FOR FLOW AND REFLOW SOLDERING
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.

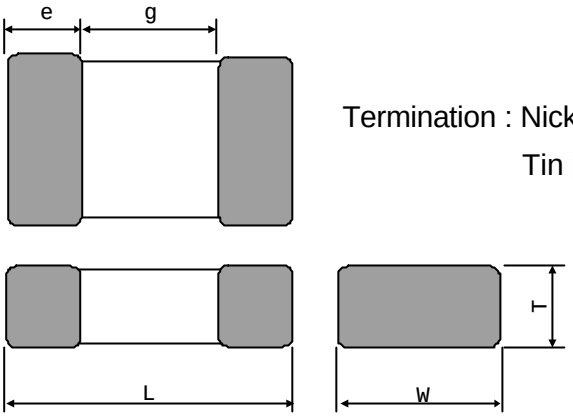
(EX.)

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

① Type : 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.
GRM188		1.6+/-0.1	0.8+/-0.1	0.8+/-0.1	0.2 to 0.5	0.5 min.
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		
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		

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.GRM21 Series B1 0J 335/475K is L:2.0+/-0.15mm W/T:1.25+/-0.15mm.
4.GRM31 Series B3/R1 1E 225K/M, B1/R1 1C 105/155/225K/M, B1 1A 335K/M, B1 0J 475K/M, R7 2A 474/684K/M is L:3.2+/-0.2mm, W:1.6+/-0.2 mm.

3.2 TEMPERATURE CHARACTERISTICS

(1)Temperature Compensating Type

Code	TEMPERATURE CHARACTERISTICS	Temp. Range	Temp. coeff.(ppm/°C)
2C	CH	-55 to 125°C	0 +/-60
3C	CJ		0 +/-120
4C	CK		0 +/-250
5C	C0G		0+/-30
6C	C0H		0+/-60
2P	PH	-25 to 85°C	-150 +/-60
3P	PJ		-150 +/-120
6P	P2H	-55 to 85°C	-150+/-60
2R	RH	-25 to 85°C	-220 +/-60
3R	RJ		-220 +/-120
4R	RK		-220+/-250
6R	R2H	-55 to 85°C	-220+/-60
2S	SH	-25 to 85°C	-330 +/-60
3S	SJ		-330 +/-120
4S	SK		-330+/-250
6S	S2H	-55 to 85°C	-330+/-60
2T	TH	-25 to 85°C	-470 +/-60
3T	TJ		-470 +/-120
4T	TK		-470+/-250
6T	T2H	-55 to 85°C	-470+/-60
3U	UJ	-25 to 85°C	-750 +/-120
4U	UK		-750 +/-250
7U	U2J	-55 to 85°C	-750+/-120
1X	SL	20 to 85°C	+350 to -1000

(2) High Dielectric Constant Type

Code	TEMPERATURE CHARACTERISTICS	Temp. Range	Cap. Change(Within%)	Standard Temp.
B1*	B	-25 to 85°C	+/-10	20°C
B3		-25 to 85°C	+/-10	
R1*	R	-55 to 125°C	+/-15	
F1*	F	-25 to 85°C	+30/-80	
R7	X7R	-55 to 125°C	+/-15	25°C
R6	X5R	-55 to 85°C	+/-15	
C7	X7S	-55 to 125°C	+/-22	
C8	X6S	-55 to 105°C	+/-22	
F5	Y5V	-30 to 85°C	+22/-82	

* : Add 50% of the rated voltage.

3.3 DC RATED VOLTAGE

Code	0J	1A	1C	1E	1H	2A
DC Rated voltage	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
C	Temperature Compensating Type	ΔC to ΔX	<10pF	+/-0.25pF	0.5,1,2,3,4,5,7(pF)
D				+/-0.5pF	5,6,7,8,9(pF)
R			≧10pF	+/-2.5%	10(pF)
J				+/-5%	E24 Step
K	High Dielectric Constant Type	B1/B3/R6/R1/R7	+/-10%		E12 Step
M			+/-20%		E6 Step
Z		F1/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	ϕ178mm Paper Tape Carrier Packaging	According to Capacitance Value and Tolerance
L	ϕ178mm Plastic Tape Carrier Packaging	
E	ϕ178mm Special Dimension Carrier Packaging	
J	ϕ330mm Paper Tape Carrier Packaging	
K	ϕ330mm Plastic Tape Carrier Packaging	
F	ϕ330mm Special Dimension Carrier Packaging	
C	Bulk Case Packaging	

4.SPECIFICATIONS

Refer to P10 to P13 for Appendix 1 to 3.
Refer to P14 to P16 for Appendix 4.
Refer to P17 to P19 for Appendix 5.
Refer to P20 to P21 for Appendix 6.

Appendix 1. CAPACITANCE VALUE AND TOLERANCE 50V max.
<Temperature Compensating Type>

