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

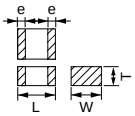
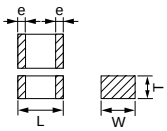
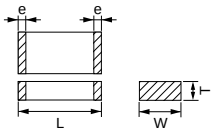
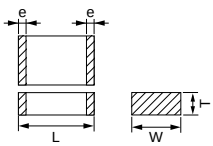
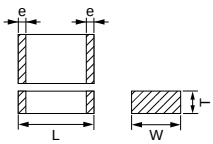
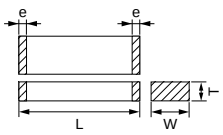
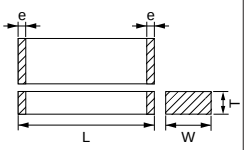
Code	Standards
500	500VDC
1K	1kVDC
2K	2kVDC
3K	3.15kVDC
4K	4kVDC

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		

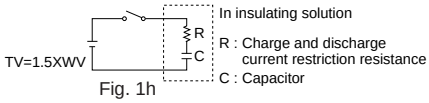
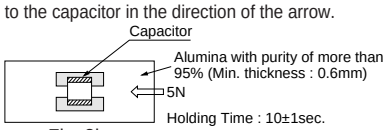
MONOLITHIC CERAMIC CAPACITOR

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

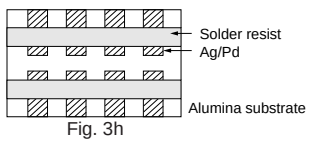


Fig. 3h

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.

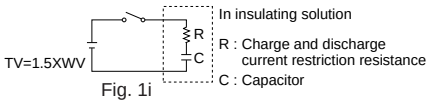
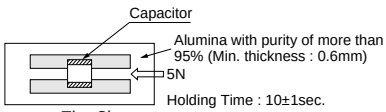
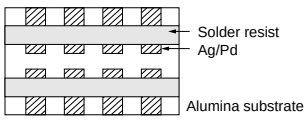
MONOLITHIC CERAMIC CAPACITOR

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

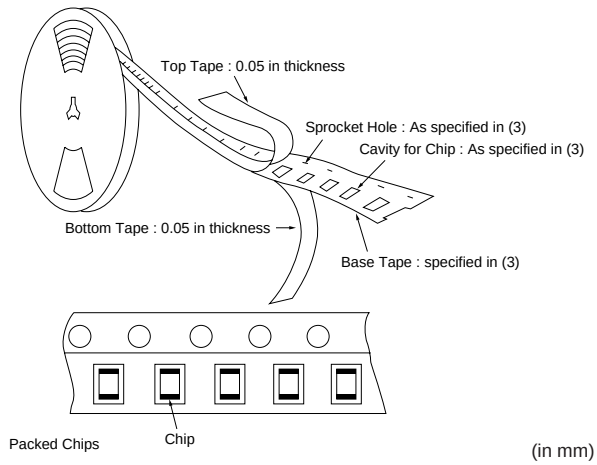
* "Minimum Quantity" means the numbers of units of each delivery or order. The quantity should be an integral multiple of the "minimum quantity"
(Please note that the actual delivery quantity in a package may change sometimes.)

2. TAPE CARRIER PACKAGING

Packaging code : PT

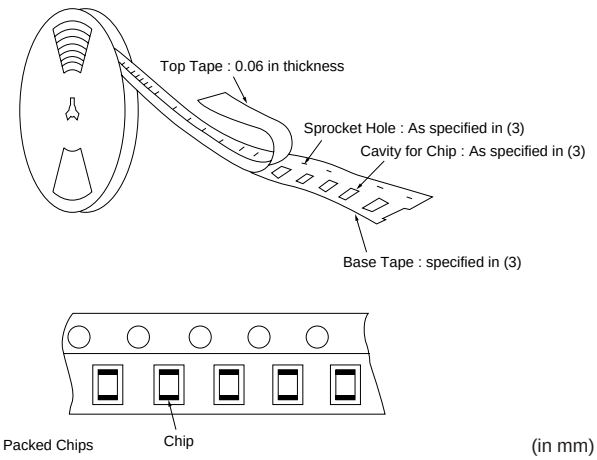
(1) Appearance of taping

• Paper Tape



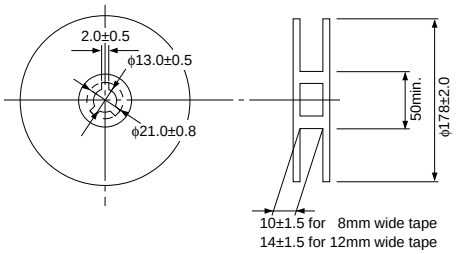
(in mm)

