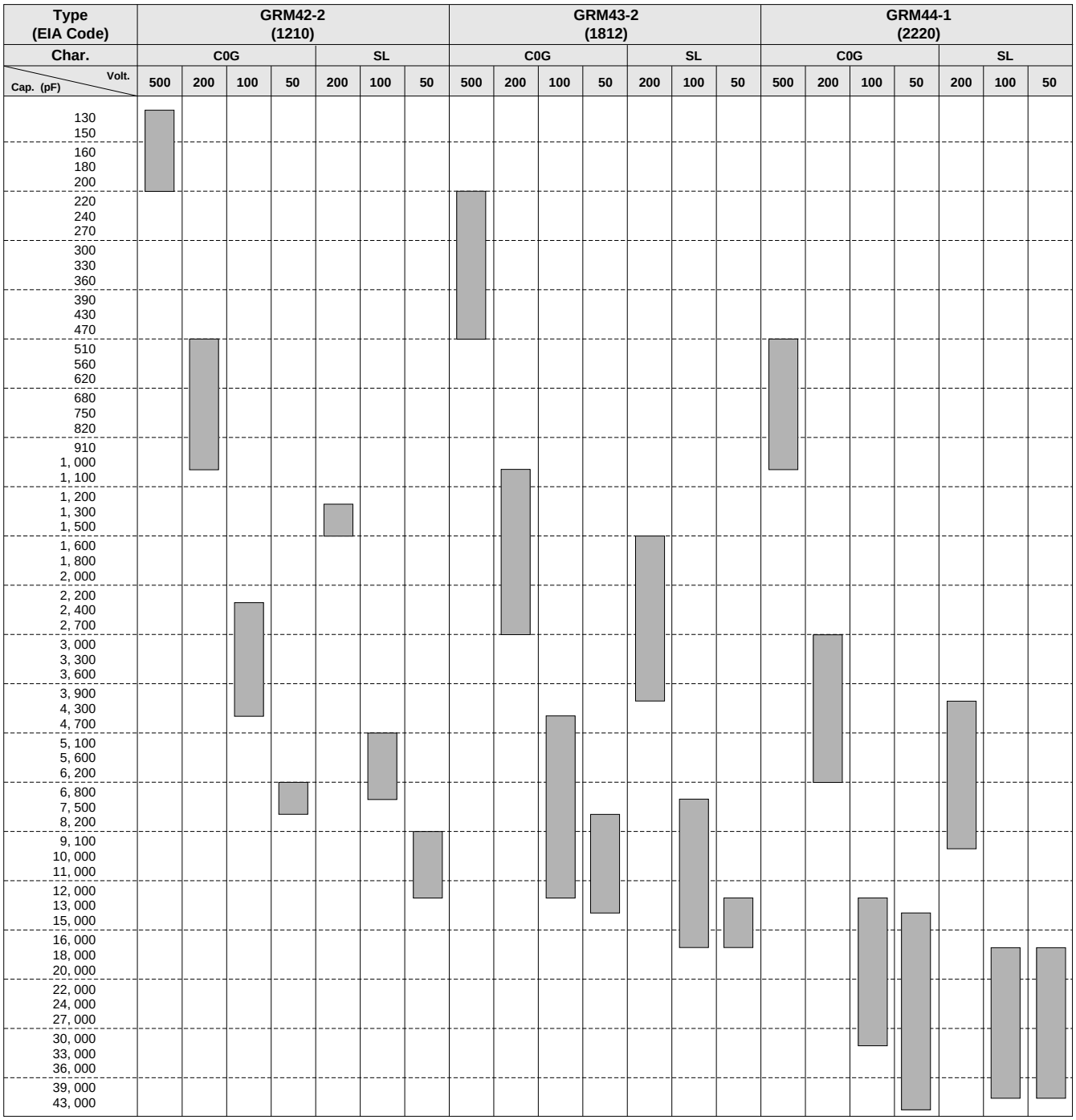
Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

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	: 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.

MONOLITHIC CERAMIC CAPACITOR

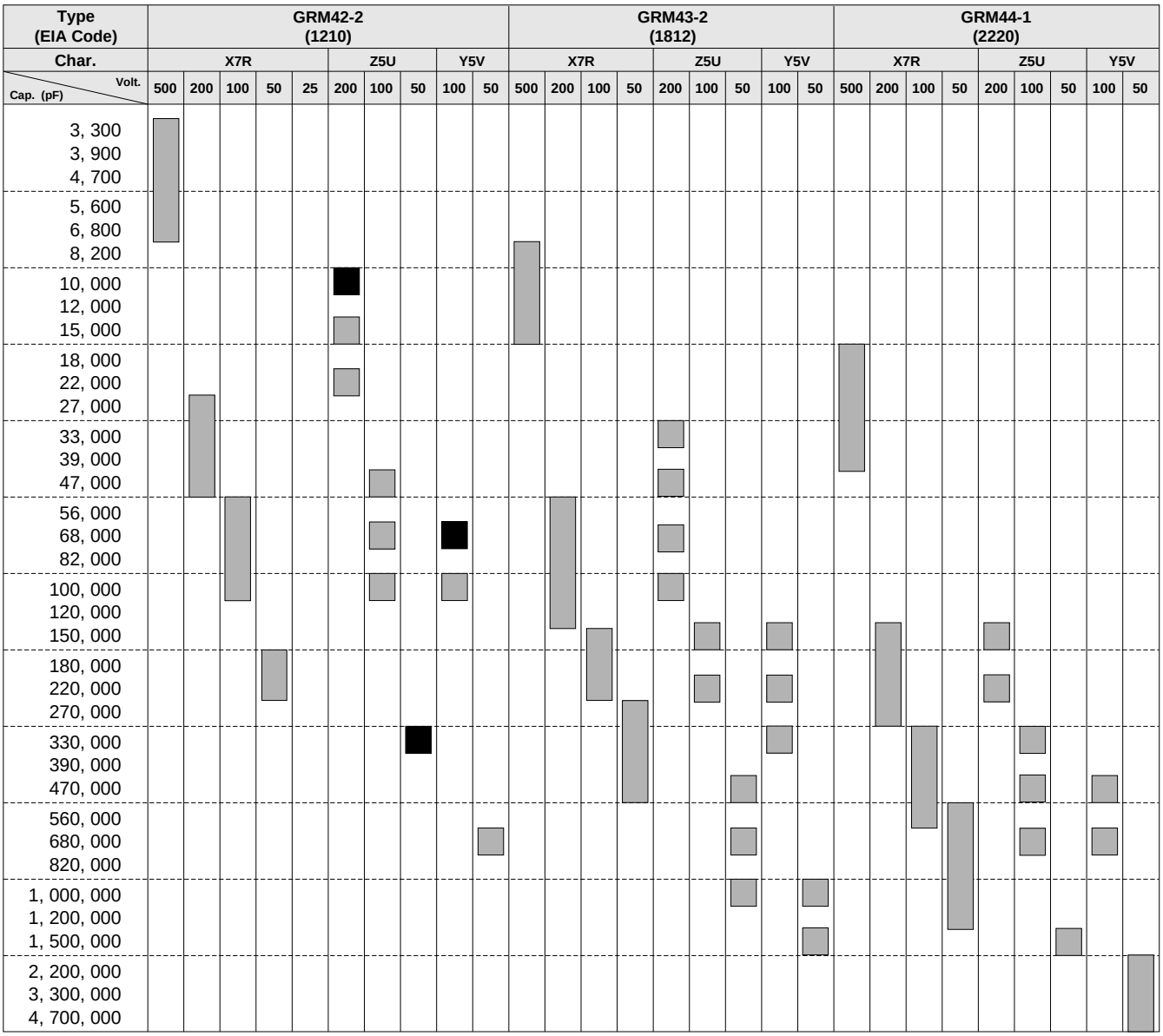
Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

FOR REFLOW SOLDERING

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)*
GRM42-2	■ : 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

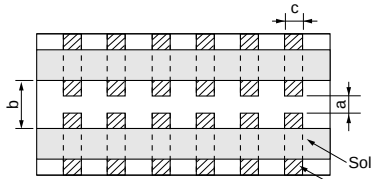
*φ330mm reel is available on request.

MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

■SPECIFICATIONS AND TEST METHODS

No	Item	Specification: Temperature Compensating Type	Specification: High Dielectric Constant Type	Test Method
1	Operating Temperature Range	-55 to +125˚C	X5R : -55 to +85˚C X7R : -55 to +125˚C Z5U : +10 to +85˚C Y5V : -30 to +85˚C	
2	Rated Voltage	See the previous pages.		The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, 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 (C0Δ to U2J and SL) or *250% of the rated voltage (X5R, X7R, Z5U and Y5V) is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA. *200% for 500V
6	Insulation Resistance	More than 10,000MΩ or 500Ω · F. (Whichever is smaller)		The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25˚C and 75%RH max. and within 2 minutes of charging.
7	Capacitance	Within the specified tolerance.		The capacitance/Q/D.F. shall be measured at 25˚C at the frequency and voltage shown in the table.
8	Q/Dissipation Factor (D.F.)	30pF min. : Q>=1000 30pF max. : Q>=400+20C C : Nominal Capacitance (pF)	Char. / 25V min. / 16V / 10V max. X5R, X7R: 0.025 max. / 0.035 max. / 0.035 max. Z5U: 0.025 max. / —— / —— Y5V: 0.05 max. / 0.07 max. (C<1.0μF) 0.09 max. (C>=1.0μF) / 0.125 max.	
9	Capacitance Temperature Characteristics — Capacitance Change	Within the specified tolerance. (Table A-1)	Char. / Temp. Range / Reference Temp. / Cap. Change X5R: -55 to +85˚C X7R: -55 to +125˚C Z5U: +10 to +85˚C Y5V: -30 to +85˚C Reference Temp.: 25˚C Cap. Change: Within±15% / Within +22 -56% / Within +22 -82%	(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˚C to+125˚C ; other temp. coeffs.:+25˚C to+85˚C) the capacitance shall be within the specified tolerance for the temperature coefficient and capacitance change as Table A-1. The capacitance drift is caluculated by dividing the differences between the maximum and minimum measured values in the step 1, 3 and 5 by the cap. value in step 3.
	Capacitance Temperature Characteristics — Temperature Coefficient	Within the specified tolerance. (Table A-1)		
	Capacitance Temperature Characteristics — Capacitance Drift	Within ±0.2% or ±0.05pF. (Whichever is larger.) *Not apply to SL/25V		
10	Adhesive Strength of Termination	No removal of the terminations or other defects shall occur.	 Fig. 1a	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)
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).
	Vibration Resistance — Capacitance	Within the specified tolerance.		
	Vibration Resistance — Q/D.F.	30pF min. : Q>=1000 30pF max. : Q>=400+20C C : Nominal Capacitance (pF)	Char. / 25V min. / 16V / 10V max. X5R, X7R: 0.025 max. / 0.035 max. / 0.035 max. Z5U: 0.025 max. / —— / —— Y5V: 0.05 max. / 0.07 max. (C<1.0μF) 0.09 max. (C>=1.0μF) / 0.125 max.	

Char. / Item	C0Δ to U2J, SL (1000pF and below)	C0Δ to U2J, SL (more than 1000pF) X5R, X7R, Y5V	Z5U
Frequency	1±0.1MHz	1±0.1kHz	1±0.1kHz
Voltage	0.5 to 5Vrms	1±0.2Vrms	0.5±0.05Vrms

Step	Temperature (˚C)
1	25±2
2	-55±3
3	25±2
4	125±3 (for C0Δ)/85±3 (for other TC)
5	25±2

(2) High Dielectric Constant Type
The ranges of capacitance change compared with the 25˚C value over the temperature ranges shown in the table shall be within the specified ranges.

Type	a	b	c
GRM36	0.4	1.5	0.5
GRM39	1.0	3.0	1.2
GRM40	1.2	4.0	1.65
GRM42-6	2.2	5.0	2.0
GRM42-2	2.2	5.0	2.9
GRM43-2	3.5	7.0	3.7
GRM44-1	4.5	8.0	5.6

(in mm)

MONOLITHIC CERAMIC CAPACITOR

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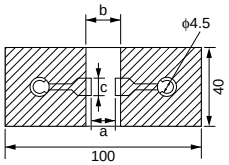
GRM Series for General Electronic Equipment

<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.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.
 

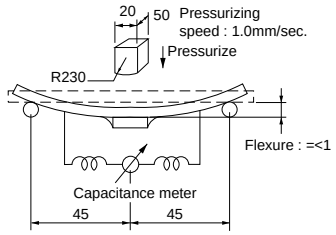
t : 1.6mm (GRM36 : 0.8mm)
Fig. 2a
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM36</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM39</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM40</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM42-6</td><td>2.2</td><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˚C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5˚C.</td></tr>
<tr><td>14</td><td>Resistance to Soldering Heat</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.
<table><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 max.</th></tr><tr><td>X5R X7R</td><td>0.025 max.</td><td>0.035 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</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></tr></table></td></tr><tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr><tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr></table></td><td>Preheat the capacitor at 120 to 150˚C* for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5˚C 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$^{+0}_{-10}$˚C 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˚C to 120˚C</td><td>1 min.</td></tr><tr><td>2</td><td>170˚C to 200˚C</td><td>1 min.</td></tr></table></td></tr>
<tr><td>15</td><td>Temperature Cycle</td><td colspan="2">The measured and observed characteristics shall satisfy the specifications in the following table.
<table><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 max.</th></tr><tr><td>X5R X7R</td><td>0.025 max.</td><td>0.035 max.</td><td>0.035 max.</td></tr><tr><td>Z5U</td><td>0.025 max.</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></tr></table></td></tr><tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω · F (Whichever is smaller)</td></tr><tr><td>Dielectric Strength</td><td colspan="2">No failure</td></tr></table></td><td>Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (˚C)</td><td>Min. Operating Temp.$^{+0}_{-3}$</td><td>Room Temp.</td><td>Max. Operating Temp.$^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>• Initial measurement for high dielectric constant type
Perform a heat treatment at 150$^{+0}_{-10}$˚C for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.</td></tr>
</table>

MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

<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>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="4">Sit the capacitor at 40±2˚C and 90 to 95% humidity for 500±12 hours.
Remove and let sit for 24±2 hours (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 (F)</td><td><table><tr><th>Char.</th><th>25V min.</th><th>16V</th><th>10V max.</th></tr><tr><td>X5R X7R</td><td>0.05 max.</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.05 max.</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></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>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˚C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then muasure. The charge/discharge current is less than 50mA.

• Initial measurement for Y5V/10V
Apply the rated DC voltage for 1 hour at 40±2˚C.
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)
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 max.</th></tr><tr><td>X5R X7R</td><td>0.05 max.</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.05 max.</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></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>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 1000±12 hours at the maximum operating temperature ±3˚C. 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˚C. 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 max.</th></tr><tr><td>X5R X7R</td><td>0.04 max.</td><td>0.05 max.</td><td>0.05 max.</td></tr><tr><td>Z5U</td><td>0.04 max.</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></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>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.	Nominal Values (ppm/˚C) Note 1	Capacitance Change from 25˚C (%)					
		-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˚C to 125˚C (for C0Δ) /85˚C (for other TC).

MONOLITHIC CERAMIC CAPACITOR

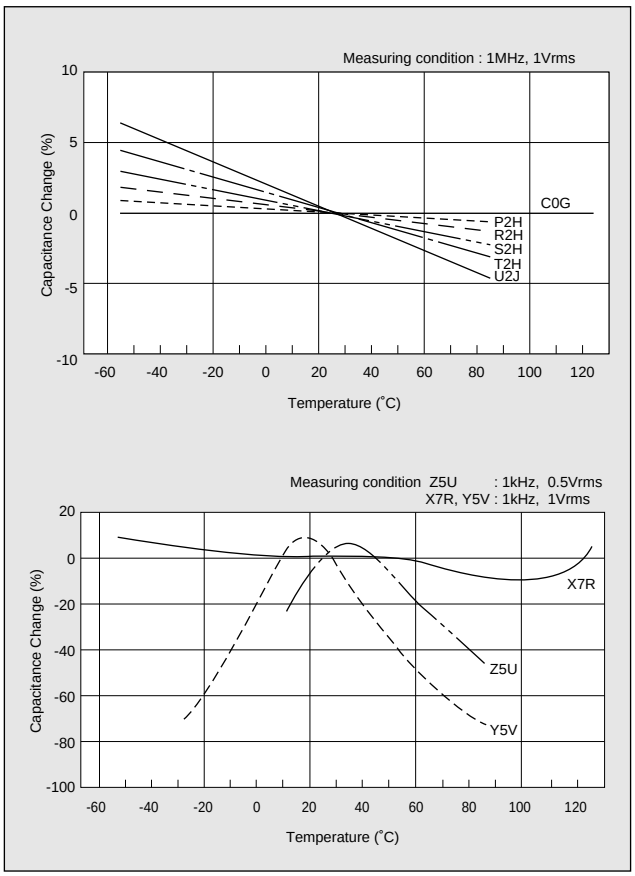
Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

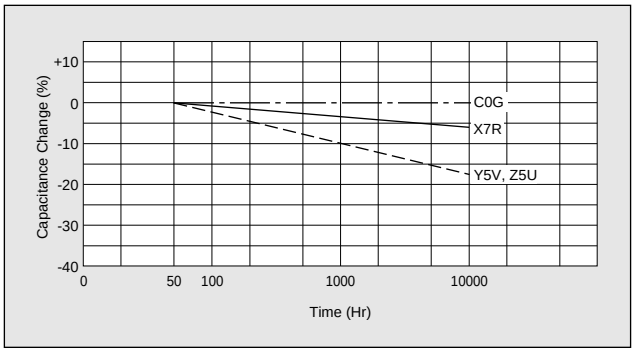
■CHARACTERISTICS (REFERENCE DATA)

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

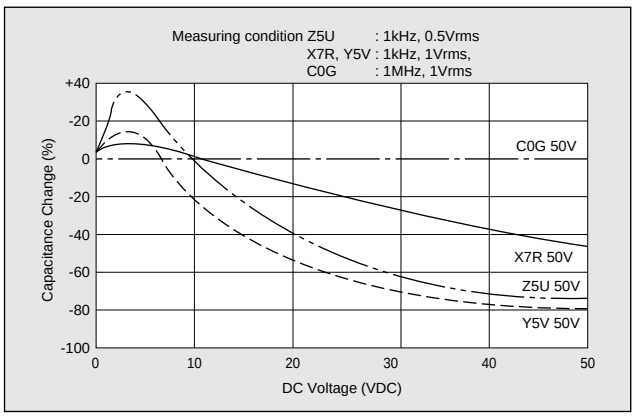
• Capacitance-Temperature Characteristics



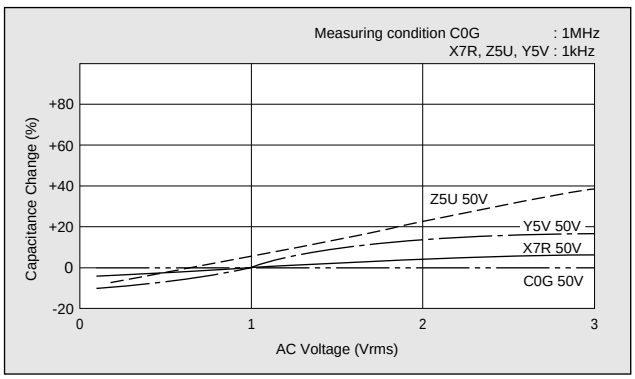
• Capacitance Change- Aging



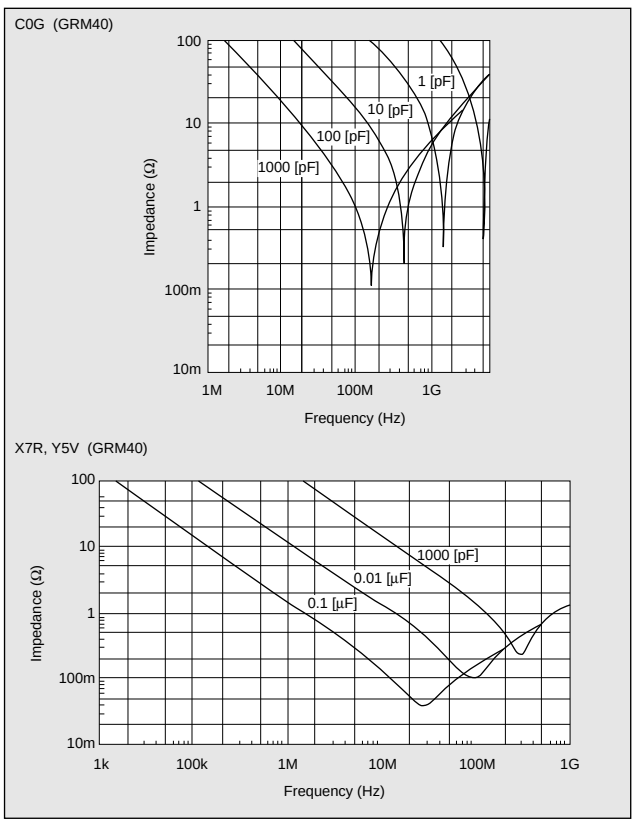
• Capacitance- DC Voltage Characteristics



• Capacitance- AC Voltage Characteristics



• Impedance- Frequency Characteristics



MONOLITHIC CERAMIC CAPACITOR

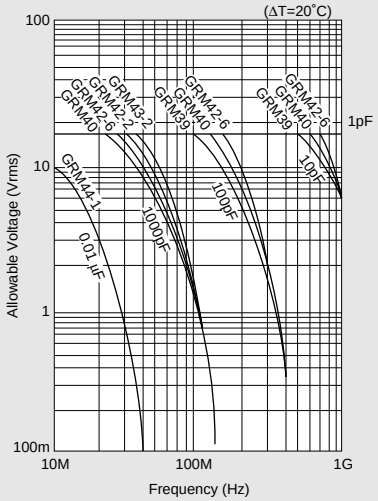
Nickel Barriered Termination Type

GRM Series for General Electronic Equipment

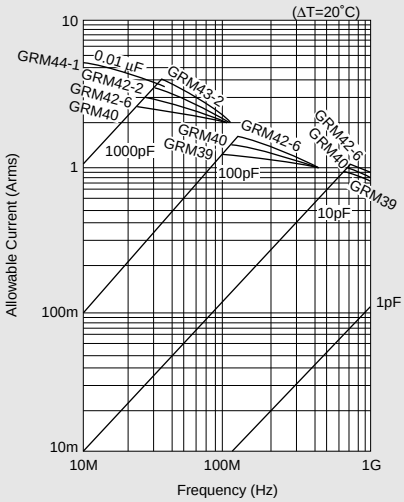
- High Frequency-Power Capacity
  The monolithic ceramic capacitor has a small dielectric loss. When high frequency current is applied to the capacitor, the capacitor generates heat (power consumption) by its E.S.R. Temperature rise of the capacitor (ΔT) should be kept below 20˚C (ΔT=<20˚C) in the actual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

Temperature Compensating Type (C0G 50V)

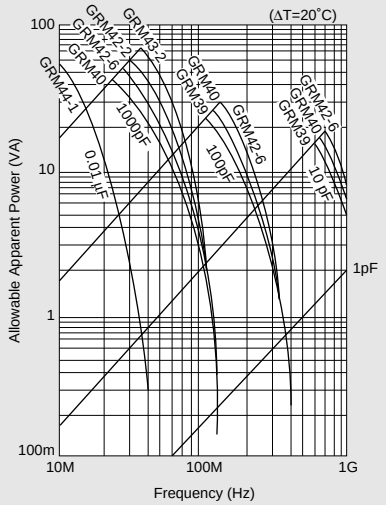
Allowable Voltage



Allowable Current

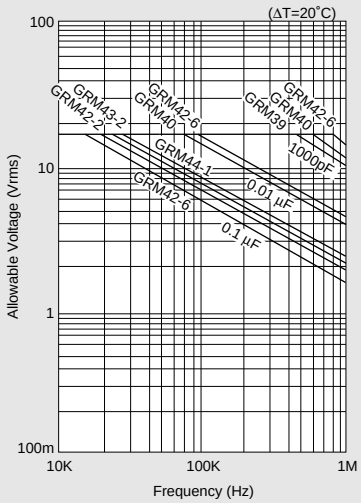


Allowable Apparent Power

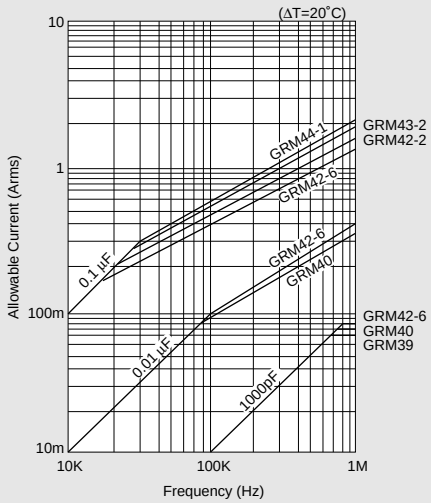


High Dielectric Constant Type (X7R 50V)

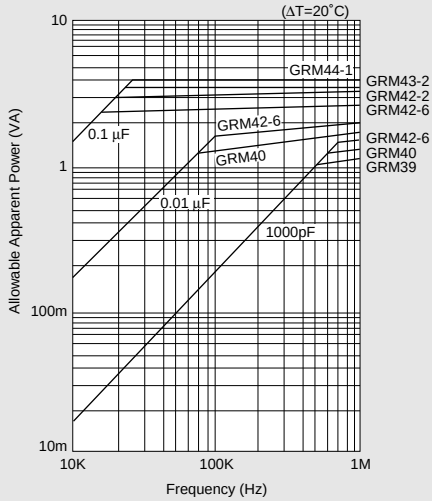
Allowable Voltage



Allowable Current



Allowable Apparent Power



MONOLITHIC CERAMIC CAPACITOR

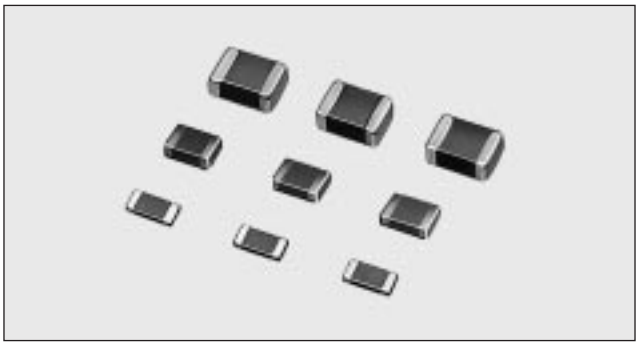
Nickel Barriered Termination Type

GRM400 Series ; Low Distortion

■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

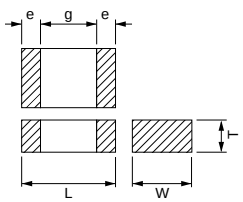
(*Please specify the part number when ordering.)