Type	DC RATED VOLTAGE (V)	T		Temperature Characteristics and Capacitance(pF)							ϕ178 Packaging Unit (pcs/Reel)
		Code	Thickness (mm)	ΔC	ΔP	ΔR	ΔS	ΔT	ΔU	1X	
GRM03	50	3	0.3+/-0.03	-	-	-	-	-	1 to 15	-	15000
	25			0.5 to 100	-	1to 100	1to 100	1to 100	16 to 100	-	
GRM15	50	5	0.5+/-0.05	0.5 to 1000	3to 30	3to 33	3to 39	3to 100	3 to 200	0.5 to 200	10000
	25			180 to 270	-	-	-	-	-	220 to 390	
GRM18	50	8	0.8 +/-0.1	0.5to 2700	3to 160	3to 180	3to 220	3to 470	3 to 750 1000 to 10000	0.5 to 750 1000 to 10000	4000
	25			560 to 1500	-	-	-	-	-	820 to 1500	
GRM21	50	6	0.6 +/-0.1	0.5 to 4700	3to 160	3to 180	3to 240	3to 130	3 to 1300 10000, 12000, 15000, 18000	0.5 to 1300 10000, 12000, 15000, 18000	4000
		9	0.85+/-0.1	1000, 5100 to 15000	180 to 360	200 to 470	270 to 470	150 to 390	1500 to 2200 22000 to 27000	1500 to 2200 22000 to 27000	
		A	1.0+0/-0.2	-	-	-	-	-	33000	33000	3000
		B	1.25+/-0.1	18000 to 22000	390 to 620	510 to 750	510 to 820	430 to 1800	2400 to 3300 39000 to 47000	2400 to 3300 39000 to 47000	3000
	25	9	0.85+/-0.1	-	-	-	-	-	-	3600 to 4700	4000
		B	1.25+/-0.1	-	-	-	-	-	-	5100 to 6800	3000
GRM31	50	6	0.6+/-0.1	0.5 to 750	3 to 330	3 to 390	3 to 510	3 to 390	3 to 1800	0.5 to 1800	4000
		9	0.85+/-0.1	820 to 22000, 27000, 33000	360 to 910	430 to 820	560 to 1100	430 to 750	2000 to 6200 56000	2000 to 6200 56000	
		M	1.15+/-0.1	39000 to 47000	1000 to 1600	910 to 1600	1200 to 2000	820 to 4300	6800 to 8200 68000to100000	6800 to 8200 68000to100000	3000
		C	1.6+/-0.2	56000 to 82000	-	-	-	-	-	-	2000
	25	M	1.15+/-0.1	-	-	-	-	-	-	9100 to 16000	3000
		C	1.6+/-0.2	100000	-	-	-	-	-	-	2000
GRM32	50	N	1.35+/-0.15	-	-	-	-	-	-	9100 to 12000	2000
GRM43	50	R	1.8+/-0.2	-	-	-	-	-	-	13000 to 16000	1000
GRM55	50	M	1.15+/-0.1	-	-	-	-	-	-	18000	1000
		N	1.35+/-0.15	-	-	-	-	-	-	20000 to 22000	
		R	1.8+/-0.2	-	-	-	-	-	-	24000 to 39000	
Capacitance Tolerance				(0.5 to 7.0pF) C:+/-0.25pF	(5.0 to 9.1pF) D:+/-0.5pF		(More than 10pF) J:+/-5%		(10pF) R:+/-2.5%		

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

Appendix 2-1. CAPACITANCE VALUE AND TOLERANCE 50V max.
<High Dielectric Constant Type>

Type	DC RATED VOLTAGE (V)	T Code	T Thickness (mm)	Temperature Characteristics and Capacitance(pF) B1	B3/R6	R1/R7	R7	F1/F5	F5	ϕ178 Packaging Unit (pcs/Reel)
GRM03	25	3	0.3+/-0.03	100 to 1500	-	100 to 1500	-	-	-	15000
	16			100 to 1000	1800to3300	100 to 1000, 1800 to 3300	-	-	-	
	10			1200 to 10000	-	1200 to 10000	-	1500 to 10000	-	
	6.3			1200 to 10000	-	1200 to 10000	-	-	-	
GRM15	50	5	0.5+/-0.05	220 to 4700	-	220 to 4700	-	1000 to 15000	-	10000
	25			5600 to 22000	27000 to 47000	5600 to 47000	-	22000 to 100000	-	
	16			27000 to 47000	56000 to 100000	15000 to 100000	-	33000 to 100000	-	
	10			56000 to 100000	-	27000 to 47000	-	150000 to 470000	-	
GRM18	50	8	0.8 +/-0.1	220 to 47000	56000 to 100000	220 to 100000	-	1000 to 220000	-	4000
	25			8200 to 150000	180000 to 220000	8200 to 220000	-	15000 to 100000 220000 to 470000	-	
	16			12000 to 330000	390000 to 470000	12000 to 470000	-	33000 to 1000000	-	
	10			120000 to 220000, 330000 to 1000000	470000, 1000000	120000 to 220000	-	470000 to 1000000	-	
	6.3			330000 to 1000000	-	-	-	-	-	
GRM21	50	6	0.6+/-0.1	220 to 22000	-	220 to 22000	-	1000 to 68000	-	4000
		9	0.85+/-0.1	27000 to 39000	330000	27000 to 39000	330000	100000 to 150000	470000 to 1000000	
		B	1.25+/-0.1	47000 to 100000	470000	47000 to 100000	150000to 220000	220000	-	3000
	25	6	0.6+/-0.1	10000 to 33000	-	10000 to 33000	-	33000 to 150000	-	4000
		9	0.85+/-0.1	39000 to 68000 220000 to 270000	470000, 680000 to 1000000	39000 to 68000 220000 to 270000 4700000	-	220000,1000000	-	
		B	1.25+/-0.1	82000 to 180000 330000 to 470000	560000, 1500000	82000 to 180000 330000 to 820000	-	330000 to 470000 1500000,4700000	-	3000
			1.25+/-0.15	-	1000000	1000000	-	-	-	
	16	6	0.6+/-0.1	15000 to 56000	-	15000 to 56000	-	100000,220000	-	4000
		9	0.85+/-0.1	68000 to 100000 220000 to 270000 470000 to 680000	-	68000 to 100000 220000 to 270000 470000 to 680000	-	150000,330000 470000,1000000	-	
		B	1.25+/-0.1	120000 to 180000 330000 to 390000 820000 to1000000	-	120000 to 180000 330000 to 390000 820000 to1000000	-	470000 to 680000 150000 to 2200000	-	3000
	10	6	0.6+/-0.1	220000 to 390000	-	220000 to 390000	-	330000 to 680000	-	4000
		9	0.85+/-0.1	1000000	-	-	-	1000000,3300000	-	
		B	1.25+/-0.1	680000 to 820000 1000000,2200000	-	680000 to1000000	-	1500000to 2200000 4700000	-	3000
	6.3	B	1.25+/-0.1	2200000	-	-	-	-	-	3000
			1.25+/-0.15	3300000,4700000	-	-	-	-	-	
GRM31	50	6	0.6+/-0.1	220 to 15000	-	220 to 15000	-	1000 to 47000	-	4000
		9	0.85+/-0.1	220 to 100000	-	220 to 100000	270000 to 330000	68000 to 330000	-	
		M	1.15+/-0.1	120000 to 220000	1000000	120000 to 220000	390000 to 470000	470000	-	3000
		C	1.6+/-0.2	-	1500000, 2200000	-	-	-	-	2000
	25	6	0.6+/-0.1	18000 to 33000	-	18000 to 33000	-	68000 to 150000	-	4000
		9	0.85+/-0.1	39000 to 150000 270000 to 680000	-	39000 to 150000 270000 to 680000	-	220000 to 470000	-	
		M	1.15+/-0.1	180000 to 220000 820000to1000000	-	180000 to 220000 820000 to1000000	-	680000 to 4700000	-	3000
			1.15+/-0.15	-	2200000	2200000	-	-	-	
		C	1.6+/-0.2	-	3300000, 4700000	-	-	6800000to10000000	-	2000
	16	6	0.6+/-0.1	47000 to 56000	-	47000 to 56000	-	220000	-	4000
		9	0.85+/-0.1	68000 to 220000 330000, 470000 to 560000 1000000	-	68000 to 220000 330000, 470000 to 560000 1000000	-	330000 to 470000 1000000	-	
		M	1.15+/-0.1	270000 680000 to 820000	-	270000 680000 to 820000	-	680000 to 4700000	-	3000
			1.15+/-0.15	1500000, 2200000	-	1500000, 2200000	-	-	-	
		C	1.6+/-0.2	4700000	3300000, 4700000	3300000, 4700000		-	-	
	10	9	0.85+/-0.1	820000 to 1000000 2200000, 3300000	-	820000 to 1000000	-	2200000 to 3300000	-	4000
		M	1.15+/-0.1	-	-	2200000	-	4700000 to 10000000	-	3000
		C	1.6 +/-0.2	4700000, 10000000	-	10000000	-	-	-	2000
	6.3	M	1.15+/-0.1	4700000	-	-	-	10000000	-	3000
		C	1.6 +/-0.2	4700000, 10000000	-	-	-	-	-	2000
Capacitance Tolerance				K:+/-10%, M +/-20%				Z : +80/-20%		