• Plastic Tape



(in mm)

(2) Dimensions of Reel



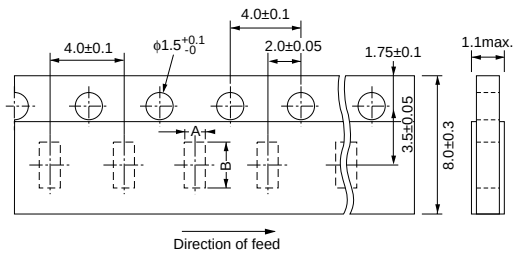
ϕ330mm reel is available on request.

(in mm)

(3) Dimensions of Tape

(a) Paper Tape

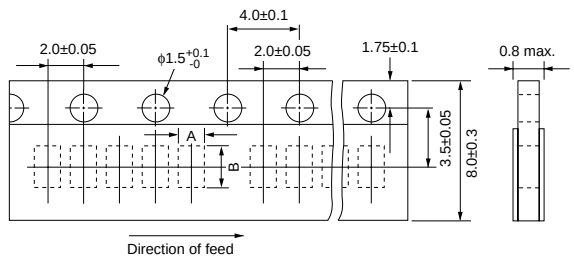
• 4mm Pitch Tape



	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

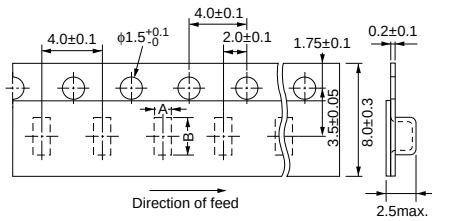
(Nominal value)

(in mm)

PACKAGE

(b) Plastic Tape

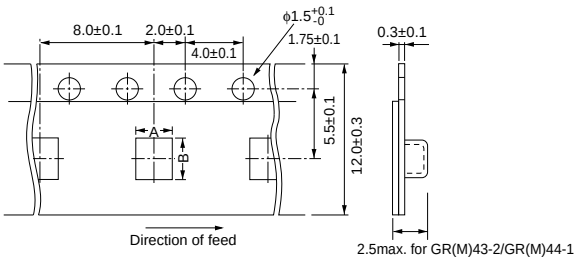
• 4mm Pitch Tape



	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)

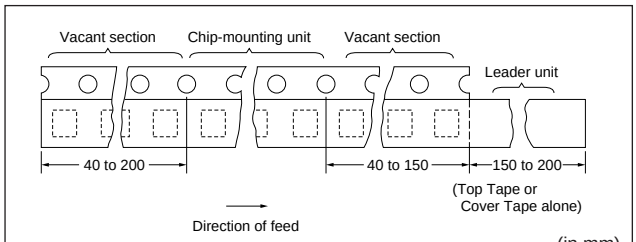
(4) Minimum Quantity*

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)

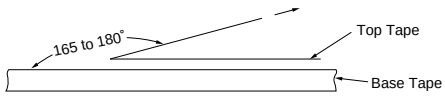
③ The top tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.

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.

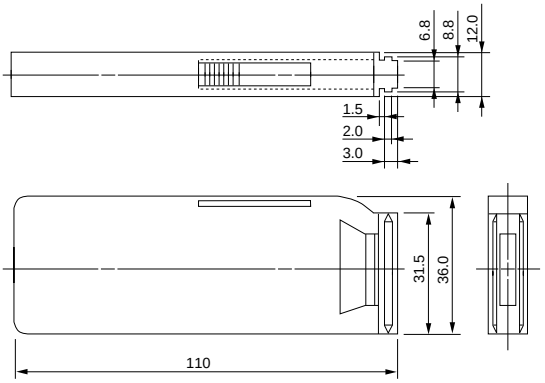
⑦ Peeling off force : 0.1 to 0.6N in the direction shown below.



