Specification No. : JEMCG2-004505

Messrs.
AT4wireless Inc. (Spain)
Engineering

Product Specification for Approval

Issued Date : 29 JUN. 2010

Part Description : Chip Monolithic Ceramic Capacitor

Customer Part No. :

MURATA Part No. : GRM Series (High Dielectric Type)

(Acknowledgement of reception)

We have received the attached specification. Date: _____ Company: _____ Division: _____
Approved by (Signiture) _____ (Type)

Please return one copy of these specifications with your acceptance. If the copy is not returned by 29 JUL. 2010 , these specifications will be deemed to have been accepted by you.

Technical Dept.

Business Development Support Sec. 1
Planning & Market Promotion Department
Fukui Murata MFG. Co., Ltd.

Prepared by _____
MIKI YAMAMOTO

Representative _____
Kazuo MAKIDA

CHIP MONOLITHIC CERAMIC CAPACITOR GRM SERIES

1.SCOPE

This product specification is applied to CHIP MONOLITHIC CERAMIC CAPACITOR used for General Electronic equipment.

2.MURATA PART NO. SYSTEM

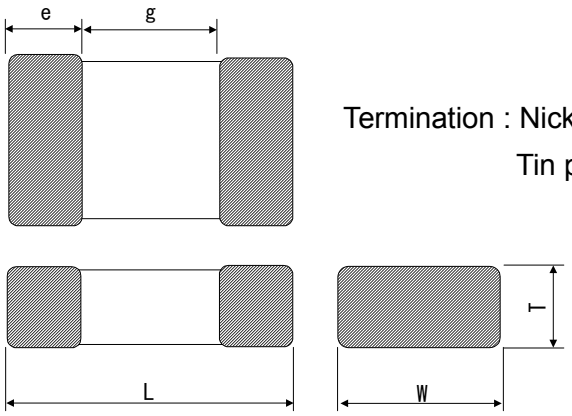
2.1 NEW PART NO.

(EX.)	GRM	188	B1	1H	102	K	---	D
	①	②	③	④	⑤	⑥	⑦	⑧

①Type	: According to 3.1
②Dimensions	: According to 3.1
③Temperature Characteristics	: According to 3.2
④DC Rated Voltage	: According to 3.3
⑤Nominal Capacitance	: According to 3.4
⑥Capacitance Tolerance	: According to 3.5
⑦Murata's Control	: Murata's Control Code
⑧Packaging Code	: According to 3.6

3.TYPE

3.1 TYPE & DIMENSIONS



Termination : Nickel plated barrier layer
Tin plated

(Unit:mm)

TYPE		L	W	T	e	g
GRM033		0.6+/-0.03	0.3+/-0.03	0.3+/-0.03	0.1 to 0.2	0.2 min.
GRM155		1.0+/-0.05	0.5+/-0.05	0.5+/-0.05	0.15 to 0.35	0.3 min.
GRM18	5	1.6+/-0.1	0.8+/-0.1	0.5+0/-0.1	0.2 to 0.5	0.5 min.
	8			0.8+/-0.1		
GRM21	6	2.0+/-0.1	1.25+/-0.1	0.6+/-0.1	0.2 to 0.7	0.7 min.
	9			0.85+/-0.1		
	A			1.0+0/-0.2		
	B			1.25+/-0.1		
GRM31	6	3.2+/-0.15	1.6+/-0.15	0.6+/-0.1	0.3 to 0.8	1.5 min.
	9			0.85+/-0.1		
	M			1.15+/-0.1		
	X	3.2+/-0.2	1.6+/-0.2	1.2+/-0.1		
	C			1.6+/-0.2		
GRM32	9	3.2+/-0.3	2.5+/-0.2	0.85+0.15/-0.05	0.3 min.	1.0 min.
	M			1.15+/-0.1		
	N			1.35+/-0.15		
	C			1.6+/-0.2		
	R			1.8+/-0.2		
	D			2.0+/-0.2		
	E			2.5+/-0.2		
GRM43	N	4.5+/-0.4	3.2+/-0.3	1.35+/-0.15	0.3 min.	2.0 min.
	C			1.6+/-0.2		
	R			1.8+/-0.2		
	D			2.0+/-0.2		
	E			2.5+/-0.2		
	S			2.8+/-0.2		
GRM55	M	5.7+/-0.4	5.0+/-0.4	1.15+/-0.1	0.3 min.	2.0 min.
	N			1.35+/-0.15		
	C			1.6+/-0.2		
	R			1.8+/-0.2		
	D			2.0+/-0.2		
	E			2.5+/-0.2		
	F			3.2+/-0.2		

1.Thickness dimensions(T) : According to appendix.
2.GRM18 Series Bulk case packaging is L:1.6+/-0.07mm,W/T:0.8+/-0.07mm.
3.GRM18 Series R6 0J 106M is L:1.6+/-0.15mm W/T:0.8+/-0.15mm,e:0.2 ~ 0.55mm.
4.GRM21B Series R7 1E 105/225, R6/C7 1A 335/475, R6 0J 335K/475K/226M, R7 0J 106, C8 0G 226M is L:2.0+/-0.15mm,W/T:1.25+/-0.15mm.
5.GRM31M Series R7 1E 225K/M, R7 1C 225K/M, R7 2A 474/684K/M is L:3.2+/-0.2mm, W:1.6+/-0.2 mm, T:1.15+/-0.15mm.
6.GRM31C R6 0J 107M is L:3.2+/-0.3mm W/T:1.6+/-0.3mm.

3.2 TEMPERATURE CHARACTERISTICS

(1)Temperature Compensating Type

Code	Temp. Range	Temp. coeff.(ppm/°C)
5C	-55 to125°C	0 +/-30
6C		0 +/-60
6P	-55 to 85°C	-150 +/-60
6R		-220 +/-60
6S		-330 +/-60
6T		-470 +/-60
7U		-750 +/-120
1X	20 to 85°C	+350 to -1000

(2)High Dielectric Constant Type

Code	Cap. Change(Within%)	Temp. Range	Standard Temp.
R7	+/-15	-55 to 125°C	25°C
R6	+/-15	-55 to 85°C	
C8	+/-22	-55 to 105°C	
C7	+/-22	-55 to 125°C	
F5	+22/-82	-30 to 85°C	

3.3 DC RATED VOLTAGE

Code	0G	0J	1A	1C	1E	1H	2A
DC Rated voltage	4V	6.3V	10V	16V	25V	50V	100V

3.4 NOMINAL CAPACITANCE

Nominal Capacitance shall be expressed by three digits. The first two digits represents significant figures. The last specifies the number of zero to follow. The letter R is used as the decimal point. According to appendix.

(EX.)

Code	Capacitance
R50	0.5pF
5R0	5.0pF
220	22pF
221	220pF

3.5 CAPACITANCE TOLERANCE

Code	Type	Temperature Characteristics	Capacitance Tolerance		Capacitance Step
B	Temperature Compensating Type	ΔC to ΔX	< 10pF	+/-0.1pF	0.5,1,2,3,4,5,6,7,8,9 (pF)
C				+/-0.25pF	0.5,1,2,3,4,4.7,5,6,7,8,9 (pF)
D				+/-0.5pF	0.5,1,2,3,4,5,6,7,8,9 (pF)
G			≧10pF	+/-2%	E24 Step
J				+/-5%	
R			+/-2.5%		10(pF)
K	High Dielectric Constant Type	R6/R7/C7/C8	+/-10%		E12 Step
M			+/-20%		E6 Step
Z		F5	+80/-20%		

*E24 step is also available for GRM03/15/18 1 to 9.1pF.

E Step

E24	1	1.1	1.2	1.3	1.5	1.6	1.8	2	2.2	2.4	2.7	3	3.3	3.6	3.9	4.3	4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1
E12	1		1.2		1.5		1.8		2.2		2.7		3.3		3.9		4.7		5.6		6.8		8.2	
E6	1				1.5				2.2				3.3				4.7				6.8			

3.6 PACKAGING

Packaging is the following method. According to Packaging Methods.

Packaging Code	Specification	Packaging Unit
B	Bulk Packaging in a bag	1000pcs/bag (Only GRM43S,GRM55E/F: 500pcs./bag)
D	ϕ180mm Paper Tape Carrier Packaging	According to Capacitance Value and Tolerance
L	ϕ180mm Plastic Tape Carrier Packaging	
E	ϕ180mm Special Packaging	
J	ϕ330mm Paper Tape Carrier Packaging	
K	ϕ330mm Plastic Tape Carrier Packaging	
F	ϕ330mm Special Packaging	
C	Bulk Case Packaging	

4.SPECIFICATIONS

According to Specifications and Test Methods.

Appendix 1-1. CAPACITANCE VALUE AND TOLERANCE 50V max.

<High Dielectric Constant Type>: Please refer to SPECIFICATIONS AND TEST METHODS 1.

Type	DC RATED VOLTAGE (V)	T		Temperature Characteristics and Capacitance (pF)			ϕ180 Packaging Unit (pcs/Reel)
		Code	Thickness (mm)	R6	R7	F5	
GRM03	25	3	0.3+/-0.03	-	100 to 1500	-	15000
	16			-	100 to 1000, 1800 to 3300	-	
	10			1200 to 10000	1200 to 10000	1500 to 10000	
	6.3			-	1200 to 10000	-	
GRM15	50	5	0.5+/-0.05	-	220 to 4700	1000 to 15000	10000
	25			-	5600 to 47000	22000 to 100000	
	16			56000 to 100000	10000 to 100000	33000 to 100000	
	10			56000 to 100000	27000 to 47000	150000 to 470000	
GRM18	50	8	0.8 +/-0.1	-	220 to 100000	1000 to 220000	4000
	25			-	8200 to 220000	15000 to 100000 220000 to 470000	
	16			-	12000 to 470000	33000 to 1000000	
	10			-	120000 to 220000	470000 to 1000000	
	6.3			1000000	1000000	-	
GRM21	50	6	0.6+/-0.1	-	220 to 22000	1000 to 68000	4000
		9	0.85+/-0.1	-	27000 to 39000 330000	100000 to 220000 470000 to 1000000	
		B	1.25+/-0.1	-	47000 to 100000 150000 to 220000,470000	220000	3000
	25	6	0.6+/-0.1	-	10000 to 33000	33000 to 150000	4000
		9	0.85+/-0.1	-	39000 to 68000 220000 to 270000 470000 680000 to 1000000	220000, 1000000	
		B	1.25+/-0.1	-	82000 to 180000 330000 to 820000, 1500000	330000 to 470000 1500000 to 4700000	3000
			1.25+/-0.15	-	1000000	-	
	16	6	0.6+/-0.1	-	15000 to 56000	100000, 220000	4000
		9	0.85+/-0.1	-	68000 to 100000 220000 to 270000 470000 to 680000	150000, 330000 470000, 1000000	
		B	1.25+/-0.1	-	120000 to 180000 330000 to 470000 820000 to 1000000	470000 to 680000 150000 to 2200000	3000
	10	6	0.6+/-0.1	-	220000 to 390000	330000 to 680000	4000
		9	0.85+/-0.1	-	-	1000000, 3300000	
		B	1.25+/-0.1	-	680000 to 1000000	1500000 to 2200000 4700000	3000
	6.3	B	1.25+/-0.1	-	-	-	3000
			1.25+/-0.15	-	-	-	
GRM31	50	6	0.6+/-0.1	-	220 to 15000	1000 to 47000	4000
		9	0.85+/-0.1	-	220 to 100000 270000 to 330000	68000 to 330000	
		M	1.15+/-0.1	-	120000 to 220000 390000 to 470000, 1000000	470000	3000
	25	6	0.6+/-0.1	-	18000 to 33000	68000 to 150000	4000
		9	0.85+/-0.1	-	39000 to 150000 270000 to 680000	220000 to 470000	
		M	1.15+/-0.1	-	180000 to 220000 820000 to 1000000	680000 to 4700000	3000
			1.15+/-0.15	-	2200000	-	
		C	1.6+/-0.2	-	3300000	6800000 to 10000000	2000
	16	6	0.6+/-0.1	-	47000 to 56000	220000	4000
		9	0.85+/-0.1	-	68000 to 220000 330000, 470000 to 560000 1000000	330000 to 470000 1000000	
		M	1.15+/-0.1	-	270000 680000 to 820000	680000 to 4700000	3000
			1.15+/-0.15	-	1500000, 2200000	-	
		C	1.6+/-0.2	3300000, 4700000	3300000, 4700000	-	
	10	9	0.85+/-0.1	-	820000 to 1000000	2200000 to 3300000	4000
		M	1.15+/-0.1	-	2200000	4700000 to 10000000	3000
		C	1.6 +/-0.2	-	10000000	-	2000
	6.3	M	1.15+/-0.1	-	-	10000000	3000
		C	1.6 +/-0.2	-	-	-	2000
Capacitance Tolerance				K:+/-10%, M:+/-20%		Z : +80/-20%	