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

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

<High Dielectric Constant Type>

Type	DC RATED VOLTAGE (V)	T		Temperature Characteristics and Capacitance (pF)						ϕ178 Packag-ing Unit (pcs/Reel)
		Code	Thickness (mm)	B1	B3/R6	R1/R7	R7	F1/F5	F5	
GRM32	50	M	1.15+/-0.1	390000 to470000	-	390000 to470000	-	-	-	3000
		N	1.35+/-0.15	180000 to220000 560000 to680000	-	180000 to220000 560000 to680000	-	680000	-	2000
		R	1.8 +/-0.2	820000 to1000000	-	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	-	-	2200000	-	-	1000
		D	2.0+/-0.2	3300000,4700000	-	3300000,4700000		-	-	1000
	16	M	1.15+/-0.1	2200000	-	2200000	-	-	-	3000
		N	1.35+/-0.15	3300000	-	3300000	-	10000000	-	2000
		R	1.8 +/-0.2	4700000	-	4700000	-	-	-	1000
		D	2.0+/-0.2	10000000	10000000	10000000	-	-	-	1000
	10	9	0.85+/-0.1	-	-	-	-	10000000	-	4000
		D	2.0+/-0.2	-	-	-	10000000	-	-	1000
		E	2.5 +/-0.2	10000000	-	-	-	-	-	1000
GRM43	50	R	1.8 +/-0.2	270000 to 680000	-	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 to1500000	-	560000 to1500000	-	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	-	10000000	-	-	-	1000
Capacitance Tolerance				K:+/-10%, M:+/-20%				Z : +80/-20%		

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

Appendix 3. CAPACITANCE VALUE AND TOLERANCE(100V)

Type	DC RATED VOLTAGE (V)	T		Temperature Characteristics and Capacitance				ϕ178 Packag-ing Unit (pcs/ Reel)
				Temperature Compensating Type		High Dielectric Constant Type		
		Code	Thickness (mm)	ΔC	1X	R7	F5	
GRM15	100	5	0.5+/-0.05	-	-	220 to 4700	-	10000
GRM18	100	8	0.8+/-0.1	0.5 to 1000	0.5 to 430	220 to 3300, 100000	1500 to 4700	4000
GRM21	100	6	0.6+/-0.1	100 to 560	-	-	-	4000
		9	0.85+/-0.1	0.5 to 91, 620 to 1500	0.5 to 750	220 to 6800	680 to 6800	
		B	1.25+/-0.1	-	820 to 2000	8200 to 47000	10000 to 22000	3000
GRM31	100	9	0.85+/-0.1	0.5 to 5600	0.5 to 1800	220 to 15000, 100000	1000 to 22000	4000
		M	1.15+/-0.1	-	2000 to 4700	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	-	5100 to 6800	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	-	7500 to 8200	-	-	1000
		R	1.8+/-0.2	6200 to 12000	9100 to 16000	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	-	18000	-	-	1000
		N	1.35+/-0.15	13000 to 16000	20000 to 22000	270000	-	
		R	1.8+/-0.2	18000 to 30000	24000 to 39000	330000 to 560000	470000 to 680000	
		D	1.6+/-0.2	-	-	820000 to 1000000 3300000	-	
		E	2.5+/-0.2	-	-	4700000	-	500
Capacitance Tolerance				(0.5 to 5.0pF) C:+/-0.25pF (5.1 to 9.1pF) D:+/-0.5pF (More than 10pF) J:+/-5%		K:+/-10% M:+/-20%	Z:+80/-20%	

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

Appendix 4. CAPACITANCE VALUE

Type	DC RATED VOLTAGE (V)	T		Temperature Characteristics and Capacitance (μF)							ϕ178 Packaging Unit (pcs/Reel)
		Code	Thickness (mm)	B1	B3/R6	R7	R1/R7	C8	C7	F1/F5	
GRM03	6.3	3	0.3+/-0.03	0.015 to 0.033	0.047 to 0.10	-	-	-	-	-	15000
GRM15	10	5	0.5+/-0.05	-	0.15to 1.0	-	-	-	-	0.22to 1.0	10000
	6.3			0.15to 0.33	0.47, 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	-	-	-	1.0	-	
	10			-	2.2	-	-	-	1.0	2.2, 4.7	
	6.3			2.2	2.2, 4.7	-	-	-	2.2	2.2, 4.7	
	4			-	-	-	-	4.7	2.2	-	
GRM21	25	6	0.6+/-0.1	-	1.0	-	-	-	-	-	4000
		B	1.25+/-0.15	-	2.2, 3.3, 4.7	2.2	-	-	-	-	3000
	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	4.7, 10	-	-	-	-	-	4000
		B	1.25+/-0.1	10	10	-	-	-	-	10	3000
			1.25+/-0.15	-	22	-	-	-	-	-	
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	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	22	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 (GRM21BB3/R60J226M, GRM21BB3/R60G226M, GRM31CB3/R60J476M, GRM32DB3/R60J336M, GRM32EB3/R60J476M, GRM32EB3/R60J107M, GRM32EC80G107M, GRM43SB3/R60J107M) M : +/-20%						Z : +80/-20%	