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)

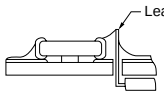
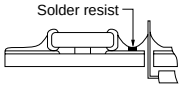
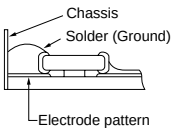
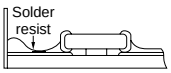
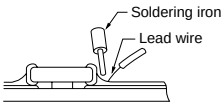
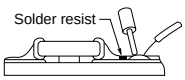
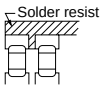
Type / Thickness	GRM36	GRM39	GRM40
0.5 mm	50,000	–	–
0.8 mm	–	15,000	–
0.6 mm	–	–	10,000
1.25mm	–	–	5,000

* "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]

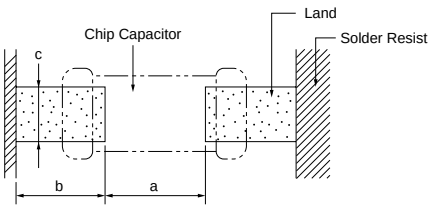


Table 1 Flow soldering method (in mm)

		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

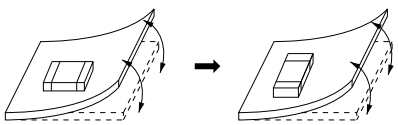
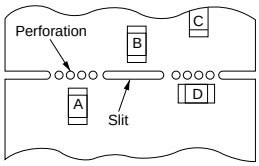
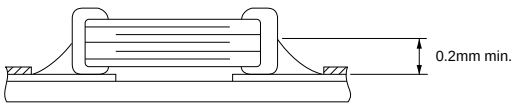
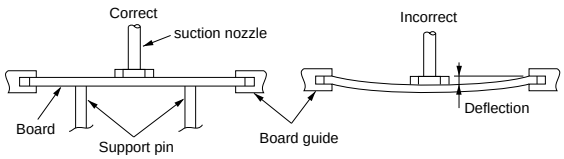
Process	Cautions	Control Points	Reference Data
3. PCB Design		Table 2 Reflow soldering method (in mm) (see tables below) • Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board. [Component Direction]  Locate chip horizontal to the direction in 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)

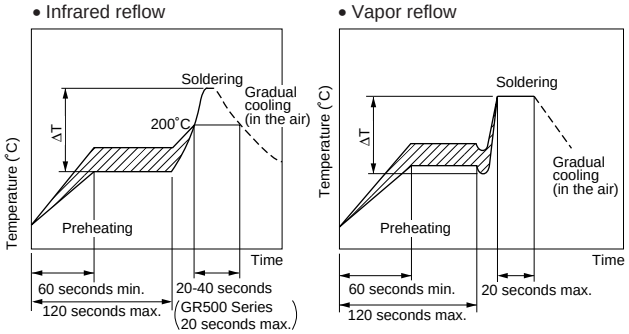
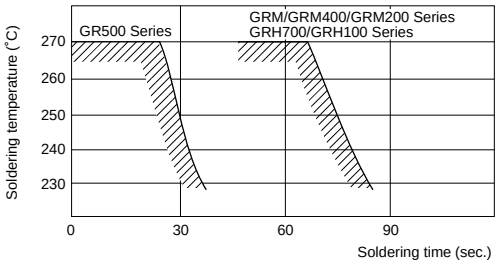
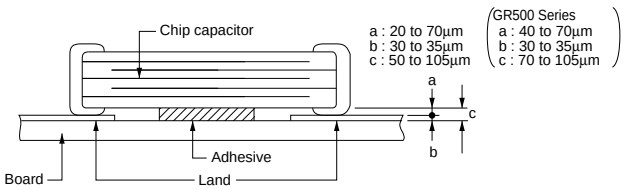
		GRM36	GRM39 GRM420 GRM220	GRM40 GRM425	GRM42-6 GRM430 GRM230	GRM42-2 GRM235	GRM43-2	GRM44-1	GRH706	GRH708	GRH710	GRH110	GRH111
Dimensions	L	1.0	1.6	2.0	3.2	3.2	4.5	5.7	1.25	2.0	3.2	1.4	2.8
	W	0.5	0.8	1.25	1.6	2.5	3.2	5.0	1.0	1.25	2.5	1.4	2.8
a		0.3 -0.5	0.6-0.8	1.0-1.2	2.2-2.4	2.0-2.4	3.0-3.5	4.0-4.6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