1.Inner electrode : Nickel , Palladium , or Silver/Palladium

2. "–" means "Not Applicable"

Appendix 1-2. CAPACITANCE VALUE AND TOLERANCE 50V max.

<High Dielectric Constant Type>: Please refer to SPECIFICATIONS AND TEST METHODS 1.

Type	DC RATED VOLTAGE (V)	T		Temperature Characteristics and Capacitance (pF)			ϕ180 Packaging Unit (pcs/Reel)
		Code	Thickness (mm)	R6	R7	F5	
GRM32	50	M	1.15+/-0.1	-	390000 to 470000	-	3000
		N	1.35+/-0.15	-	180000 to 220000 560000 to 680000	680000	2000
		R	1.8 +/-0.2	-	820000 to1000000	1000000	1000
		D	2.0+/-0.2	-	3300000	10000000	1000
		E	2.5+/-0.2	-	4700000	-	1000
	25	9	0.85+/-0.1	-	-	4700000	4000
		N	1.35+/-0.15	-	1500000	10000000	2000
		R	1.8 +/-0.2	-	2200000	-	1000
		D	2.0+/-0.2	-	3300000, 4700000	-	1000
	16	M	1.15+/-0.1	-	2200000	-	3000
		N	1.35+/-0.15	-	3300000	10000000	2000
		R	1.8 +/-0.2	-	4700000	-	1000
		D	2.0+/-0.2	-	10000000	-	1000
	10	9	0.85+/-0.1	-	-	10000000	4000
		E	2.5 +/-0.2	-	-	-	1000
GRM43	50	R	1.8 +/-0.2	-	270000 to 680000	1000000 to 2200000	1000
		D	2.0 +/-0.2	-	1500000	-	500
		E	2.5 +/-0.2	-	2200000	-	500
	25	E	2.5 +/-0.2	-	4700000	-	500
GRM55	50	R	1.8 +/-0.2	-	560000 to 1500000	3300000 to 4700000	1000
		D	2.0+/-0.2	10000000	3300000	-	1000
		E	2.5+/-0.2	-	4700000	-	500
	25	D	2.0+/-0.2	-	10000000	-	1000
Capacitance Tolerance				K:+/-10%, M:+/-20%		Z : +80/-20%	

1.Inner electrode : Nickel , Palladium , or Silver/Palladium
2. "–" means "Not Applicable"

Appendix 2. CAPACITANCE VALUE AND TOLERANCE (100V)

<High Dielectric Constant Type>: Please refer to SPECIFICATIONS AND TEST METHODS 1.

Type	DC RATED VOLTAGE (V)	T		Temperature Characteristics and Capacitance(pF)		ϕ180 Packaging Unit (pcs/ Reel)
		Code	Thickness (mm)	R7	F5	
GRM15	100	5	0.5+/-0.05	220 to 4700	-	10000
GRM18	100	8	0.8+/-0.1	220 to 3300, 100000	1500 to 4700	4000
GRM21	100	6	0.6+/-0.1	-	-	4000
		9	0.85+/-0.1	220 to 6800	680 to 6800	
		B	1.25+/-0.1	8200 to 47000	10000 to 22000	3000
GRM31	100	9	0.85+/-0.1	220 to 15000, 100000	1000 to 22000	4000
		M	1.15+/-0.1	18000 to 82000 150000, 220000	33000 to 47000	3000
			1.15+/-0.15	470000, 680000	-	
		C	1.6+/-0.2	1000000	-	2000
GRM32	100	M	1.15+/-0.1	47000	68000	3000
		N	1.35+/-0.15	56000 to 100000	68000 to 100000	2000
		C	1.6+/-0.2	680000, 1000000	-	2000
		D	2.0+/-0.2	1500000	-	1000
		E	2.5+/-0.2	1000000, 2200000	-	1000
GRM43	100	N	1.35+/-0.15	-	-	1000
		R	1.8+/-0.2	120000 to 220000	150000 to 330000	
		D	1.6+/-0.2	390000 to 470000 1500000	-	
		E	2.5+/-0.2	2200000	-	500
GRM55	100	M	1.15+/-0.1	-	-	1000
		N	1.35+/-0.15	270000	-	
		R	1.8+/-0.2	330000 to 560000	470000 to 680000	
		D	1.6+/-0.2	820000 to 1000000 3300000	-	
		E	2.5+/-0.2	4700000	-	500
Capacitance Tolerance				K:+/-10%, M:+/-20%	Z:+80/-20%	

1.Inner electrode : Nickel , Palladium , or Silver/Palladium
2. "–" means "Not Applicable"

Appendix 3. CAPACITANCE VALUE (Thin Layer Large-capacitance Type)

: Please refer to SPECIFICATIONS AND TEST METHODS 2.

Type	DC RATED VOLTAGE (V)	T		Temperature Characteristics and Capacitance (μF)					φ180 Packaging Unit (pcs/Reel)
		Code	Thickness (mm)	R6	R7	C8	C7	F5	
GRM03	6.3	3	0.3+/-0.03	0.015 to 0.10	-	-	-	-	15000
GRM15	10	5	0.5+/-0.05	0.15 to 1.0	-	-	-	0.22 to 1.0	10000
	6.3			0.15 to 1.0	-	-	-	1.0	
GRM18	16	5	0.5+0/-0.1	1.0	-	-	-	-	4000
	25	8	0.8+/-0.1	0.47, 1.0	-	-	-	-	
	16			0.47, 1.0, 2.2	-	-	-	-	
	10			2.2	-	-	-	2.2, 4.7	
	6.3			2.2, 4.7	-	-	-	2.2, 4.7	
	4			-	-	4.7	-	-	
GRM21	25	6	0.6+/-0.1	1.0	-	-	-	-	4000
		9	0.85+/-0.1	2.2	-	-	-	-	
		B	1.25+/-0.1	2.2, 3.3, 4.7	-	-	-	-	3000
			1.25+/-0.15	-	2.2	-	-	-	
	16	6	0.6+/-0.1	1.0	-	-	-	-	4000
		9	0.85+/-0.1	2.2	-	-	-	-	
		B	1.25+/-0.1	2.2, 3.3, 4.7	-	-	-	-	3000
	10	6	0.6+/-0.1	1.0, 2.2	-	-	-	-	4000
		9	0.85+/-0.1	2.2, 3.3, 4.7	-	-	-	-	
		B	1.25+/-0.1	10	-	-	-	-	3000
			1.25+/-0.15	3.3, 4.7	-	-	3.3, 4.7	-	
	6.3	9	0.85+/-0.1	4.7, 10	-	-	-	-	4000
		B	1.25+/-0.1	10	-	-	-	10	3000
			1.25+/-0.15	22	10	-	-	-	
GRM31	25	6	0.6+/-0.1	2.2	-	-	-	-	4000
		9	0.85+/-0.1	4.7	-	-	-	-	
		C	1.6+/-0.2	10	-	-	-	-	2000
	16	6	0.6+/-0.1	2.2	-	-	-	-	4000
		9	0.85+/-0.1	4.7	-	-	-	-	
	10	6	0.6+/-0.1	3.3, 4.7	-	-	-	-	4000
		9	0.85+/-0.1	4.7, 10	-	-	-	-	
		M	1.15+/-0.1	10	-	-	-	-	3000
		C	1.6+/-0.2	-	-	-	-	22	2000
	6.3	9	0.85+/-0.1	10	-	-	-	-	4000
		M	1.15+/-0.1	10	-	-	-	-	3000
		C	1.6+/-0.2	15, 22, 47	-	-	-	22	2000
GRM32	25	E	2.5+/-0.2	22	-	-	-	-	1000
	16	C	1.6+/-0.2	-	-	-	-	22	2000
		E	2.5+/-0.2	22, 47	-	-	-	-	1000
	10	N	1.35+/-0.15	22	-	-	-	-	2000
		C	1.6+/-0.2	-	-	-	-	22	2000
		E	2.5+/-0.2	22, 47	22	-	-	-	1000
	6.3	D	2.0+/-0.2	22, 33	-	-	-	-	1000
		E	2.5+/-0.2	47, 100	-	-	-	100	1000
	4	E	2.5+/-0.2	-	-	100	-	-	1000
GRM43	16	E	2.5+/-0.2	22	-	-	-	-	500
	10	D	2.0+/-0.2	33	-	-	-	-	1000
		E	2.5+/-0.2	47	22	-	-	-	500
	6.3	D	2.0+/-0.2	33	-	-	-	-	1000
		E	2.5+/-0.2	47	-	-	-	-	500
		S	2.8+/-0.2	100	-	-	-	-	500
GRM55	6.3	F	3.2+/-0.2	100	-	-	-	-	300
Capacitance Tolerance				K : +/-10% Not apply to (GRM21BR60J226M/ GRM31CR60J476M GRM32DR60J336M/GRM32EB30J476M/107M GRM32EC80G107M/ GRM43SB30J107M) M : +/-20%				Z : +80/-20%	

1 : "–" means "Not Applicable"

■SPECIFICATIONS AND TEST METHODS 1.