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

*T : Please refer to the capacitance range table

❷TEMPERATURE CHARACTERISTICS

Code	Capacitance Change	Temp. Range	Reference Temp.
B	Within ±10%	-25 to 85˚C	20˚C
R	Within ±15%		

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)
102	1000
103	10000
104	100000

❹CAPACITANCE TOLERANCE

Code	Cap. Tolerance (%)
K	±10
M	±20

❺RATED VOLTAGE

Code	Rated Voltage (VDC)
16	16
50	50

❻PACKAGING CODE

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

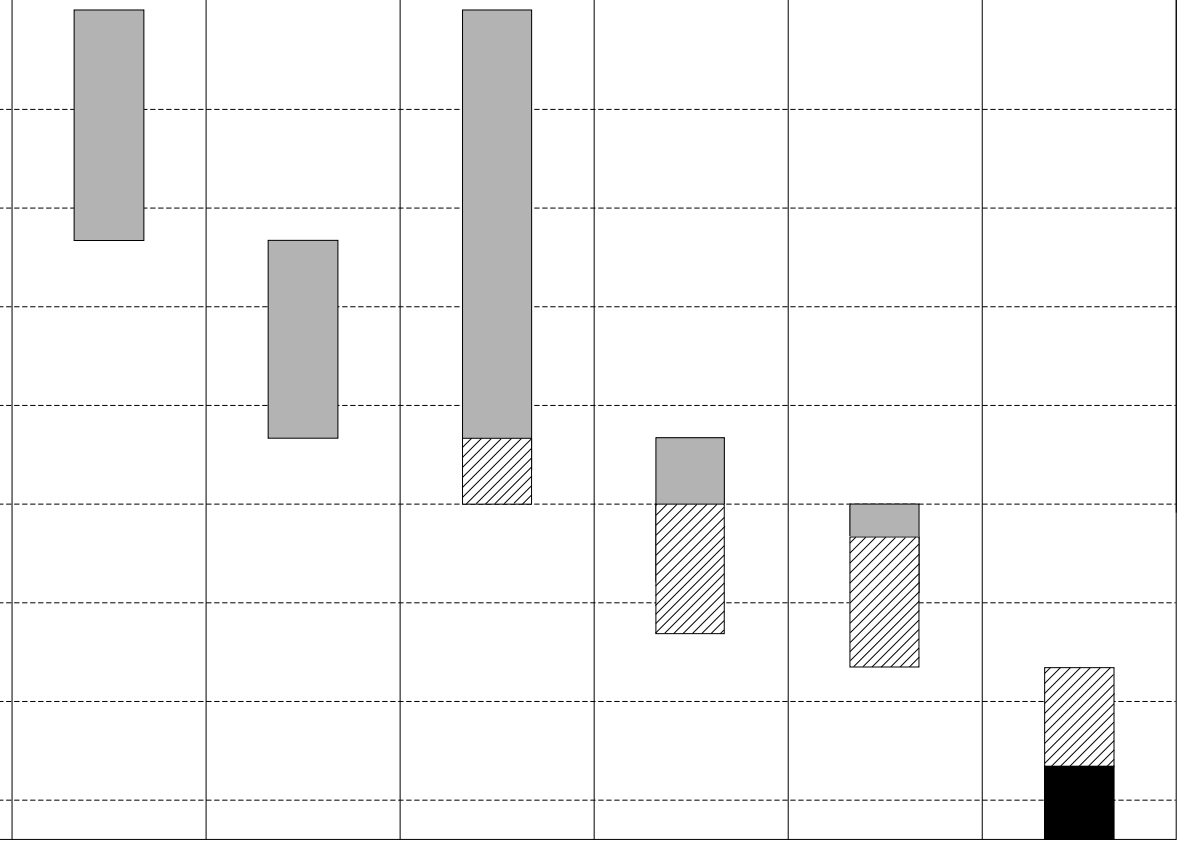
MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Type

GRM400 Series ; Low Distortion

■CAPACITANCE RANGE TABLE

Type (EIA Code)	GRM420 (0603)		GRM425 (0805)		GRM430 (1206)	
Char.	B	R	B	R	B	R
Cap. (pF) \ Volt.	50	16	50	16	50	16
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

MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Type

GRM400 Series ; Low Distortion

■OTHER SPECIFICATIONS AND TEST METHODS

No.	Item	Specification	Test Method
1	Operating Temperature Range	B, R : -25˚C to +85˚C	
2	Rated Voltage	See the previous page.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance	No defects or abnormalities.	Visual inspection.
4	Dimension	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.)	C=<0.047 μF : 10,000MΩ min. C>0.047 μF : 500Ω · F min. C : Nominal Capacitance (μF)	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 shall be measured at 20˚C, at a frequency of 1±0.1kHz and a voltage of 1±0.2Vrms.
8	Dissipation Factor (D.F.)	B, R : 0.01 max.	D.F. shall be measured under the same conditions as the capacitance.
9	Capacitance Temperature Characteristics	Char. B: Temp. Range -25˚C to +85˚C; Capacitance Change: Without Voltage Within ±10%, With 50% Rated Voltage Within $^{+10}_{-20}$% Char. R: Temp. Range -25˚C to +85˚C; Capacitance Change: Without Voltage Within ±15%, With 50% Rated Voltage Within $^{+15}_{-20}$%	The ranges of capacitance change compared with the 20˚C value over the temperature ranges shown in the table shall be within the specified ranges.
10	Distortion	50V : -90dB max. 16V : -80dB max.	The distortion shall be measured using the third harmonic distortion, 10±1kHz in frequency and 1±0.2Vrms in voltage.
11	Adhesive Strength of Termination	No removal of the terminations or other defects shall occur.	Solder the capacitor to the test jig shown in Fig.1b 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 counducted with care so that the soldering is uniform and free of defect such as heat shock. *5N (GRM420)
12	Vibration Resistance	The measured and observed characteristics shall satisfy the specifications in the following table. Item: Appearance — No marking defects. Capacitance — Within the specified tolerance. DF — 0.01 max.	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).
13	Deflection	No cracks or marking defects shall occur.	Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 2b using a eutectic solder. Then apply force in the direction shown in Fig.3b 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.

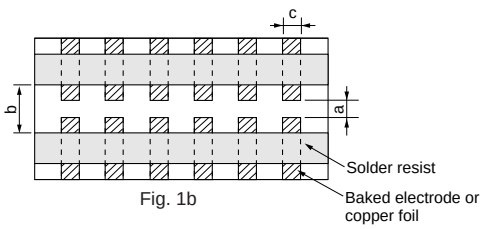


Fig. 1b

Type	a	b	c
GRM420	1.0	3.0	1.2
GRM425	1.2	4.0	1.65
GRM430	2.2	5.0	2.0

(in mm)

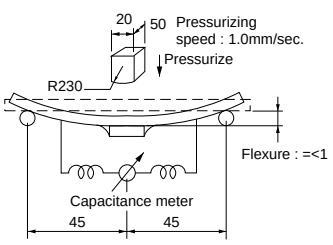


Fig. 3b

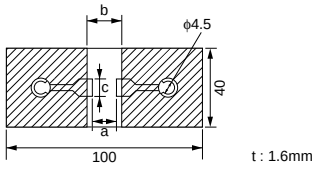


Fig. 2b

Type	a	b	c
GRM420	1.0	3.0	1.2
GRM425	1.2	4.0	1.65
GRM430	2.2	5.0	2.0

(in mm)

MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Type

GRM400 Series ; Low Distortion

No	Item	Specification	Test Method
14	**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˚C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5˚C.
15	**Resistance to Soldering Heat**	The measured and observed characteristics shall satisfy the specifications in the following table. **Item** — Specification **Appearance** — No marking defects. **Capacitance Change** — Within ±7.5% **I.R.** — More than 10,000MΩ or 500Ω · F (Whichever is smaller) **D.F.** — 0.01 max. **Dielectric Strength** — No failure	Perform a heat treatment at 150^{0}_{-10}˚C 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˚C. Immerse the capacitor in a eutectic solder solution at 270±5˚C for 10±0.5 seconds (flow soldering bath). Let sit for 48±4 hours at room temperature, then measure values of items in table.
16	**Temperature Cycle**	The measured and observed characteristics shall satisfy the specifications in the following table. **Item** — Specification **Appearance** — No marking defects. **Capacitance Change** — Within ±7.5% **I.R.** — More than 10,000MΩ or 500Ω · F (Whichever is smaller) **D.F.** — 0.01 max. **Dielectric Strength** — No failure	Perform a heat treatment at 150^{0}_{-10}˚C 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. **Step** — 1 — 2 — 3 — 4 **Temp. (˚C)** — Min. Operating Temp.$^{+0}_{-3}$ — Room Temp. — Max. Operating Temp.$^{+3}_{-0}$ — Room Temp. **Time (min.)** — 30±3 — 2 to 3 — 30±3 — 2 to 3
17	**Humidity (Steady State)**	The measured and observed characteristics shall satisfy the specifications in the following table. **Item** — Specification **Appearance** — No marking defects. **Capacitance Change** — Within ±12.5% **I.R.** — More than 1,000MΩ or 50Ω · F (Whichever is smaller) **D.F.** — 0.015 max.	Set the capacitor at 40±2˚C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 48±4 hours at room temperature, then measure values of items in table.
18	**Humidity Load**	The measured and observed characteristics shall satisfy the specifications in the following table. **Item** — Specification **Appearance** — No marking defects. **Capacitance Change** — Within ±12.5% **I.R.** — More than 500MΩ or 25Ω · F (Whichever is smaller) **D.F.** — 0.015 max.	Apply the rated voltage at 40±2˚C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 48±4 hours at room temperature, then measure values of items in table. The charge/discharge current is less than 50mA.
19	**High Temperature Load**	The measured and observed characteristics shall satisfy the specifications in the following table. **Item** — Specification **Appearance** — No marking defects. **Capacitance Change** — Within ±12.5% **I.R.** — More than 1,000MΩ or 50Ω · F (Whichever is smaller) **D.F.** — 0.015 max.	Apply 200% of the rated DC voltage for one hour at the maximum operating temperature ±3˚C. 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 1000±12 hours at maximum operating temperature ±3˚C. 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.

MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Type

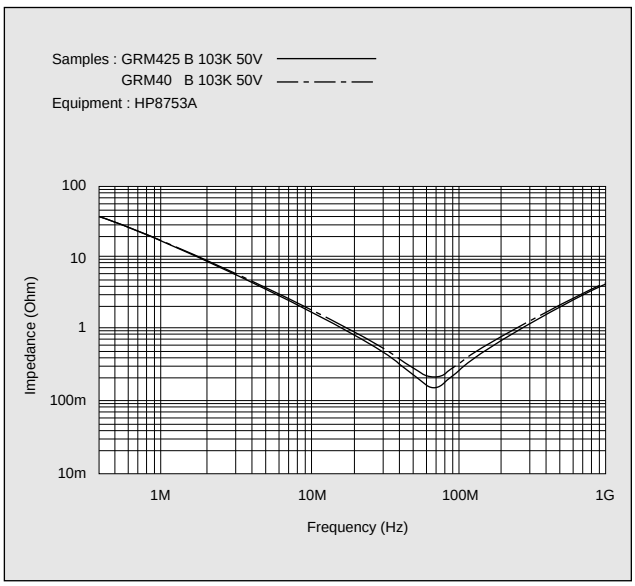
GRM400 Series ; Low Distortion

■CHARACTERISTICS

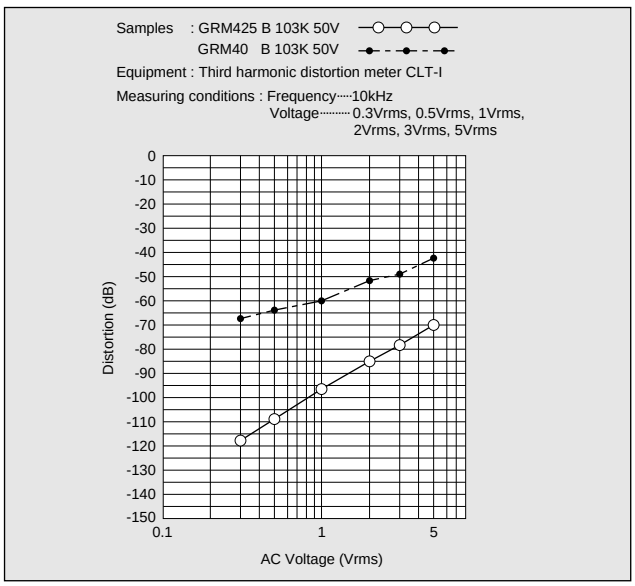
- SELECTION OF CERAMIC CAPACITORS

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

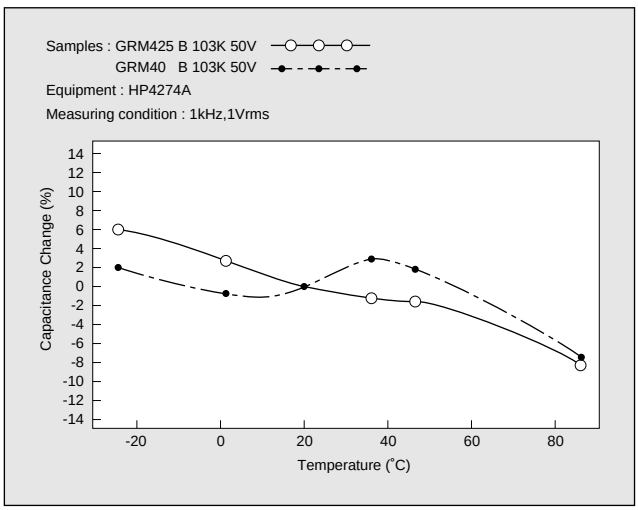
- Impedance-Frequency Characteristics



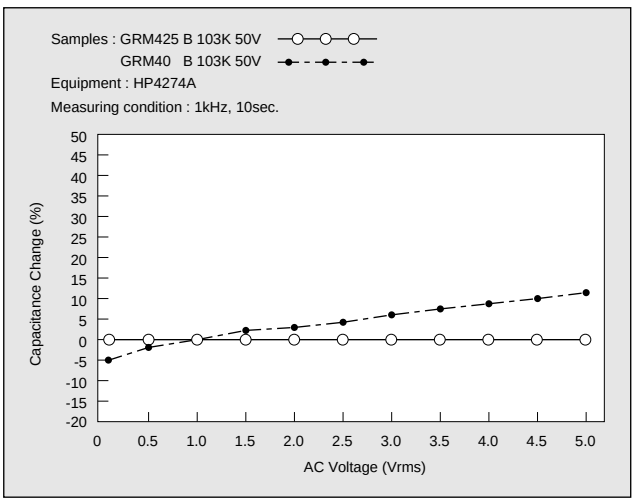
- Third Harmonic Distortion



- Capacitance-Temperature Characteristics



- Capacitance-AC Voltage Characteristics

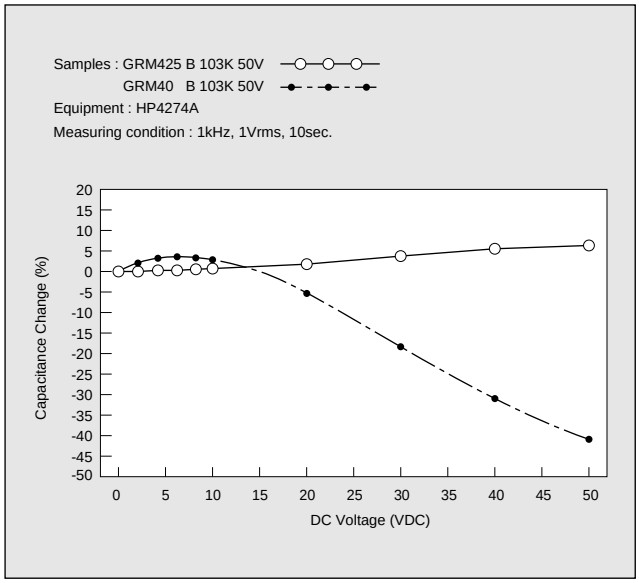


MONOLITHIC CERAMIC CAPACITOR

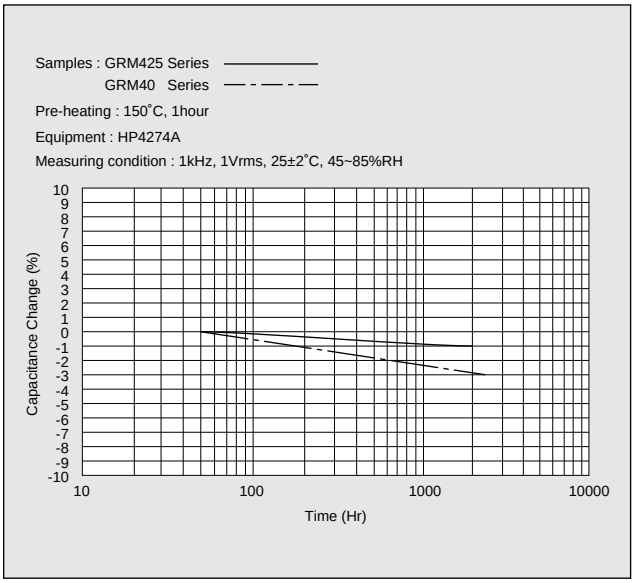
Nickel Barriered Termination Type

GRM400 Series ; Low Distortion

- Capacitance-DC Voltage Characteristics



- Capacitance Change-Aging



MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Thin Type

GRM Series for Thin Equipment

■FEATURES

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

■APPLICATION

Thin equipment such as IC cards.

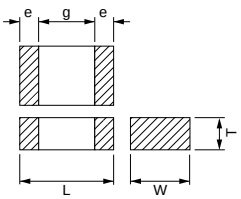
■PART NUMBERING

(*Please specify the part number when ordering.)

(Ex.) GRM42-625 (❶) Y5V (❷) 224 (❸) Z (❹) 25 (❺) [ ] (❻) PT (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.
GRM40-024	2.0±0.1	1.25±0.1	0.5 max.	0.2	0.7
GRM42-625	3.2±0.15	1.6 ±0.15	0.6 max.	0.3	1.5

❷TEMPERATURE CHARACTERISTICS

- Temperature Compensating Type

Code	C0G	SL
Temp. range	-55 to 125˚C	-55 to 85˚C
Temp. coeff. (ppm/˚C)	0±30	+350 to -1000

- High Dielectric Constant Type

Code	X7R	Y5V
Temp. range	-55 to 125˚C	-30 to 85˚C
Cap. change (%)	±15	+22 -82

❸CAPACITANCE (Ex.)

Code	Capacitance (pF)	Code	Capacitance (pF)
0R5	0.5	102	1000
030	3	103	10000
101	100	224	220000

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	Rated voltage (VDC)
16	16
25	25
50	50

❻PACKAGING CODE

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

■CAPACITANCE RANGE TABLE

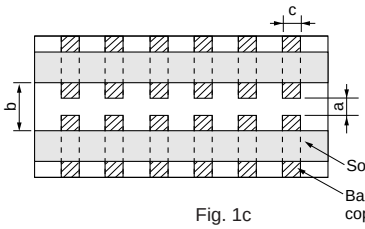
Type	Temp. Char. / Rated Voltage	C0G	SL	X7R	Y5V
GRM40-024	50VDC	0.5~360	220~470	220~ 6,800	10,000
	25VDC	—	—	8,200~10,000	15,000~ 33,000
	16VDC	—	—	12,000~27,000	47,000~100,000
GRM42-625	25VDC	—	—	—	150,000~220,000

MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Thin Type

GRM Series for Thin Equipment

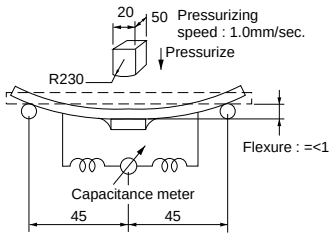
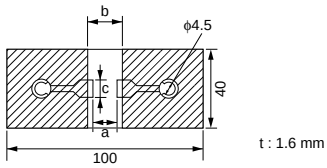
■SPECIFICATIONS AND TEST METHODS

<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>-55 to +125˚C</td><td>X7R : -55 to +125˚C
Y5V : -30 to + 85˚C</td><td></td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td colspan="2">See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, 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">Dimension</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 and SL) 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</td><td colspan="2">10,000MΩmin. 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˚C and 75% RH max. and within 2 minutes of charging.</td></tr>
<tr><td>7</td><td colspan="2">Capacitance</td><td colspan="2">Within the specified tolerance.</td><td rowspan="2">The capacitance/Q/D.F. shall be measured at 25˚C at the frequency and voltage shown in the table.
<table><tr><th>Item \ Char.</th><th>C0G, SL (1000pF and below)</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 5Vrms</td><td>1±0.2Vrms</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>50V · 25V</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>9</td><td rowspan="3">Capacitance Temperature Characteristics</td><td>Capacitance Change</td><td>Within the specified tolerance. (Table A-2)</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˚C</td><td rowspan="2">25˚C</td><td>Within±15%</td></tr><tr><td>Y5V</td><td>-30 to + 85˚C</td><td>Within $^{+22}_{-82}$ %</td></tr></table></td><td rowspan="3">(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˚C to +125˚C ; SL. : +25˚C to +85˚C) 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 (˚C)</th></tr><tr><td>1</td><td>25±2</td></tr><tr><td>2</td><td>-55±3</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3 (for C0G)/85±3 (for SL)</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˚C 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 detects 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 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. *5N (GRM40-024)
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></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></table>(in mm)
 
Fig. 1c</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>50V · 25V</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>

MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Thin Type

GRM Series for Thin Equipment

No.	Item	Specification		Test Method
		Temperature Compensating Type	High Dielectric Constant Type	
12	Deflection	No cracks or marking defects shall occur.		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. 3c		 Fig. 2c (in mm)
				Type / a / b / c GRM40: 1.2 / 4.0 / 1.65 GRM42-6: 2.2 / 5.0 / 2.0
13	Solderability of Temination	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°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C.
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°C for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5°C 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 $^{+0}_{-10}$°C for one hour and then let sit for 48±4 hous at room temperature. Perform the initial measurement.
	Appearance	No marking defects.		
	Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	X7R ·····Within ±7.5% Y5V ·····Within ±20%	
	Q	30pF and over : Q>=1,000 30pF and below : Q>=400+20C C : Nominal Capacitance (pF)	**Char. / 50V · 25V / 16V** X7R: 0.025 max. / 0.035 max. Y5V: 0.05 max. / 0.07 max.	
	I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)		
	Dietectric 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. Sit it for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric coustant type) at room temperature, then measure.
	Appearance	No marking defects		
	Capacitance Change	Within±2.5% or ±0.25pF (Whichever is lager)	X7R ·····Within ±7.5% Y5V ·····Within ±20%	
	Q	30pF and over : Q>=1,000 30pF and below : Q>=400+20C C : Nominal Capacitance (pF)	**Char. / 50V · 25V / 16V** X7R: 0.025 max. / 0.035 max. Y5V: 0.05 max. / 0.07 max.	
	I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)		
	Dietectric Strength	No failure		
				Step / 1 / 2 / 3 / 4 Temp. (°C): Min. Operating Temp. $^{+0}_{-3}$ / Room Temp. / Max. Operating Temp. $^{+3}_{-0}$ / Room Temp. Time (min.): 30±3 / 2 to 3 / 30±3 / 2 to 3
				• Initial measurement for high dielectric constant type Perform a heat treatment at 150 $^{+0}_{-10}$°C for one hour and then let sit for 48±4 hous at room temperature. Perform the initial measurement.
16	Humidity, Steady State	The measured and observed characteristics shall satisfy the specifications in the following table.		Sit the capacitor at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
	Appearance	No marking defects		
	Capacitance Change	Within ±5% or ±0.5pF (Whichever is lager)	X7R ·····Within ±12.5% Y5V ·····Within ±30%	
	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)	**Char. / 50V · 25V / 16V** X7R: 0.05 max. / 0.05 max. Y5V: 0.075 max. / 0.1 max.	
	I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)		

MONOLITHIC CERAMIC CAPACITOR

Nickel Barriered Termination Thin Type

GRM Series for Thin Equipment

<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>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="6">Apply the rated voltage at 40±2˚C and in 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then muasure.
The charge/discharge current is less than 50mA.</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>X7R ·····Within ±12.5%
Y5V ·····Within ±30%</td></tr>
<tr><td>Q</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>50V · 25V</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>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="6">Apply 200% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3˚C. 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˚C 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 lager)</td><td>X7R ·····Within ±12.5%
Y5V ·····Within ±30%</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
C : Nominal Capacitance (pF)</td><td><table><tr><th>Char.</th><th>50V · 25V</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>

Table A-2

Char.	Nominal Values (ppm/˚C) Note 1	Capacitance Change from 25˚C Value (%)					
		-55˚C		-25˚C		-10˚C	
		Max.	Min.	Max.	Min.	Max.	Min.
C0G	0± 30	0.58	-0.24	0.40	-0.17	0.25	-0.11
SL	+350 to-1,000	—	—	—	—	—	—

Note 1 : Nominal values denote the temperature coefficient within a range of 25˚C to 125˚C (for C0G) /85˚C (for SL).

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 (LXWXT : 1.0X0.5X0.5mm) to the larger sized GR44-1 (LXWXT : 5.7X5.0X2.0mm).
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

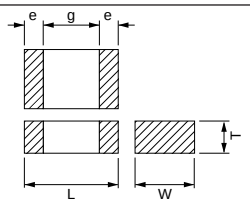
(*Please specify the part number and adhesive method when ordering.)

(Ex.) GR40 X7R 102 K 50 [ ] PT

❶ ❷ ❸ ❹ ❺ ❻ ❼

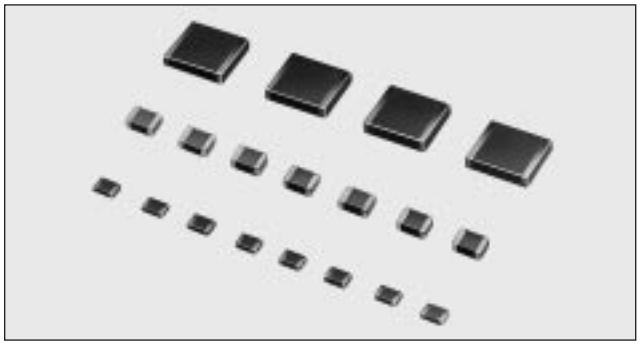
❶Type
❷Temperature Characteristics
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging Code

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 $^{+0}$		
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˚C	-55 to 85˚C		
Temp. coeff. (ppm/˚C)	0±30	-220±60	-750±120	+350 to -1000

- High Dielectric Constant Type

Code	X7R	Z5U	Y5V
Temp. range	-55 to 125˚C	+10 to 85˚C	-30 to 85˚C
Cap. change (%)	±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	10000

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	Rated voltage (VDC)
16	16
25	25
50	50
100	100
200	200
500	500

❻PACKAGING CODE

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

MONOLITHIC CERAMIC CAPACITOR

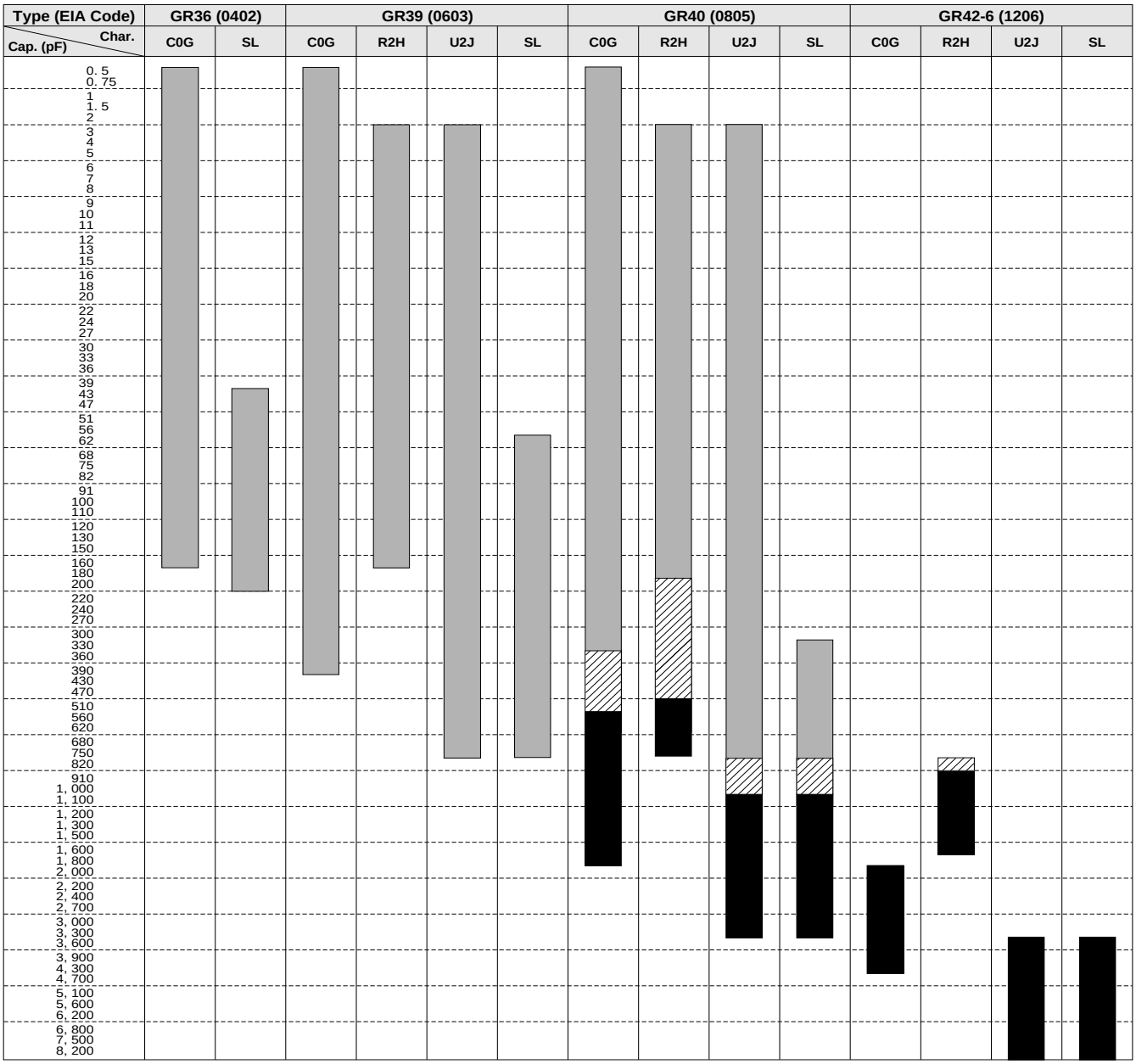
Silver Termination Type

GR Series for General Electronic Equipment

■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.