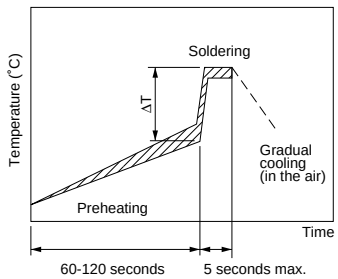
NOTICE

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

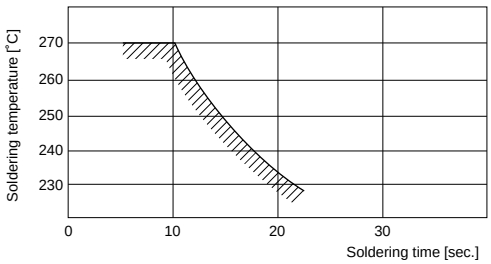
Table 4

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

[Standard Conditions for Flow Soldering]

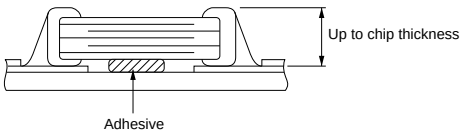


[Allowable Soldering Temperature and Time]



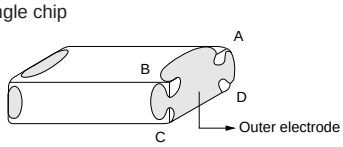
In case of repeated soldering, the accumulated soldering time must be within the range shown above.

[Optimum Solder Amount for Flow Soldering]

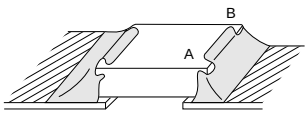


• Set temperature and time to ensure that leaching of the outer electrode does not exceed 25% of the chip end area as a single chip (full length of the edge A-B-C-D shown below) and 25% of the length A-B shown below as mounted on substrate.

As a single chip



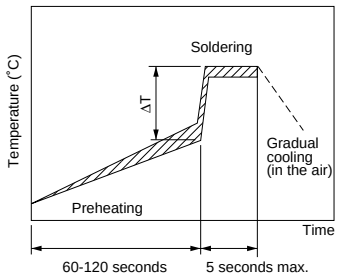
As mounted on substrate



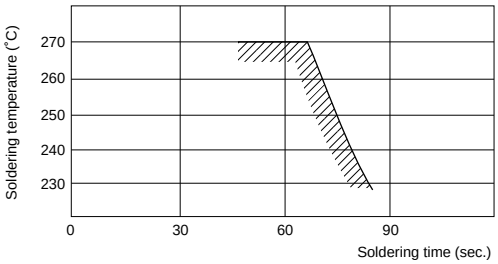
NOTICE

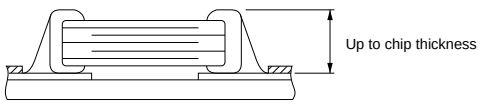
<table>
<tr><th>Process</th><th>Cautions</th><th>Control Points</th><th>Reference Data</th></tr>
<tr>
<td>12. Correction with a Soldering Iron</td>
<td>〈For chip type capacitors except GRM200 series〉
• Sudden heating of the chip results in distortion due to a high internal temperature differential, causing 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

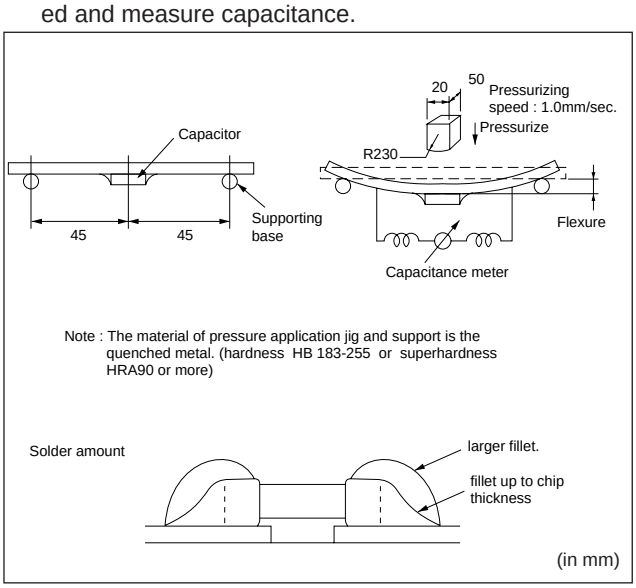
Table 7

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%

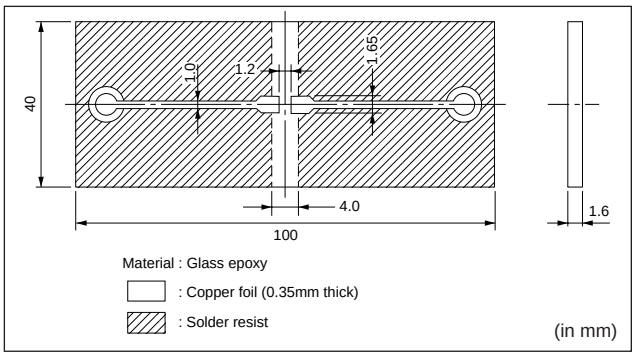
2. Board Bending Strength for Solder Fillet Height