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>-55°C to +125°C</td><td>R6 : -55°C to + 85°C R7 : -55°C to +125°C
C8 : -55°C to +105°C E4 : 10°C to + 85°C
F5 : -30°C to + 85°C L8/R9 : -55°C to +150°C</td><td>Reference Temperature : 25°C</td></tr>
<tr><td>2</td><td>Rated Voltage</td><td colspan="2">See the previous pages</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td>Dimension</td><td colspan="2">Within the specified dimensions</td><td>Using calipers or Microscope. (GRM02 size is based on Microscope)</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td colspan="2">No defects or abnormalities</td><td>No failure should be observed when 300% of the rated voltage (ΔC to 7U and 1X) or 250% of the rated voltage (R6, R7,C8,E4 and F5) is applied between the terminations for 1 to 5 seconds, provided the charge/ discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td colspan="2">More than 10,000MΩ or 500Ω·F
(whichever is smaller)</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25°C and 75%RH max. and within 2 minutes of charging.</td></tr>
<tr><td>7</td><td>Capacitance</td><td colspan="2">Within the specified tolerance</td><td rowspan="2">The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table.
<table><tr><th>Char. / Item</th><th>ΔC to 7U,1X (1000pF and below)</th><th>ΔC to 7U,1X (more than 1000pF) R6,R7,C8,F5 (C ≦ 10μF)</th><th>R6,R7,F5 (C>10μF)</th><th>E4</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td><td>120±24Hz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vrms</td><td>1±0.2Vrms</td><td>0.5±0.1Vrms</td><td>0.5±0.05Vrms</td></tr></table></td></tr>
<tr><td>8</td><td>Q/
Dissipation Factor
(D.F.)</td><td>30pF and over :
Q ≧ 1000

30pF and below :
Q ≧ 400+20C

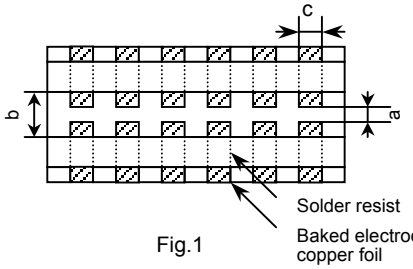
C:Nominal Capacitance (pF)</td><td>[R6,R7,C8,L8]
W.V.:100V : 0.025max.(C < 0. 068μF)
: 0.05max.(C ≧ 0.068μF)
W.V.:25/50V :0.025max.
W.V.:16/10V :0.035max.
W.V.:6.3V/4V :0.05max. (C < 3.3μF)
:0.1max.(C ≧ 3.3μF)
[R9]W.V.:50V: 0.05max.
[E4] W.V.:25Vmin :0.025max.
[F5] W.V.:25Vmin.
:0.05max. (C < 0.1μF) :0.09max. (C ≧ 0.1μF)
W.V.:16/10V:0.125max. W.V.:6.3V:0.15max.</td></tr>
<tr><td>9</td><td>Capacitance Temperature Character-istics</td><td>Capacitance Change</td><td>Within the specified tolerance.
(Table A -1)</td><td><table><tr><th>Char.</th><th>Temp. Range</th><th>Reference Temp.</th><th>Cap. Change</th></tr><tr><td>R6</td><td>-55°C to +85°C</td><td rowspan="8">25°C</td><td>Within ±15%</td></tr><tr><td>R7</td><td>-55°C to +125°C</td><td>Within ±15%</td></tr><tr><td>C8</td><td>-55°C to +105°C</td><td>Within ±22%</td></tr><tr><td rowspan="2">L8</td><td>-55°C to +125°C</td><td>Within ±15%</td></tr><tr><td>+125°C to+150°C</td><td>Within+15/-40%</td></tr><tr><td>R9</td><td>-55°C to+150°C</td><td>Within ±15%</td></tr><tr><td>E4</td><td>+10°C to +85°C</td><td>Within+22/-56%</td></tr><tr><td>F5</td><td>-30°C to +85°C</td><td>Within+22/-82%</td></tr></table></td><td rowspan="2">The capacitance change should be measured after 5 min. at each specified temperature stage.
(1)Temperature Compensating Type
The temperature coefficient is determind using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step1 through 5 (ΔC:+25°C to +125°C , other temp. coeffs.:+25°C to +85°C) the capacitance should 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 betweeen 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(forΔC to 7U/1X/R6/R7/C8/L8/R9)
-30±3(for F5), 10±3(for E4)</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>150±3(for R9),125±3(for ΔC/R7),
105±3(for C8),85±3(for other TC)</td></tr><tr><td>5</td><td>25±2</td></tr></table>
(2) High Dielectric Constant Type
The ranges of capacitance change compared with the 25°C value over the temperature ranges shown in the table should be within the specified ranges.
· Initial measurement for high dielectric constant type.
Perform a heat treatment at 150+0/-10°C for one hour and then set for 24±2 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td></td><td>Temperature Coefficent</td><td>Within the specified tolerance.
(Table A -1)</td><td rowspan="2"></td></tr>
<tr><td></td><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05 pF
(Whichever is larger.)
*Not apply to 1X/25V</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur.
 

Fig.1</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply *10N force in parallel with the test jig for 10±1sec.
The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock
*5N (GR□15, GRM18)
2N (GR□03),1N(GR□02)
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GR□02</td><td>0.2</td><td>0.56</td><td>0.23</td></tr><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table>(in:mm)</td></tr>
</table>

■SPECIFICATIONS AND TEST METHODS 1.

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="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 Type</th></tr>
<tr><td>11</td><td>Vibration Resistance</td><td>Appearance</td><td colspan="3">No defects or abnormalities</td><td rowspan="3">Solder the capacitor on the test jig (glass epoxy board) in the same manner and under the same conditions as(10). The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each 3 mutually perpendicular directions(total of 6 hours).</td></tr>
<tr><td></td><td>Capacitance</td><td colspan="3">Within the specified tolerance</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pF and over :
Q ≧ 1000

30pF and below:
Q ≧ 400+20C

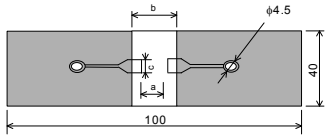
C:Nominal Capacitance (pF)</td><td colspan="2">[R6,R7,C8,L8]
W.V.:100V : 0.025max. (C < 0. 068μF)
: 0.05max.(C ≧ 0.068μF)
W.V.:25/50V :0.025max.
W.V.:16/10V :0.035max.
W.V.:6.3V/4V :0.05max. (C < 3.3μF)
:0.1max.(C ≧ 3.3μF)
[R9]W.V.:50V: 0.05max.
[E4] W.V.:25Vmin. :0.025max
[F5] W.V.:25Vmin.
:0.05max. (C < 0.1μF) :0.09max.(C ≧ 0.1μF)
W.V.:16/10V:0.125max. W.V.:6.3V:0.15max.</td></tr>
<tr><td>12</td><td>Deflection</td><td>Appearance</td><td colspan="3">No defects or abnormalities.</td><td rowspan="2">Solder the capacitor on the test jig (glass epoxy board) shown in Fig.2 using a eutectic solder. Then apply a force in the direction shown in Fig 3 for 5±1sec. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
 

Fig.2 t : 1.6mm
(GR□02/03,GR□15:0.8mm)

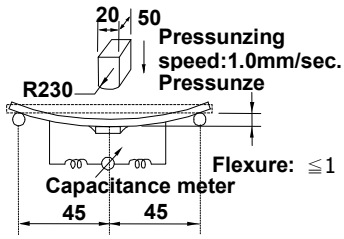
Type | a | b | c
GR□02 | 0.2 | 0.56 | 0.23
GR□03 | 0.3 | 0.9 | 0.3
GR□15 | 0.4 | 1.5 | 0.5
GRM18 | 1.0 | 3.0 | 1.2
GRM21 | 1.2 | 4.0 | 1.65
GRM31 | 2.2 | 5.0 | 2.0
GRM32 | 2.2 | 5.0 | 2.9
GRM43 | 3.5 | 7.0 | 3.7
GRM55 | 4.5 | 8.0 | 5.6 (in:mm)</td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td><td colspan="2">Within ±10%</td></tr>
<tr><td></td><td></td><td colspan="4"> 

Fig.3</td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td colspan="3">75% of the terminations is to be soldered evenly and continuously</td><td>Immerse the capacitor in a solution of ethanol(JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight propotion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating , immerse in an eutectic solder solution for 2±0.5 seconds at 230±5°C or Sn-3.0Ag-0.5Cu solder solution for 2±0.5 seconds at 245±5°C.</td></tr>
<tr><td>14</td><td colspan="2">Resistance to Soldering Heat</td><td colspan="3">The measured and observed characteristics should satisfy the specifications in the following table</td><td>Preheat the capacitor at *120 to 150°C for 1 minute. Immerse the capacitor in an eutectic solder solution* or Sn-3.0Ag-0.5Cu solder solution at 270±5°C for 10±0.5 seconds. Set at room temperature for 24±2 hours, then measure.
*Not apply to GRM02

· Initial measurement for high dielectric constant type
Perform a heat treatment at 150+0/-10°C for one hour and then set at room temperature for 24±2 hours.
Perform the initial measurement.

*Preheating for GRM32/43/55

Step | Temperature | Time
1 | 100°C to 120°C | 1 min.
2 | 170°C to 200°C | 1 min.</td></tr>
<tr><td></td><td></td><td>Appearance</td><td colspan="3">No defects or abnormalities</td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td><td colspan="2">R6,R7,C8,L8,R9:Within ±7.5%
E4,F5:Within ±20%</td></tr>
<tr><td></td><td></td><td>Q/D.F.</td><td>30pF and over :
Q ≧ 1000

30pF and below:
Q ≧ 400+20C

C:Nominal Capacitance (pF)</td><td colspan="2">[R6,R7,C8,L8]
W.V.:100V : 0.025max.(C < 0. 068μF)
: 0.05max. (C ≧ 0.068μF)
W.V.:25/50V :0.025max.
W.V.:16/10V :0.035max.
W.V.:6.3V/4V :0.05max.(C < 3.3μF)
:0.1max.(C ≧ 3.3μF)
[R9]W.V.:50V: 0.05max.
[E4] W.V.:25Vmin :0.025max
[F5] W.V.:25Vmin
:0.05max. (C < 0.1μF) :0.09max. (C ≧ 0.1μF)
W.V.:16/10V:0.125max. W.V.:6.3V:0.15max.</td></tr>
<tr><td></td><td></td><td>I.R.</td><td colspan="3">More than 10,000MΩor 500Ω·F(Whichever is smaller)</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td colspan="3">No defects</td></tr>
</table>

■SPECIFICATIONS AND TEST METHODS 1.