Appendix 5. CAPACITANCE VALUE

No	MURATA New P/N	SIZE(mm)		T(mm)	T.C.	DC RATED VOLTAGE (V)	CAP.		CAP.TOL.
		L	W						
1	GRM 31M F5 1C 106 Z A12 L	3.2	1.6	1.15+/-0.1	F5	16	10	μF	+80/-20%

No	MURATA New P/N	CUSTOMER P/N	ϕ178 PACKAGING Q'TY (pcs/Reel)
1	GRM 31M F5 1C 106 Z A12 L		3000

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

Appendix 6. CAPACITANCE VALUE

No	MURATA New P/N	SIZE(mm)		T(mm)	T.C.	DC RATED VOLTAGE (V)	CAP.		CAP.TOL.
		L	W						
1	GRM 188 R6 0J 106 M E47 D	1.6	0.8	0.8+/-0.1	R6	6.3	10	μF	+/-20%

No	MURATA New P/N	CUSTOMER P/N	ϕ178 PACKAGING Q'TY (pcs/Reel)
1	GRM 188 R6 0J 106 M E47 D		4000

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

■SPECIFICATIONS AND TEST METHODS

No	Item		Specification: Temperature Compensating Type	Specification: High Dielectric Constant Type	Test Method
1	Operating Temperature Range		ΔC,1X:– 55°C to 125°C Other :–25°C to 85°C	B1,B3,F1 :–25°C to 85°C R1,R7 :–55°C to 125°C R6 :–55°C to 85°C C8 :–55°C to 105°C F5 :–30°C to 85°C	Standard Temperature : 20 °C (R6,R7,C8,F5 : 25 °C)
2	Rated Voltage		See the previous pages.		The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance		No defects or abnormalities.		Visual inspection.
4	Dimension		Within the specified dimensions. .		Using calipers. (GRM02 size is based on Microscope)
5	Dielectric Strength		No defects or abnormalities.		No failure shall be observed when 300% of the rated voltage (temperature compensating type) or 250% of the rated voltage (high dielectric constant type) is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance		C ≧ 0.047μF:More than 10000MΩ C > 0.047μF:500Ω · F C:Nominal Capacitance		The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 20°C /25°C and 75%RH max. and within 2 minutes of charging, provided the charge/discharge current is less than 50mA.
7	Capacitance		Within the specified tolerance.		The capacitance/D.F. shall be measured at 20°C /25°C at the frequency and voltage shown in the table.
8	Q/Dissipation Factor (D.F.)		30pFand over:Q ≧1000 30pF and below: Q ≧ 400+20C C:NominalCapacitance (pF)	[B1,B3,R1,R6,R7,C8] 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) [F1,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.	
9	Capacitance Temperature Characteristics	No bias	Within the specified tolerance.(Table A-1)	B1,B3 : Within ±10% (-25°C to +85°C) R1,R7 : Withn ±15% (-55°C to +125°C) R6 : Withn ±15% (-55°C to +85°C) C8 : Withn ±22% (-55°C to +105°C) F1 : Within +30/-80% (-25°C to +85°C) F5 :Within +22/-82% (-30°C to +85°C)	The capacitance change shall be measured after 5min. at each specified temp.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 step 1 through 5 (+20°C to +125°C:other temp.coeffs.:+20°C to +85°C) the capacitance shall be within the specified tolerance for the temperature coefficient and capacitance change as Table A-1. The capacitance drift is caluculated by dividing the differences between the maximum and minimum measured values in the step 1,3 and 5 by the cap.value in step 3. (2) High Dielectric Constant Type The ranges of capacitance change compared with the 20°C value over the temperature ranges shown in the table shall be within the specified ranges.* In case of applying voltage, the capacitance change shall be measured after 1 more min. with applying voltage in equilibration of each temp. stage.
		50% of the rated voltage		B1: Within +10/-30% R1: Within +15/-40% F1: Within +30/-95%	
		Capacitance Drift	Within±0.2% or±0.05pF (Whichever is larger.) *Not apply to 1X/25V	*Initial measurement for high dielectric constant type Perform a heat treatment at 150 +0/-10°C for one hour and then set for 48±4 hours at room temperature. Perform the initial measure-ment.	

Char. / Item	ΔC to 3U,1X (1000pF and below)	ΔC to 3U,1X (more than 1000pF) B1,R1,R6,R7,F1,F5
Frequency	1±0.1MHz	1±0.1kHz
Voltage	0.5 to 5Vrms	1±0.2Vrms

Step	Temperature(°C)
1	20±2
2	-55±3(for ÄC)/-25±3(for other TC)
3	20±2
4	125±3(for ÄC)/85±3(for other TC)
5	20±2

Step	Temperature(°C)	Applying voltage(V)
1	20±2/25±2	No bias
2	-55±3(for R1,R7,R6,C8)/ -25±3(for B1,B3,F1)/ -30±3(for F5)	
3	20±2/25±2	
4	125±3(for R1,R7)/ 105±3(for C8) 85±3(for B1,B3,R6,,F1,F5)	
5	20±2	50% of the rated voltage
6	-55±3(for R1)/ -25±3(for B1,F1)	
7	20±2	
8	125±3(for R1)/ 85±3(for B1,F1)	

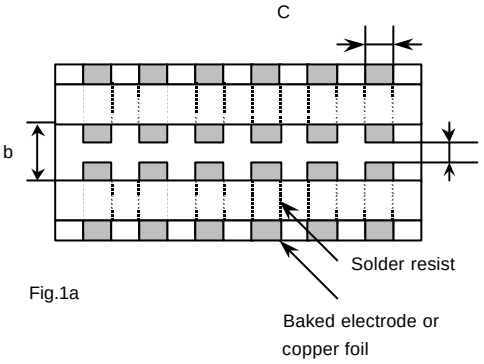
<table>
<tr><th rowspan="2">No</th><th rowspan="2">Item</th><th colspan="3">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th colspan="2">Temperature Compensating Type</th><th>High Dielectric Constant Type</th></tr>
<tr><td>10</td><td>Adhesive Strength of Termination</td><td colspan="3">No removal of the terminations or other defect shall occur.
 