(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

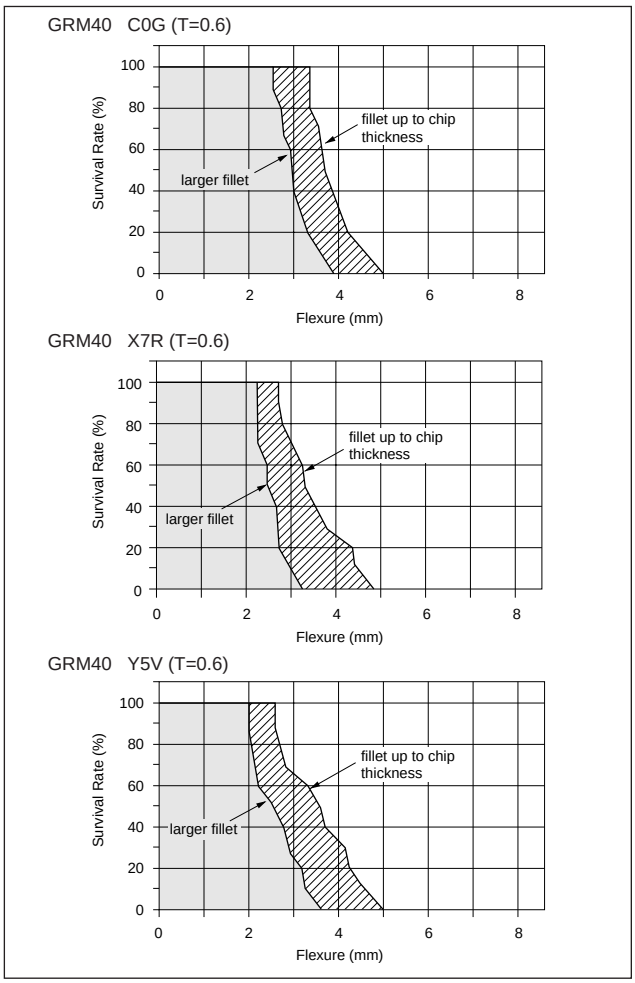
(4) Acceptance criteria

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

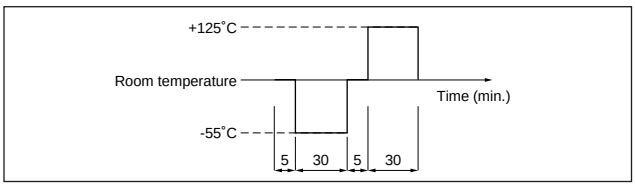


GRM SERIES REFERENCE DATA

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 :

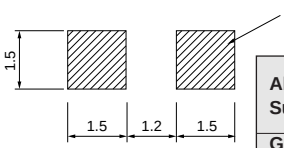
Substrate		Alumina*1	Glass Epoxy*2 or Paper Phenol
Solder Amount	①	0.5T	T
	②	0.7T	1.3T
	③	T	1.6T
Solder to be Used		6X4 Eutectic solder	