<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 Type</th></tr>
<tr><td>15</td><td colspan="2">Temperature Cycle</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments shown in the following table. Set for 24±2 hours at room temperature, then measure
<table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Temp.(°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 set at room temperature for 24±2 hours. Perform the initial measurement</td></tr>
<tr><td></td><td>Appearance</td><td>No defects or abnormalities</td><td colspan="2"></td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td><td colspan="2">R6,R7,C8,L8,R9:Within ±7.5%
E4,F5:Within ±20%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pF and over :
Q ≧ 1000
30pF and below:
Q ≧ 400+20C
C:Nominal Capacitance (pF)</td><td colspan="2">[R6,R7,C8,L8]
W.V.:100V : 0.025max. (C < 0. 068μF)
: 0.05max.(C ≧ 0.068μF)
W.V.:25/50V :0.025max.
W.V.:16/10V :0.035max.
W.V.:6.3V/4V :0.05max. (C < 3.3μF)
:0.1max. (C ≧ 3.3μF)
[R9]W.V.:50V: 0.05max.
[E4] W.V.:25Vmin. :0.025max
[F5] W.V.:25Vmin.
:0.05max. (C < 0.1μF) :0.09max.(C ≧ 0.1μF)
W.V.:16/10V:0.125max. W.V.:6.3V:0.15max.</td></tr>
<tr><td></td><td>I.R.</td><td colspan="3">More than 10,000MΩor 500Ω·F (Whichever is smaller)</td></tr>
<tr><td></td><td>Dielectric Strength</td><td colspan="3">No defects</td></tr>
<tr><td>16</td><td colspan="2">Humidity Steady State</td><td colspan="2">The measured and observed characteristics should satisfy the specifications in the following table</td><td rowspan="5">Set the capacitor at 40±2°C and in 90 to 95% humiduty for 500±12 hours.
Remove and set for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td></td><td>Appearance</td><td>No defects or abnormalities</td><td colspan="2"></td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td><td colspan="2">R6,R7,C8,L8,R9:Within ±12.5%
E4,F5:Within ±30%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pF and over : Q ≧ 350
10pF and over,
30pF and below:
Q ≧ 275 + 5/2 C
10pF and below:
Q ≧ 200+10C
C:Nominal Capacitance(pF)</td><td colspan="2">[R6,R7,C8,L8]
W.V.:100V : 0.05max. (C < 0.068μF)
: 0.075max. (C ≧ 0.068μF)
W.V.:25/50V :0.05max.
W.V.:16/10V :0.05max.
W.V.:6.3V/4V:0.075max. (C < 3.3μF)
:0.125max. (C ≧ 3.3μF)
[R9]W.V.:50V: 0.075max.
[E4] W.V.:25Vmin.:0.05max.
[F5] W.V.:25Vmin.
:0.075max. (C<0.1μF) :0.125max. (C≧0.1μF)
W.V.:16/10V:0.15max. W.V.:6.3V:0.2max.</td></tr>
<tr><td></td><td>I.R.</td><td colspan="3">More than 1,000MΩor 50Ω·F(Whichever is smaller)</td></tr>
<tr><td></td><td>Dielectric Strength</td><td colspan="3">No defects</td></tr>
<tr><td>17</td><td colspan="2">Humidity Load</td><td colspan="2">The measured and observed characteristics should 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 set for 24±2 hours at room temprature, then measure.
The charge/discharge current is less than 50mA.

·Initial measurement for F5/16Vmax.
Apply the rated DC voltage for 1 hour at 40±2°C .
Remove and set for 24±2 hours at room temperature.
Perform initial measurement.</td></tr>
<tr><td></td><td>Appearance</td><td>No defects or abnormalities</td><td colspan="2"></td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±7.5% or ±0.75pF (Whichever is larger)</td><td colspan="2">R6,R7,C8,L8,R9:Within ±12.5%
E4:Within ±30%
F5:Within ±30% (W.V.>10V)
F5:Within +30/-40% (W.V. ≦10V)</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pF and over : Q ≧ 200
30pF and below:
Q≧100 + 10/3 C
C:Nominal Capacitance(pF)</td><td colspan="2">[R6,R7,C8,L8]
W.V.:100V : 0.05max. (C < 0.068μF)
: 0.075max. (C ≧ 0.068μF)
W.V.:25/50V :0.05max.
W.V.:16/10V :0.05max.
W.V.:6.3V/4V:0.075max. (C < 3.3μF)
:0.125max. (C ≧ 3.3μF)
[R9]W.V.:50V: 0.075max.
[E4] W.V.:25Vmin.:0.05max.
[F5] W.V.:25Vmin.
:0.075max. (C<0.1μF) :0.125max. (C≧0.1μF)
W.V.:16/10V:0.15max. W.V.:6.3V:0.2max.</td></tr>
<tr><td></td><td>I.R.</td><td colspan="3">More than 500MΩ or 25Ω·F(Whichever is smaller)</td></tr>
<tr><td></td><td>Dielectric Strength</td><td colspan="3">No defects</td></tr>
</table>

■SPECIFICATIONS AND TEST METHODS 1.

No.	Item	Specification		Test Method
		Temperature Compensating Type	High Dielectric Type	
18	High Temperature Load	The measured and observed characteristics should satisfy the specifications in the following table		Apply 200% of the rated voltage at the maximun operating temperature ±3°C for 1000±12 hours . Set for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA. ·Initial measurement for high dielectric constant type. Apply 200% of the rated DC voltage at the maximun operating temperature ±3°C for one hour. Remove and set for 24±2 hours at room temperature.Perform initial measurement.
	Appearance	No defects or abnormalities		
	Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	R6,R7,C8,L8,R9:Within ±12.5% E4:Within ±30% F5:Within±30% (Cap<1.0μF) F5:Within +30/-40% (Cap≧1.0μF)	
	Q/D.F.	30pF and over : Q ≧ 350 10pF and over, 30pF and below: $Q \geqq 275+\frac{5}{2}C$ 10pF and below: Q ≧ 200+10C C:Nominal Capacitance(pF)	[R6,R7,C8,L8] W.V.:100V : 0.05max. (C < 0.068μF) : 0.075max. (C ≧ 0.068μF) W.V.:25/50V :0.05max. W.V.:16/10V :0.05max. W.V.:6.3V/4V:0.075max. (C < 3.3μF) :0.125max. (C ≧ 3.3μF) [R9]W.V.:50V: 0.075max. [E4] W.V.:25Vmin.:0.05max. [F5] W.V.:25Vmin. :0.075max. (C<0.1μF) :0.125max.(C≧0.1μF) W.V.:16/10V:0.15max. W.V.:6.3V:0.2max.	
	I.R.	More than 1,000MΩor 50Ω·F(Whichever is smaller)		
	Dielectric Strength	No defects		

Table A-1

Char.	Nominal Values (ppm/°C) Note 1	Capacitance Change from 25 °C (%)					
		-55		-30		-10	
		Max.	Min.	Max.	Min.	Max.	Min.
5C	0± 30	0. 58	-0.24	0.40	-0.17	0.25	-0.11
6C	0± 60	0.87	-0.48	0.59	-0.33	0.38	-0.21
6P	-150± 60	2.33	0.72	1.61	0.50	1.02	0.32
6R	-220± 60	3.02	1.28	2.08	0.88	1.32	0.56
6S	-330± 60	4.09	2.16	2.81	1.49	1.79	0.95
6T	-470± 60	5.46	3.28	3.75	2.26	2.39	1.44
7U	-750±120	8.78	5.04	6.04	3.47	3.84	2.21
1X	+350~-1000	–	–	–	–	–	–

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

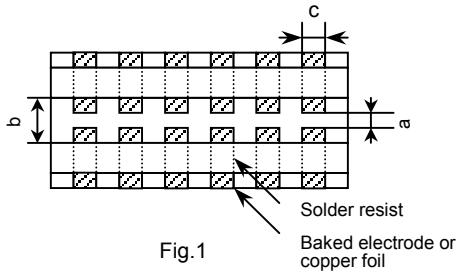
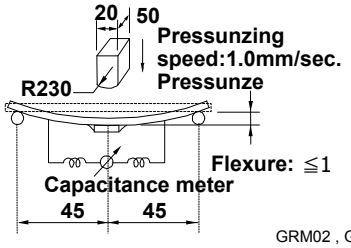
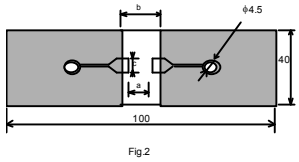
<table>
<tr><th>No</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>R6 : -55°C to +85°C
R7/ C7/ E7/ D7 : -55°C to +125°C
F5 : -30°C to +85°C
C8 : -55°C to +105°C</td><td>Reference Temperature : 25°C</td></tr>
<tr><td>2</td><td>Rated Voltage</td><td>See the previous pages</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td>No defects or abnormalities</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td>Dimensions</td><td>Within the specified dimension</td><td>Using calipers or Microscope. (GRM02 size is based on Microscope)</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td>No defects or abnormalities</td><td>No failure should be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td>More than 50Ω· F</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 25°C and 75%RH max. and within 1 minutes of charging.</td></tr>
<tr><td>7</td><td>Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/D.F. should be measured at 25°C at the frequency and voltage shown in the table.
<table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>C≦10μF (10V min.)</td><td>1 ± 0.1kHz</td><td>＊1.0 ± 0.2 Vrms</td></tr><tr><td>C≦10μF (6.3V max.)</td><td>1 ± 0.1kHz</td><td>0.5 ± 0.1 Vrms</td></tr><tr><td>C ﹥ 10μF</td><td>120 ± 24Hz</td><td>0.5 ± 0.1 Vrms</td></tr></table>＊ Measuring Voltage : 0.5±0.1Vrms
GRM155R61A124 to 105,GRM022R61A103
GRM185R61A/1C105,GRM188R61A/1C225
GRM188C8/D71A225,GRM188R71A225
GRM188R61A335, GRM219R61A106/475, GRM219R61C475
GRM21BR6/R71A/1C106, GRM319R61A/1C106</td></tr>
<tr><td>8</td><td>Dissipation Factor (D.F.)</td><td>R6 / R7 / C7/ C8/ E7 /D7 : 0.1 max.
F5 : 0.2 max.</td></tr>
<tr><td>9</td><td>Capacitance Temperature Characteristics</td><td><table><tr><th>Char.</th><th>Temp.Range</th><th>Reference Temp.</th><th>Cap.Change</th></tr><tr><td>R6</td><td>-55°C to +85°C</td><td>25°C</td><td>Within ±15%</td></tr><tr><td>R7</td><td>-55°C to +125°C</td><td>25°C</td><td>Within ±15%</td></tr><tr><td>F5</td><td>-30°C to +85°C</td><td>25°C</td><td>Within+22/-82%</td></tr><tr><td>C7</td><td>-55°C to +125°C</td><td>25°C</td><td>Within ±22%</td></tr><tr><td>C8</td><td>-55°C to +105°C</td><td>25°C</td><td>Within ±22%</td></tr><tr><td>E7</td><td>-55°C to +125°C</td><td>25°C</td><td>Within +22/-56%</td></tr><tr><td>D7</td><td>-55°C to +125°C</td><td>25°C</td><td>Within +22/-33%</td></tr></table></td><td>The capacitance change should be measured after 5 min.at each specified temperature stage.
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.
Measuring Voltage : GRM43 R6 0J/1A 336/476 : 1.0+/-0.2Vrms
· Initial measurement for high dielectric constant type
Perform a heat treatment at 150+0/-10°C for one hour and then set for 24±2 hour at room temperature.
Perform the initial measurement.</td></tr>
<tr><td>10</td><td>Adhesive Strength of Termination</td><td>No removal of the terminations or other defects should occur.
 