Fig.1a</td><td>Solder the capacitor on the test jig (glass epoxy board)shown in Fig.1a using an eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1sec.
The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*1N(GRM02),2N(GR□03),5N(GR□15,GRM18)
(in:mm)
<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></td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td colspan="2">No defects or abnormalities.</td><td rowspan="3">Solder the capacitor on the test jig (glass epoxy board) in the same manner and under the same conditions as (10).
The capacitor shall be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions(total of 6 hours).</td></tr>
<tr><td>Capacitance</td><td colspan="2">Within the specified tolerance.</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over:Q≧1000
30pF and beloow:
Q≧400+20C

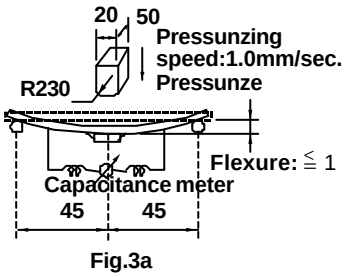
C:Nominal Capacitance (pF)</td><td>[B1,B3,R1,R6,R7,C8]
W.V.:100V: 0.025max.(C< 0. 068μF)
: 0.05max.(C≧0.068μF)
W.V.:25/50V :0.025max.
W.V.:16/10V :0.035max.
W.V.:6.3V/4V :0.05max. (C<3.3μF)
:0.1max.(C≧3.3μF)
[F1,F5]
W.V.:25Vmin
:0.05max. (C <0.1μF)
:0.09max. (C≧0.1μF)
W.V.:16/10V:0.125max.
W.V.:6.3V:0.15max.</td></tr>
<tr><td>12</td><td>Deflection</td><td colspan="3">No crack or marked defect shall occur.
 

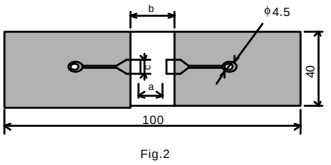
Fig.3a</td><td>Solder the capacitor on the test jig (glass epoxy board) shown in Fig.2a using an eutectic solder. Then apply a force in the direction shown in Fig 3a for 5±1 sec. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering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

Fig.2 t : 1.6mm
(GRP15,GRM18 : t:0.8mm)
<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>13</td><td>Solderability of Termination</td><td colspan="3">75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight propotion) .
Preheat at 80 to 120 ° for 10-to 30 seconds.
After preheating, immerse in an eutectic solder solution for 2±0.5 seconds at 230±5°C.</td></tr>
</table>

<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 Constant Type</th></tr>
<tr><td>14</td><td colspan="2">Resistance to Soldering Heat</td><td colspan="3">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Preheat the capacitor at 120 to 150°C for 1 minute.
Immerse the capacitor in an eutectic solder Solution at 270±5°C for 10±0.5 seconds. Set at room temperature for 24±2 hours (temperature compensating tyoe) or 48±4 hours (high dielectric constant type), then measure.
∗GRM02- Soldering method: Reflow Soldering
Solder type: SnAgCu

·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 48±4 hours.
Perform the initial measurement.

∗Preheating for GRM32/43/55
<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100°C to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170°C to 200°C</td><td>1 min.</td></tr></table></td></tr>
<tr><td></td><td>Appearance</td><td colspan="3">No defects or abnormalities.</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±2.5% or± 0.25pF (Whichever is larger)</td><td colspan="2">B1,B3,R1,R6,R7,C8: Within ±7.5%
F1,F5 :Within ±20%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pF and over: Q≧ 1000
30pF and beloow:
Q≧ 400+20C

C:Nominal Capacitance (pF)</td><td colspan="2">[B1,B3,R1,R6,R7,C8]
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)
[F1,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 10,000MΩ or 500Ω·F (Whichever is smaller)</td></tr>
<tr><td></td><td>Dielectric Strength</td><td colspan="3">No defects.</td></tr>
<tr><td>15</td><td colspan="2">Temperature Cycle</td><td colspan="3">The measured and observed characteristics shall satisfy the specifications in the following table.</td><td rowspan="5">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10).
Perform the five cycles according to the four heat treatments shown in the following table.
Set for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. ( )</td><td>Min. Operating Temp.+0/-3</td><td>Room Temp.</td><td>Max. Operating Temp.+3/-0</td><td>Room Temp.</td></tr><tr><td>Time (min)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>
Initial measurement for high dielectric constant type
Perform a heat treatment at 150+0/-10·°C for one hour and then set at room temperature for 48±4 hours.
Perform the initial measurement.</td></tr>
<tr><td></td><td>Appearance</td><td colspan="3">No defects or abnormalities.</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±2.5% or± 0.25pF (Whichever is larger)</td><td colspan="2">B1,B3,R1,R6,R7,C8 :Within ±7.5%
F1,F5 :Within ±20%</td></tr>
<tr><td></td><td>Q/D.F.</td><td>30pF and over: Q≧ 1000
30pF and beloow:
Q≧ 400+20C

C:Nominal Capacitance (pF)</td><td colspan="2">[B1,B3,R1,R6,R7,C8]
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)
[F1,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 10,000MΩ or 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="3">The measured and observed characteristics shall 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 (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.</td></tr>
<tr><td></td><td>Appearance</td><td colspan="3">No defects or abnormalities.</td></tr>
<tr><td></td><td>Capacitance Change</td><td>Within ±5% or± 0.5pF (Whichever is larger)</td><td colspan="2">B1,B3,R1,R6,R7,C8:Within ±12.5%
F1,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+2.5C
10pF and below:
Q≧ 200+10C

C:Nominal Capacitance (pF)</td><td colspan="2">[B1,B3,R1,R6,R7,C8]
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)

[F1,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 1,000MΩ or 50Ω · F (Whichever is smaller)</td></tr>
</table>