*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

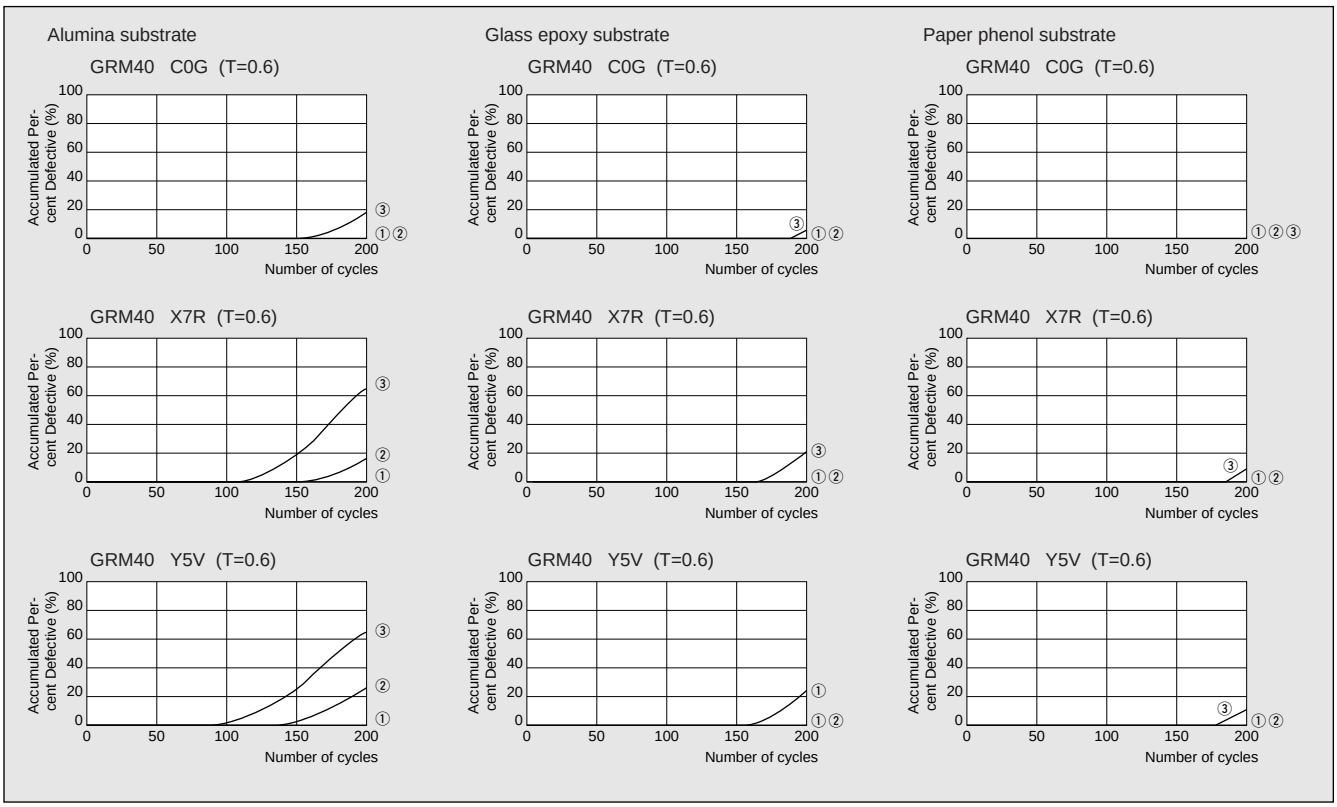
(4) Acceptance criteria

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

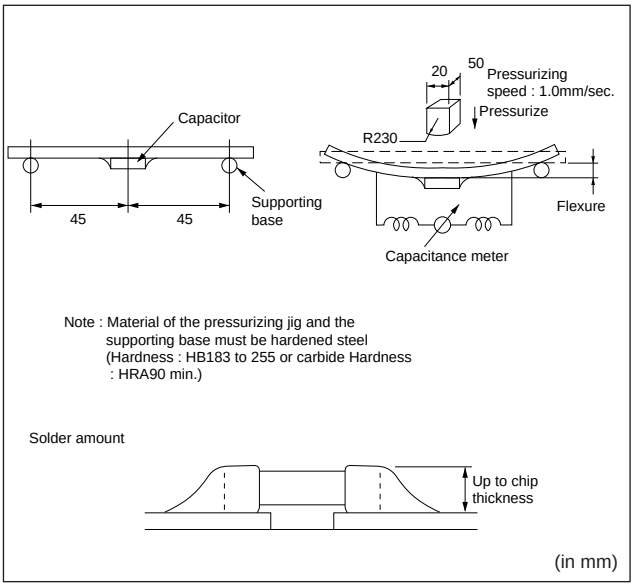


GRM SERIES REFERENCE DATA

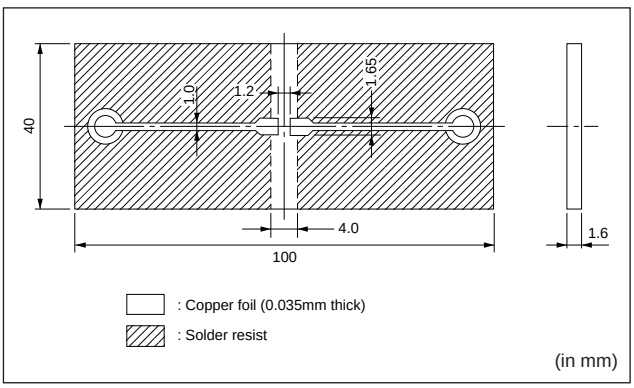
4. Board Bending Strength for Board Material