Fig.1</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1 sec. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*1N:GRM02 , 2N:GR□03 , 5N:GR□15/GRM18,
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM02</td><td>0.2</td><td>0.56</td><td>0.23</td></tr><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table>(in:mm)</td></tr>
<tr><td>11</td><td>Vibration</td><td>Appearance</td><td>No defects or abnormalities</td><td rowspan="3">Solder the capacitor on the test jig (glass epoxy board) in the same manner and under the same conditions as (10).
The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz.
The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute.
This motion should be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).</td></tr>
<tr><td></td><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td></td><td>D.F</td><td>R6/R7/C7/C8/E7/D7 : 0.1 max.
F5: 0.2 max.</td></tr>
</table>

No	Item	Specification		Test Method
12	Deflection	Appearance	No defects or abnormalities	Solder the capacitor to the test jig (glass epoxy board) shown in Fig.2 using a eutectic solder. Then apply a force in the direction shown in Fig.3. The soldering should be done by the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
		Capacitance Change	Within ±10%	
		 Fig.3	 Fig.2 GRM02 , GR□03/15 : t : 0.8mm t : 1.6mm	
13	Solderability of Termination	75% of the terminations is to be soldered evenly and continuously		Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120°C for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 230±5°C or Sn-3.0 Ag-0.5 Cu solder solution for 2±0.5 seconds at 245±5°C.
14	Resistance to Soldering Heat	Appearance	No defects or abnormalities	Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in an eutectic solder solution* or Sn-3.0 Ag-0.5 Cu solder solution at 270±5°C for 10±0.5 seconds. Set at room temperature for 24±2 hours, then measure. * Not apply to GRM02 · Initial measurement for high dielectric constant type Perform a heat treatment at 150+0/-10°C for one hour and then set at room temperature for 24±2 hours. Perform the initial measurement. * Preheating for GRM32/43/55
		Capacitance Change	R6/R7/C7/C8/E7/D7 : Within ±7.5% F5: Within ±20%	
		D.F.	R6/R7/C7/C8/E7/D7 : 0.1 max. F5: 0.2 max.	
		I.R.	More than 50Ω· F	
		Dielectric Strength	No defects	
15	Temperature Sudden Change	Appearance	No defects or abnormalities	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments shown in the following table. Set for 24±2 hours at room temperature, then measure.
		Capacitance Change	R6/R7/C7/C8/D7 : Within ±7.5% E7 : Within ±30% F5 : Within ±20%	
		D.F.	R6/R7/C7/C8/E7/D7 : 0.1 max. F5 : 0.2 max.	
		I.R.	More than 50Ω· F	
		Dielectric Strength	No defects	· Initial measurement for high dielectric constant type Perform a heat treatment at 150+0/-10°C for one hour and then set at room temperature for 24±2 hours. Perform the initial measurement.
16	High Temperature High Humidity (Steady)	Appearance	No defects or abnormalities	Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. The charge/discharge current is less than 50mA. · Initial measurement Perform a heat treatment at 150+0/-10°C for one hour and then set for 24±2 hours at room temperature. Perform the initial measurement. · Measurement after test Perform a heat treatment at 150+0/-10°C for one hour and then set for 24±2 hours at room temperature, then measure.
		Capacitance Change	R6/R7/C7/C8/E7/D7 : Within ±12.5% F5: Within ±30%	
		D.F.	R6/R7/C7/C8/E7/D7 : 0.2max. F5: 0.4max.	
		I.R.	More than 12.5Ω· F	
17	Durability	Appearance	No defects or abnormalities	Apply 150% of the rated voltage for 1000±12 hours at the maximum operating temperature ±3°C. Set for 24±2 hours at room temperature, then measure. The charge/ discharge current is less than 50mA. · Initial measurement Perform a heat treatment at 150+0/-10°C for one hour and then set for 24±2 hours at room temperature. Perform the initial measurement. · Measurement after test Perform a heat treatment at 150+0/-10°C for one hour and then set for 24±2 hours at room temperature, then measure.
		Capacitance Change	R6/R7/C7/C8/E7/D7 : Within ±12.5% F5: Within ±30%	
		D.F.	R6/R7/C7/C8 /E7/D7 : 0.2max. F5: 0.4max.	
		I.R.	More than 25Ω· F	

Type	a	b	c
GRM02	0.2	0.56	0.23
GR□03	0.3	0.9	0.3
GR□15	0.4	1.5	0.5
GRM18	1.0	3.0	1.2
GRM21	1.2	4.0	1.65
GRM31	2.2	5.0	2.0
GRM32	2.2	5.0	2.9
GRM43	3.5	7.0	3.7
GRM55	4.5	8.0	5.6

(in:mm)

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

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

PACKAGING
GRM/F Type

There are three type of packaging for chip monolithic ceramic capacitor.
Please specify the packaging code.

1.Bulk Packaging(Packaging Code=B):In a bag.
Minimum Quantity : 1000(pcs./bag) , Only GR□43S, GR□55E/F : 500(pcs./bag)

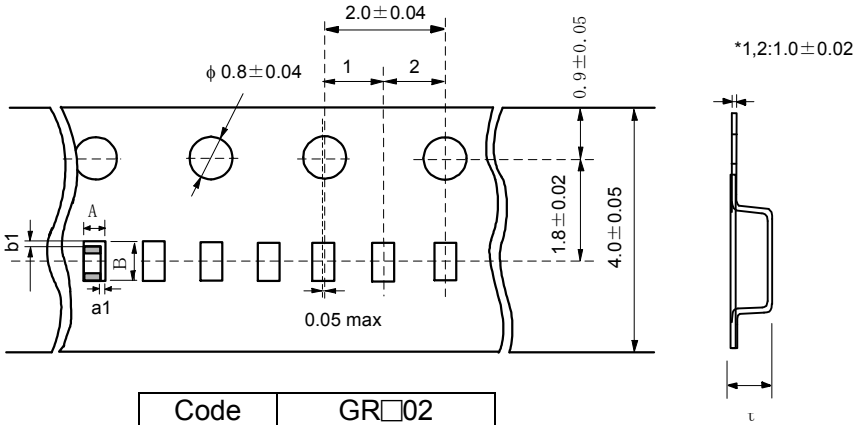
2.Tape Carrier Packaging(Packaging Code:D/E/F/L/J/K)

2.1 Minimum Quantity(pcs./reel)

Type		φ180 reel		φ330 reel	
		Paper Tape	Plastic Tape	Paper Tape	Plastic Tape
		Code:D/E	Code:L	Code:F/J	Code:K
GR□02		20000	40000		
GR□03		15000		50000	
GR□15		10000		50000	
GR□18		4000		10000	
GR□21	5/6/9	4000		10000	
	A/B		3000		10000
GR□31	6/9	4000		10000	
	M/X		3000		10000
	C		2000		6000
GR□32	5/6/9	4000		10000	
	A/M		3000		10000
	N		2000		8000
	C		2000		6000
	R/D/E		1000		4000
GR□43	M		1000		5000
	N/C/R		1000		4000
	D		1000		4000
	E		500		2000
	S		500		1500
GR□55	M		1000		5000
	N/C/R		1000		4000
	D		1000		4000
	E		500		
	F/X		300		1500

2.2 Dimensions of Tape

(1)GR□02 (Code:L)



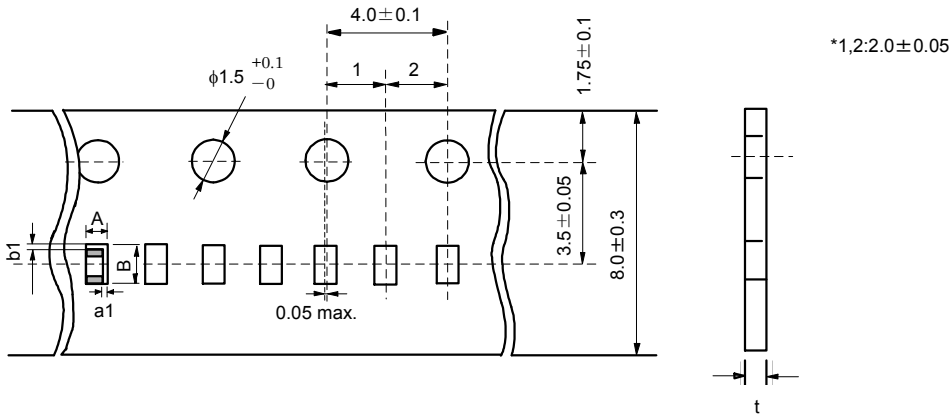
Code	GR□02
A *3	0.23
B *3	0.43
t	0.5 max.

*3 Nominal value

2.2 Dimensions of Tape

(in : mm)

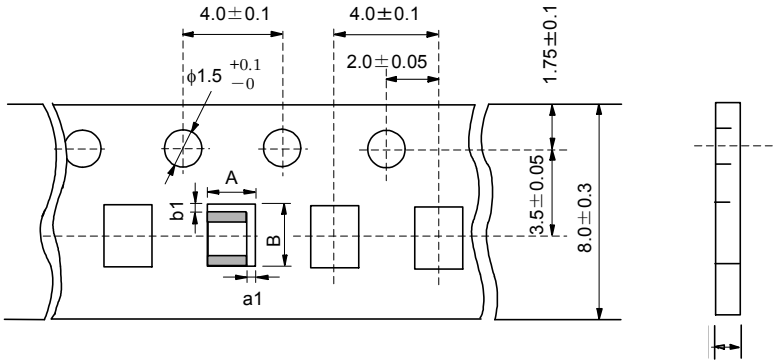
(2)GR□02(Code:D)/03/15



Code	GR□02	GR□03	GR□15
A *3	0.25	0.37	0.65
B *3	0.45	0.67	1.15
a1,b1 *3			0.15
t	0.4 max.	0.5 max.	0.8 max.

*3 Nominal value

(3) GR□18/21/31/32 T:0.85 max.