No	Item	Specification: Temperature Compensating Type	Specification: High Dielectric Constant Type	Test Method
17	Humidity Load	The measured and observed characteristics shall satisfy the specifications in the following table.		Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and set for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temprature, then muasure. The charge/discharge current is less than 50mA. ·Initial measurement for F1/10Vmax. Apply the rated DC voltage for 1 hour at 40±2°C. Remove and set for 48±4 hours at room temperature. Perform initial measurement.
	Appearance	No defects or abnormalities.		
	Capacitance Change	Within ±7.5% or±0.75pF (Whichever is larger)	B1,B3,R1,R6,F7,C8:Within ±12.5% F1,F5 :Within ±30% [W.V.:10Vmax.] F1 :Within+30/-40%	
	Q/D.F.	30pF and over:Q ≧ 200 30pF and below: Q ≧ 100+10C/3 C:Nominal Capacitance (pF)	[B1,B3,R1,R6,R7C8] 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:0.075max.(C<3.3μF) :0.125max.(C ≧ 3.3μF) [F1,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 500MΩ or 25Ω ·F(Whichever is smaller)		
18	High Temperature Load	The measured and observed characteristics shall satisfy the specifications in the following table.		Apply 200% of the rated voltage atThe maximum operating temperature ±3 for 1000±12 hours. Set for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA. ·Initial measurement for high dielectric constant type. Apply 200% of the rated DC voltage at the maximun operating temperature ±3°C for one hour. Remove and set for 48±4 hours at room temperature. Perform initial measurement.
	Appearance	No defects or abnormalities.		
	Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	B1B3,,R1,R6,R7,C8:Within ±12.5% F1,F5 :Within ±30% [Except 10Vmax and C= 1.0. μF] F1,F5 :Within+30/-40% [10Vmax and C ≧ 1.0μF]	
	Q/D.F.	30pF and over:Q ≧350 10pF and over 30pF and below: Q ≧ 275+2.5C 10pF and below: Q ≧ 200+10C C:Nominal Capacitance (pF)	[B1,B3,R1,R6,R7,C8] W.V.:100V: 0.05max.(C < 0.068μF) : 0.075max.(C ≧ 0.068μF) W.V.:25/50V :0.04max. W.V.:16/10V :0.05max. W.V.:6.3V/4V:0.075max.(C<3.3μF) :0.125max.(C ≧ 3.3μF) [F1,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)		

Table A-1

Char.	Nominal Values (ppm/) Note 1	Capacitance Change from 20°C (%)					
		-55		-25		-10	
		Max.	Min.	Max.	Min.	Max.	Min.
2C	0± 60	0.82	-0.45	0.49	-0.27	0.33	-0.18
3C	0±120	1.37	-0.90	0.82	-0.54	0.55	-0.36
4C	0±250	2.56	-1.88	1.54	-1.13	1.02	-0.75
2P	-150± 60	–	–	1.32	0.41	0.88	0.27
3P	-150±120	–	–	1.65	0.14	1.10	0.09
4P	-150±250	–	–	2.36	-0.45	1.57	-0.30
2R	-220± 60	–	–	1.70	0.72	1.13	0.48
3R	-220±120	–	–	2.03	0.45	1.35	0.30
4R	-220±250	–	–	2.74	-0.14	1.83	-0.09
2S	-330± 60	–	–	2.30	1.22	1.54	0.81
3S	-330±120	–	–	2.63	0.95	1.76	0.63
4S	-330±250	–	–	3.35	0.36	2.23	0.24
2T	-470± 60	–	–	3.07	1.85	2.05	1.23
3T	-470±120	–	–	3.40	1.58	2.27	1.05
4T	-470±250	–	–	4.12	0.99	2.74	0.66
3U	-750±120	–	–	4.94	2.84	3.29	1.89
4U	-750 250	–	–	5.65	2.25	3.77	1.50
1X	+350 -1000	–	–	–	–	–	–

Table A-2

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

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

■SPECIFICATIONS AND TEST METHODS

<table>
<tr><th>No</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>B1,B3,F1,F5 :-25°C to 85°C
R1,R7:-55°C to 125°C
C6,R6:-55°C to 85°C
C7:-55°C to 125°C
C8:-55°C to 105°C</td><td>Standard Temperature : 20°C
(R6,R7,C6,C7,C8,F5 : 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, shall be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td>No defects or abnormalities.</td><td>Visual inspection.(GRM02 size is based on Microscope)</td></tr>
<tr><td>4</td><td>Dimension</td><td>Within the specified dimensions. .</td><td>Using calipers.</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td>No defects or abnormalities.</td><td>No failure shall be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td>More than 50Ω · F</td><td>The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at Standard Temperature and 75%RH max. and within 1 minutes of charging, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>7</td><td>Capacitance</td><td>Within the specified tolerance.
*Table 1
GRM155 B3/R6 1A 124 to 105
GRM185 B3/R6 1C/1A 105
GRM188 B3/R6 1C/1A 225
GRM219 B3/R6 1A 475
GRM21B B3/R6 1C/1A 106
GRM319 B3/R6 1A 106</td><td>The capacitance shall be measured at Standard Temperature at the frequency and voltage shown in the table.
Capacitance / Frequency / Voltage
*1 C ≦ 10µF (10V min) / 1+/-0.1kHz / 1.0+/-0.2Vrms
C ≦ 10µF (6.3V max.) / 1+/-0.1kHz / 0.5+/-0.1Vrms
C > 10µF / 120+/-24Hz / 0.5+/-0.1Vrms
*1 However the Voltage is 0.5+/-0.1Vrms about Table 1 items on the left side.</td></tr>
<tr><td>8</td><td>Dissipation Factor (D.F.)</td><td>B1,B3,R1,R6,R7,C7,C8 : 0.1 max.
C6 :0.125 max
F1,F5 : 0.2 max
*Table 1
GRM155 B3/R6 1A 124 to 105
GRM185 B3/R6 1C/1A 105
GRM188 B3/R6 1C/1A 225
GRM219 B3/R6 1A 475
GRM21B B3/R6 1C/1A 106
GRM319 B3/R6 1A 106</td><td>The D.F. shall be measured at Standard Temperature at the Frequency and voltage shown in the table.
Capacitance / Frequency / Voltage
*1 C ≦ 10µF (10V min) / 1+/-0.1kHz / 1.0+/-0.2Vrms
C ≦ 10µF (6.3V max.) / 1+/-0.1kHz / 0.5+/-0.1Vrms
C > 10µF / 120+/-24Hz / 0.5+/-0.1Vrms
*1 However the Voltage is 0.5+/-0.1Vrms about Table 1 items on the left side.</td></tr>
<tr><td>9</td><td>Capacitance Temperature Characteristics</td><td>No bias</td><td>B1,B3 : Within +/-10% (-25°C to +85°C)
R1,R7 : Withn ±15% (-55°C to +125°C)
F1,F5 : Within +30/-80% (-25°C to +85°C)
R6 : Within +/-15% (-55°C to +85°C)
C6 : Within +/-22% (-55°C to +85°C)
C7 : Within +/-22% (-55°C to +125°C)
C8 : Within +/-22% (-55°C to +105°C)</td><td>The capacitance change shall be measured after 5min. at each specified temp.stage.
The ranges of capacitance change compared with the Standard Temperature value over the temperature ranges shown in the table shall be within the specified ranges.*
In case of applying voltage, the capacitance change shall be measured after 1 more min. with applying voltage in equilibration of each temp. stage.
*GRM43 B1/R6 0J/1A 336/476 only : 1.0±0.2Vrms
Step / Temperature(°C) / Applying voltage(V)
1 / 20+/-2 * / No bias
2 / -55+/-3(for R1,R6,R7,C6,C7,C8) -25+/-3(for B1,B3,F1,F5) / No bias
3 / 20+/-2 * / *
4 / 85+/-3(for B1,B3,F1,F5,R6,C6) 125+/-3(for R1,R7,C7) 105+/-3(for C8) / * R6,C7,C8 : 25+/-2°C
5 / 20+/-2 / 50% of the rated voltage
6 / -55±3(for R1) -25+/-3(for B1,F1,F5) / 50% of the rated voltage
7 / 20+/-2 / 50% of the rated voltage
8 / 125±3(for R1) 85±3(for B1,F1,F5) / 50% of the rated voltage
*Initial measurement for high dielectric constant type
Perform a heat treatment at 150 +0/-10°C for one hour and then set for 48±4 hours at room temprature.
Perform the initial measure-ment.</td></tr>
<tr><td></td><td></td><td>50% of the rated voltage</td><td>B1: Within +10/-30%
R1: Within +15/-40%
F1: Within +30/-95%</td><td></td></tr>
</table>