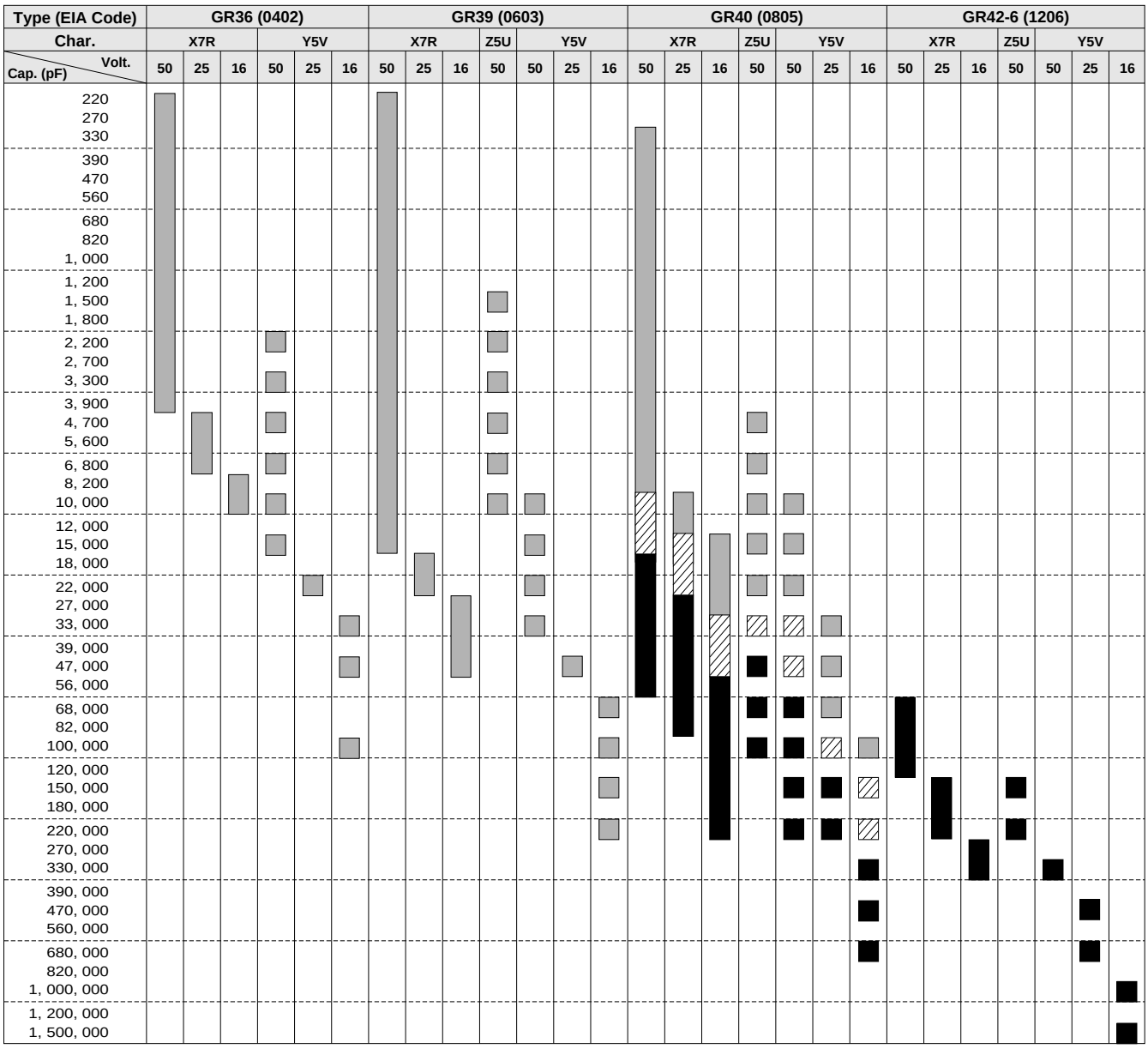
MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR Series for General Electronic Equipment

FOR SILVER EPOXY CONDUCTIVE ADHESIVE

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



■CAPACITANCE TOLERANCE

X7R Characteristics

K : ±10% (E12 Series)

M : ±20% (E 6 Series)

Z5U Characteristics

M : ±20% (E 6 Series)

Z : $^{+80}_{-20}$% (E 6 Series)

Y5V Characteristics

Z : $^{+80}_{-20}$% (E 6 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	: 1.25 $^{+0}_{-0.2}$	1,000	3,000

*φ330mm reel is available on request.

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR Series for General Electronic Equipment

FOR SILVER EPOXY CONDUCTIVE ADHESIVE

Temperature Compensating Type

500V/200V/100V

Type (EIA Code)	GR39 (0603)				GR40 (0805)				GR42-6 (1206)				
Char.	C0G		SL		C0G		SL		C0G			SL	
Cap. (pF) \ Volt.	200	100	200	100	200	100	200	100	500	200	100	200	100
1 1. 5 2													
3 4 5													
6 7 8													
9 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 1, 100													
1, 200 1, 300 1, 500													
1, 600 1, 800 2, 000													
2, 200 2, 400 2, 700													
3, 000 3, 300 3, 600													
3, 900 4, 300 4, 700													

High Dielectric Constant Type

500V/200V/100V

Type (EIA Code)	GR39 (0603)				GR40 (0805)					GR42-6 (1206)					
Char.	X7R		Z5U	Y5V	X7R		Z5U		Y5V	X7R			Z5U		Y5V
Cap. (pF) \ Volt.	200	100	100	100	200	100	200	100	100	500	200	100	200	100	100
220 270 330															
390 470 560															
680 820 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															

■CAPACITANCE TOLERANCE

C0G/SL Characteristics

C : ±0.25pF ····· 5pF and below

D : ±0.5pF ····· 6pF=<cap.=<10pF

J : ±5% ····· More than 10pF

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)*
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.

MONOLITHIC CERAMIC CAPACITOR

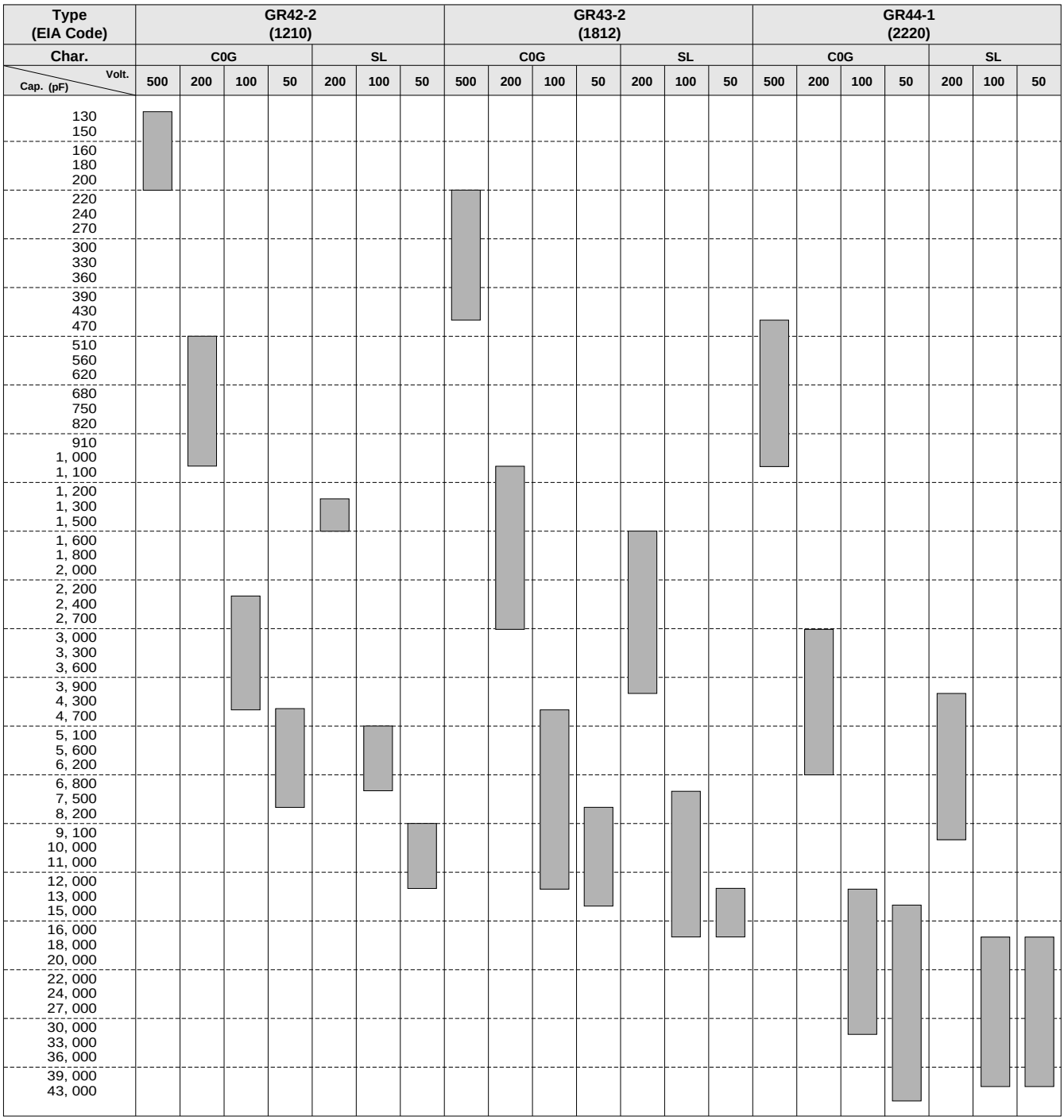
Silver Termination Type

GR Series for General Electronic Equipment

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.

MONOLITHIC CERAMIC CAPACITOR

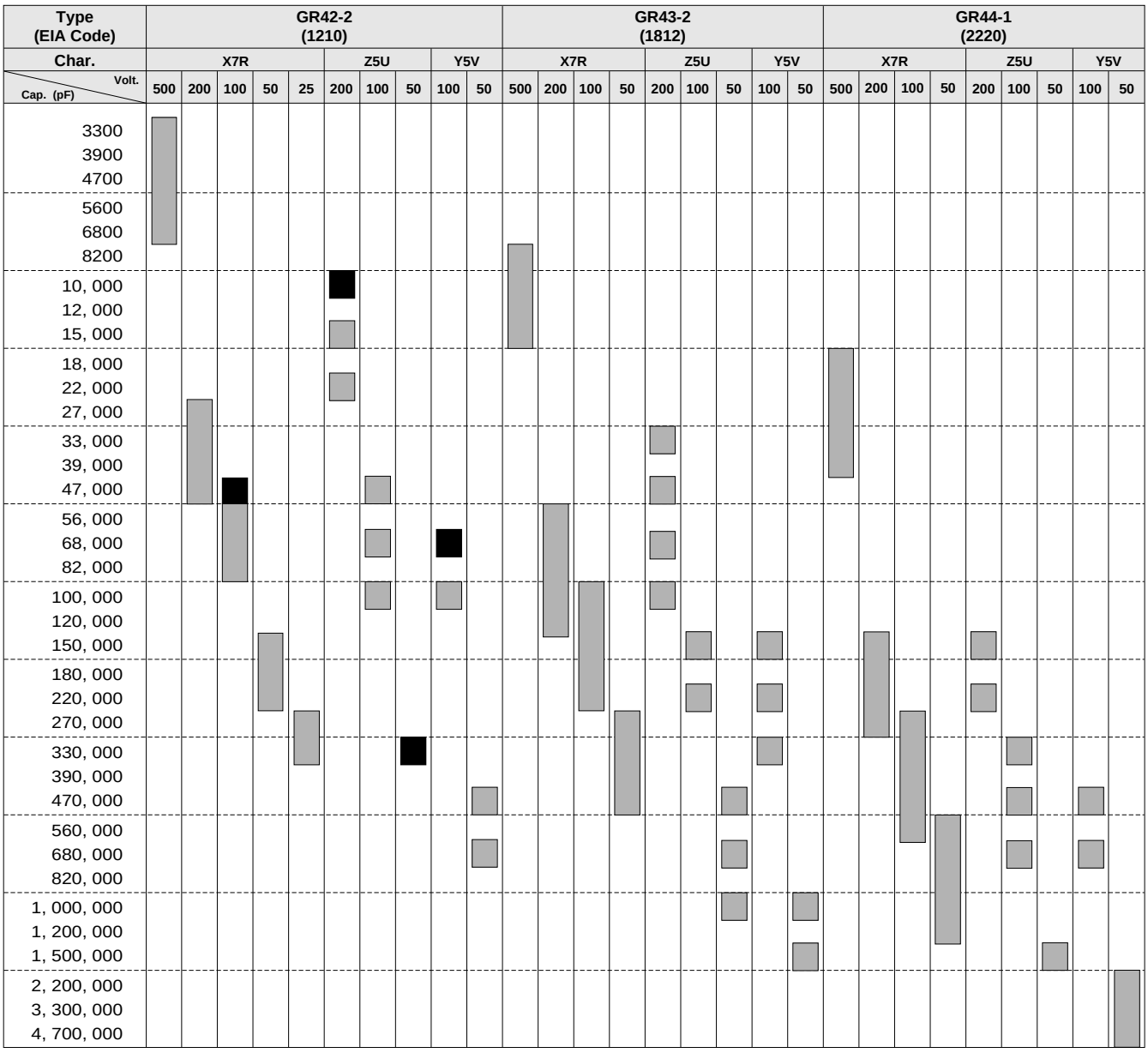
Silver Termination Type

GR Series for General Electronic Equipment

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)*
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

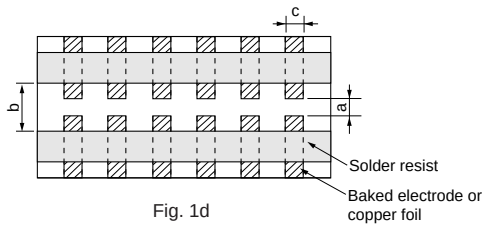
*φ330mm reel is available on request.

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR Series for General Electronic Equipment

■SPECIFICATIONS AND TEST METHODS

No.	Item		Specification: Temperature Compensating Type	Specification: High Dielectric Constant Type	Test Method
1	Operating Temperature Range		-55 to +125˚C	X7R : -55 to +125˚C Z5U : +10 to + 85˚C Y5V : -30 to + 85˚C	
2	Rated Voltage		See the previous pages.		The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance		No defects or abnormalities.		Visual inspection.
4	Dimension		Within the specified dimension.		Using calipers.
5	Dielectric Strength		No defects or abnormalities.		No failure shall be observed when *300% of the rated voltage (C0G to U2J, 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
6	Insulation Resistance		More than 10,000MΩ or 500Ω·F (Whichever is smaller)		The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25˚C and 75%RH max. and within 2 minutes of charging.
7	Capacitance		Within the specified tolerance.		The capacitance/Q/D.F. shall be measured at 25˚C at the frequency and voltage shown in the table.
8	Q/Dissipation Factor (D.F.)		30pF min. : Q>=1,000 30pF max. : Q>=400+20C C : Nominal Capacitance (pF)	Char. / 25V min. / 16V X7R 0.025 max. 0.035 max. Z5U 0.025 max. —— Y5V 0.05 max. 0.07 max.	Char. / Item: C0G to U2J, SL (1000pF and below) / C0G to U2J, SL (more than 1000pF) X7R, Y5V / Z5U Frequency: 1±0.1MHz / 1±0.1kHz / 1±0.1kHz Voltage: 0.5 to 5Vrms / 1±0.2Vrms / 0.5±0.05Vrms
9	Capacitance Temperature Characteristics	Capacitance Change	Within the specified tolerance. (Table A-3)	Char. / Temp. Range / Reference Temp. / Cap. Change X7R -55 to +125˚C / 25˚C / Within±15% Z5U +10 to + 85˚C / 25˚C / Within $^{+22}_{-56}$ % Y5V -30 to + 85˚C / 25˚C / Within $^{+22}_{-82}$ %	(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˚C to +125˚C; other temp. coeffs. :+25˚C to +85˚C) 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. Step / Temperature (˚C) 1 25±2 2 -55±3 3 25±2 4 125±3 (for C0G)/85±3 (for other TC) 5 25±2 (2) High Dielectric Constant Type The ranges of capacitance change compared with the 25˚C value over the temperature ranges shown in the table shall be within the specified ranges.
		Temperature Coefficient	Within the specified tolerance. (Table A-3)		
		Capacitance Drift	Within ±0.2% or ±0.05pF. (Whichever is larger.)		
10	Adhesive Strength of Termination		No removal of the terminations or other detects shall occur.		Fix the capacitor to the test jig (glass epoxy board) shown in Fig.1d using silver epoxy conductive adhesive. Then apply 10N* force in parallel with the test jig par 10±1 sec. *5N (GR36, GR39)
			 Fig. 1d		Type / a / b / c GR36 0.4 1.5 0.5 GR39 1.0 3.0 1.2 GR40 1.2 4.0 1.65 GR42-6 2.2 5.0 2.0 GR42-2 2.2 5.0 2.9 GR43-2 3.5 7.0 3.7 GR44-1 4.5 8.0 5.6
11	Vibration Resistance (Not apply for GR36)	Appearance	No defects or abnormalities.		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).
		Capacitance	Within the specified tolerance.		
		Q/D.F.	30pF min. : Q>=1,000 30pF max. : Q>=400+20C C : Nominal Capacitance (pF)	Char. / 25V min. / 16V X7R 0.025 max. 0.035 max. Z5U 0.025 max. —— Y5V 0.05 max. 0.07 max.	

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR Series for General Electronic Equipment

No.	Item	Specification		Test Method
		Temperature Compensating Type	High Dielectric Constant Type	
12	**Temperature Cycle (Not apply for GR36)**	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 (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
	Appearance	No marking defects		
	Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	X7R ……Within ±7.5% Z5U, Y5V ……Within ±20%	
	Q / D.F.	30pF and over : Q>=1,000 30pF and below : Q>=400+20C C : Nominal Capacitance (pF)	Char. / 25V min. / 16V X7R: 0.025 max. / 0.035 max. Z5U: 0.025 max. / —— Y5V: 0.05 max. / 0.07 max.	
	I.R.	More than 10,000MΩ or 500Ω·F (Whichever is smaller)		
	Dielectric Strength	No failure		• Initial measurement for high dielectric constant type. Perform a heat treatment at 150^{+0}_{-10}°C, for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement.
13	**Humidity, Steady State**	The measured and observed characteristics shall satisfy the specifications in the following table.		Sit the capacitor at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 24±2 hours (temperature compensating type) and 48±4 hours (high dielectric constant type), then measure.
	Appearance	No marking detects		
	Capacitance Change	Within ±5% or ±0.5pF (Whichever is larger)	X7R ……Within ±12.5% Z5U, Y5V ……Within ±30%	
	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)	Char. / 25V min. / 16V X7R: 0.05 max. / 0.05 max. Z5U: 0.05 max. / —— Y5V: 0.075 max. / 0.1 max.	
	I.R.	More than 1,000MΩ or 50Ω·F (Whichever is smaller)		
14	**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°C. 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 detects		
	Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	X7R ……Within ±12.5% Z5U, Y5V ……Within ±30%	
	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)	Char. / 25V min. / 16V X7R: 0.04 max. / 0.05 max. Z5U: 0.04 max. / —— Y5V: 0.075 max. / 0.1 max.	• Initial measurement for high dielectric constant type. Apply *200% of the rated DC voltage for one hour at the maximum operating temperature ±3°C. Remove and let sit for 48±4 hours at room temperature. Perform initial measurement.
	I.R.	More than 1,000MΩ or 50Ω·F (Whichever is smaller)		
	Dielectric Strength	No failure		*150% for 500V
15	**Notice**	When mounting capacitor of 500V rated voltage, perform the epoxy resin coating (min. 1.0mm thickness).		

Step

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

Table A-3

Char.	Nominal Values (ppm/°C) Note 1	Capacitance Change from 25°C Value (%)					
		-55°C		-30°C		-10°C	
		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°C to 125°C (for C0G) /85°C (for other TC).

MONOLITHIC CERAMIC CAPACITOR

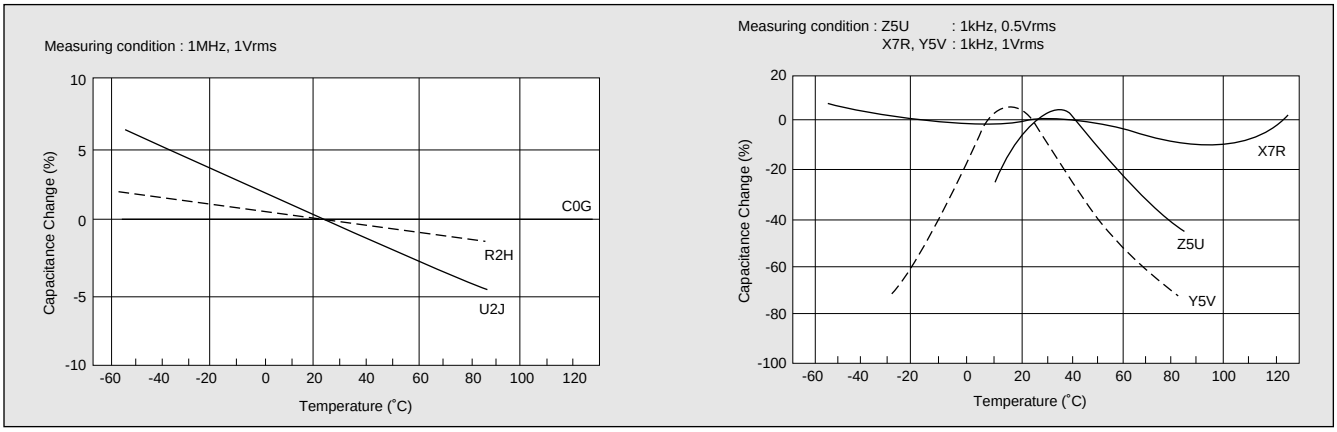
Silver Termination Type

GR Series for General Electronic Equipment

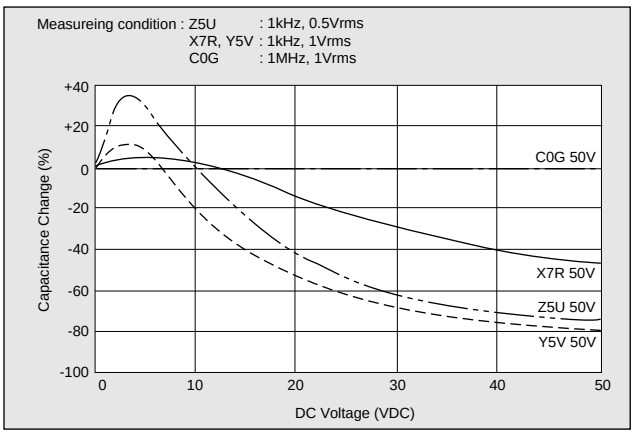
■CHARACTERISTICS (REFERENCE DATA)

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

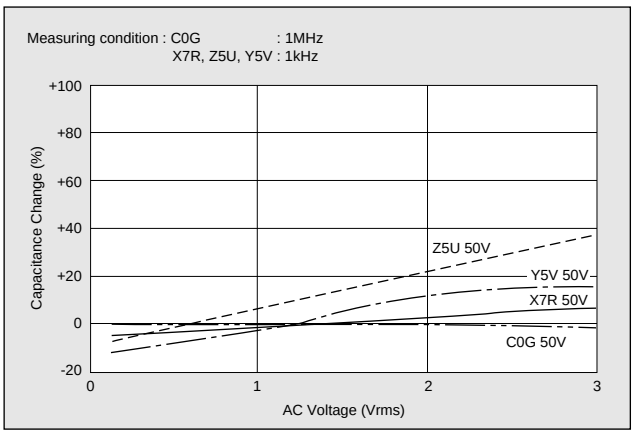
- Capacitance-Temperature Characteristics



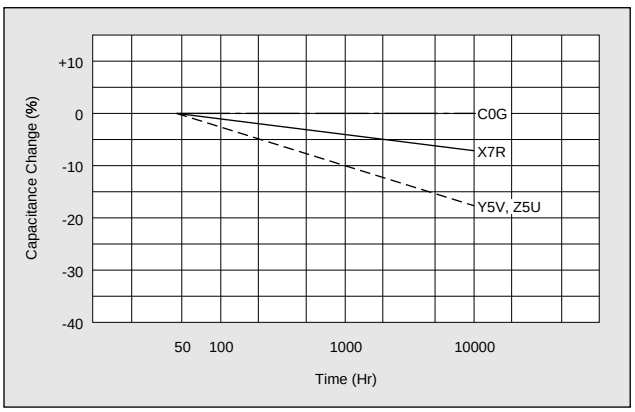
- Capacitance-DC Voltage Characteristics



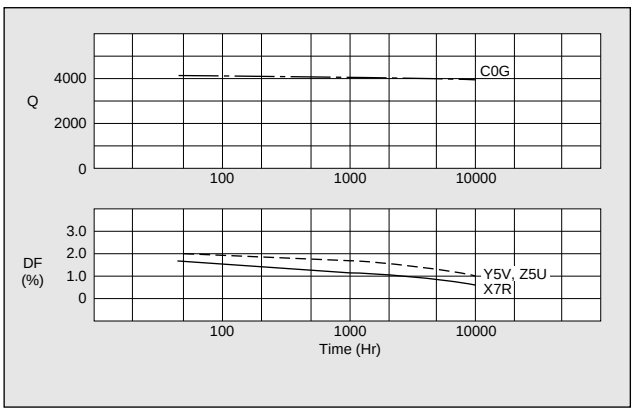
- Capacitance-AC Voltage Characteristics



- Capacitance Change-Aging



- Q/DF Change-Aging



MONOLITHIC CERAMIC CAPACITOR

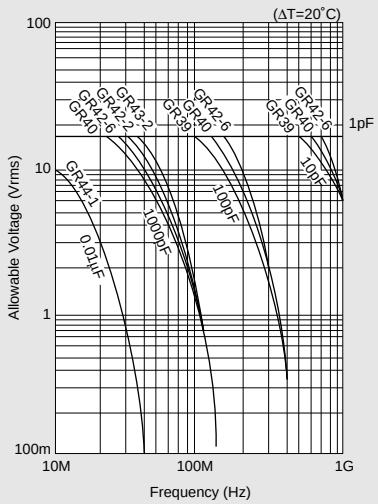
Silver Termination Type

GR Series for General Electronic Equipment

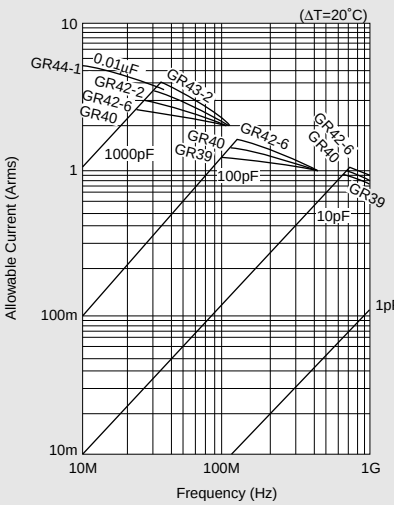
- High Frequency-Power Capacity
  The monolithic ceramic capacitor has a small dielectric loss. When high frequency current is applied to the capacitor, the capacitor generates heat (power consumption) by its E.S.R. Temperature rise of the capacitor (ΔT) should be kept below 20˚C (ΔT=<20˚C) in the actual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

Temperature Compensating Type (C0G 50V)

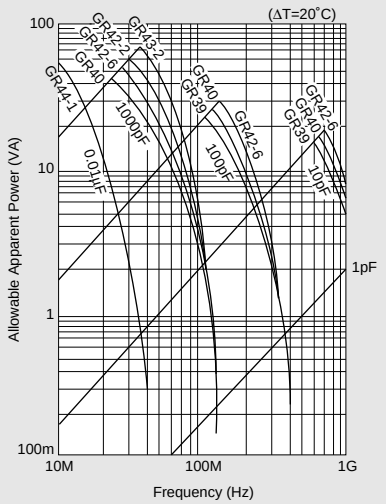
Allowable Voltage



Allowable Current

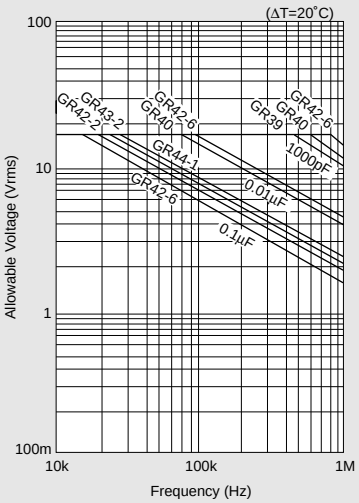


Allowable Apparent Power

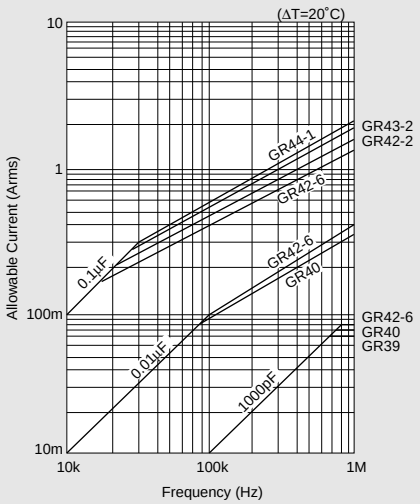


High Dielectric Constant Type (X7R 50V)

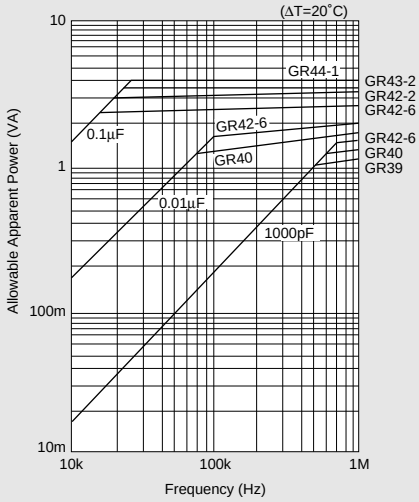
Allowable Voltage



Allowable Current



Allowable Apparent Power



MONOLITHIC CERAMIC CAPACITOR

Reflow Soldering Nickel Barriered Termination Type

GRM200 Series ; Smoothing

■FEATURES

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

■APPLICATION

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

■PART NUMBERING

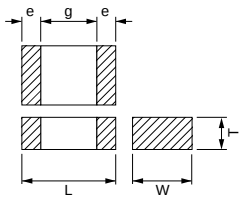
(* Please specify the part number when ordering)

(Ex.) GRM230 | Y5V | 106 | Z | 10 | | PT

❶ ❷ ❸ ❹ ❺ ❻ ❼

❶Type
❷Temperature Characteristics
(Please refer to the table)
❸Capacitance
❹Capacitance Tolerance
❺Rated Voltage
❻Murata's Control No.
❼Packaging

❶TYPE AND DIMENSIONS

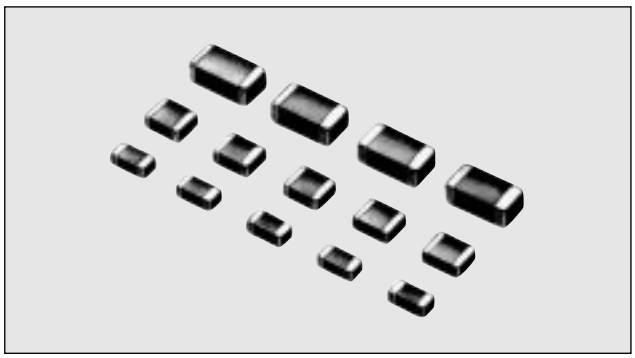


(in mm)

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	0.5min.
GRM230 (1206)	3.2±0.15	1.6±0.15		0.3-0.8	0.5min.
GRM235 (1210)	3.2±0.3	2.5±0.2		0.3min.	1.0min.