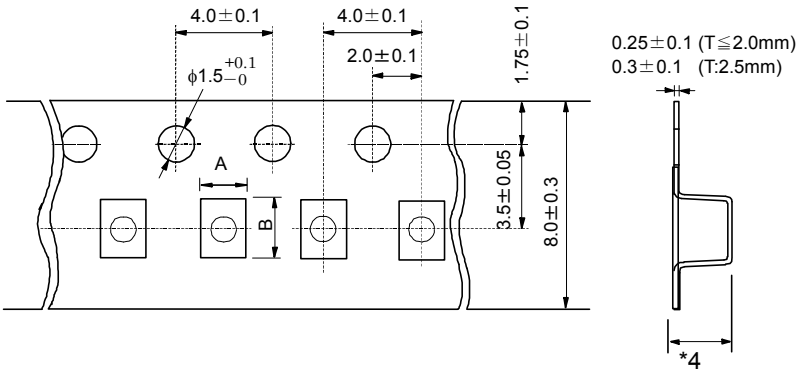
0.8 max (T=0.5mm)

1.1 max (T=0.85mm)

Code	GR□18	GR□21	GR□31	GR□32
A	1.05±0.1	1.55±0.15	2.0±0.2	2.8±0.2
B	1.85±0.1	2.3±0.15	3.6±0.2	3.6±0.2
a1,b1	0.25±0.2	0.4±0.2	0.4±0.2	0.4+0.3/-0.2

PACKAGING
GRM/F Type

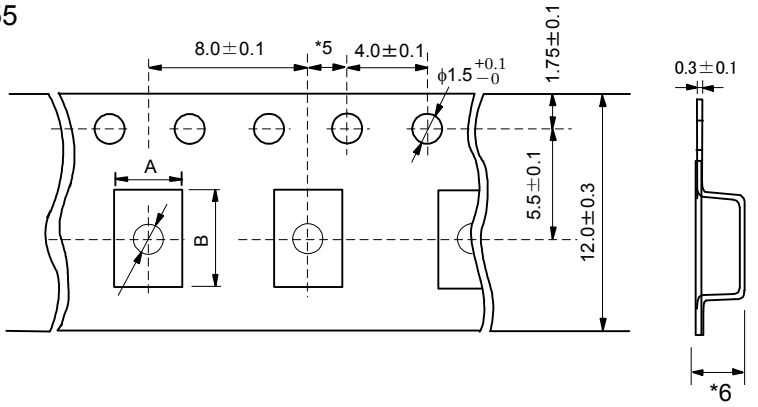
(4) GR□21/31/32 T:1.0 min.



*4
1.7 max. (T≦1.25mm)
2.5 max. (T:1.35/1.6mm)
3.0 max. (T:1.8/2.0mm)
3.7 max. (T≧2.5mm)

Code	GR□21	GR□31	GR□32
A	1.45±0.2	1.9±0.2	2.8±0.2
B	2.25±0.2	3.5±0.2	3.5±0.2

(5) GR□43/55



*5 : 2.0±0.1

*6
2.5 max. (T≦1.8mm)
3.7 max. (T= 2.0/2.5mm)
4.7 max. (T≧2.8mm)

Code	GR□43	GR□55
A *7	3.6	5.2
B *7	4.9	6.1

*7Nominal value

PACKAGING
GRM/F Type

Fig.1 Package Chips

(in : mm)

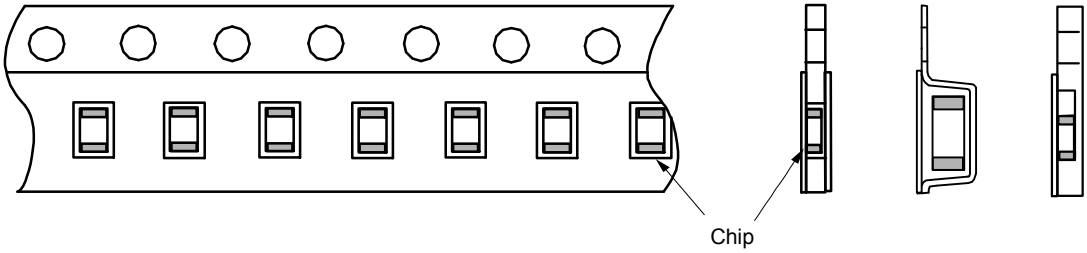


Fig.2 Dimensions of Reel

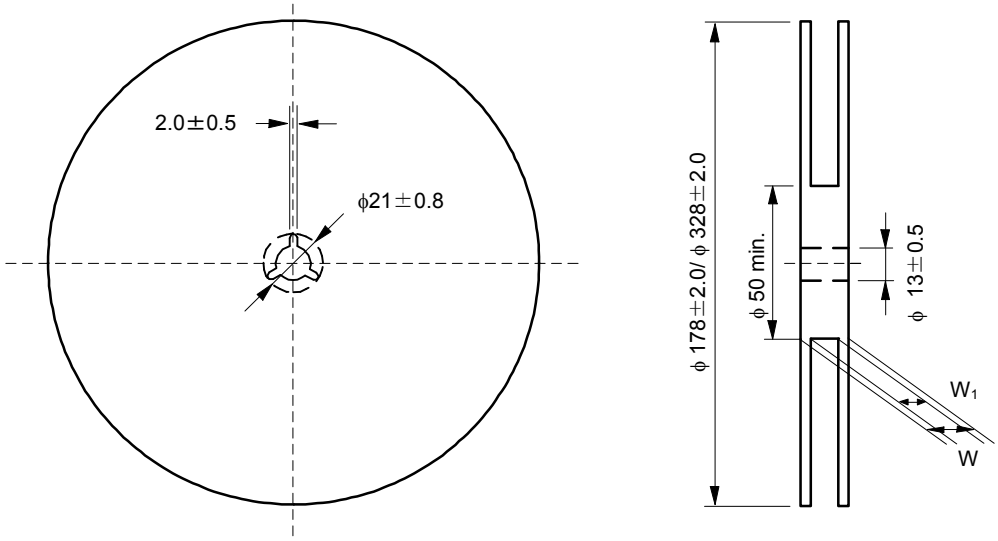
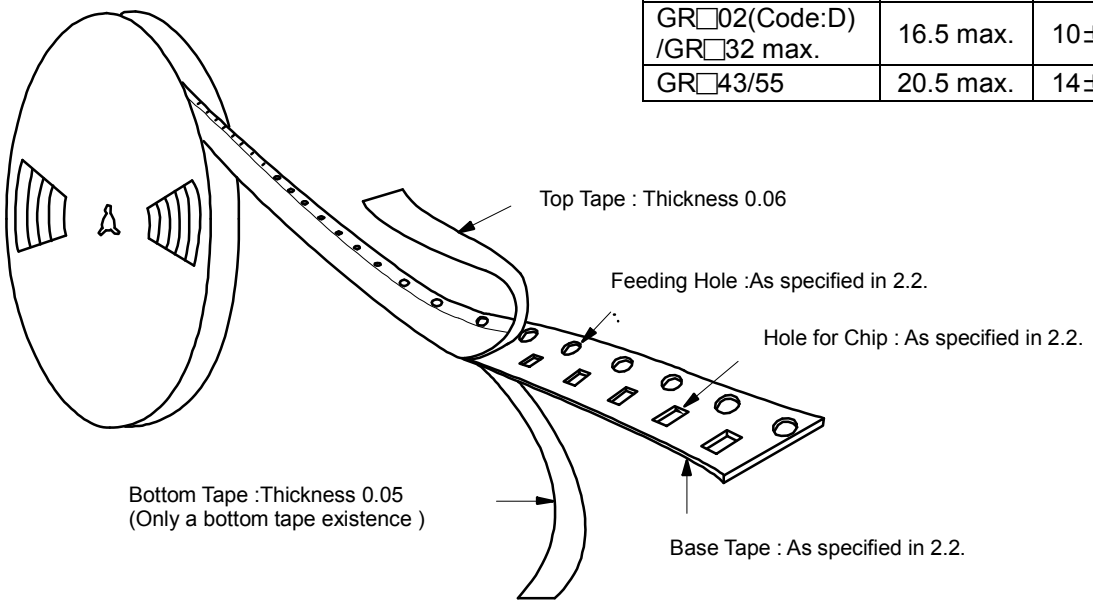


Fig.3 Taping Diagram

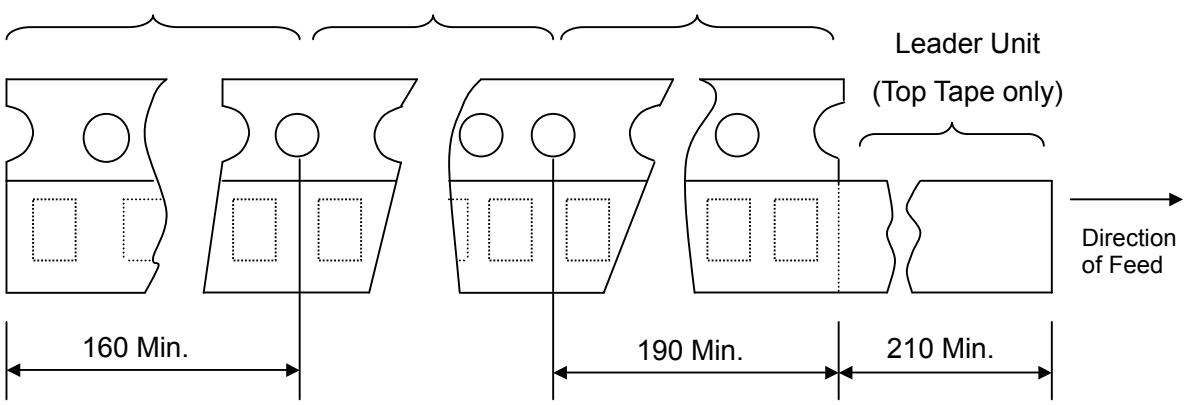
	W	w_1
GR□02(Code:L)	8.0 max	5±1.5
GR□02(Code:D) /GR□32 max.	16.5 max.	10±1.5
GR□43/55	20.5 max.	14±1.5



2.3 Tapes for capacitors are wound clockwise shown in Fig.3.
(The sprocket holes are to the right as the tape is pulled toward the user.)

2.4 Part of the leader and part of the vacant section are attached as follows.

(in : mm)



2.5 Accumulate pitch : 10 of sprocket holes pitch = 40±0.3mm

2.6 Chip in the tape is enclosed by top tape and bottom tape as shown in Fig.1.

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

2.8 There are no jointing for top tape and bottom tape.

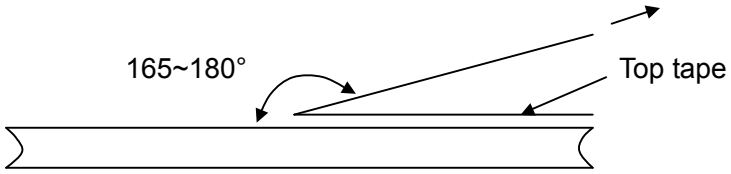
2.9 There are no fuzz in the cavity.

2.10 Break down force of top tape : 5N min.
Break down force of bottom tape : 5N min. (Only a bottom tape existence)

2.11 Reel is made by resin and appeaser and dimension is shown in Fig 2. There are possibly to change the material and dimension due to some impairment.