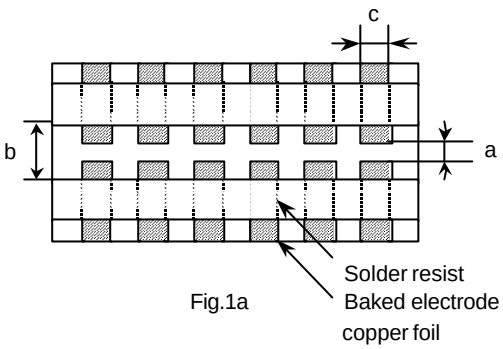
<table>
<tr><th>No</th><th>Item</th><th colspan="2">Specification</th><th>Test Method</th></tr>
<tr><td>10</td><td>Adhesive Strength of Termination</td><td colspan="2">No removal of the terminations or other defect shall occur.
 

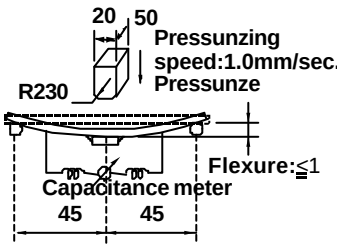
Fig.1a</td><td>Solder the capacitor on the test jig (glass epoxy board)shown in Fig.1a using an eutectic solder. Then apply 10N* force in parallel with the test jig for 10+/-1sec.
The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*1N : GR□02,2N : 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></td></tr>
<tr><td>11</td><td>Vibration Resistance</td><td>Appearance
Capacitance
Q/D.F.
</td><td>No defects or abnormalities.
Within the specified tolerance.
B1,B3,R1,R6,R7,C7,C8:0.1max.
C6 : 0.125 max
F1,F5 : 0.2 max
</td><td>Solder the capacitor on the test jig (glass epoxy board) in the same manner and under the same conditions as (10).
The capacitor shall be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions(total of 6 hours).</td></tr>
<tr><td>12</td><td>Deflection</td><td colspan="2">No crack or marked defect shall occur.
 

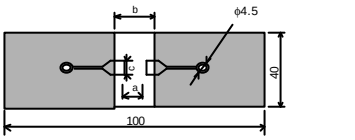
Fig.3a</td><td>Solder the capacitor on the test jig (glass epoxy board) shown in Fig.2a using an eutectic solder. Then apply a force in the direction shown in Fig 3a for 5+/-1 sec. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the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

Fig.2 t : 1.6mm
(GRM02,GR□03/15 : t:0.8mm)
<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>13</td><td>Solderability of Termination</td><td colspan="2">75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight 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.</td></tr>
</table>

<table>
<tr><th>No</th><th>Item</th><th colspan="2">Specification</th><th>Test Method</th></tr>
<tr><td>14</td><td>Resistance to Soldering Heat</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="6">Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in an eutectic solder solution at 270+/-5°C for 10+/-0.5 seconds. Set at room temperature for 24+/-2 hours (temperature compensating tyoe) or 48+/-4 hours (high dielectric constant type), then measure.
*GRM02- Soldering method: Reflow Soldering
Solder type: SnAgCu
· 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 48+/-4 hours.
Perform the initial measurement.

*Preheating for GRM32/43/55
<table><tr><th>Step</th><th>Temperature</th><th>Time</th></tr><tr><td>1</td><td>100°C to 120°C</td><td>1 min.</td></tr><tr><td>2</td><td>170°C to 200°C</td><td>1 min.</td></tr></table></td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>B1,B3,R1,R6,R7,C6,C7,C8:Within +/-7.5%
F1,F5 : Within +/-20%</td></tr>
<tr><td></td><td></td><td>Q/D.F.</td><td>B1,B3,R1,R6,R7,C7,C8: 0.1 max.
C6 : 0.125 max
F1,F5 : 0.2 max</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 50Ω · F</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>No defects.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>15</td><td>Temperature Sudden Change</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="6">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments shown in the following table.
Set for 24+/-2 hours (temperature compensating type) or 48+/-4 hours (high dielectric constant type) at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (°C)</td><td>Min. Operating Temp.+0/-3</td><td>Room Temp.</td><td>Max. Operating Temp.+3/-0</td><td>Room Temp.</td></tr><tr><td>Time (min)</td><td>30+/-3</td><td>2 to 3</td><td>30+/-3</td><td>2 to3</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 48+/-4 hours.
Perform the initial measurement.</td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>B1,B3,R1,R6,R7,C6,C7,C8:Within +/-7.5%
F1,F5 : Within +/-20%</td></tr>
<tr><td></td><td></td><td>Q/D.F.</td><td>B1,B3,R1,R6,R7,C7,C8: 0.1 max.
C6 : 0.125 max
F1,F5 : 0.2 max</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 50Ω · F</td></tr>
<tr><td></td><td></td><td>Dielectric Strength</td><td>No defects.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>16</td><td>High Temperature High Humidity (Steady)</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="5">Apply the rated voltage at 40+/-2°C and 90 to 95% humidity for 500+/-12 hours. The charge/discharge currentis less than 50mA.