❷TEMPERATURE CHARACTERISTICS

Code	Capacitance Change Rate	Temp. Range	Reference Temp.
Y5V	Within $\pm^{22}_{82}$ %	-30 to 85˚C	25˚C



❸CAPACITANCE (Ex.)

Code	Capacitance (μF)
105	1
226	22

❹CAPACITANCE TOLERANCE

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

❺RATED VOLTAGE

Code	Rated Voltage (VDC)
10	10
16	16
25	25

❺RATED VOLTAGE

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

■CAPACITANCE RANGE

(in μF)

Type (EIACode)	Tickness T (mm)	Rated Voltage		
		25VDC	16VDC	10VDC
GRM220 (0603)	0.8±0.1	–	–	1
GRM230 (1206)	1.15±0.1	–	4.7	10
GRM235 (1210)	1.5± $^{0}_{0.3}$	6.8	6.8, 10	22
	2.0± $^{0}_{0.4}$	10	–	–
Capacitance Tolerance		Z : $\pm^{80}_{20}$%		

Type (EIACode)	Tickness T (mm)	Bulk (pcs./bag)	Taping (pcs./ϕ178mm reel)
GRM220 (0603)	0.8±0.1	1,000	4,000
GRM230 (1206)	1.15±0.1	–	3,000
GRM235 (1210)	1.5± $^{0}_{0.3}$	–	2,000
	2.0± $^{0}_{0.4}$	–	1,000

MONOLITHIC CERAMIC CAPACITOR

Reflow Soldering Nickel Barriered Termination Type

GRM200 Series ; Smoothing

■SPECIFICATIONS AND TEST METHODS

No	Item	Specification	Test Method
1	Operating Temperature Range	Y5V : -30˚C to +85˚C	
2	Rated Voltage	See the previous page.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance	No defects or abnormalities.	Visual inspection.
4	Dimension	Within the specified dimension.	Using calipers.
5	Dielectric Strength	No defects or abnormalities.	No failure shall be observed when a voltage 250% of the rated voltage is applied between the both terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance	10000MΩ 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 20˚C at the frequency and voltage shown in the table.
8	Dissipation Factor (D. F.)	Y5V : 0.09 max.	

Capacitance	Frequency	Voltage
C=<10μF	1±0.1kHz	1±0.2Vrms
C>10μF	120kHz±20%	0.5±0.1Vrms

9	Capacitance Temperature Characteristics	Char.	Temp. Range	Reference Temp.	Cap. Change Rate	The ranges of capacitance change reference to 25˚C within the temperature ranges shown in the table shall be within the specified ranges.
		Y5V	-30 to 85˚C	25˚C	Within $\pm^{22}_{82}$%	

10	Adhesive strength of Terrmination	No removal of the terminations or other defect shall occur.	Solder the capacitor on the testing jig (glass epoxy board) shown in Fig. 1e by an 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 counducted with care so that the soldering is uniform and free of defect such as heat shock. *5N (GRM220 only)

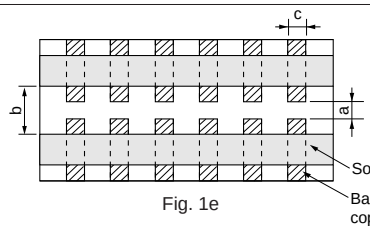


Fig. 1e

Type	a	b	c
GRM220	1.0	3.0	1.2
GRM230	2.2	5.0	2.0
GRM235	2.2	5.0	2.9

(in mm)

11	Vibration Resistance	Appearance	No defects or abnormalities.	Solder the capacitor to the testing jig (glass epoxy boards)in the same manner and under the same conditions as (10). 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 viblation 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).
		Capacitance	Within the specified tolerance.	
		Dissipation Factor(D.F.)	Y5V : 0.09 max.	

12	Deflection	No cracks or marked defect shall occur.	Solder the capacitor to the test jig (glass epoxy boards) shown in Fig.2e using a eutectic solder. Then apply a force in the direction shown in Fig.3e. 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.

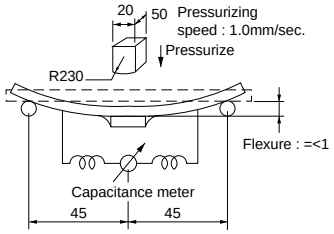


Fig. 3e

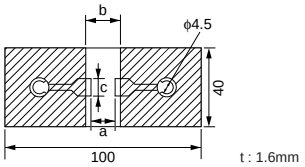


Fig. 2e

Type	a	b	c
GRM220	1.0	3.0	1.2
GRM230	2.2	5.0	2.0
GRM235	2.2	5.0	2.9

(in mm)

MONOLITHIC CERAMIC CAPACITOR

Reflow Soldering Nickel Barriered Termination Type

GRM200 Series ; Smoothing

<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 a ethanol (JIS-K-8101) solution of rosin (JIS-K-5902) (25% rosin in weight proportion), then in an eutectic solder solution for 2±0.5 seconds at 230±5˚C after preheating for 10 to 30 seconds at 80 to 120˚C.</td></tr>
<tr><td>14</td><td>Resistance to Soldering Heat</td><td>The measured values shall satisfy the values in the following table.
<table><tr><th>Item</th><th>Specification</th></tr><tr><td>Appearance</td><td>No marking defect.</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±20%</td></tr><tr><td>I.R.</td><td>More than 10000MΩ or 500Ω・F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>Y5V : 0.09 max.</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˚C±$^{0}_{10}$˚C. Immerse the capacitor in a eutectic solder solution at 270±5˚C for 10±0.5 seconds (flowsoldering bath) 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>3.2X1.6mm max.</td><td>1 minute at 120 to 150˚C</td></tr><tr><td>3.2X2.5mm min.</td><td>Each 1 minute at 100 to 120˚C and then 170 to 200˚C</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><th>Item</th><th>Specification</th></tr><tr><td>Appearance</td><td>No marking defect.</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±20%</td></tr><tr><td>I.R.</td><td>More than 10000MΩ or 500Ω・F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>Y5V : 0.09 max.</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˚C±$^{0}_{10}$˚C, then measure for the initial measurement. Fix capacitor to the supporting jig in the same manner and under the same conditions as in (10) and conduct the five sycles 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. (˚C)</td><td>Min. Operating Temp.$^{+0}_{-3}$</td><td>Room Temp.</td><td>Max. Operating Temp.$^{+3}_{-0}$</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table></td></tr>
<tr><td>16</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 marking defect.</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±30%</td></tr><tr><td>I.R.</td><td>More than 1000MΩ or 50Ω・F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>Y5V : 0.125 max.</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table></td><td>Set the capacitor at 500±12 hours at 40±2˚C. in 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><th>Item</th><th>Specification</th></tr><tr><td>Appearance</td><td>No marking defect.</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±30%</td></tr><tr><td>I.R.</td><td>More than 1000MΩ or 25Ω・F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>Y5V : 0.125 max.</td></tr><tr><td>Dielectric Strength</td><td>No failure</td></tr></table></td><td>Apply the rated voltage at 500±12 hours at 40±2˚C and 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.</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><th>Item</th><th>Specification</th></tr><tr><td>Appearance</td><td>No marking defect.</td></tr><tr><td>Capacitance Change</td><td>Y5V : Within ±30%</td></tr><tr><td>I.R.</td><td>More than 1000MΩ or 50Ω・F (Whichever is smaller)</td></tr><tr><td>D.F.</td><td>Y5V : 0.125 max.</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˚C then it shall be set for 48±4 hours at room temperature and the measurement shall be conducted. Then apply the above mentioned voltage continuousty 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>

MONOLITHIC CERAMIC CAPACITOR

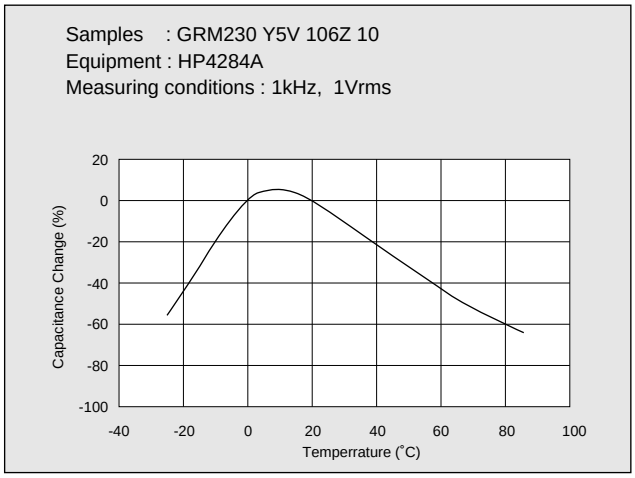
Reflow Soldering Nickel Barriered Termination Type

GRM200 Series ; Smoothing

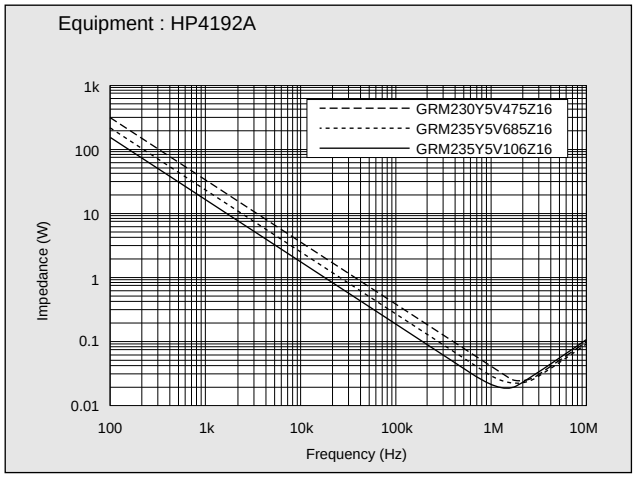
■CHARACTERISTICS (REFERENCE DATA)

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

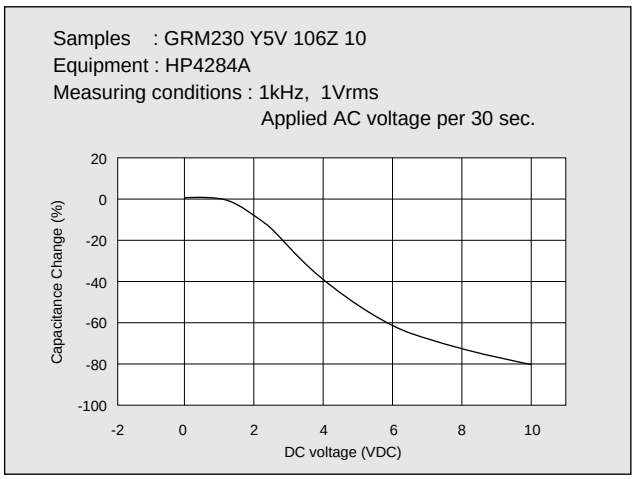
- Capacitance-Temperature Characteristics



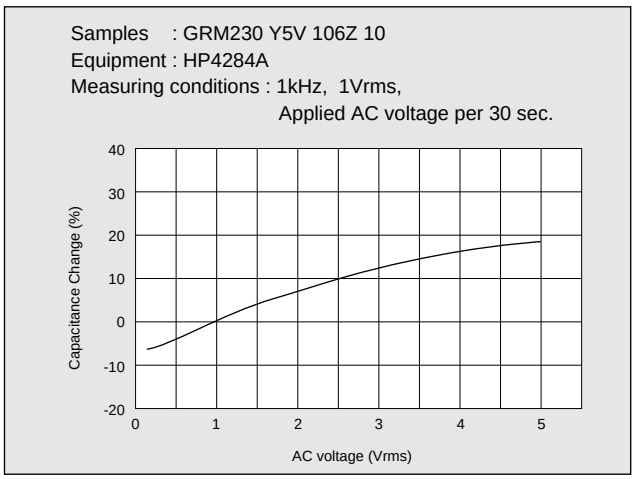
- Impedauce-Frequency Characteristics



- Capacitance-DC Voltage Characteristics



- Capacitance-AC Voltage Characteristics



MONOLITHIC CERAMIC CAPACITOR

Reflow Soldering Nickel Barriered Termination Type

GRM200 Series ; Smoothing

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

- Allowable Ripple Current Value

Rated Voltage : 10V

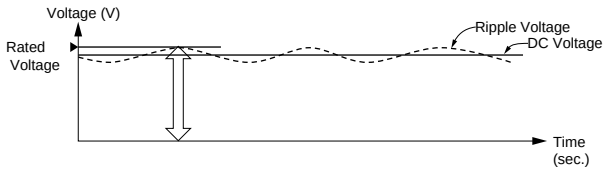
Chip Size	100kHz=<f <300kHz	300kHz=<f <500kHz	500kHz=<f =<1MHz
GRM220	1.4Arms	1.5Arms	1.6Arms
GRM230	1.5Arms	1.6Arms	1.6Arms
GRM235	1.7Arms	1.8Arms	2.0Arms

Rated Voltage : 16V

Chip Size	100kHz=<f <300kHz	300kHz=<f <500kHz	500kHz=<f =<1MHz
GRM230	1.5Arms	1.6Arms	1.6Arms
GRM235	1.7Arms	1.8Arms	2.0Arms

Rated Voltage : 25V

Chip Size	100kHz=<f <300kHz	300kHz=<f <500kHz	500kHz=<f =<1MHz
GRM230	2.0Arms	2.2Arms	2.2Arms



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

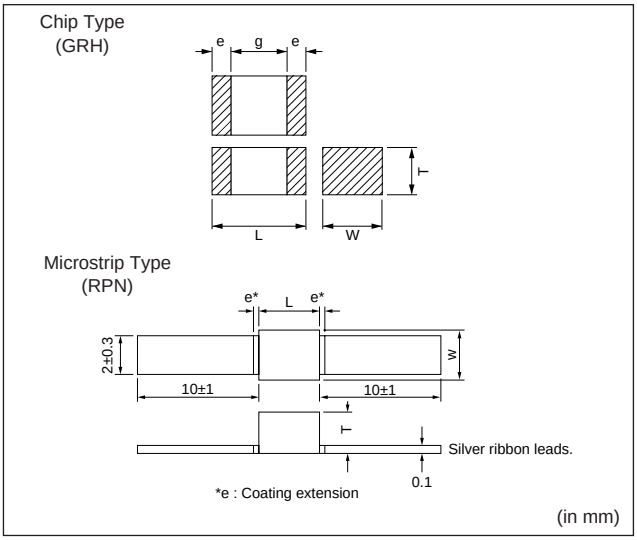
(*Please specify the part number when ordering)

(Ex.) GRH710 C0G 151 J 200 [ ] PB

❶ ❷ ❸ ❹ ❺ ❻ ❼

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

❶TYPE AND DIMENSIONS



Type	Dimensions (mm)				
	L	W	T	e	g
GRH706	1.25 +0.5 -0.3	1.0 +0.5 -0.3	1.2 max.	0.15min.	0.3min.
GRH708	2.0 +0.5 -0.3	1.25 +0.5 -0.3	1.45max.	0.2 min.	0.5min.
GRH710	3.2 +0.6 -0.4	2.5 +0.5 -0.3	1.9 max.	0.3 min.	0.5min.
RPN710	4.0 max.	3.0 max.	2.3 max.	1.5 max.	—

❷TEMPERATURE CHARACTERISTIC

Code	Temp. coeff.	Temp. range	Reference temp.
C0G	0±30ppm/˚C	-55˚C to 125˚C	25˚C

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

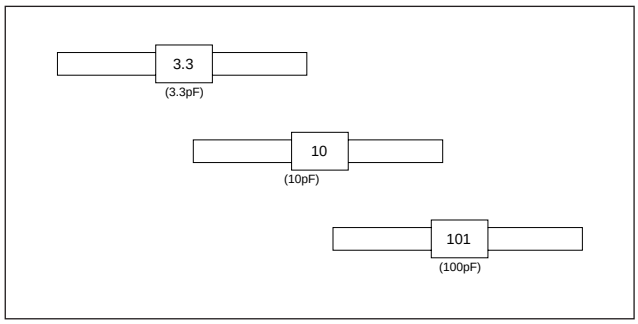
Code	Rated voltage
50	50VDC
100	100VDC
200	200VDC

❻PACKAGING 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.



MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN700 Series ; High-frequency Type

■CAPACITANCE RANGE TABLE

T. C.	C0G								
Type	GRH706			GRH708			GRH710/RPN710		
Cap. (pF) \ Volt.	200	100	50	200	100	50	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)
GRH706	1,000	——
GRH708	1,000	3,000
GRH710	1,000	2,000
RPN710	100	——

MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN700 Series ; High-frequency Type

■SPECIFICATIONS AND TEST METHODS

Temperature Compensating Type

No	Item		Specification	Test Method
1	Operating Temperature Range		-55 to +125˚C	
2	Rated Voltage		See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance		No defects or abnormalities.	Visual inspection.
4	Dimension		Within the speified 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		10,000MΩ min.	The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25˚C and standard humidity and within 2 minutes of charging.
7	Capacitance		Within the specified tolerance.	The capacitance/Q shall be measured at 25˚C 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-4)	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-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.
		Temperature Coefficient	Within the specified tolerance. (Table A-4)	
		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 (alumna substrate) shown in Fig. 1f 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.2f 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 varid 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)	

Item \ Char.	C0G (1,000pF and below)
Frequency	1±0.1MHz
Voltage	0.5 to 5Vrms

Step	Temperature (˚C)
1	25±2
2	-55±3
3	25±2
4	125±3
5	25±2

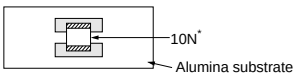


Fig. 1f *5N (GRH 706)

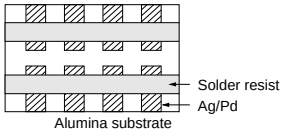


Fig. 2f

MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN700 Series ; High-frequency Type

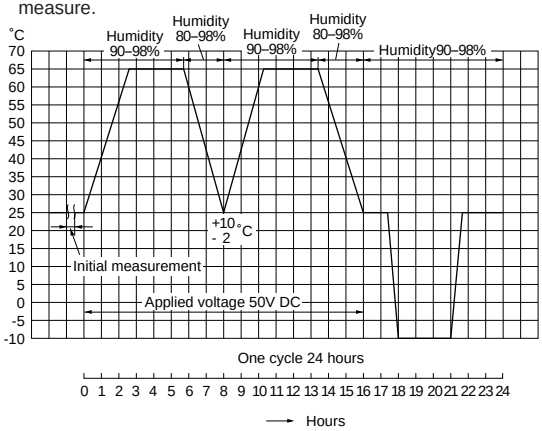
<table>
<tr><th>No</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>12</td><td>Solderability of Temination</td><td>75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120˚C for 10 to 30 seconds. After preheating immerse in solder containing 2.5% silver for 5±0.5 seconds at 230±5˚C. 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 marking defects</td></tr><tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td>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 falilure</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˚C. 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>2.0X1.25 mm max.</td><td>1 minute at 120 to 150˚C</td></tr><tr><td>3.2X2.5mm</td><td>Each 1 minute at 100 to 120˚C and then 170 to 200˚C</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 marking defects</td></tr><tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td></tr><tr><td>Q</td><td>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 falilure</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. (˚C)</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 marking defects</td></tr><tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td></tr><tr><td>Q</td><td>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˚C) 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 marking defects</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˚C. Remove and set for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.</td></tr>
</table>

Table A-4

Char.	Temperature Coefficient (ppm/˚C) Note1	Capacitance Change from 25˚C Value (%)					
		-55˚C		-30˚C		-10˚C	
		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 wihin a range of 25˚C to 125˚C

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 teminations.
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

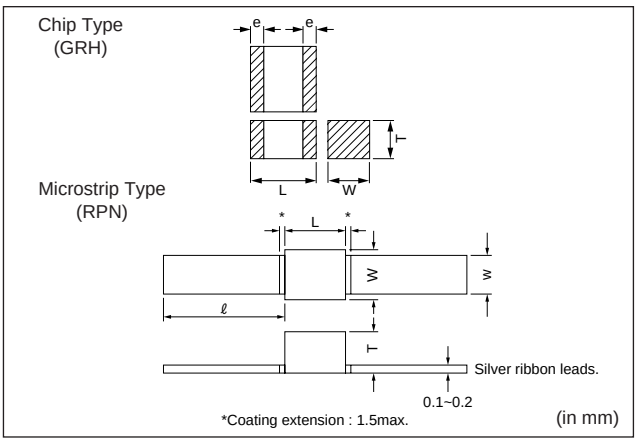
(*Please specify the part number when ordering)

(Ex.) GRH111 C0G 151 J 300 [ ] PB

❶ ❷ ❸ ❹ ❺ ❻ ❼

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

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 CHARACTERISTIC

Code	Temp. coeff.	Temp. range	Rererence temp.
C0G	0±30ppm/˚C	-55˚C to 125˚C	25˚C

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	Rated voltage	Code	Rated Voltage
50	50VDC	300	300VDC
100	100VDC	500	500VDC
200	200VDC		

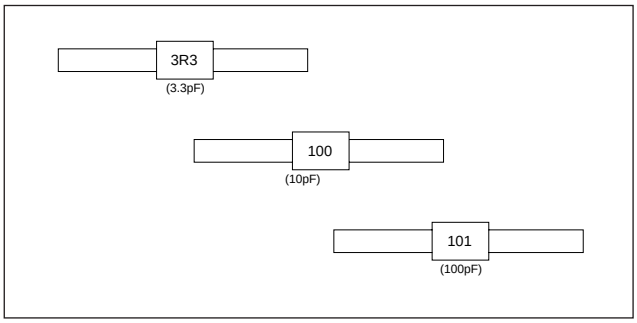
❻PACKAGING CODE

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

■MARKING

Marking is omitted from the GRH110, GRH111 and RPN110.

The three digit code is marked on the RPN111 series.



MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN100 Series ; HiQ and High-power Type

■CAPACITANCE RANGE TABLE

T. C. / Type / Volt. / Cap. (pF)	C0G					
	GRH110/RPN110	GRH111/RPN111				
	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	---

MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN100 Series ; HiQ and High-power Type

■SPECIFICATIONS AND TEST METHODS

Temperature Compensating Type

No	Item		Specification	Test Method
1	Operating Temperature Range		-55 to +125˚C	
2	Rated Voltage		See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance		No defects or abnormalities.	Visual inspection.
4	Dimension		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	25˚C	C=< 470pF : 1,000,000MΩmin. 470pF< C=<1,000pF : 100,000MΩmin.	The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25˚C and 125˚C, standard humidity and within 2 minutes of charging.
		125˚C	C=< 470pF : 100,000MΩmin. 470pF< C=<1,000pF : 10,000MΩmin.	
7	Capacitance		Within the specified tolerance.	The capacitance/Q shall be measured at 25˚C 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-5)	The temperature coefficient is determined using the capacitance mesured 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.
		Temperature Coefficient	Within the specified tolerance. (Table A-5)	
		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 1g using solder containing 2.5% silver. The soldering shall be done either with an iron or in a 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.2g 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 varid 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 5Vrms

Step	Temperature (˚C)
1	25±2
2	-55±3
3	25±2
4	125±3
5	25±2

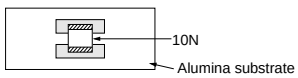


Fig. 1g

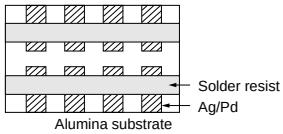


Fig. 2g

MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

GRH/RPN100 Series ; HiQ and High-power Type

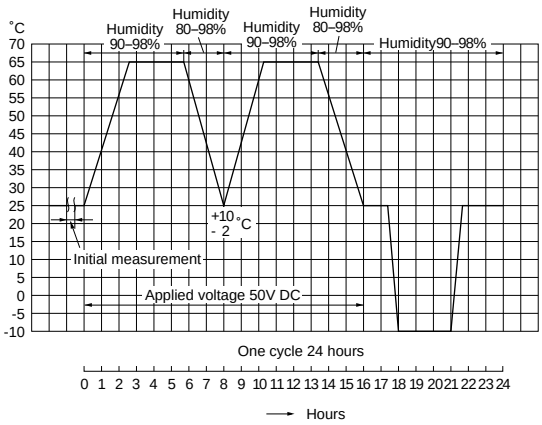
<table>
<tr><th>No</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>12</td><td>Solderability of Temination</td><td>95% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion), Preheat at 80 to 120˚C for 10 to 30 seconds. After preheating immerse in solder containing 2.5% silver for 5±0.5 seconds at 230±5˚C. The dipping depth for microstrip type capacitors is up to 1mm 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 marking defects</td></tr><tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td>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˚C.</td></tr><tr><td>Dielectric Strength</td><td>No falilure</td></tr></table>C : Nominal Capacitance (pF)</td><td>Preheat the capacitor at 80 to 100˚C for 2 minutes and then at 150 to 200˚C for 5 minutes.
Immerse in solder containing 2.5% silver for 3±0.5 seconds at 270±5˚C. 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 and Immersion 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 marking defects</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˚C.</td></tr><tr><td>Dielectric Strength</td><td>No falilure</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} ˚C for 15 minutes and immersion in a saturated uqueous solution of salt at 0±3˚C 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. (˚C)</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 marking defects</td></tr><tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td></tr><tr><td>Q</td><td>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˚C.</td></tr></table>C : Nominal Capacitance (pF)</td><td>Apply the 24-hour heat (-10 to +65˚C) 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 characterisics shall satisfy the specifications in the following table.
<table><tr><th>Item</th><th>Specification</th></tr><tr><td>Appearance</td><td>No marking defects</td></tr><tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td></tr><tr><td>Q</td><td>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˚C.</td></tr></table>C : Nominal Capacitance (pF)</td><td>Apply 150% of the rated voltage for 2000±12 hours at 125±3˚C. Remove and set for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.</td></tr>
</table>

Table A-5

Char.	Temperature Coefficient (ppm/˚C) Note 1	Capacitance Change from 25˚C Value (%)					
		-55˚C		-30˚C		-10˚C	
		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˚C to 125˚C

MONOLITHIC CERAMIC CAPACITOR

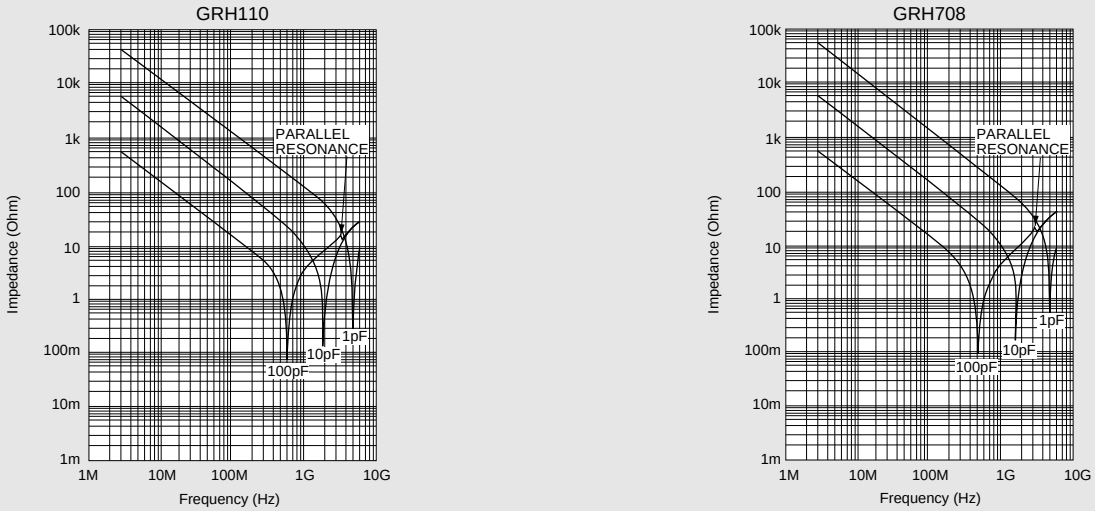
Solder Coated Type

GRH/RPN700 Series and GRH/RPN100 Series

■CHARACTERISTICS

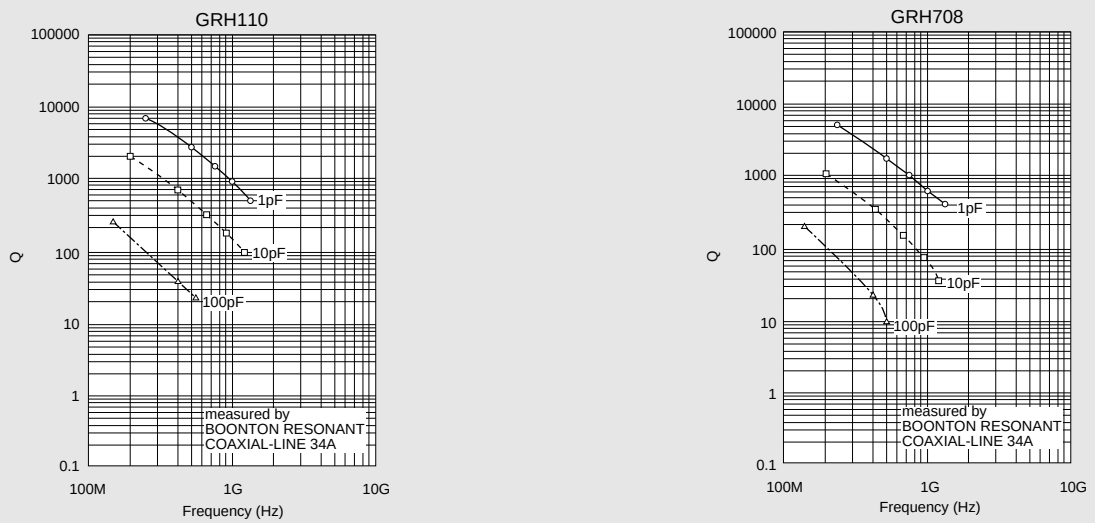
- Impedance-Frequency Characteristics

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

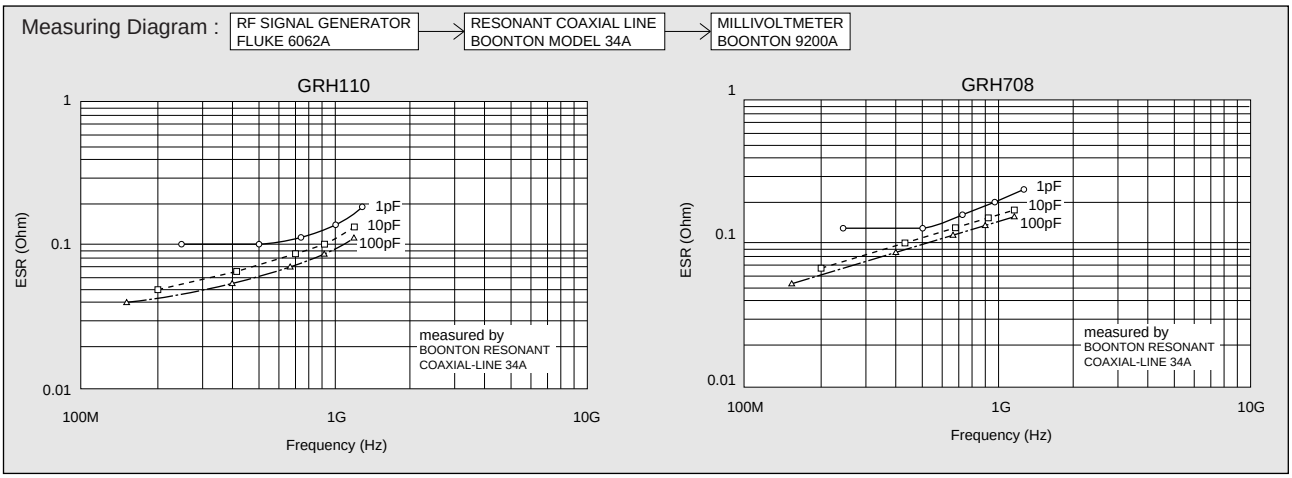


MONOLITHIC CERAMIC CAPACITOR

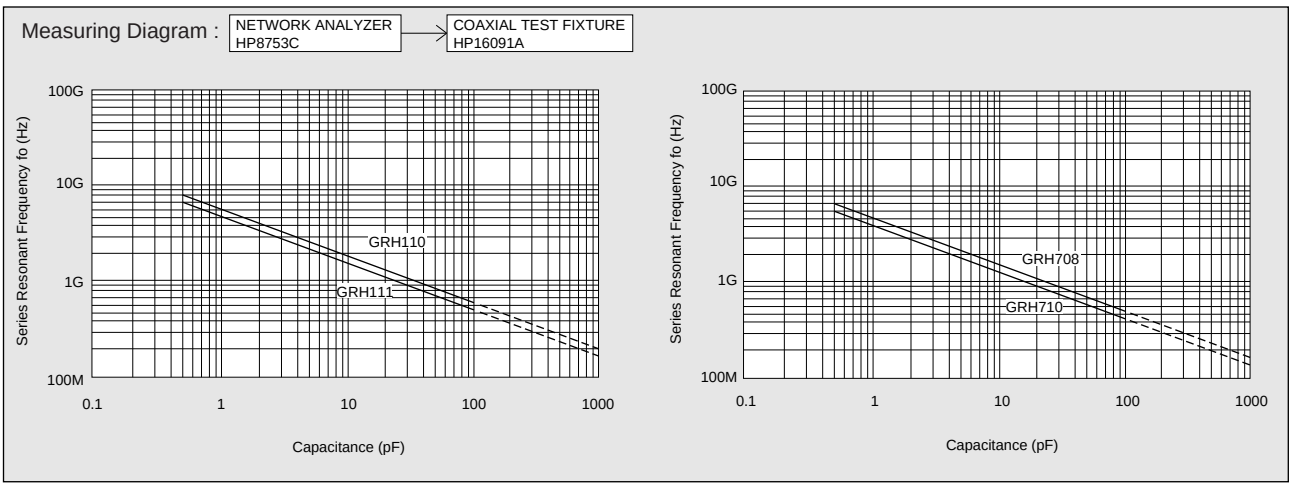
Solder Coated Type

GRH/RPN700 Series and GRH/RPN100 Series

- ESR-Frequency



- Resonant Frequency-Capacitance



MONOLITHIC CERAMIC CAPACITOR

Solder Coated Type

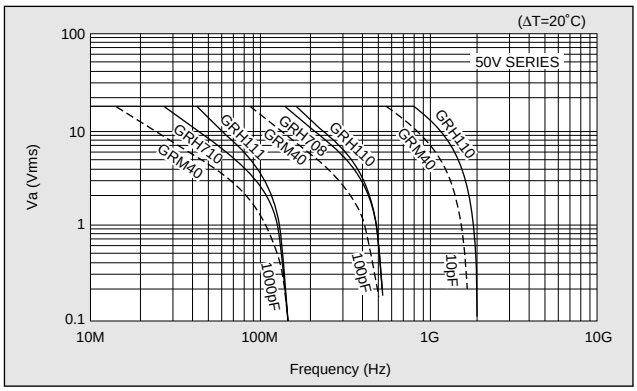
GRH/RPN100 Series ; HiQ and High-power Type

- 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˚C (ΔT=<20˚C) in the actual circuit.
  Therefore, when selecting capacitors, the applicable voltage, power and current should be considered within the follwing limits.

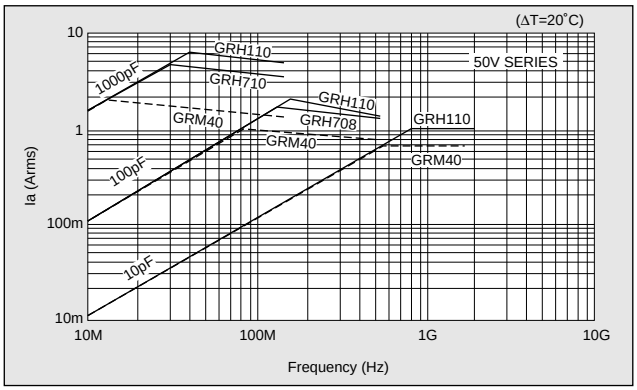
Effective power at ΔT=20˚C is as follows

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

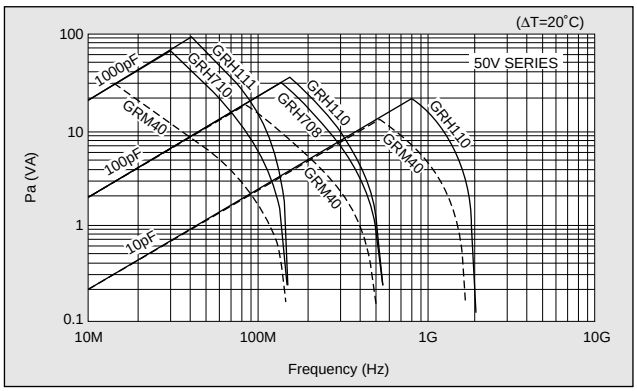
- Allowable Voltage-Frequency



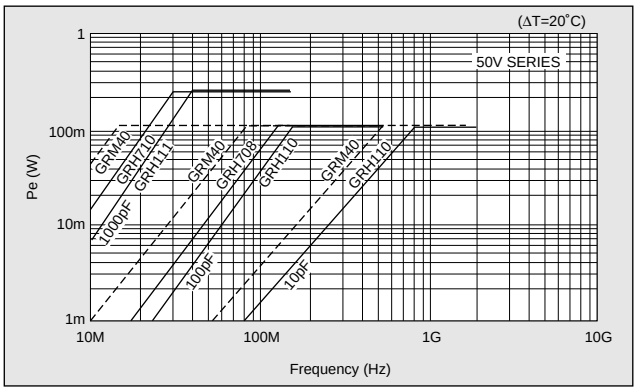
- Allowable Current-Frequency



- Allowable Apparent Power-Frequency



- Allowable Effective Power-Frequency



MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR500 Series ; High-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. Coefficeint : 0±30ppm/˚C

Temperature Range : -55˚C to +125 ˚C
Standard Temperature : 25˚C

❸Nominal Capacitance (Ex.)

Code	Capacitance (pF)
100	10
101	100
222	2200
683	68000
334	330000 (=0.33µF)

❹Capacitance Tolerance

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

❺Rated Voltage

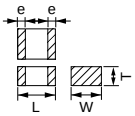
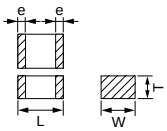
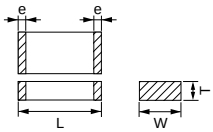
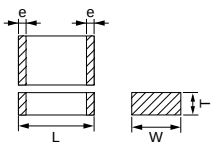
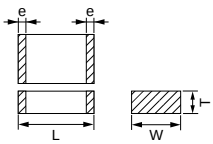
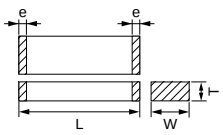
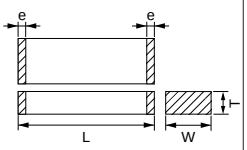
Code	Standards
500	500VDC
1K	1kVDC
2K	2kVDC
3K	3.15kVDC
4K	4kVDC

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

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR500 Series ; High-voltage

■CAPACITANCE RANGE

Temperature Characteristic : C0G

● 500VDC 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		

● 1kVDC 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			

● 2kVDC 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			

● 3.15kVDC 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				

● 4kVDC 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.

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR500 Series ; High-voltage

■CAPACITANCE RANGE

Temperature Characteristic : X7R

● **500VDC** 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			

● **1kVDC** 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			

● **2kVDC** 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			

● **3.15kVDC** Tol. : ±10% (K)

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

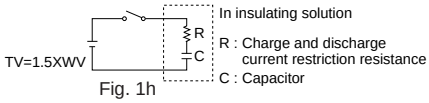
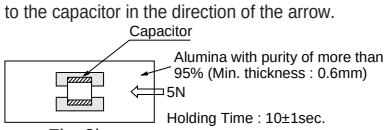
MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR500 Series ; High-voltage

■SPECIFICATIONS AND TEST METHODS

Temperature Compensating Type

No	Items		Specifications	Test Methods
1	Operating Temperature Range		-25˚C to +85˚C	
2	Rated Voltage		See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance		No defects or abnormality.	Visual inspection.
4	Dimension		Within the specified dimension.	Using calipers.
5	Dielectric Strength		No defect 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.1h for 1 to 5 seconds, in insulating solution, provided the charge/discharge current is less than 50mA.  Fig. 1h
6	Insulation Resistance		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.
7	Capacitance		Within the specified tolerance.	The capacitance/Q shall be measured at 25˚C with 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 Variation Rate	Within the specified tolerance. (Table A-6)	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˚C shall be within the specified tolerance for the temperature coefficient. -55 to +25˚C 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).
		Temperature Coefficient	Within the specified tolerance. (Table A-6)	
		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 (alumna substrate) shown in Fig. 2h 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. 2h
11	Vibration Resistance	Appearance	No defect nor abnormality.	Solder the capacitor on the testing jig (alumina substrate) shown in Fig. 3h 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).
		Capacitance	Within the specified tolerance.	
		Q	Satisfies the initial value. 30pF min. : Q >=1,000 30pF max. : Q >=400+20C C : Nominal Capacitance (pF)	

Rated voltage	Voltage applied
WV : 500VDC	500VDC
WV>=1kVDC	1kVDC

Item \ Char	C0G, (1000pF and below)	C0G, (more than 1000pF)
Frequency	1±0.2MHz	1±0.2kHz
Voltage	5Vrms max.	5Vrms max.

Step	Temperature (˚C)
1	25±2
2	-55±3
3	25±2
4	125±3
5	25±2

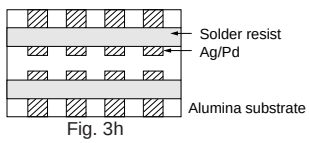


Fig. 3h

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR500 Series ; High-voltage

Temperature Compensating Type

No	Items	Specifications	Test Methods
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˚C after preheating for 5 minutes at 80 to 100˚C and then 1 to 2 minutes at 160 to 170˚C.
13	**Resistance to Soldering Heat**	The measured values shall satisfy the values in the following table. **Item** / **Specification** **Appearance**: No marked defect **Capacitance Change**: Within ± 2.5% or ±0.25pF (Whichever is larger) **Q**: 30pF and over : Q >=1,000; 30pF and below : Q>=400+20C **I.R.**: More than 10,000MΩ or 100Ω·F (Whichever is smaller) **Dielectric Strength**: No failure C : Nominal Capacitance	Immerse the capacitor in solder containing 2.5% silver of 260±5˚C for 5±0.5 seconds after preheating for 5 minutes at 80 to 100˚Cand then for 1 to 2 minutes at 160 to 170˚C. Set it for 24±2 hours at room temperature, then measure.
14	**Temperature Cycle**	The measured values shall satisfy the values in the following table. **Item** / **Specification** **Appearance**: No marked defect **Capacitance Change**: Within ± 2.5% or ±0.25pF (Whichever is larger) **Q**: 30pF and over : Q >=1,000; 30pF and below : Q>=400+20C **I.R.**: More than 10,000MΩ or 100Ω·F (Whichever is smaller) **Dielectric Strength**: No failure C : Nominal Capacitance	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11) and conduct the five cycles according to the temperatures and time shown in the following table. Set it for 24±2 hours at room temperature, then measure. **Step** / **1** / **2** / **3** / **4** **Temp. (˚C)**: -25^{+0}_{-3} / Room temp. / $+85^{+3}_{-0}$ / Room temp. **Time (min.)**: 30±3 / 2 to 3 / 30±3 / 2 to 3
15	**Humidity (Steady State)**	The measured values shall satisfy the values in the following table. **Item** / **Specification** **Appearance**: No marked defect **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 **I.R.**: More than 1,000MΩ or 10Ω·F (Whichever is smaller) C : Nominal Capacitance (pF)	Set the capacitor for 500^{+24}_{-0} hours at 40±2˚C, in 90 to 95% humidity. Take it out and set it for 24±2 hours at room temperature, then measure.
16	**High Temperature Load**	The measured values shall satisfy the values in the following table. **Item** / **Specification** **Appearance**: No marked defect **Capacitance Change**: Within ±3% or ±0.3pF (Whichever is larger) **Q**: 30pF and over : Q >=350; 10pF and over, 30pF and below : Q>=275+$\frac{5}{2}$C; 10pF and below : Q >=200+10C **I.R.**: More than 2,000MΩ or 20Ω·F (Whichever is smaller) **Dielectric Strength**: No failure C : Nominal Capacitance (pF)	Apply a voltage of 125 % of the rated voltage for 1000^{+48}_{-0} hours at 85±3˚C and set it for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA.
17	**Notice**	When mounting capacitor, perform the epoxy resin coating (min. 0.1mm thickness).	

Table A-6

Char.	Temperature Coefficient (ppm/˚C)	Capacitance Change from 25˚C (%)					
		-55˚C		-30˚C		-10˚C	
		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 ˚C to 125˚C.

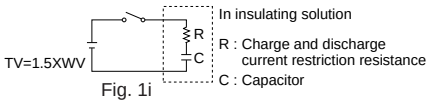
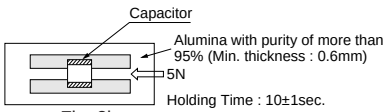
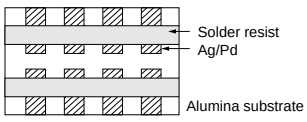
MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR500 Series ; High-voltage

■SPECIFICATIONS AND TEST METHODS

High Dielectric Constant Type

No	Items	Specifications	Test Methods
1	Operating Temperature Range	-25˚C to +85˚C	
2	Rated Voltage	See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance	No defects or abnormality.	Visual inspection.
4	Dimensions	Within the specified dimension.	Using calipers.
5	Dielectric Strength	No defect 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.1i for 1 to 5 seconds, in insulating solution, provided the charge/discharge current is less than 50mA.  Fig. 1i
6	Insulation Resistance	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. Rated voltage: WV : 500VDC → Voltage applied: 500VDC Rated voltage: WV>=1kVDC → Voltage applied: 1kVDC
7	Capacitance	Within the specified tolerance.	The capacitance shall be measured at 25˚C with 1±0.2kHz in frequency and 1±0.2Vrms in voltage.
8	Dissipation Factor (D.F.)	0.025max.	DF shall be measured under the same conditions as the capacitance.
9	Capacitance Temperature Characteristics	Char. X7R; Temp. Range -55~+125˚C; Reference Temp. 25˚C; Cap. Change Rate Within ±15%	The range of capacitance change in reference to 25˚C 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 (alumna substrate) shown in Fig. 2i 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. 2i
11	Vibration Resistance	Appearance: No defect nor abnormality Capacitance: Within the specified tolerance. Dissipation Factor (DF): 0.025 max.	Solder the capacitor on the testing jig (alumina substrate) shown in Figs. 3i 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. 3i
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˚C after preheating for 5 minutes at 80 to 100˚C and then 1 to 2 minutes at 160 to 170˚C.

MONOLITHIC CERAMIC CAPACITOR

Silver Termination Type

GR500 Series ; High-voltage

High Dielectric Constant Type

No	Items	Specifications	Test Methods
13	**Resistance to Soldering Heat**	The measured values shall satisfy the values in the following table. **Item** / **Specification** **Appearance**: No marked defect **Capacitance Change**: Within ± 7.5% **I.R.**: More than 10,000MΩ or 100Ω·F (Whichever is smaller) **DF**: 0.025 max. **Dielectric Strength**: No failure	The capacitor shall be set for 24±2 hours at room temperature after one hour heat of treatment at 150^{+0}_{-10}°C. Immerse the capacitor in solder containing 2.5% silver of 260±5 °C for 5±0.5 seconds after preheating for 5 minutes at 80 to 100°C and then for 1 to 2 minutes at 160 to 170°C. Then set it for 48 ±4 hours at room temperature and measure.
14	**Temperature Cycle**	The measured values shall satisfy the values in the following table. **Item** / **Specification** **Appearance**: No marked defect **Capacitance Change**: Within ±7.5% **I.R.**: More than 10,000MΩ or 100Ω·F (Whichever is smaller) **DF**: 0.025 max. **Dielectric Strength**: No failure	The capacitor shall be set for 24±2 hours at room temperature after one hour heat of treatment at 150^{+0}_{-10}°C then measure for the initial measurement. Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11) and conduct the five cycles according to the temperatures and time shown in the following table. Set it for 24 ±2 hours at room temperature, then measure. **Step** / **1** / **2** / **3** / **4** **Temp. (°C)**: -25^{+0}_{-3} / Room temp. / $+85^{+3}_{-0}$ / Room temp. **Time (min.)**: 30±3 / 2 to 3 / 30±3 / 2 to 3
15	**Humidity (Steady State)**	The measured values shall satisfy the values in the following table. **Item** / **Specification** **Appearance**: No marked defect **Capacitance Change**: Within ±10% **I.R.**: More than 1,000MΩ or 10Ω·F (Whichever is smaller) **DF**: 0.05 max. **Dielectric Strength**: No failure	The capacitor shall be set for 24±2 hours atroom temperature after one hour heat of treatment at 150^{+0}_{-10}°C, then measure for the initial measurement. Set the capacitor for 500^{+24}_{-0}°C hours at 40±2°C, in 90 to 95% humidity. Take it out and set it for 24±2 hours at room temperature, then measure.
16	**High Temperature Load**	The measured values shall satisfy the values in the following table. **Item** / **Specification** **Appearance**: No marked defect **Capacitance Change**: Within ±12.5% **I.R.**: More than 2,000MΩ or 20Ω·F (Whichever is smaller) **DF**: 0.05 max. **Dielectric Strength**: No failure	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°C 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.
17	**Notice**	When mounting capacitor, perform the epoxy resin coating (min. 1.0mm thickness).	

PACKAGE

■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 GR500 Series)
Minimum Quantity*

Type	Minimum Quantity (pcs./bag or tray)
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, GRM220 GRH110, GRH111, GRH706, GRH708, GRH710	1,000
RPN710	100
RPN110, RPN111, GR530, GR535	50
GR540, GR545, GR550	20
GR555, GR580	40

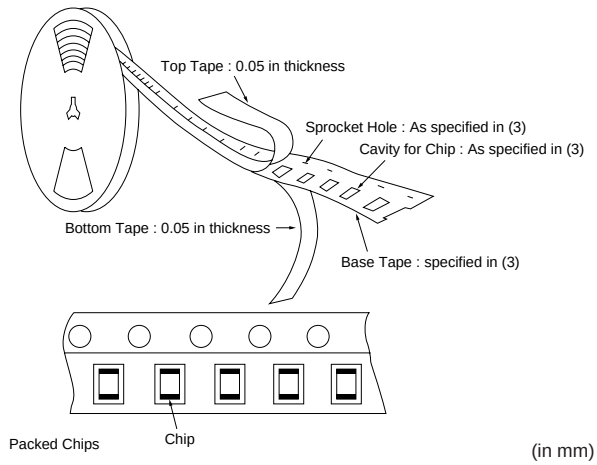
* "Minimum Quantity" means the numbers of units of each delivery or order. The quantity should be an integral multiple of the "minimum quantity"
(Please note that the actual delivery quantity in a package may change sometimes.)

2. TAPE CARRIER PACKAGING

Packaging code : PT

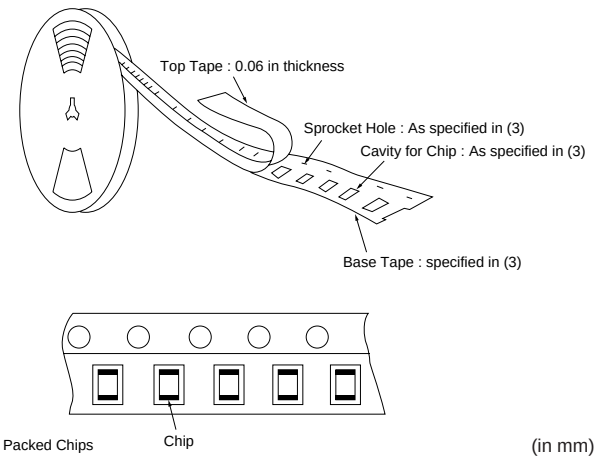
(1) Appearance of taping

• Paper Tape



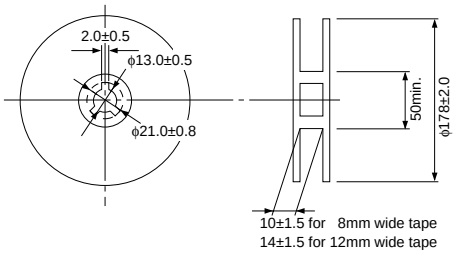
(in mm)

• Plastic Tape



(in mm)

(2) Dimensions of Reel



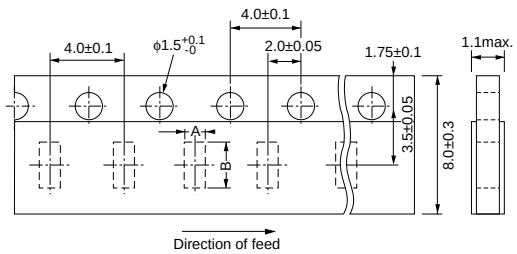
ϕ330mm reel is available on request.