(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

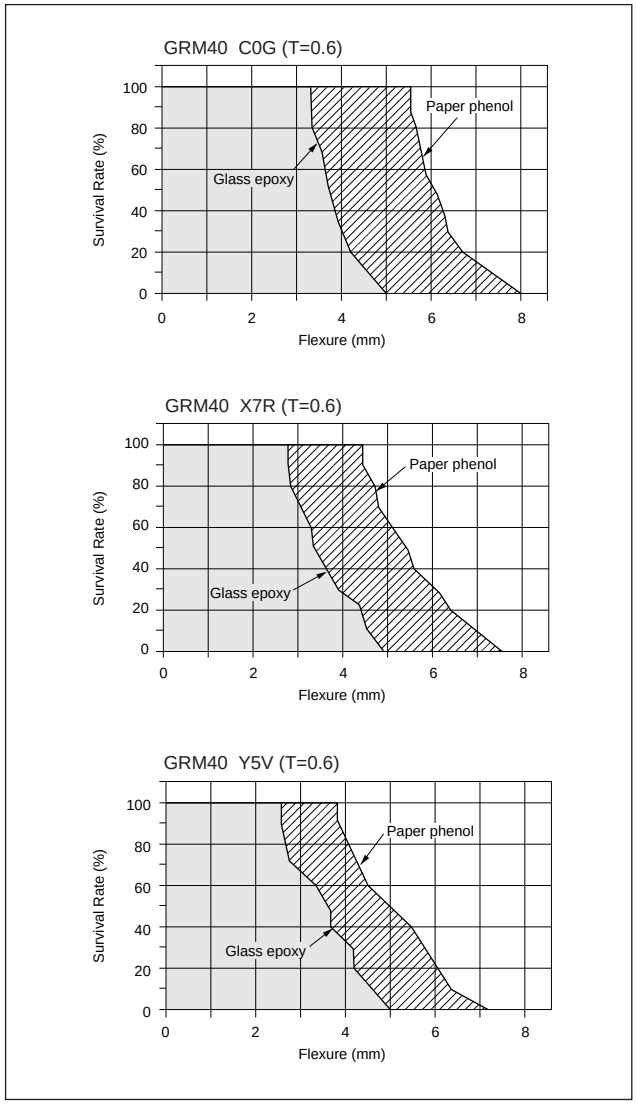
(4) Acceptance criteria

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

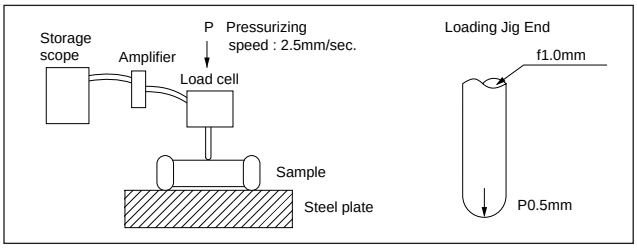


GRM SERIES REFERENCE DATA

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.

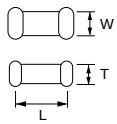
(4) Explanation

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 :

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

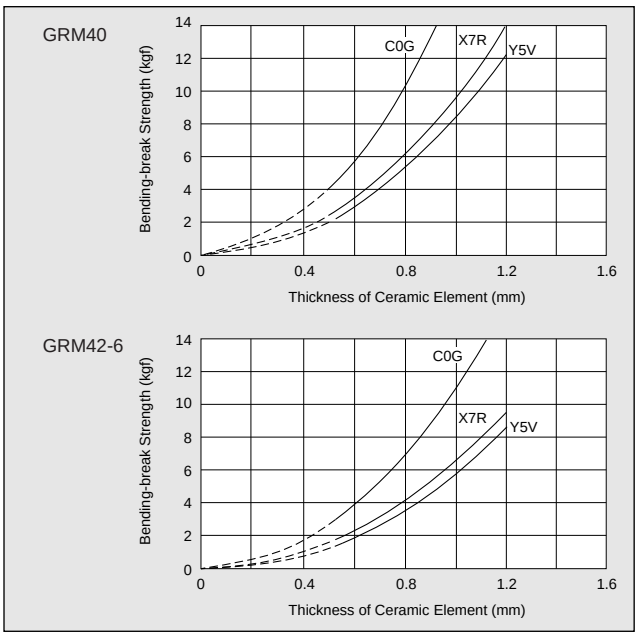
W : Width of ceramic element (mm)
T : Thickness of element (mm)
L : Distance between fulcrums (mm)
γ : Bending stress (N/mm²)