2.12 Peeling off force : 0.1 to 0.6N[*8] in the direction as shown below.

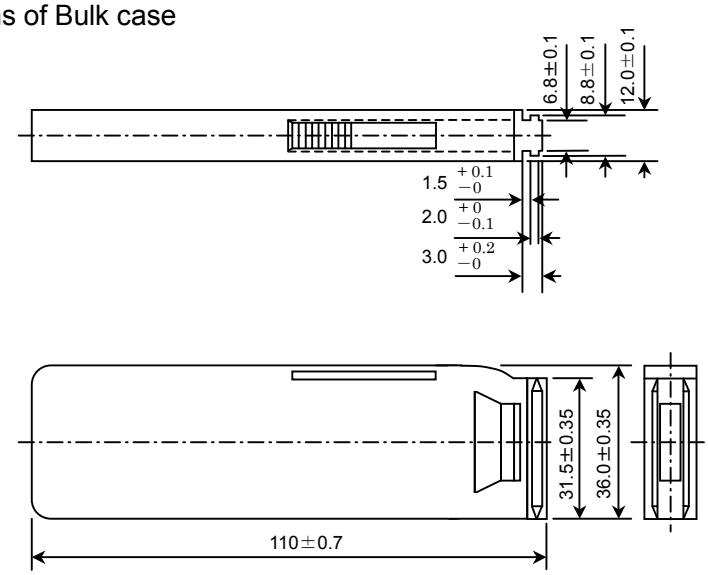
*8□GR□02,03:0.05N~0.5N



2.13 Label that show the customer parts number, our parts number, our company name, inspection number and quantity, will be put in outside of reel.

3.Bulk Case Packaging (Packaging Code=C)

Fig.4 Dimensions of Bulk case



3.1 Minimum Quantity(pcs./case)

GR□15		50000
GR□18		15000
GR□21	6	10000
	B	5000

3.2 Case is made by resin of transparence or semitransparency, and appeaser and dimension is shown in Fig.4.

There are possibility to change the material and dimension due to some impairment.

3.3 Case must be marked in Customer ‘s part number, MURATA part number, MURATA name, Inspection number and quantity(pcs).

⚠CAUTION

◆Limitation of use

Please contact our sales representatives or product engineers before using our products for the applications listed below which require of our products for other applications than specified in this product.

①Aircraft equipment ②Aerospace equipment ③Undersea equipment ④Power plant control equipment
⑤Medical equipment ⑥Transportation equipment(vehicles,trains,ships,etc.) ⑦Traffic signal equipment
⑧Disaster prevention / crime prevention equipment ⑨Data-processing equipment
⑩Application of similar complexity and/or requirements to the applications listed in the above

⚠CAUTION

◆Storage and Operating Conditions

1.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 temperatureof 5-40 °C. and an ambient humidity of 20-70%RH. Use chip within 6 months. If 6 months or more have elapsed, check solderability before use. (Reference Data 1/ Solderability) Insulation Resistance should be deteriorated on specific condition of high humidity or incorrosion gas such as hydrogen sulfide, sulfurous acid gas,cholorine. Those condition are not suitable for use.

2.Use of Sn-Zn based solder will deteriorate reliability of MLCC. Please contact murata factory for the use of Sn-Zn based solder in advance.

3.Do not use under the condition that causes condensation.
Use dampproof countermeasure if using under the condition that causes condensation.

⚠CAUTION

◆Handling

1.Inspection

- ●Thrusting force of the test probe can flex the PCB, resulting in cracked chips or open solder joints. Provide support pins on the back side of the PCB to prevent warping or flexing.

2.Board Separation (or Depane-lization)

- ●Board flexing at the time of separation causes cracked chips or broken solder.
- ●Severity of stresses imposed on the chip at the time of board break is in the order of: Pushback<Slitter<V Slot<Perforator.
- ●Board separation must be performed using special jigs, not with hands.

3.Reel and bulk case

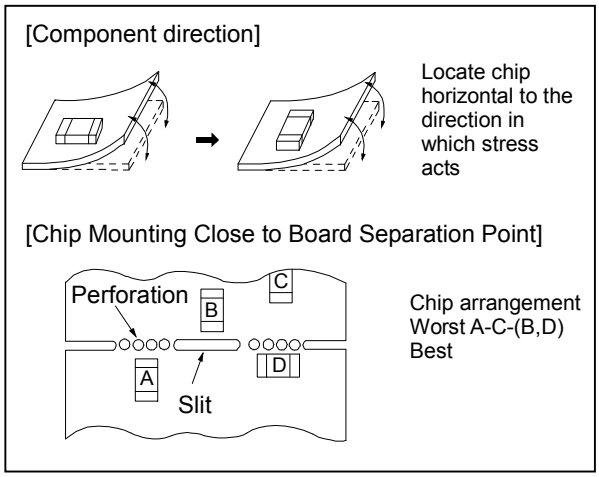
- ●In the handling of reel and case, please pay attention not to drop it. Please do not use chip of the case which dropped.

⚠CAUTION

◆Soldering and Mounting

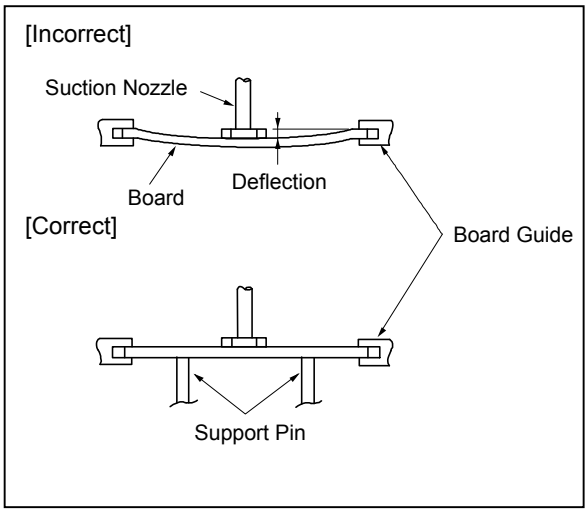
1.Mounting Position

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



2.Chip Placing

- An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips. So adjust the suction nozzle's bottom dead point by correcting warp in the board.
  Normally, the suction nozzle's bottom dead point must be set on the upper surface of the board. Nozzle pressure for chip mounting must be a 1 to 3N static load.
- Dirt particles and dust accumulated between the suction nozzle and the cylinder inner wall prevent the nozzle from moving smoothly. This imposes great force on the chip during mounting, causing cracked chips. And the locating claw, when worn out, imposes uneven forces on the chip when positioning, causing cracked chips. The suction nozzle and the locating claw must be maintained, checked and replaced periodically.



3.Caution for Soldering

(1)Reflow soldering

- When the sudden heat is given to the components, the mechanical strength of the components should go down because remarkable temperature change causes deformity of components inside. In order to prevent mechanical damage in the components, preheating should be required for both of the components and the PCB board.Preheating conditions are shown in table 1. It is required to keep temperature differential between the soldering and the components surface (ΔT) as small as possible.

- Solderability of Tin plating termination chip might be deteriorated when low temperature soldering profile where peak solder temperature is below the Tin melting point is used.
  Please confirm the solderability of Tin plating termination chip before use.

- When components are immersed in solvent after mounting, be sure to maintain the temperature difference (ΔT) between the component and solvent within the range shown in the table 1.

Table 1

Part Number	Temperature Differential
GR□02/03/15 GR□18/21/31	Δ T ≦ 190°C
GR□32/43/55	Δ T ≦ 130°C

Recommended Conditions

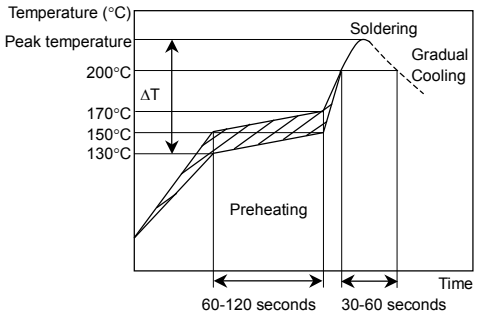
	Pb-Sn Solder		Lead Free Solder
	Infrared Reflow	Vapor Reflow	
Peak Temperature	230-250°C	230-240°C	240-260°C
Atmosphere	Air	Air	Air or N_2

Pb-Sn Solder: Sn-37Pb

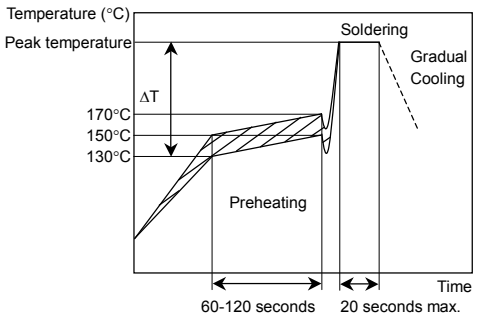
Lead Free Solder: Sn-3.0Ag-0.5Cu

[Standard Conditions for Reflow Soldering]

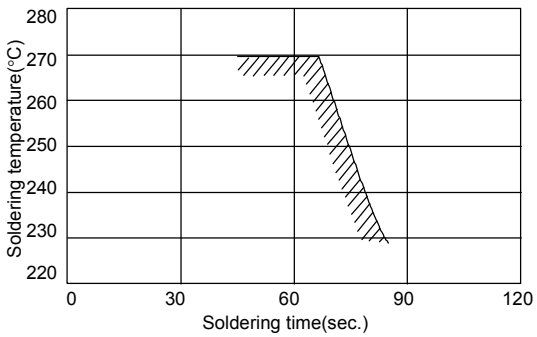
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]



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

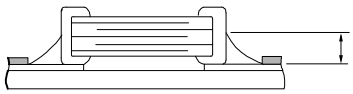
●Optimum Solder Amount for Reflow Soldering

●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]



*GRM02/03 : 1/3 of Chip Thickness min.

Inverting the PCB

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

(2)Leaded Component Insertion

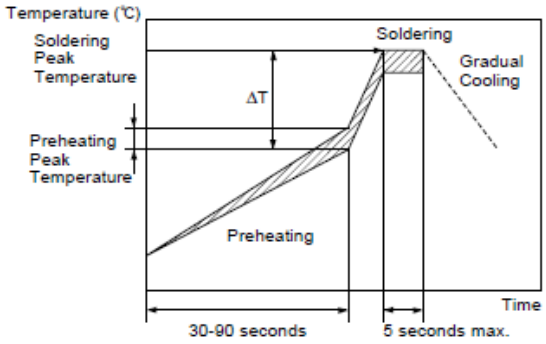
If the PCB is flexed when leaded components (such as transformers and ICs) are being mounted, chips may crack and solder joints may break.
Before mounting leaded components, support the PCB using backup pins or special jigs prevent warping.

(3)Flow Soldering

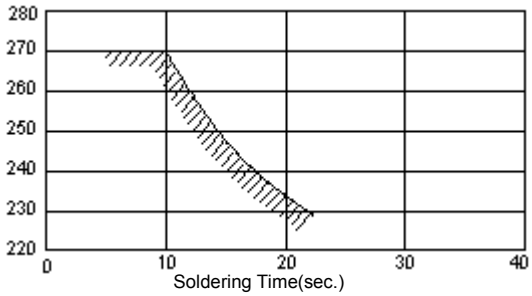
● When the sudden heat is given to the components, the mechanical strength of the components should go down because remarkable temperature change causes deformity of components inside. And an excessively long soldering time or high soldering temperature results in leaching of the outer electrodes, causing poor adhesion or a reduction in capacitance value due to loss of contact between electrodes and end termination.