(in mm)

(3) Dimensions of Tape

(a) Paper Tape

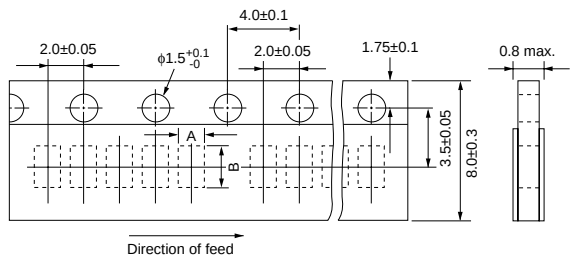
• 4mm Pitch Tape



	GR(M)39 GRM420 GRM220	GR(M)40* GRM425 (T=<1.0mm)	GR(M)42-6* GRM430* (T=<1.0mm)
A	1.05±0.1	1.55±0.15	2.0±0.2
B	1.85±0.1	2.3 ±0.15	3.6±0.2

* Please see plastic tape of page 54 for 1.25mm thickness type.

• 2mm Pitch Tape



	GR(M)36
A	0.65
B	1.15

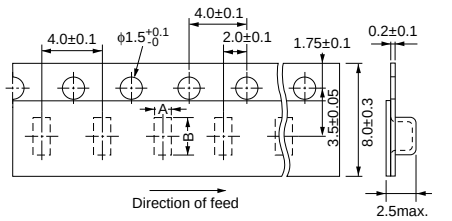
(Nominal value)

(in mm)

PACKAGE

(b) Plastic Tape

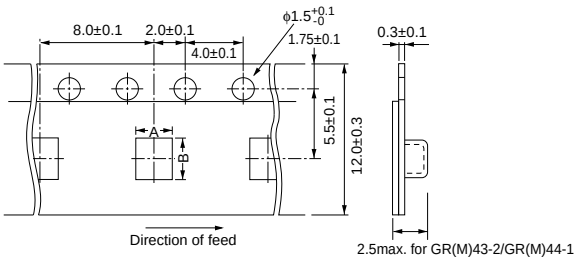
• 4mm Pitch Tape



	GR(M)40 (T=1.25mm)	GR(M)42-6 GRM430 GRM230 (T>=1.15mm)	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



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

(Nominal value) (in mm)

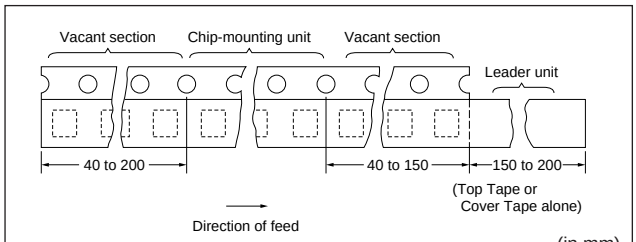
(4) Minimum Quantity*

Type	Chip Thickness	Minimum Quantity(pcs./reel)	
		φ178mm reel	φ330mm reel
GR(M)36	All	10,000	50,000
GR(M)39, GR(M)40, GR(M)42-6 GRM420, GRM425, GRM430 GRM220	1.0mm max.	4,000	10,000
GR(M)40, GR(M)42-6, GR(M)42-2, GRM430, GRM230	1.15/1.25mm	3,000	10,000
GRH708	All	3,000	–
GR(M)42-2, GRM235	1.35/1.5mm	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
GRM235	2.0mm	1,000	–
GRM42-6	1.6mm	2,000	–

(5) 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.



(in mm)

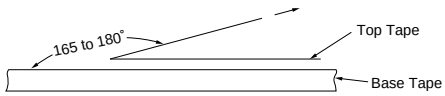
③ The top tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

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.

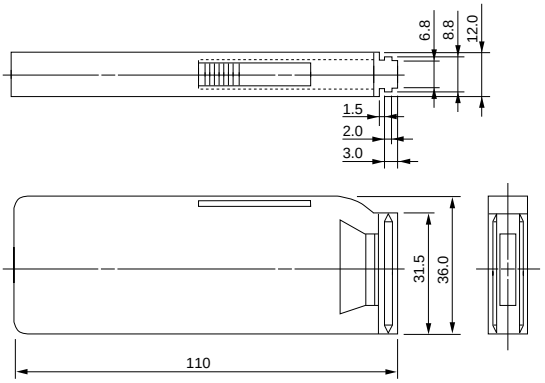
⑦ Peeling off force : 0.1 to 0.6N in the direction shown below.



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)

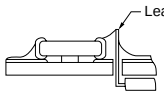
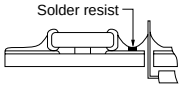
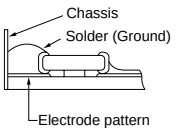
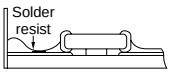
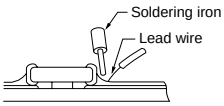
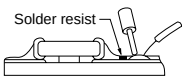
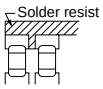
Type / Thickness	GRM36	GRM39	GRM40
0.5 mm	50,000	–	–
0.8 mm	–	15,000	–
0.6 mm	–	–	10,000
1.25mm	–	–	5,000

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

NOTICE

■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 minumum 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. Curcuit 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 designig 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
Plaing of chip components and leaded components		
Placing close to chassis		
Placing of leaded components after chip components		
Lateral mounting		

[Land Dimensions]

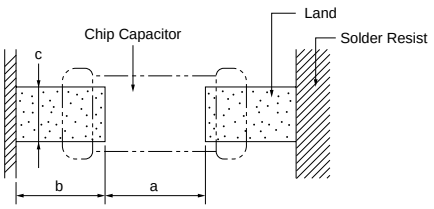


Table 1 Flow soldering method (in mm)

		GRM39 GRM420	GRM40 GRM425	GRM42-6 GRM430	GRH706	GRH708	GRH110
Dimensions	L	1.6	2.0	3.2	1.25	2.0	1.4
	W	0.8	1.25	1.6	1.0	1.25	1.4
a		0.6-1.0	1.0-1.2	2.2-2.6	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	0.6-0.8	0.9-1.0	0.8-0.9
c		0.6-0.8	0.8-1.1	1.0-1.4	0.8-1.0	0.8-1.0	1.0-1.2

NOTICE

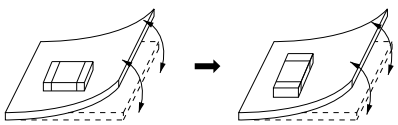
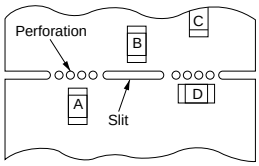
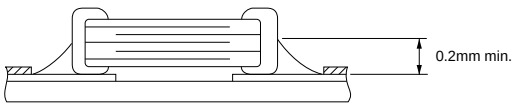
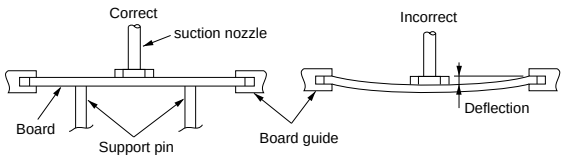
Process	Cautions	Control Points	Reference Data
3. PCB Design		Table 2 Reflow soldering method (in mm) (see tables below) • Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board. [Component Direction]  Locate chip horizontal to the direction in 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]  	
5. Chip Placing	• 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.	• 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 suface 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.	Data 5 Break Strength
6. Reflow Soldering	• Sudden heating of the chip results in distortion due to excessive expansion and construction forces within the chip causing cracked chips.	• When preheating, keep temperature differential, ΔT, within the range shown in Table 3. The smaller the ΔT, the less stress on the chip. Table 3 (see table below)	

Table 2 Reflow soldering method (in mm)

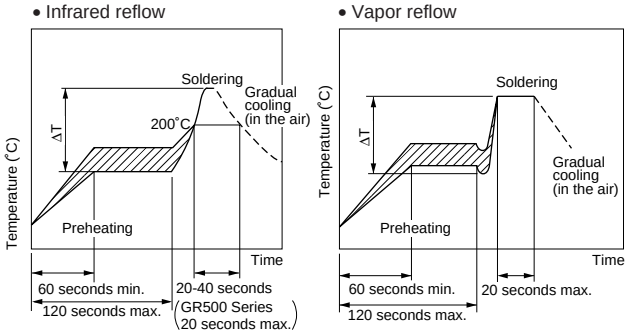
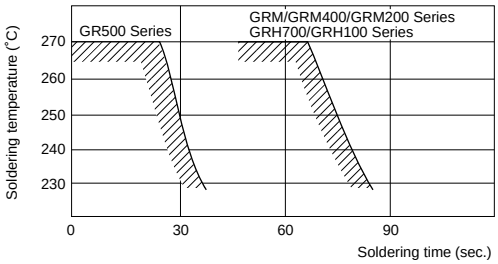
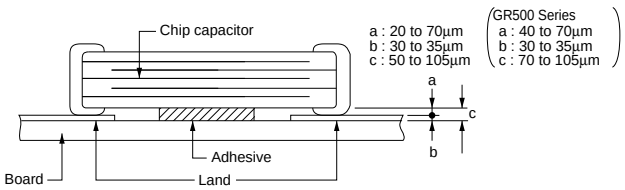
		GRM36	GRM39 GRM420 GRM220	GRM40 GRM425	GRM42-6 GRM430 GRM230	GRM42-2 GRM235	GRM43-2	GRM44-1	GRH706	GRH708	GRH710	GRH110	GRH111
Dimensions	L	1.0	1.6	2.0	3.2	3.2	4.5	5.7	1.25	2.0	3.2	1.4	2.8
	W	0.5	0.8	1.25	1.6	2.5	3.2	5.0	1.0	1.25	2.5	1.4	2.8
a		0.3 -0.5	0.6-0.8	1.0-1.2	2.2-2.4	2.0-2.4	3.0-3.5	4.0-4.6	0.4-0.6	1.0-1.2	2.2-2.5	0.4-0.8	1.8-2.1
b		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	0.6-0.8	0.6-0.8	0.8-1.0	0.6-0.8	0.7-0.9
c		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	0.8-1.0	0.8-1.0	1.9-2.3	1.0-1.2	2.2-2.6

		GR530	GR535	GR540	GR545	GR550	GR555	GR580
Dimensions	L	4.5	5.6	10.6	10.6	11.8	16.0	28.1
	W	3.8	5.0	5.0	10.0	10.6	5.0	13.2
a		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		0.9-1.2	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		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

Chip Size	Temperature Differential
GRM36/39/40/42-6 GRM420/425/430 GRM220/230 GRH706/708/110	ΔT=<190˚C
GRM42-2/43-2/44-1 GRH710/111 GRM235 GR530/535/540/545/550/555/580	ΔT=<130˚C

NOTICE

Process	Cautions	Control Points	Reference Data
		• 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.	
Inverting the PCB		• Make sure not to impose an abnormal mechanical shock on the PCB.	
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˚C) 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 containning 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.	

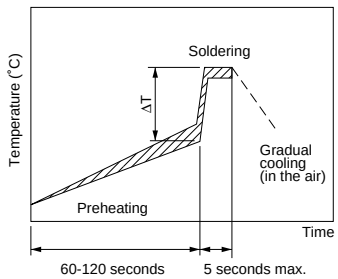
NOTICE

Process	Cautions	Control Points	Reference Data
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 4. The smaller the ΔT, the less stress on the chip. • When components are immeresed in solvent after mounting, be sure to maintain the temperature difference between the component and solvent within the range shown in Table 4. • Do not apply flow soldering to chips not listed inTable 4.	Data 6 Thermal shock Data 7 Solder heat resistance

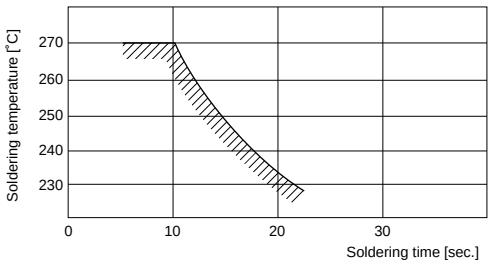
Table 4

Chip Size	Temperature Differential
GRM39/40/42-6 **GRM420/425/430** **GRH706/708/110**	ΔT=<150˚C

[Standard Conditions for Flow Soldering]

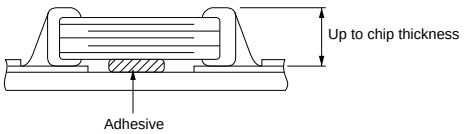


[Allowable Soldering Temperature and Time]



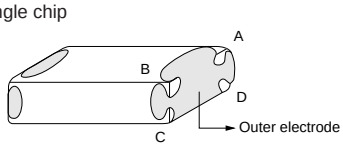
In case of repeated soldering, the accumulated soldering time must be within the range shown above.

[Optimum Solder Amount for Flow Soldering]

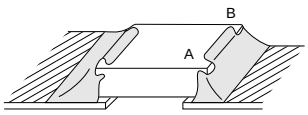


• Set temperature and time to ensure that leaching of the outer electrode does not exceed 25% of the chip end area as a single chip (full length of the edge A-B-C-D shown below) and 25% of the length A-B shown below as mounted on substrate.

As a single chip



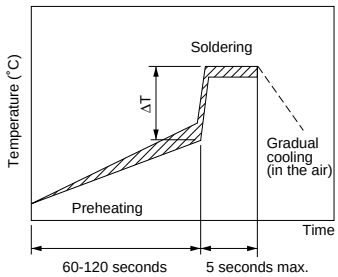
As mounted on substrate



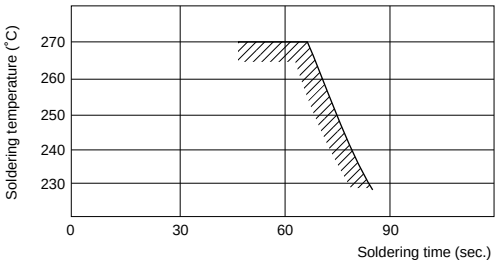
NOTICE

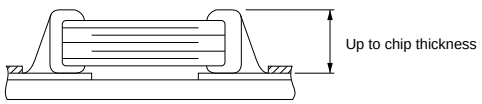
<table>
<tr><th>Process</th><th>Cautions</th><th>Control Points</th><th>Reference Data</th></tr>
<tr>
<td>12. Correction with a Soldering Iron</td>
<td>〈For chip type capacitors except GRM200 series〉
• Sudden heating of the chip results in distortion due to a high internal temperature differential, causing cracked chips.</td>
<td>• When preheating, keep temperature differential, ΔT, within the range shown in Table 5. The smaller theΔT, the less stress on the chip.

Table 5
<table>
<tr><th>Chip Size</th><th>Temperature Differential</th></tr>
<tr><td>GRM36/39/40/42-6
GRM420/425/430
GRH706/708/110</td><td>ΔT=<190˚C</td></tr>
<tr><td>GRM42-2/43-2/44-1
GRH710/111
GR530/535/540/545/550/555/580</td><td>ΔT=<130˚C</td></tr>
</table>

[Standard Conditions for Soldering Iron Temperature]


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

The accumulated soldering time/temperature including reflow/flow soldering must be within the range shown 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 6 and the following conditions (Table 6) are met.
Preheating should be performed on chips not listed in Table 6.

Table 6
<table>
<tr><th>Item</th><th colspan="2">Conditions</th></tr>
<tr><td>Chip size</td><td>GRM36/39/40
GRM420/425
GRH706/708/110</td><td>GRM42-6
GRM430</td></tr>
<tr><td>Temperature of iron tip</td><td>300˚C max.</td><td>270˚C 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">ϕ3mm 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>
</table>

NOTICE

<table>
<tr><th>Process</th><th>Cautions</th><th>Control Points</th><th>Reference Data</th></tr>
<tr><td></td><td>〈For GRM200 series〉</td><td>• When solder GRM200 series chip capacitor, keep the following conditions.
〈Solding iron method〉
<table><tr><th>Item</th><th colspan="2">Condition</th></tr><tr><td>Chip type</td><td>GRM220</td><td>GRM230/235</td></tr><tr><td>Pre-heating</td><td>no pre-heating is possible</td><td>ΔT=<130˚C</td></tr><tr><td>Temperature of iron tip</td><td colspan="2">300˚C 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">ϕ3mm 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">Don't allow the iron tip to directly tuch 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˚C 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 perfomed using special jigs, not with hands.</td><td></td></tr>
</table>

■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˚C 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˚C)

Prepared left at high humidity (for 100 hours under 90%RH to 95%RH at 40˚C)

(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

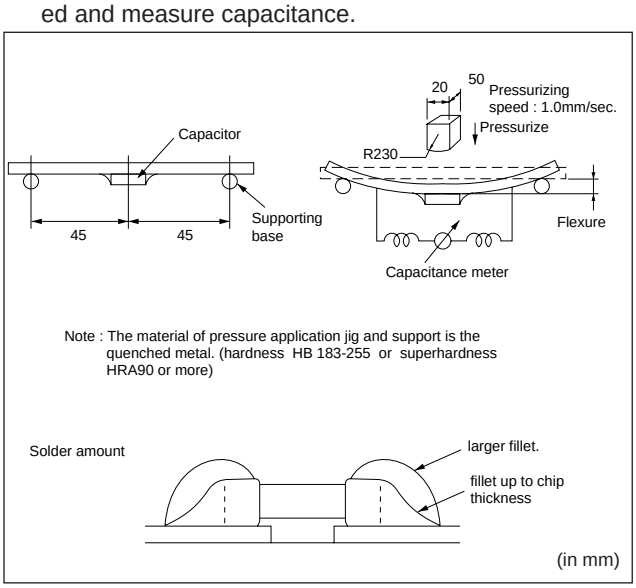
Table 7

Sample	Initial state	Prepared at room temperature		Prepared at high temperature for 100 hours at 85˚C	Prepared at high humidity for 100 hours at 90 to 95%RH and 40˚C
		6 months	12 months		
GRM40 for flow/reflow soldering	95 to 100%	95 to 100%	95%	90 to 95%	95%

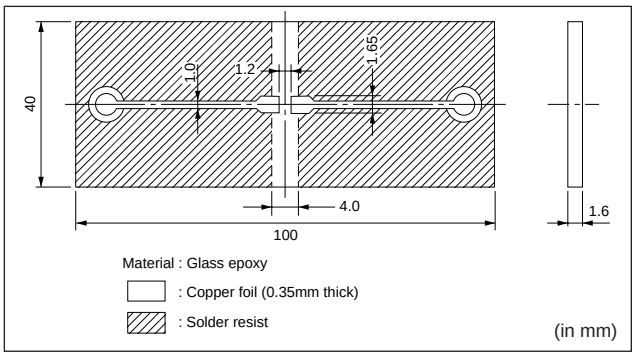
2. Board Bending Strength for Solder Fillet Height

(1) Test method

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



(2) Test board



(3) Test samples

GRM40 C0G/X7R/Y5V Characteristics T=0.6mm

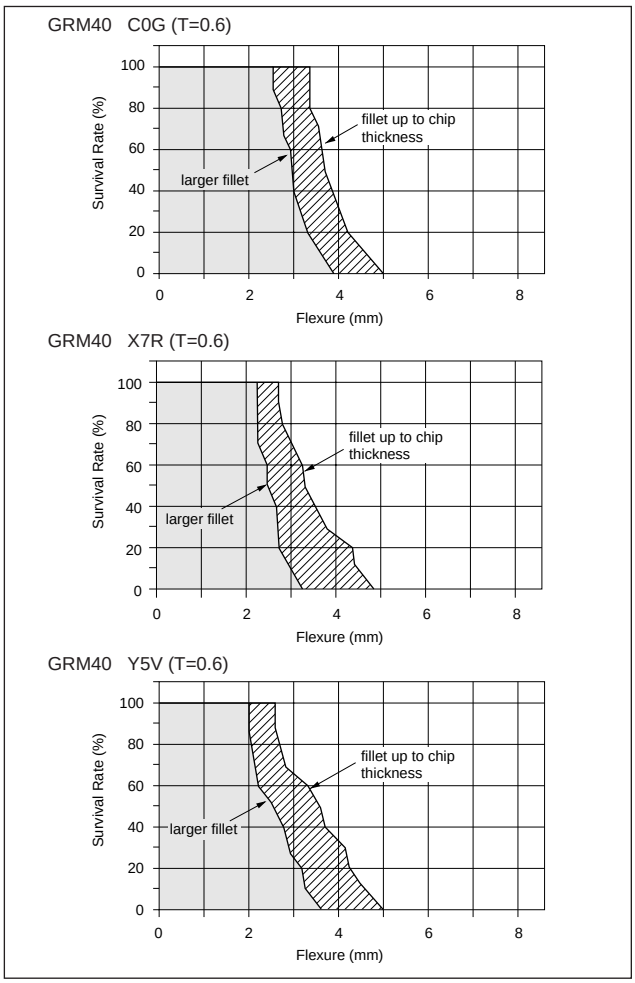
(4) Acceptance criteria

Products shall be determined to be defective if the change in capacitance has exceeded the values specified in Table 8.

Table 8

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

(5) Results

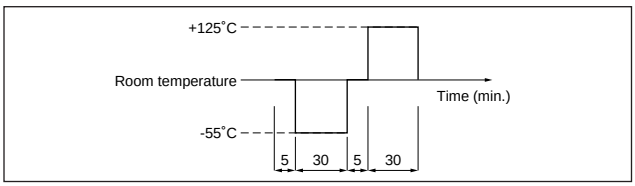


GRM SERIES REFERENCE DATA

3. Temperature Cycling for Solder Fillet Height

(1) Test method

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



Solder Amount :

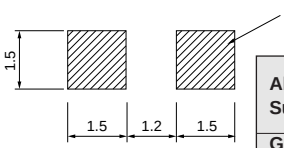
Substrate		Alumina*1	Glass Epoxy*2 or Paper Phenol
Solder Amount	①	0.5T	T
	②	0.7T	1.3T
	③	T	1.6T
Solder to be Used		6X4 Eutectic solder	

*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)

Land Dimension :



Alumina Substrate	Ag/Pd=72/28 Thickness10 to 12μm
Glass Epoxy Substrate	Cu
Paper Phenol Substrate	Thickness35μm

(3) Test samples

GRM40 C0G/X7R/Y5V Characteristics T=0.6mm

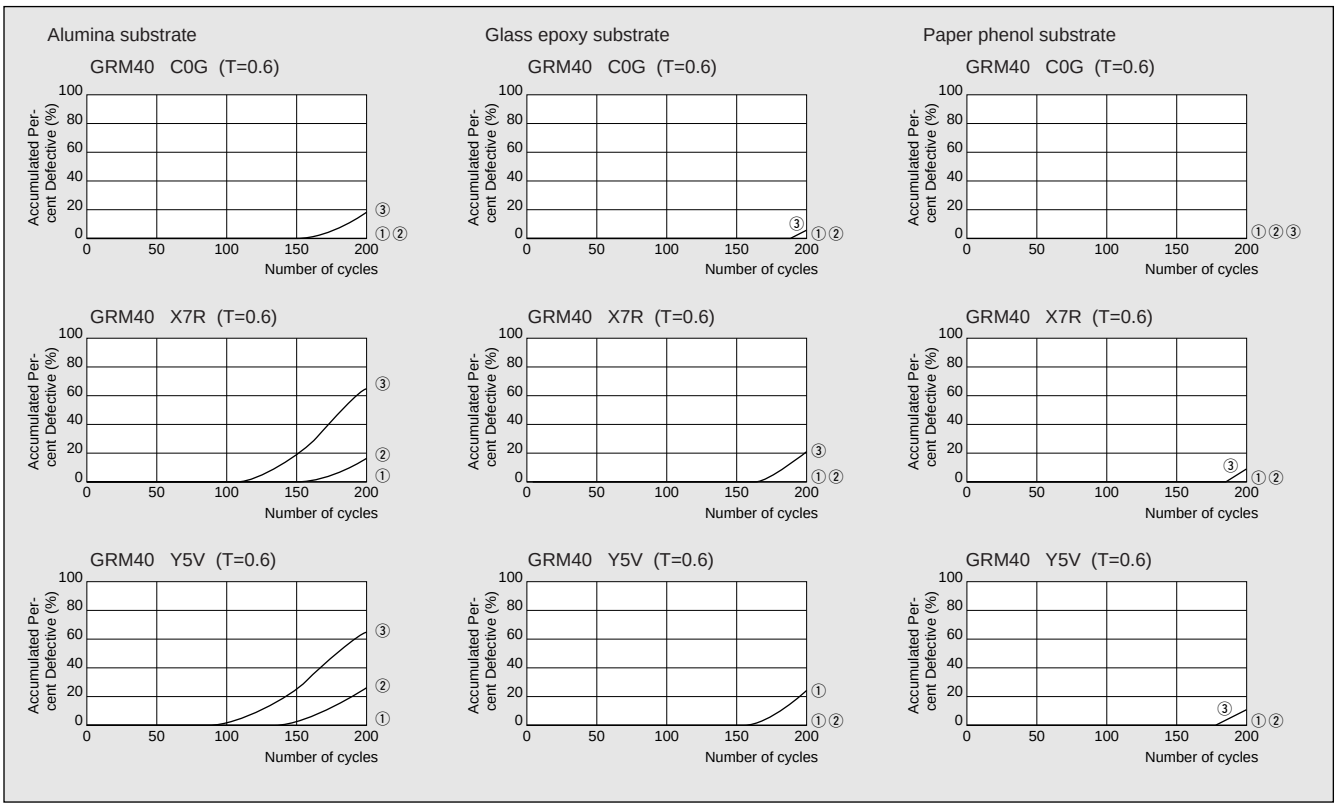
(4) Acceptance criteria

Products shall be determined to be defective if the change in capacitance has exceeded the values specified in Table 9.

Table 9

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

(5) Results

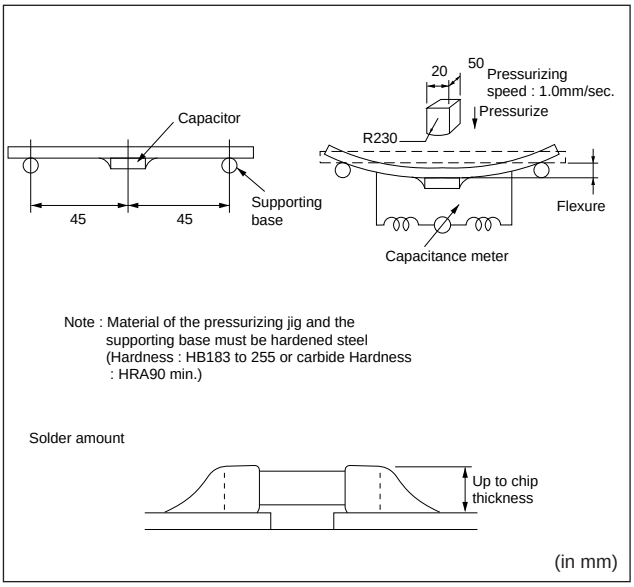


GRM SERIES REFERENCE DATA

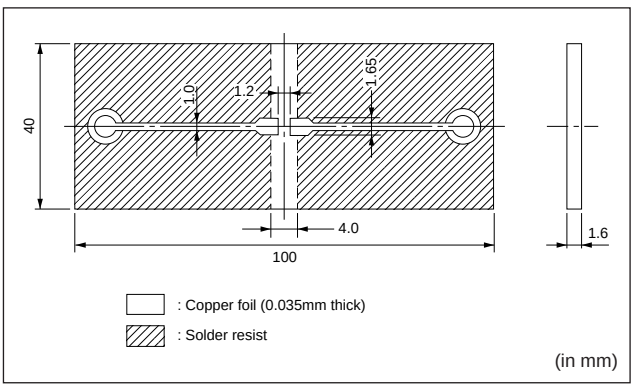
4. Board Bending Strength for Board Material

(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

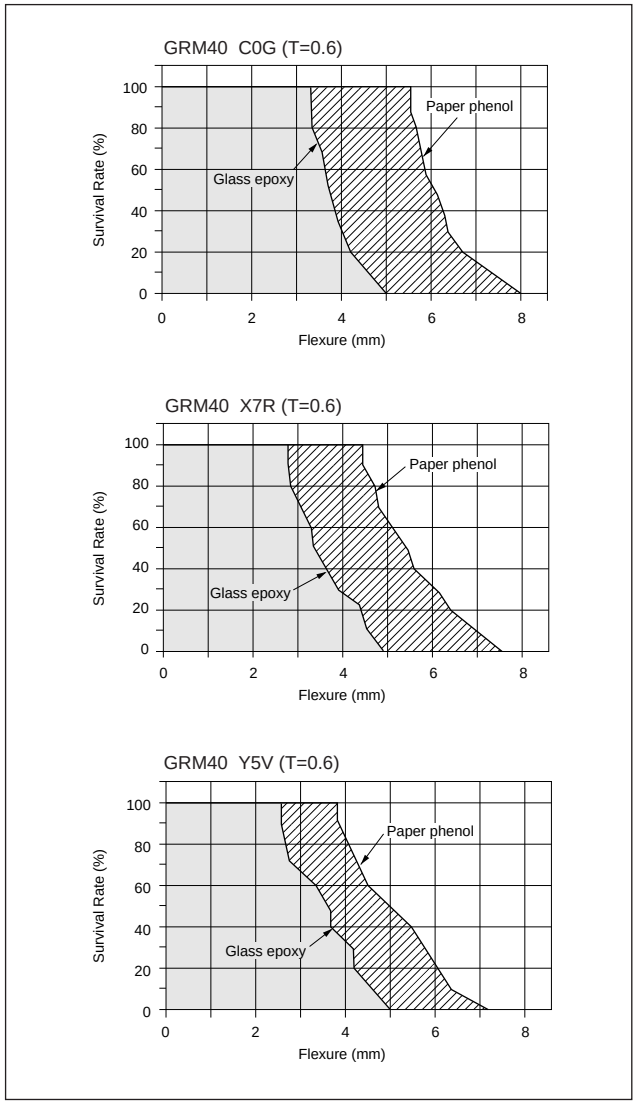
(4) Acceptance criteria

Products shall be determined to be defective if the change in capacitance has exceeded the values speciffied in Table 10.