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

(in mm)

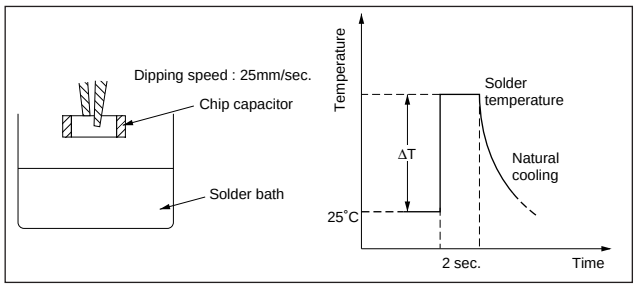
(5) Results



6. Thermal Shock

(1) Test method

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



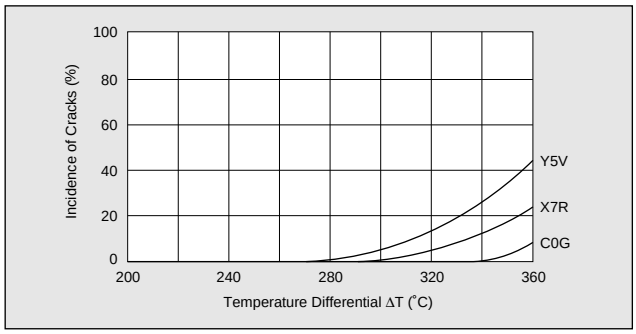
(2) Test samples

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

(3) Acceptance criteria

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

(4) Results



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.

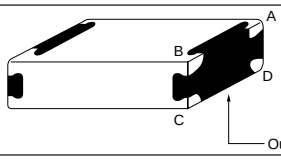
③ Flux to be used : An ethanol solution of 25 % rosin

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.

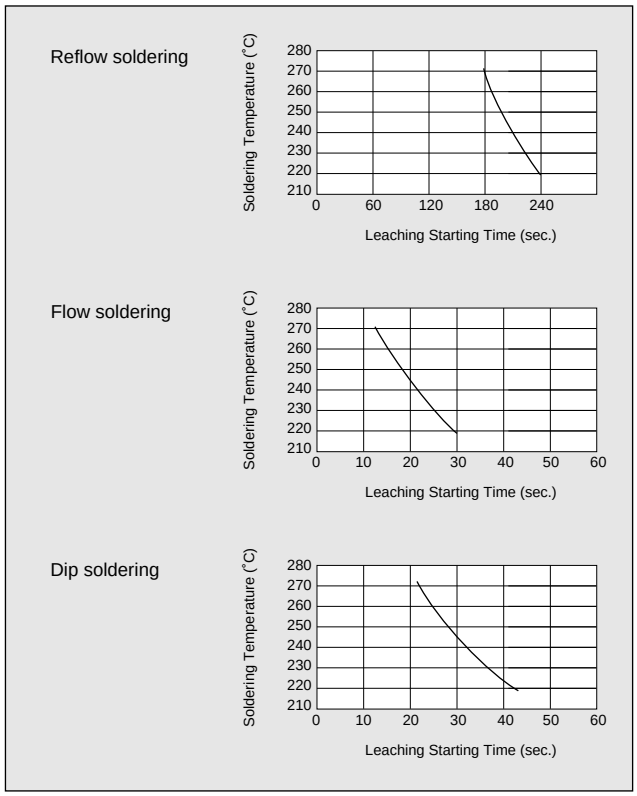
⑤ Flux to be used : An ethanol solution of 25 % rosin

(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 :

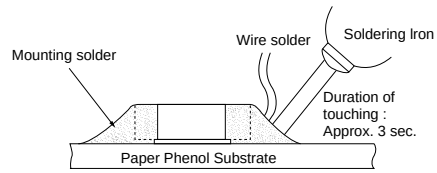


(4) Results



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