● In order to prevent mechanical damage in the components, preheating should be required for both of the components and the PCB board.Preheating conditions are shown in table 2. It is required to keep temperature differential between the soldering and the components surface (ΔT) as small as possible.
When components are immersed in solvent after mounting, be sure to maintain the temperature difference between the component and solvent within the range shown in Table 2.
Do not apply flow soldering to chips not listed in Table 2.

[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.

Table 2

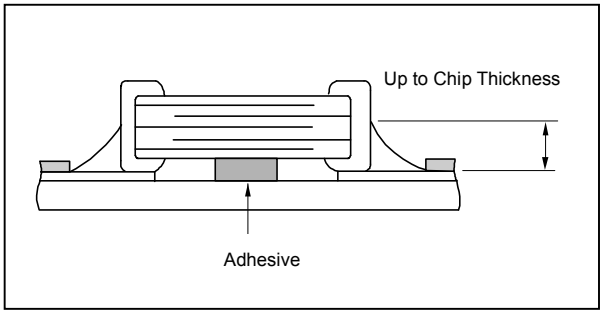
Part Number	Temperature Differential
GR□18/21/31	Δ T ≦ 150°C

Recommended Conditions

	Pb-Sn Solder	Lead Free Solder
Preheating Peak Temperature	90-110°C	100-120°C
Soldering Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N_2

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

●Optimum Solder Amount for Flow Soldering
The top of the solder fillet should be lower than the thickness of components. If the solder amount is excessively big, the risk of cracking is higher during board bending or under any other stressful conditions.



(4)Correction with a Soldering Iron

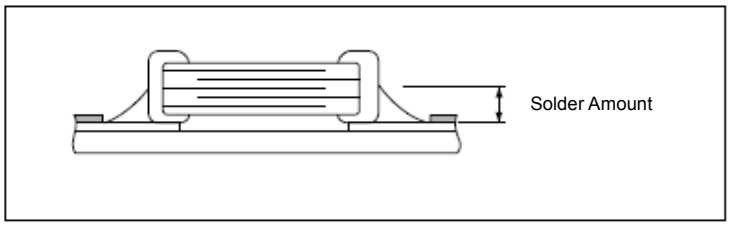
●When sudden heat is applied to the components by use of a soldering iron, the mechanical strength of the components will go down because the extreme temperature change causes deformations inside the components. In order to prevent mechanical damage to the components, preheating is required for both the components and the PCB board.
Preheating conditions, （The "Temperature of the Soldering Iron tip", "Preheating Temperature", "Temperature Differential" between the iron tip and the components and the PCB）, should be within the conditions of table 3.
It is required to keep the temperature differential between the soldering Iron and the components surface (ΔT) as small as possible.
After soldering, do not allow the component/PCB to cool down rapidly.
The operating time for the re-working should be as short as possible. When re-working time is too long, it may cause solder leaching, and that will cause a reduction of the adhesive strength of the terminations.

Table 3

Part Number	Temperature of Soldering Iron tip	Preheating Temperature	Temperature Differential	Atmosphere
G□□03/15 G□□18/21/31	350°C max	150°C min	ΔT ≦ 190°C	Air
G□□32/43/55	280°C max	150°C min	ΔT ≦ 130°C	Air

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

●Optimum Solder Amount when re-working Using a Soldering Iron
In case of smaller sizes than 0603, the top of the solder fillet should be lower than 2/3's of the thickness of the component or 0.5mm whichever is smaller.
In case of 0805 and larger sizes, the top of the solder fillet should be lower than 2/3's of the thickness of the component.
If the solder amount is excessive, the risk of cracking is higher during board bending or under any other stressful conditions.
A Soldering iron ϕ3mm or smaller should be used.
It is also necessary to keep the soldering iron from touching the components during the re-work.
Solder wire with ϕ0.5mm or smaller is required for soldering.



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

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

NOTICE

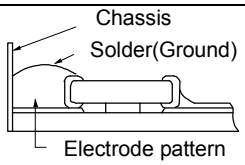
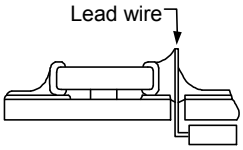
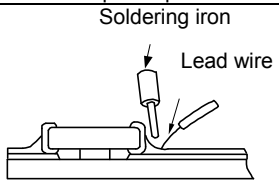
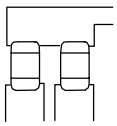
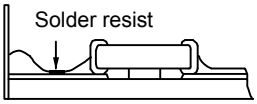
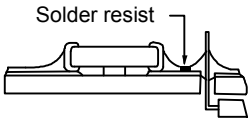
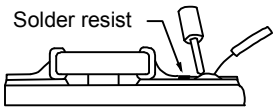
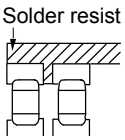
◆Soldering and Mounting

1.PCB Design

(1)Notice for Pattern Forms

- Unlike leaded components, chip components are susceptible to flexing stresses since they are mounted directly on the substrate.
  They are also more sensitive to mechanical and thermal stresses than leaded components.
  Excess solder fillet height can multiply these stresses and cause chip cracking. When designing substrates, take land patterns and dimensions into consideration to eliminate the possibility of excess solder fillet height.
- It has a possibility to happen the chip crack by the expansion and shrinkage of metal board. Please contact us if you want to use the ceramic capacitor on metal board such as Aluminum.

Pattern Forms

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

(2)Land Dimensions

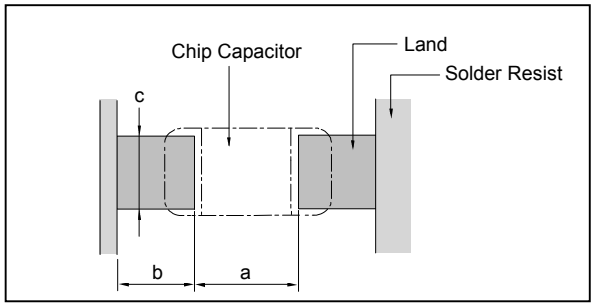


Table 1 Flow Soldering Method

Dimensions / Part Number	Dimensions(L X W)	a	b	c
GR□18	1.6 X 0.8	0.6-1.0	0.8-0.9	0.6-0.8
GR□21	2.0 X 1.25	1.0-1.2	0.9-1.0	0.8-1.1
GR□31	3.2 X 1.6	2.2-2.6	1.0-1.1	1.0-1.4

(in : mm)

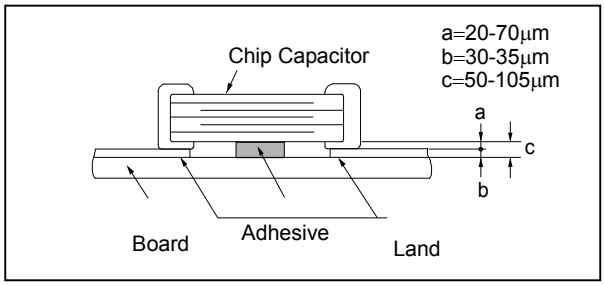
Table 2 Reflow Soldering Method

Dimensions / Part Number	Dimensions(L X W)	a	b	c
GR□02	0.4 X 0.2	0.16-0.2	0.12-0.18	0.2-0.23
GR□03	0.6 X 0.3	0.2-0.3	0.2-0.35	0.2-0.4
GR□15	1.0 X 0.5	0.3-0.5	0.35-0.45	0.4-0.6
GR□18	1.6 X 0.8	0.6-0.8	0.6-0.7	0.6-0.8
GR□21	2.0 X 1.25	1.0-1.2	0.6-0.7	0.8-1.1
GR□31	3.2 X 1.6	2.2-2.4	0.8-0.9	1.0-1.4
GR□32	3.2 X 2.5	2.0-2.4	1.0-1.2	1.8-2.3
GR□43	4.5 X 3.2	3.0-3.5	1.2-1.4	2.3-3.0
GR□55	5.7 X 5.0	4.0-4.6	1.4-1.6	3.5-4.8

(in : mm)

2.Adhesive Application

- ●Thin or insufficient adhesive causes chips to loosen or become disconnected when flow soldered. The amount of adhesive must be more than dimension c shown in the drawing below to obtain enough bonding strength. The chip's electrode thickness and land thickness must be taken into consideration.
- ●Low viscosity adhesive causes chips to slip after mounting. Adhesive must have a viscosity of 5000pa-s(500ps)min. (at 25°C)



3.Adhesive Curing

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

Inverting the PCB

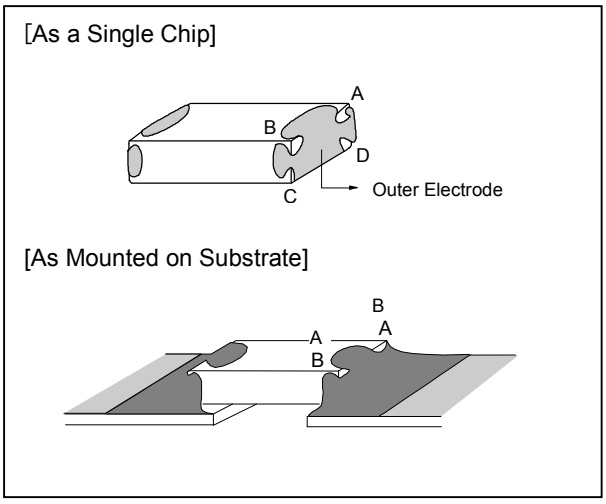
Make sure not to impose an abnormal mechanical shock on the PCB.

4.Flux Application

- ●An excessive amount of flux generates a large quantity of flux gas, causing deteriorated solderability. So apply flux thinly and evenly throughout. (A foaming system is generally used for flow soldering).
- ●Flux containing too high a percentage of halide may cause corrosion of the outer electrodes unless sufficiently cleaning. Use flux with a halide content of 0.2% max. But do not use strong acidic flux.
  Do not use water-soluble flux*.
  (*Water-soluble flux can be defined as non resin type flux including wash-type flux and non-wash-type flux.)

5.Flow Soldering

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



◆Others

1.Resin Coating

When selecting resin materials, select those with low contraction.

2.Circuit Design

These capacitors on this catalog are not safety recognized products.

3.Remarks

The above notices are for standard applications and conditions. Contact us when the products are used in special mounting conditions. Select optimum conditions for operation as they determine the reliability of the product after assembly.

⚠NOTE

1.Please make sure that your product has been evaluated in view of your specifications with our product being mounted to your product.

2.Your are requested not to use our product deviating from this product specification.

3.Please return one copy of these specifications upon your acceptance.
If the copy is not returned by a day mentioned in a cover the specifications will be deemed to have been accepted.

4.We consider it not appropriate to include any terms and conditions with regard to the business transaction in the product specifications, drawings or other technical documents. Therefore, if your technical documents as above include such terms and conditions such as warranty clause, product liability clause, or intellectual property infringement liability clause, they will be deemed to be invalid.

Revised List

DATE.	Specification No&Rev.	Change Contents	Present/ New CONTENTS & REASON	Approved by	Prepared by
2010/6/29	JEMCG2-004505		New	MAKIDA	YAMAMOTO