Table 10

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

(5) Results

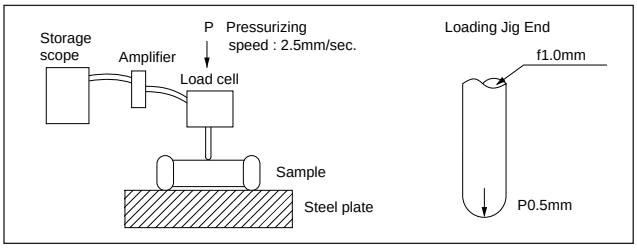


GRM SERIES REFERENCE DATA

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.

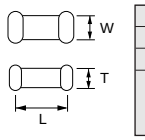
(4) Explanation

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 :

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

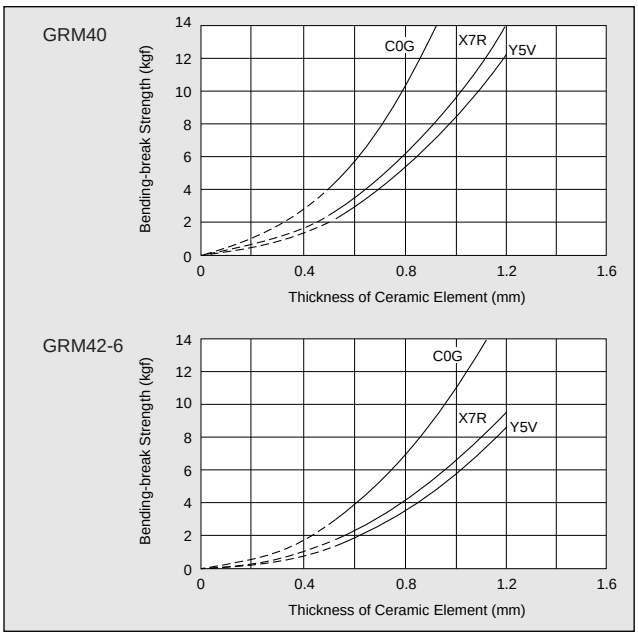
W : Width of ceramic element (mm)
T : Thickness of element (mm)
L : Distance between fulcrums (mm)
γ : Bending stress (N/mm^2)



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)

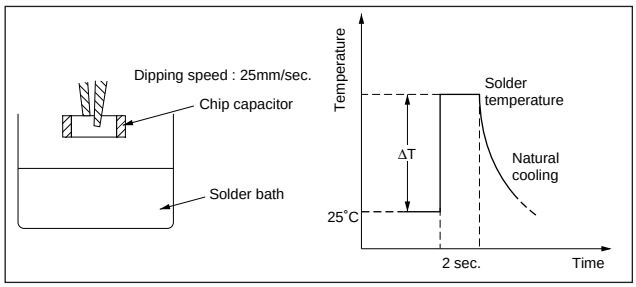
(5) Results



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 :



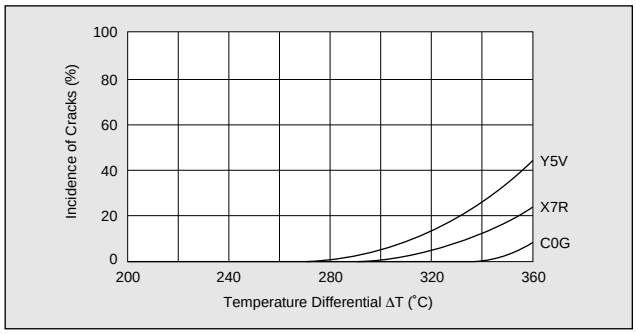
(2) Test samples

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



GRM SERIES REFERENCE DATA

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.

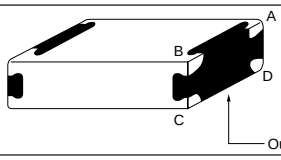
③ Flux to be used : An ethanol solution of 25 % rosin

④ Dip soldering :
After dipping the test sample with a pair of tweezers in static solder (eutectic solder), check for leacing that may have occurred on the outer electrode.

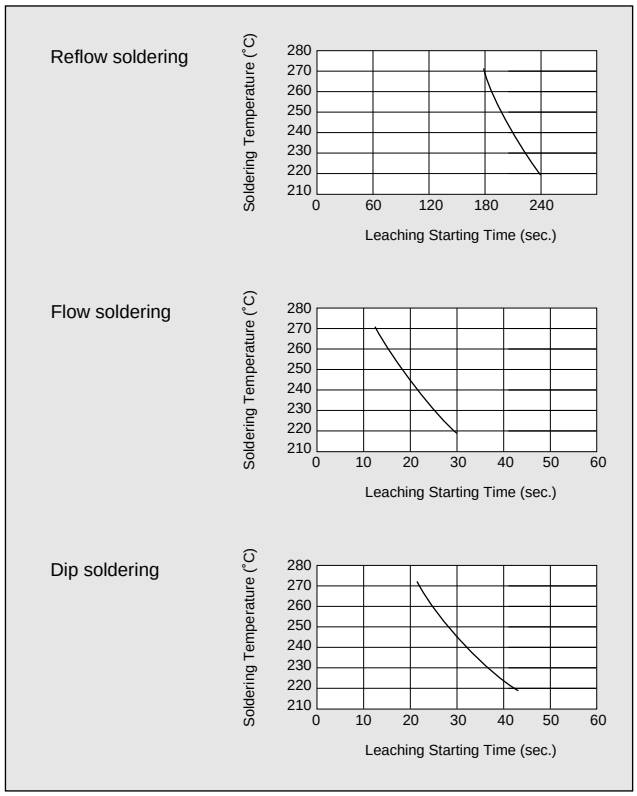
⑤ Flux to be used : An ethanol solution of 25 % rosin

(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 :

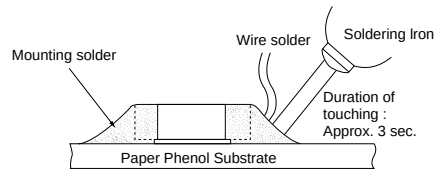


(4) Results



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.)

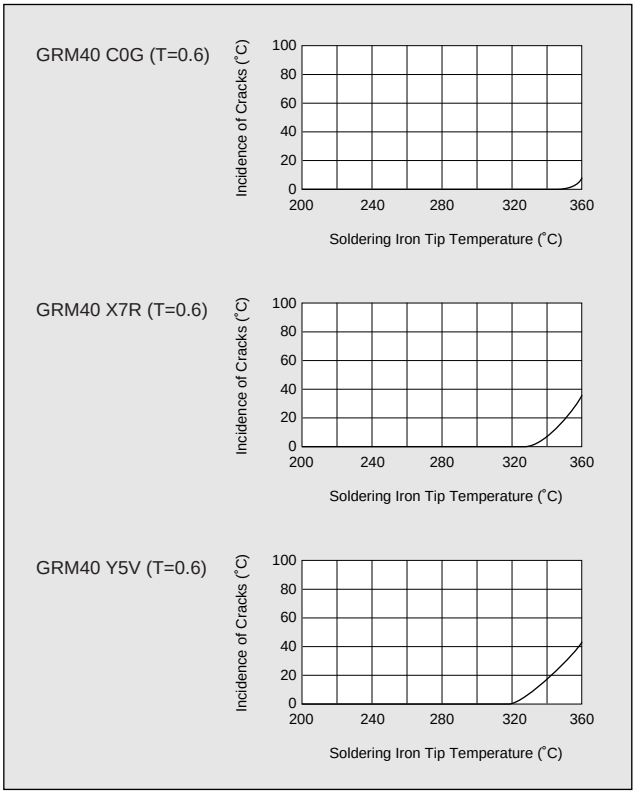


Soldering Iron	Tip diameter
Ceramic heater 20W	ϕ3mm

(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



MONOLITHIC CERAMIC CAPACITOR

muRata

High-voltage 250V-3.15kVDC/250VAC **GHM** Series

■PART NUMBERING

(*Please specify the part number when ordering.)

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

❶Type

GHMXX

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 X capacitor
GHM22	GHM2000	AC-rated capacitor Y capacitor

❷Dimension

Code (EIA Code)	Dimension (mm)	Code (EIA Code)	Dimension (mm)
25 (**0805**)	2.0X1.25	**40** (**1812**)	4.5X3.2
30 (**1206**)	3.2X1.6	**43** (**2211**)	5.7X2.8
35 (**1210**)	3.2X2.5	**45** (**2220**)	5.7X5.0
38 (**1808**)	4.5X2.0		

❸Temperature Characteristics

Code	Temp. Coeff./Cap. Change	Temp.Range (˚C)	Remarks
SL	+350~ -1000 ppm/˚C	20 to 85	
B	±10%	-25 to 85	Equivalent to X7R*
R	±15%	-55 to 125	Equivalent to X7R

* 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**	22000
121	120	**104**	100000
472	4700	–	–

❺Capacitance Tolerance

Code	Tolerance
D	±0.5pF
J	± 5%
K	±10%
M	v20%

❻Rated Voltage

Code	Voltage
250	250VDC
630	630VDC
2K	2kVDC
3K	3.15kVDC
AC250	250VAC

■CAPACITANCE TABLE

Type	Temp. Char.	Rated Voltage	Nominal Capacitance Range (pF)
			10 50 100 500 1000 5000 10000 50000 100000 500000
GHM1030	**R**	**630VDC**	100-1000
GHM1040	**SL**	**2kVDC**	120-220
GHM1038	**SL**	**3.15kVDC**	10-82
GHM1040	**SL**	**3.15kVDC**	100
GHM1525	**B**	**250VDC**	1000-10000
GHM1530	**B**	**250VDC**	15000-47000
		630VDC	1000-10000
GHM1535	**B**	**250VDC**	68000, 100000
		630VDC	15000, 22000
GHM1540	**B**	**250VDC**	150000, 220000
		630VDC	33000-100000
GHM1545	**B**	**250VDC**	330000, 470000
		630VDC	150000, 220000
GHM2143	**B**	**250VAC**	10000-47000
GHM2145	**B**	**250VAC**	100000
GHM2243	**B**	**250VAC**	470-4700

MONOLITHIC CERAMIC CAPACITOR

High-voltage Low Dissipation **GHM1000** Series

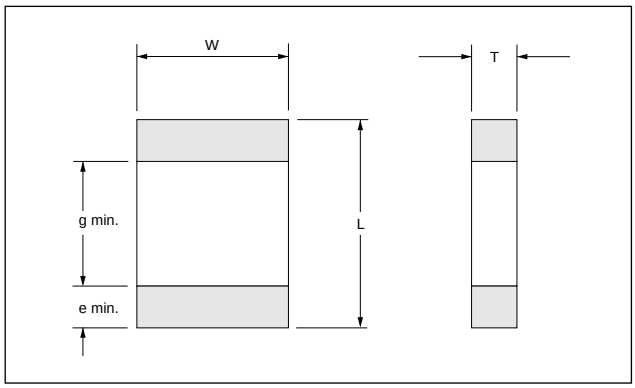
■FEATURES

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
GHM1038 (1808)	4.5±0.3	2.0±0.2		2.9	
GHM1040 (1812)	4.5±0.3	3.2±0.3			

■STANDARD LIST

Temperature Compensating Type SL Characteristic (+350 to -1000ppm/˚C)

Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	Rated Volt. (VDC)	Packaging Qty. (pcs./reel)
	L	W	T				
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	
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

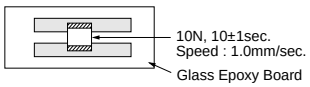
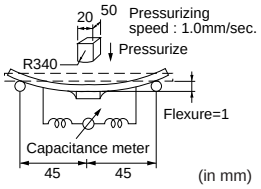
High Dielectric Constant Type R Characteristic (±15%)

Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	Rated Volt. (VDC)	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				1000			

MONOLITHIC CERAMIC CAPACITOR

High-voltage Low Dissipation **GHM1000** Series

■SPECIFICATIONS AND TEST METHODS

No.	Item	Specification		Test Method
		Temperature Compensating Type	High Dielectric Constant Type	
1	**Operating Temperature Range**	-55 to +125˚C		-
2	**Appearance**	No defects or abnormalities.		Visual inspection.
3	**Dimensions**	Within the specified dimension.		Using Calipers.
4	**Dielectric Strength**	No defects or abnormalities.		No failure shall be observed when voltage in Table is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA. **Rated voltage** / **Test voltage** **More than 1kVDC**: 120% of the rated voltage **Less than 1kVDC**: 150% of the rated voltage
5	**Insulation Resistance (I.R.)**	More than 10000MΩ		The insulation resistance shall be measured with 500±50V and within 60±5 seconds of charging.
6	**Capacitance**	Within the specified tolerance.		The capacitance/Q/D.F. shall be measured at 20˚C at the frequency and voltage shown as follows. (1) Temperature Compensating Type Frequency : 1±0.2MHz Voltage : 0.5 to 5Vrms (2) High Dielectric Constant Type Frequency : 1±0.2kHz Voltage : 1±0.2Vrms
7	**Q/ Dissipation Factor (D.F.)**	C>=30pF : Q>=1000 C<30pF : Q>=400+20C C : Nominal Capacitance (pF)	D.F.=<0.01	
8	**Capacitance Temperature Characteristics**	Temp. Coefficient +350 to -1000 ppm/˚C (Temp. Range : +20 to +85˚C)	Cap. Change Within ±15%	(1) Temperature Compensating Type The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step 1 through 5 (+20 to +85 ˚C) the capacitance shall be within the specified tolerance for the temperature coefficient. **Step** / **Temperature (˚C)** **1**: 20±2 **2**: Min. Operating Temp.±3 **3**: 20±2 **4**: Max. Operating Temp.±2 **5**: 20±2 (2) High Dielectric Constant Type The range of capacitance change compared to the 20˚C value within -55 to 125˚C shall be within the specified range. • **Pretreatment** Perform a heat treatment at 150^{+0}_{-10}˚C for 60±5 minutes and then let sit for 24±2 hours 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	**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. 3

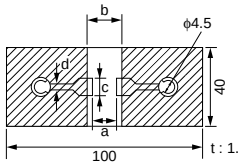


Fig. 2

LXW (mm)	Dimension (mm)			
	a	b	c	d
3.2X1.6	2.2	5.0	2.0	1.0
4.5X2.0	3.5	7.0	2.4	
4.5X3.2	3.5	7.0	3.7	

"room condition" Temperature : 15 to 35˚C, Humidity : 45 to 75%, Atmosphere pressure : 86 to 106kPa

MONOLITHIC CERAMIC CAPACITOR

High-voltage Low Dissipation **GHM1000** Series

No.	Item		Specification: Temperature Compensating Type	Specification: High Dielectric Constant Type	Test Method
11	**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 seconds at 235±5˚C. Immersing speed : 25±2.5mm/sec.
12	**Resistance to Soldering Heat**	**Appearance**	No marking defects		Preheat the capacitor at 120 to 150˚C* for 1 minute. Immerse the capacitor in eutectic solder solution at 260±5˚C for 10±1 seconds. Let sit at room condition for 24±2 hours, then measure. • **Immersing speed** : 25±2.5mm/sec. • Pretreatment for high dielectric constant type Perform a heat treatment at $150^{+}_{-10}{}^{0}$˚C for 60±5 minutes and then let sit for 24±2 hours at room condition. *Preheating for more than 3.2X2.5mm
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10%	
		Q/D.F.	C>=30pF : Q>=1000 C<30pF : Q>=400+20C C : Nominal Capacitance (pF)	D.F.=<0.01	
		I.R.	More than 10000MΩ		
		Dielectric Strength	Pass the item No.4.		
13	**Temperature Cycle**	**Appearance**	No marking defects		Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig.4 using a eutectic solder. Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room condition, then measure.
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	Within ±10%	
		Q/D.F.	C>=30pF : Q>=1000 C<30pF : Q>=400+20C C : Nominal Capacitance (pF)	D.F.=<0.01	
		I.R.	More than 10000MΩ		
		Dielectric Strength	Pass the item No.4.		
14	**Humidity (Steady State)**	**Appearance**	No marking defects		Sit the capacitor at 40±2˚C and 90 to 95% humidity for 500 $^{+24}_{-0}$ hours. Remove and let sit for 24±2 hours at room condition, then measure. • Pretreatment for high dielectric constant type Perform a heat treatment at $150^{+}_{-10}{}^{0}$˚C for 60±5 minutes and then let sit for 24±2 hours at room condition.
		Capacitance Change	Within ±5.0% or ±0.5pF (Whichever is larger)	Within ±10%	
		Q/D.F.	C>=30pF : Q>=350 C<30pF : Q>=275+$\frac{5}{2}$C C : Nominal Capacitance (pF)	D.F.=<0.01	
		I.R.	More than 1000MΩ		
		Dielectric Strength	Pass the item No.4.		
15	**Life**	**Appearance**	No marking defects		Apply the voltage in following table for 1000 $^{+48}_{-0}$ hours at maximum operating temperature±3˚C. Remove and let sit for 24±2 hours 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 minutes at test temperature. Remove and let sit for 24±2 hours at room condition.
		Capacitance Change	Within ±3.0% or ±0.3pF (Whichever is larger)	Within ±10%	
		Q/D.F.	C>=30pF : Q>=350 C<30pF : Q>=275+$\frac{5}{2}$C C : Nominal Capacitance (pF)	D.F.=<0.02	
		I.R.	More than 1000MΩ		
		Dielectric Strength	Pass the item No.4.		

*Preheating for more than 3.2X2.5mm

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

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

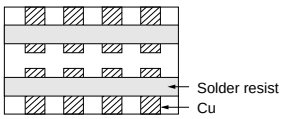


Fig. 4

Rated voltage	Test voltage
More than 1kVDC	Rated voltage
Less than 1kVDC	120% of the rated voltage

"room condition" Temperature : 15 to 35˚C, Humidity : 45 to 75%, Atmosphere pressure : 86 to 106kPa

MONOLITHIC CERAMIC CAPACITOR

muRata

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

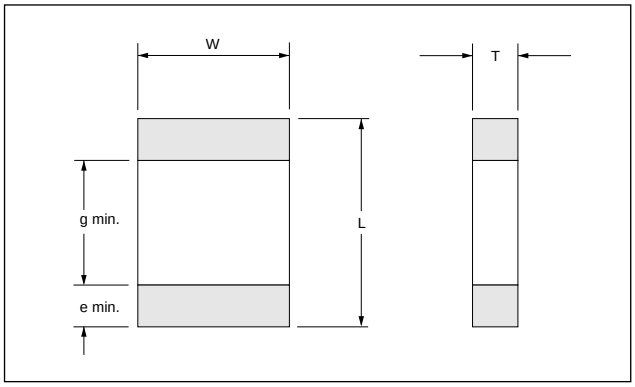
■FEATURES

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)	Dimension (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

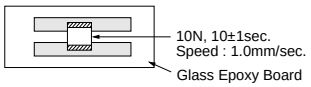
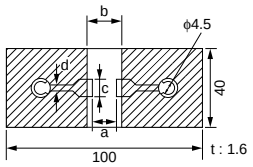
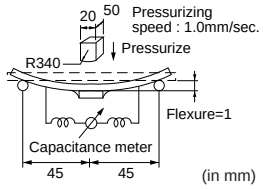
High Dielectric Constant Type B Characteristic (±10%)

Part Number	Dimensions (mm)			Nom.Cap. (pF)	Cap. Tol.	Rated Volt. (VDC)	Packaging Qty. (pcs./reel)
	L	W	T				
GHM1525 B 102 K 250	2.0±0.2	1.25±0.2	$1.0^{+0}_{-0.3}$	1000	±10%	250	4,000
GHM1525 B 152 K 250				1500			
GHM1525 B 222 K 250				2200			
GHM1525 B 332 K 250				3300			
GHM1525 B 472 K 250				4700			
GHM1525 B 682 K 250				6800			
GHM1525 B 103 K 250			1.25±0.2	10000			3,000
GHM1530 B 153 K 250	3.2±0.2	1.6 ±0.2	$1.0^{+0}_{-0.3}$	15000			4,000
GHM1530 B 223 K 250				22000			
GHM1530 B 333 K 250			$1.25^{+0}_{-0.3}$	33000			3,000
GHM1530 B 473 K 250			1.6 ±0.2	47000			2,000
GHM1535 B 683 K 250	3.2±0.3	2.5 ±0.2	$1.5^{+0}_{-0.3}$	68000			
GHM1535 B 104 K 250			$2.0^{+0}_{-0.3}$	100000			1,000
GHM1540 B 154 K 250	4.5±0.4	3.2 ±0.3		150000			
GHM1540 B 224 K 250			$2.5^{+0}_{-0.3}$	220000			500
GHM1545 B 334 K 250	5.7±0.4	5.0 ±0.4	$2.0^{+0}_{-0.3}$	330000			1,000
GHM1545 B 474 K 250				470000			
GHM1530 B 102 K 630	3.2±0.2	1.6 ±0.2	$1.25^{+0}_{-0.3}$	1000		630	3,000
GHM1530 B 152 K 630				1500			
GHM1530 B 222 K 630				2200			
GHM1530 B 332 K 630				3300			
GHM1530 B 472 K 630				4700			
GHM1530 B 682 K 630				6800			
GHM1530 B 103 K 630				10000			
GHM1535 B 153 K 630	3.2±0.3	2.5 ±0.2	$1.5^{+0}_{-0.3}$	15000			2,000
GHM1535 B 223 K 630				22000			
GHM1540 B 333 K 630	4.5±0.4	3.2 ±0.3		33000			1,000
GHM1540 B 473 K 630				47000			
GHM1540 B 683 K 630			$2.0^{+0}_{-0.3}$	68000			
GHM1540 B 104 K 630			$2.6^{+0}_{-0.3}$	100000			500
GHM1545 B 154 K 630	5.7±0.4	5.0 ±0.4	$2.0^{+0}_{-0.3}$	150000			1,000
GHM1545 B 224 K 630			$2.7^{+0}_{-0.3}$	220000			500

MONOLITHIC CERAMIC CAPACITOR

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

■SPECIFICATIONS AND TEST METHODS

No.	Item		Specification	Test Method
1	**Operating Temperature Range**		-55 to +125˚C	—
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: 250V) is applied between the terminations for 1 to 5 seconds, 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 10000MΩ	The insulation resistance shall be measured with 500±50V (250±50V in case of rated voltage: 250V) and within 60±5 seconds of charging.
6	**Capacitance**		Within the specified tolerance.	The capacitance/D.F. shall be measured at 20˚C at a frequency of 1±0.2kHz and a voltage of 1±0.2Vrms.
7	**Dissipation Factor (D.F.)**		0.025 max.	
8	**Capacitance Temperature Characteristics**		Cap. Change Within ±10% (Temp. Range -25 to 85˚C)	The range of capacitance change compeared with the 20˚C value within -25 to 85˚C shall be within the specified range. • **Pretreatment** Perform a heat treatment at 150$^{+0°}_{-10°}$C for 60±5 minutes and then let sit for 24±2 hours 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	**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 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  Fig. 3
11	**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 seconds at 235±5˚C. Immersing speed : 25±2.5mm/sec.
12	**Resistance to Soldering Heat**	**Appearance**	No marking defects	Preheat the capacitor at 120 to 150˚C* for 1 minute. Immerse the capacitor in eutectic solder solution at 260±5˚C for 10±1 seconds. Let sit at room condition for 24±2 hours, then measure. • **Immersing speed :** 25±2.5mm/sec. • **Pretreatment** Perform a heat treatment at 150$^{+0°}_{-10°}$C for 60±5 minutes and then let sit for 24±2 hours at room condition. *Preheating for more than 3.2X2.5mm
		Capacitance Change	within ±10%	
		D.F.	0.025 max.	
		I.R.	C>=0.01µF : More than 100MΩ·µF C<0.01µF : More than 10000MΩ	
		Dielectric Strength	Pass the item No.4.	

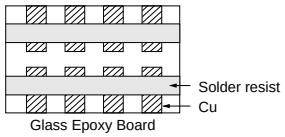
LXW (mm)	Dimension (mm)			
	a	b	c	d
2.0X1.25	1.2	4.0	1.65	1.0
3.2X1.6	2.2	5.0	2.0	
3.2X2.5	2.2	5.0	2.9	
4.5X3.2	3.5	7.0	3.7	
5.7X5.0	4.5	8.0	5.6	

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

"room condition" Temperature · 15 to 35˚C, Humidity · 45 to 75%, Atmosphere pressure · 86 to 106kPa

MONOLITHIC CERAMIC CAPACITOR

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

No.	Item		Specification	Test Method
13	Temperature Cycle	Appearance	No marking defects.	Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig.4 using a eutectic solder. Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room condition, then measure. **Step / Temperature (˚C) / Time (min.)** 1 / Min. Operating Temp.±3 / 30±3 2 / Room Temp. / 2 to 3 3 / Max. Operating Temp.±2 / 30±3 4 / Room Temp. / 2 to 3 • **Pretreatment** Perform a heat treatment at 150^{+0}_{-10}˚C for 60±5 minutes and then let sit for 24±2 hours at room condition.  Fig. 4
		Capacitance Change	Within ±7.5%.	
		D.F.	0.025 max.	
		I.R.	C>=0.01μF : More than 100MΩ·μF C<0.01μF : More than 10000MΩ	
		Dielectric Strength	Pass the item No.4.	
14	Humidity (Steady State)	Appearance	No marking defects.	Sit the capacitor at 40±2˚C and 90 to 95% humidity for 500 $^{+24}_{-0}$ hours. Remove and let sit for 24±2 hours at room condition, then measure. • **Pretreatment** Perform a heat treatment at 150^{+0}_{-10}˚C for 60±5 minutes and then let sit for 24±2 hours at room condition.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	C>=0.01μF : More than 10MΩ·μF C<0.01μF : More than 1000MΩ	
		Dielectric Strength	Pass the item No.4.	
15	Life	Appearance	No marking defects.	Apply 120% of the rated voltage (150% of the rated voltage in case of rated voltage: 250V) for 1000$^{+48}_{-0}$ hours at maximum operating temperature±3˚C. Remove and let sit for 24 ±2 hours at room condition, then measure. The charge/discharge current is less than 50mA. • **Pretreatment** Apply test voltage for 60±5 minutes at test temperature. Remove and let sit for 24±2 hours at room condition.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	C>=0.01μF : More than 10MΩ·μF C<0.01μF : More than 1000MΩ	
		Dielectric Strength	Pass the item No.4.	

"room condition" Temperature · 15 to 35˚C, Humidity · 45 to 75%, Atmosphere pressure · 86 to 106kPa

MONOLITHIC CERAMIC CAPACITOR

Ceramic Capacitor for 250VAC **GHM2000** Series

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

■FEATURES

1. Chip monolitic ceramic capacitor for AC line.
2. A new monolithic structure for small, high-capacitance capable of operating at high-voltage levels.
3. Sn-plated external electrodes allow mounting without silver compound solder.
4. For Reflow soldering.

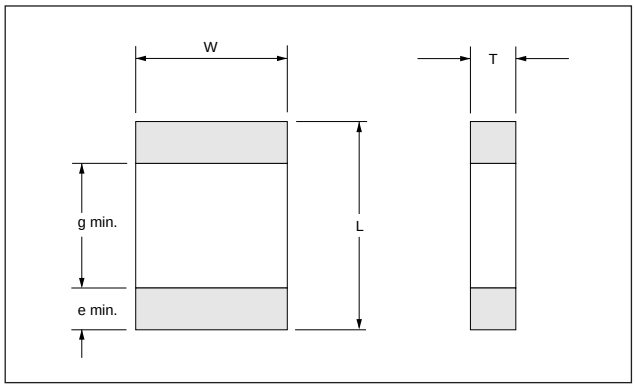
■APPLICATIONS

Ideal use as Y capacitor (line by pass) or X capacitor (across the line) for switching power supply, telephone, facsimile and modem.

■REFFERENCE 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%)

[X capacitor]

Part Number	Dimensions (mm)			Nom. Cap. (pF)	Cap. Tol.	Rated Volt. (VAC)	Packaging Qty. (pcs./reel)
	L	W	T				
GHM2143 B 103 M AC250	5.7±0.4	2.8±0.3	2.0±0.3	10000	±20%	250	1,000
GHM2143 B 223 M AC250				22000			
GHM2143 B 473 M AC250				47000			
GHM2145 B 104 M AC250		5.0±0.4		100000			

[Y capacitor]

Part Number	Dimensions (mm)			Nom. Cap. (pF)	Cap. Tol.	Rated Volt. (VAC)	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				1000			
GHM2243 B 222 M AC250				2200			
GHM2243 B 472 M AC250				4700			

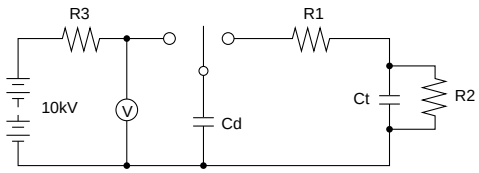
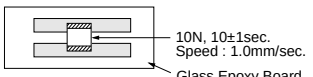
MONOLITHIC CERAMIC CAPACITOR

Ceramic Capacitor for 250VAC **GHM2000** Series

muRata

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

■SPECIFICATIONS AND TEST METHODS

No.	Item		Specification	Test Method
1	**Operating Temperature Range**		-25 to +85˚C	—
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 seconds, provided the charge/discharge current is less than 50mA. **X Capacitor**: 575VAC **Y Capacitor**: 1500VAC
5	**Insulation Resistance (I.R.)**		More than 2000MΩ	The insulation resistance shall be measured with 500±50V and within 60±5 seconds of charging.
6	**Capacitance**		Within the specified tolerance.	The capacitance/D.F. shall be measured at 20˚C at a frequency of 1±0.2kHz and a voltage of 1±0.2Vrms.
7	**Dissipation Factor (D.F.)**		0.025 max.	
8	**Capacitance Temperature Characteristics**		Cap. Change Within ±10%	The range of capacitance change compeared with the 20˚C value within -25 to 85˚C shall be within the specified range. • **Pretreatment** Perform a heat treatment at 150 $^{+0}_{-10}$˚C for 60±5 minutes and then let sit for 24±2 hours at room condition.
9	**Discharge Test (Application: Y Capacitor)**	**Appearance**	No defects or abnormalities.	As in Fig., discharge is made 50 times at 5 sec. intervals from the capacitor(Cd) charged at DC voltage of specified.  Ct : Capacitor under test Cd : 0.001μF R1 : 1000Ω R2 : 100MΩ R3 : Surge resistance
10	**Adhesive Strength of Termination**		No removal of the terminations or other defects shall occur.	Solder the capacitor to the testing jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply 10N force in the direction of the arrow. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.  Fig. 1
11	**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.
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 seconds at 235±5˚C. Immersing speed : 25±2.5mm/sec.
13	**Humidity Insulation**	**Appearance**	No marking defects.	The capacitor shall be subjected to 40±2˚C, relative humidity of 90 to 98% for 8 hours, and then removed in room condition for 16 hours until 5 cycles.
		Capacitance Change	within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 1000MΩ	
		Dielectric Strength	Pass the item No.4.	

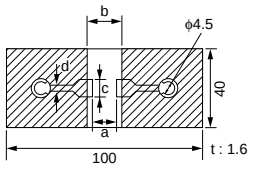


Fig. 2

LXW (mm)	Dimension (mm)			
	a	b	c	d
5.7X2.8	4.5	8.0	3.2	1.0
5.7X5.0	4.5	8.0	5.6	

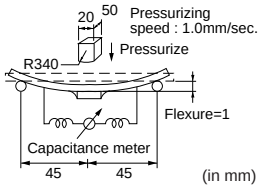


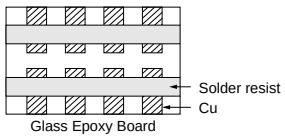
Fig. 3

"room condition" Temperature : 15 to 35˚C, Humidity : 45 to 75%, Atmosphere pressure : 86 to 106kPa

MONOLITHIC CERAMIC CAPACITOR

Ceramic Capacitor for 250VAC **GHM2000** Series

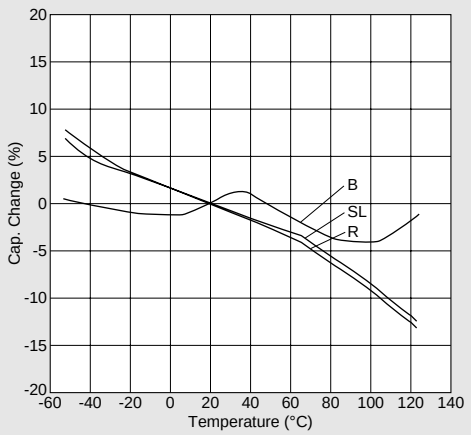
Products which are based on the Standards of the Electrical Appliance And Material Control Law of Japan

No.	Item		Specification	Test Method
14	Resistance to Soldering Heat	Appearance	No marking defects.	Preheat the capacitor as table. Immerse the capacitor in eutectic solder solution at 260±5˚C for 10±1 seconds. Let sit at room condition for 24±2 hours, then measure. • **Immersing speed :** 25±2.5mm/sec. • **Pretreatment** Perform a heat treatment at 150^{+0}_{-10}˚C for 60±5 minutes and then let sit for 24±2 hours at room condition. ***Preheating** **Step / Temperature / Time** 1 / 100˚C to 120˚C / 1 min. 2 / 170˚C to 200˚C / 1 min.
		Capacitance Change	within ±10%	
		D.F.	0.025 max.	
		I.R.	More than 2000MΩ	
		Dielectric Strength	Pass the item No.4.	
15	Temperature Cycle	Appearance	No marking defects.	Fix the capacitor to the supporting jig (glass epoxy board) shown in Fig.4 using a eutectic solder. Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 24±2 hours at room condition, then measure. **Step / Temperature (˚C) / Time (mi n.)** 1 / Min. Operating Temp.±3 / 30±3 2 / Room Temp. / 2 to 3 3 / Max. Operating Temp.±2 / 30±3 4 / Room Temp. / 2 to 3 • **Pretreatment** Perform a heat treatment at 150^{+0}_{-10}˚C for 60±5 minutes and then let sit for 24±2 hours at room condition.  Fig. 4
		Capacitance Change	Within ±7.5%	
		D.F.	0.025 max.	
		I.R.	More than 2000MΩ	
		Dielectric Strength	Pass the item No.4.	
16	Humidity (Steady State)	Appearance	No marking defects.	Sit the capacitor at 40±2˚C and 90 to 95% humidity for 500^{+24}_{-0} hours. Remove and let sit for 24±2 hours at room condition, then measure. • **Pretreatment** Perform a heat treatment at 150^{+0}_{-10}˚C for 60±5 minutes and then let sit for 24±2 hours at room condition.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 1000MΩ	
		Dielectric Strength	Pass the item No.4.	
17	Life	Appearance	No marking defects.	Apply voltage and time as Table at 85±2˚C. Remove and let sit for 24±2 hours at room condition, then measure. The charge/discharge current is less than 50mA. **Test Time / Test voltage** X Capacitor / 1000^{+48}_{-0} hours / 300VAC Y Capacitor / 1500^{+48}_{-0} hours / 500VAC* *Except that once each hour the voltage is increased to 1000VAC for 0.1 sec. • **Pretreatment** Apply test voltage for 60±5 minutes at test temperature. Remove and let sit for 24±2 hours at room condition.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 1000MΩ	
		Dielectric Strength	Pass the item No.4.	
18	Humidity Loading	Appearance	No marking defects.	Apply the rated voltage at 40±2˚C and 90 to 95% humidity for 500^{+24}_{-0} hours. Remove and let sit 24±2 hours at room condition, then measure. • **Pretreatment** Apply test voltage for 60±5 minutes at test temperature. Remove and let sit for 24±2 hours at room condition.
		Capacitance Change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	More than 1000MΩ	
		Dielectric Strength	Pass the item No.4.	

"room condition" Temperature : 15 to 35˚C, Humidity : 45 to 75%, Atmosphere pressure : 86 to 106kPa

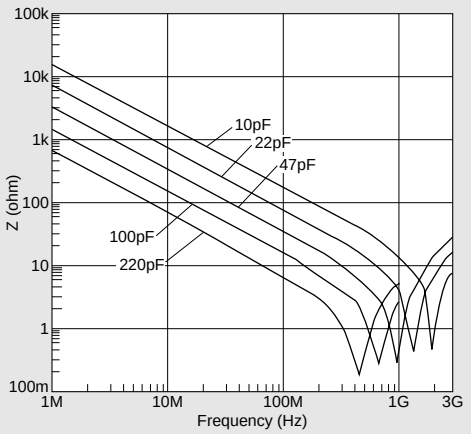
TYPICAL CHARACTERISTICS DATA

- **Capacitance-Temp. Char.**

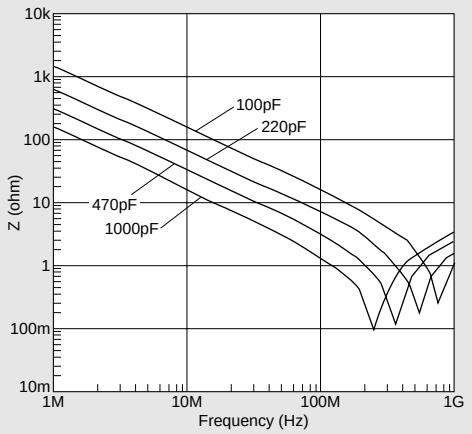


- **Impedance-Freq. Char.**

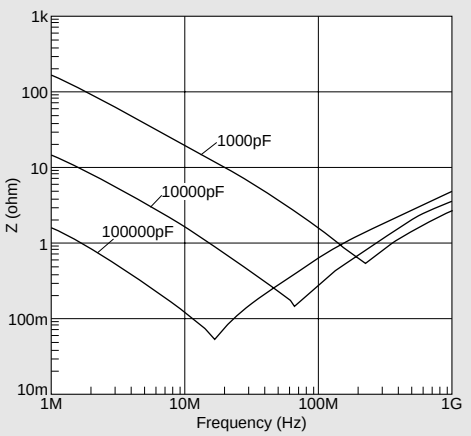
GHM1000 Series [SL Char.]



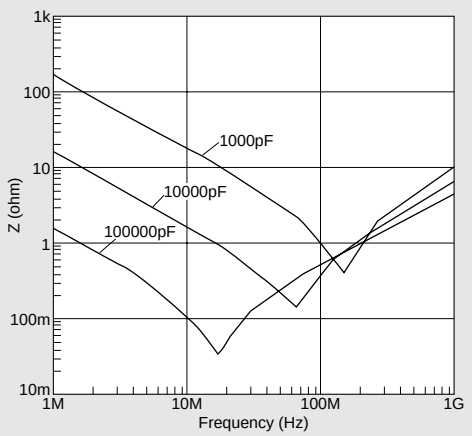
GHM1000 Series [R Char.]



GHM1500 Series



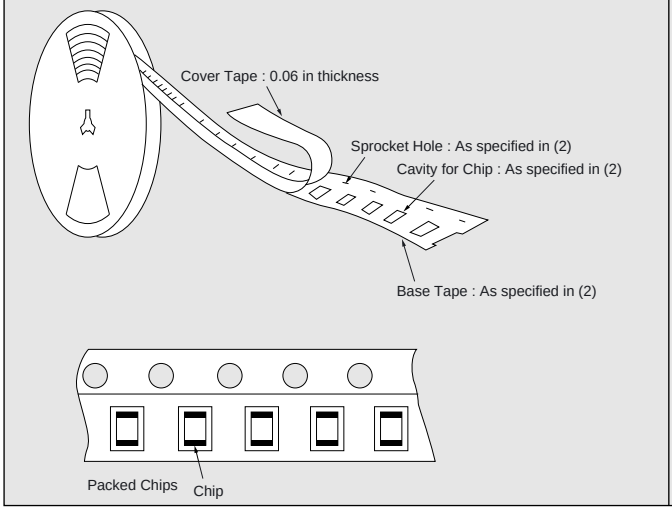
GHM2000 Series



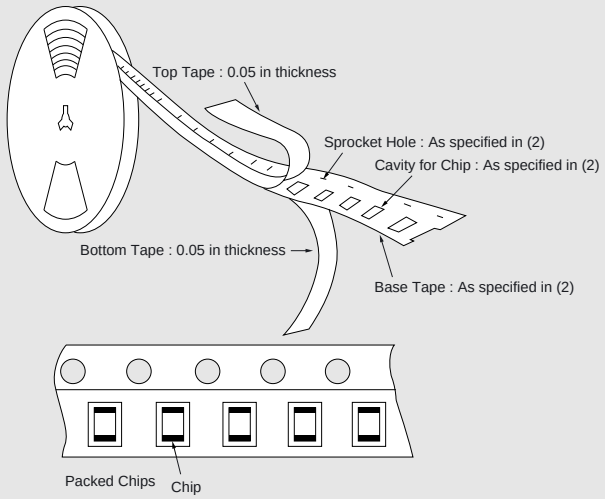
PACKAGING (Taping is standard packaging method.)

(1) Appearance of taping

Plastic Tape

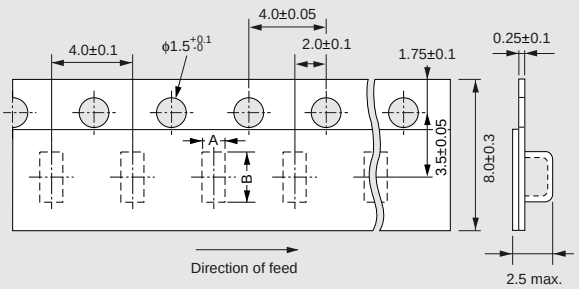


Paper Tape



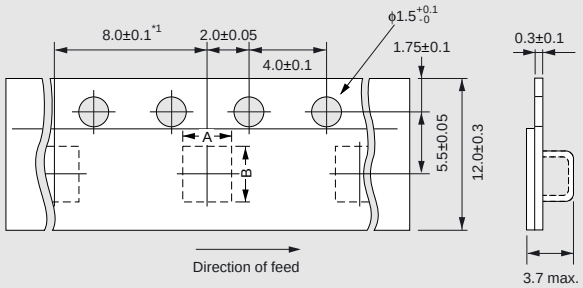
(2) Dimensions of Tape

Plastic Tape (T>=1.25 rank)



Type	*A	*B
GHM1030	2.0	3.6
GHM1525	1.45	2.25
GHM1530	2.0	3.6
GHM1535	2.9	3.6

*Nominal value



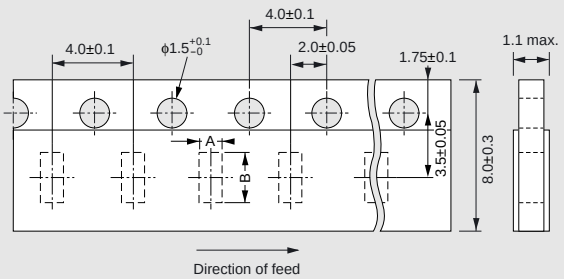
Type	*A	*B
GHM1038	2.4	4.9
GHM1040	3.6	4.9
GHM1540	3.6	4.9
GHM2143	3.2	6.1
GHM2243	3.2	6.1
GHM1545	5.4	6.1
GHM2145	5.4	6.1

*Nominal value

*1 4.0±0.1mm in case of GHM1038

(in mm)

Paper Tape (T=1.0 rank)

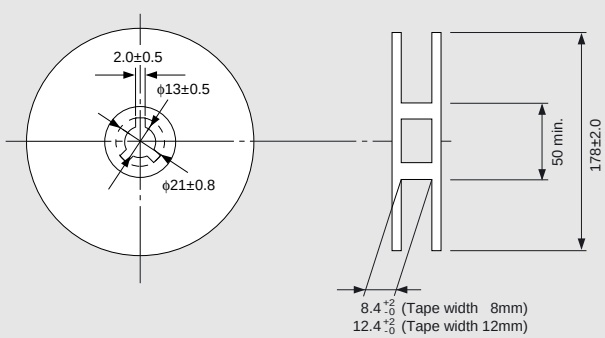


Type	*A	*B
GHM1030	2.0	3.6
GHM1525	1.45	2.25
GHM1530	2.0	3.6

*Nominal value

(in mm)

(3) Dimensions of Reel

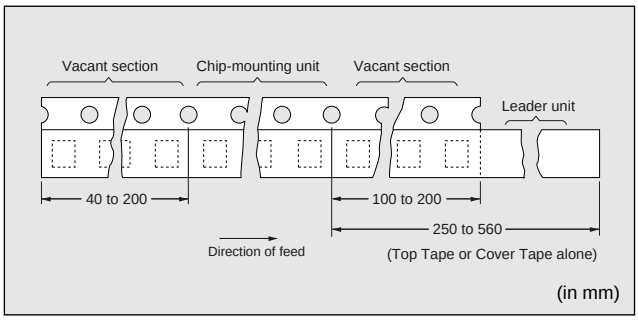


(in mm)

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

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.



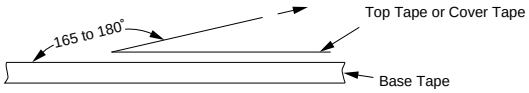
(6) The top tape or cover tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

(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 0.6N in the direction shown below.



PRECAUTION

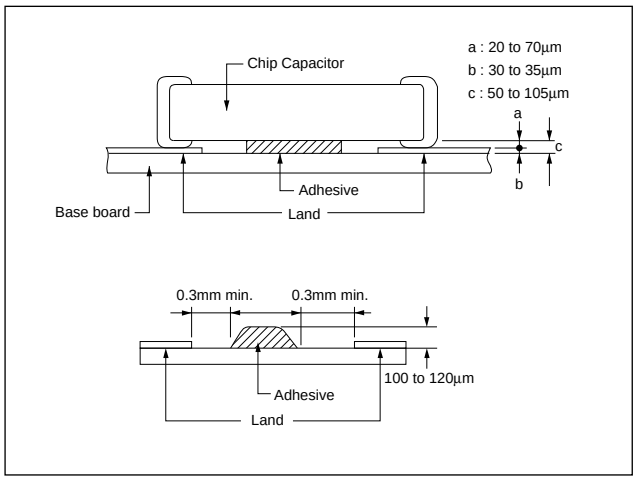
1. Operating voltage
   Be sure to use a capacitor only within its rated operating voltage range. When DC-rated capacitors are to be used in AC or ripple voltage circuits, be sure to maintain the Vp-p value of the applied voltage within the rated voltage range.
2. Operating temperature and self-generated 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˚C.
3. Operating and strage 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˚C and 20 to 70%RH.
   Use capacitors within 6 months.
4. Vibration and impact
   Do not expose a capacitor to excessive shock or vibration during use.

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

NOTICE

1. MOUNTING OF CHIPS

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



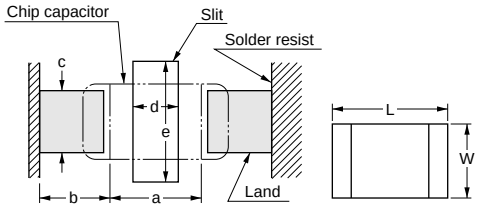
●Mechanical shock of the chip placer
When the positioning claws and pick up nozzle are worn, the load is applied to the chip while positioning is concentrated to one position, thus causing cracks, breakage, faulty positioning accuracy, etc.
Careful checking and maintenance are necessary to prevent unexpected 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.

NOTICE

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)

LXW	a	b	c
2.0X1.25	1.0-1.2	0.9-1.0	0.8-1.1
3.2X1.6	2.2-2.6	1.0-1.1	1.0-1.4

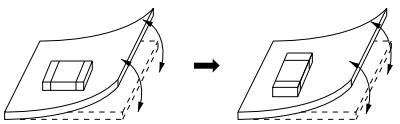
●Reflow soldering (in mm)

LXW	a	b	c	d	e
2.0X1.25	1.0-1.2	0.9-1.0	0.8-1.1	--	--
3.2X1.6	2.2-2.4	0.8-0.9	1.0-1.4	1.0-2.0	3.2-3.7
3.2X2.5	2.0-2.4	1.0-1.2	1.8-2.3	1.0-2.0	4.1-4.6
4.5X2.0	2.8-3.4	1.2-1.4	1.4-1.8	1.0-2.8	3.6-4.1
4.5X3.2	2.8-3.4	1.2-1.4	2.3-3.0	1.0-2.8	4.8-5.3
5.7X2.8	4.0-4.6	1.4-1.6	2.1-2.6	1.0-4.0	4.4-4.9
5.7X5.0	4.0-4.6	1.4-1.6	3.5-4.8	1.0-4.0	6.6-7.1

●Land layout for cropping PC board

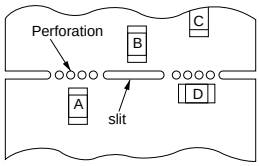
Design layout of components on the PC board to minimize the stress imposed on the wrap or flexure of the board.

[Component direction]



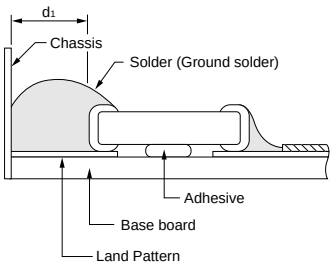
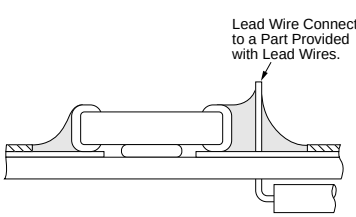
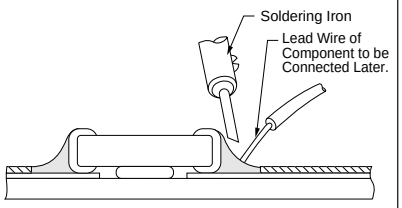
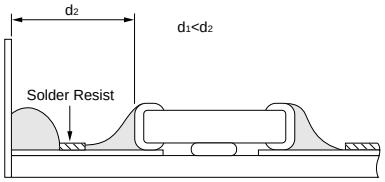
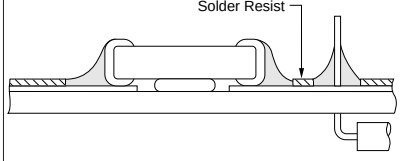
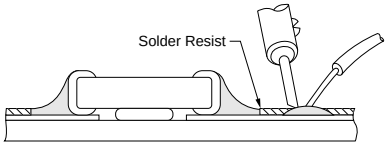
Put the component lateral to the direction in which stress acts.

[Component layout close to board break]



Susceptibility to stress is in the order of ; A>C>B≧D

●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			

NOTICE

3. SOLDERING (Prevention of the thermal shock)

●Pre-heat conditions and example.

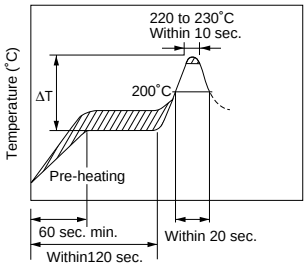
Carefully perform pre-heating so that temperature difference(ΔT) between the solder and component surface should be in the following range.

Soldering method \ Chip Size	3.2X1.6mm and under	3.2X2.5mm and over
Reflow method or Soldering iron method	ΔT=<190˚C	ΔT=<130˚C
Flow method or Dip Soldering method	ΔT=<150˚C	—

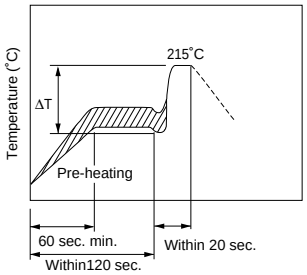
When components are immersed in solvent after mounting, pay special attention to maintain the temperature difference within 100˚C.
When correcting chips with a soldering iron, no preheating is required if the following condictions are met.
Preheating should be performed on chip not listed in following Table.

Item	Conditions
Chip size	2.0X1.25mm, 3.2X1.6mm
Temperature of iron-tip	270˚C max.
Soldering iron wattage	20W max.
Diameter of iron-tip	ϕ3.0mm max.
Soldering time	3 sec. max.
Caution	Do not allow the iron-tip to directly touch the ceramic element.

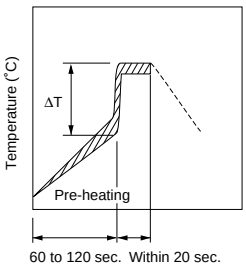
• Infrared reflow soldering conditions (Example)



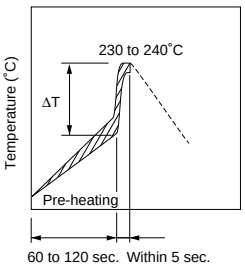
• Vapor reflow soldering(VPS) conditions(Example)



• Dip soldering/Soldering iron conditions(Example)



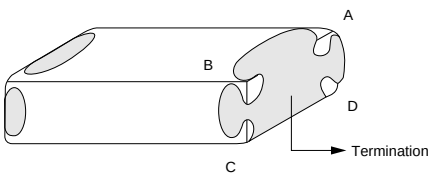
• Flow soldering conditions (Example)



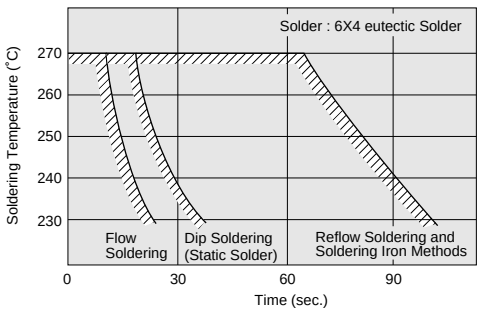
〈Care for minimizing loss of the terminations〉

●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.

NOTICE

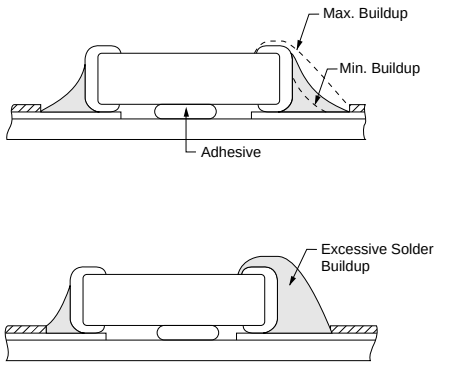
〈Flux and Solder〉

- 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〉

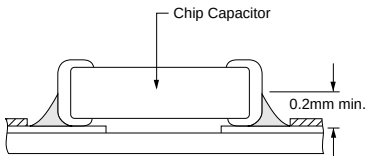
(i) Flow soldering and iron soldering
Use as little solder as possible (as shown in Fig.1), and confirm that the solder is securely placed.

(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



Solder buildup by reflow method.

Fig.2

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.

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).

■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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