· Initial measurement
Perform a heat treatment at 150+0/-10°C for one hour and then let sit for 48+/-4 hours at room temperature.
Perform the initial measurement.

· Measurement after test
Perform a heat treatment at 150+0/-10 °C for one hour and then let sit for 48+/-4 hours at room temperature, then measure.</td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>B1,B3,R1,R6,R7,C6,C7,C8:Within +/-12.5%
F1,F5 : Within +/-30%</td></tr>
<tr><td></td><td></td><td>Q/D.F.</td><td>B1,B3,R1,R6,R7,C6,C7,C8: 0.2 max.
F1,F5 : 0.4 max</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 12.5Ω · F</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>17</td><td>Durability</td><td>Appearance</td><td>No defects or abnormalities.</td><td rowspan="5">Apply 150% of the rated voltage for 1000+/-12 hours at the maximum operating temperature +/-3°C. Let sit for 48+/-4 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 let sit for 48+/-4 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 let sit for 48+/-4 hours at room temperature, then measure.</td></tr>
<tr><td></td><td></td><td>Capacitance Change</td><td>B1,B3,R1,R6,R7,C6,C7,C8:Within +/-12.5%
F1,F5 : Within +/-30%</td></tr>
<tr><td></td><td></td><td>Q/D.F.</td><td>B1,B3,R1,R6,R7,C6,C7,C8: 0.2max.
F1,F5 : 0.4max</td></tr>
<tr><td></td><td></td><td>I.R.</td><td>More than 25Ω · F</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

■SPECIFICATIONS AND TEST METHODS

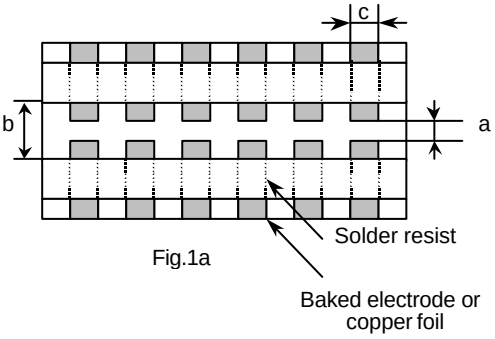
<table>
<tr><th>No</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>R7/C7 :-55°C to +125°C
R6 :-55°C to +85°C
F5 :-30°C to +85°C</td><td>Standard Temperature:25 °C</td></tr>
<tr><td>2</td><td>Rated Voltage</td><td>See the previous 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, shall be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td>No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td>Dimension</td><td>Within the specified dimensions.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td>No defects or abnormalities.</td><td>No failure shall be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td>C ≦ 0.047μF:More than 10000MΩ
(GRM188R61C334-105K : 100Ω · F)
C > 0.047μF:500Ω · F
C : Nominal Capacitance</td><td>The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25 °C and 75%RH max. and within 2 minutes of charging, provided the charge/discharge current is less than 50mA.
＊ 5 minutes (GRM188R6/334-105K)</td></tr>
<tr><td>7</td><td>Capacitance</td><td>Within the specified tolerance.</td><td>The capacitance/D.F. shall be measured at 25 °C at the frequency and voltage shown in the table.</td></tr>
<tr><td>8</td><td>Q/Dissipation Factor (D.F.)</td><td>[R6,R7,C7]
W.V.:100V :0.05max.
W.V.:35/25/16V :0.035max.
W.V.:10V :0.05max.(C< 3.3μF)
:0.1max.(C ≧ 3.3μF)
[F5]
W.V.:50V
:0.07max.(C < 0.1μF)
:0.09max.(C ≧ 0.1μF)
W.V.:35/25/16V.:0.125max.</td><td><table><tr><th>Char. / Item</th><th>R6,R7,F5,C7</th></tr><tr><td>Frequency</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>1±0.2Vrms</td></tr></table></td></tr>
<tr><td>9</td><td>Capacitance Temperature Characteristics</td><td>R7 : Withn ±15%
(-55°C to +125°C)
R6 : Withn ±15%
(-55°C to +85°C)
F5 :Within +22/-82%
(-30°C to +85°C)
C7 : Withn ±22%
(-55°C to +125°C)</td><td>The capacitance change shall be measured after 5min. at each specified temp.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.*
<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(for R6, R7,C7)/
-30±3(for F5)</td></tr><tr><td>3</td><td>25±2</td></tr><tr><td>4</td><td>125±3(for R7,C7)/
85±3(for R6,F5)</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 for 48±4 hours 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 defect shall occur.
 

Fig.1a</td><td>Solder the capacitor on the test jig (glass epoxy board) shown in Fig.1a using a n eutectic solder. Then apply ＊10N force in parallel with the test jig for 10± 1sec.
The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*5N (GRP/M15, GRM18)
2N (GRP/M03)
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRP/M03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GRP/M15</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

No	Item		Specification	Test Method
11	Vibration Resistance	Appearance	No defects or abnormalities.	Solder the capacitor o n the test jig (glass epoxy board) in thesame manner and under the same conditions as (10). The capacitor shall be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, shall be traversed inapproximately 1 minute. This motion shall be appliedfor a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).
		Capacitance	Within the specified tolerance.	
		Q/D.F.	[R6,R7,C7] W.V.:100V :0.05max. W.V.:35/25/16V :0.035max. W.V.:10V :0.05max. (C< 3.3μF) :0.1max.(C≧ 3.3μF) [F5] W.V.:50V :0.07max.(C< 0.1μF) :0.09max.(C≧ 0.1μF) W.V.:35/25/16V.:0.125max.	
12	Deflection		No crack or marked defect shall occur.	Solder the capacitor on the test jig (glass epoxy board) shown in Fig.2a using an eutectic solder. Then apply a force in the direction shown in Fig 3a for 5±1 sec. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.

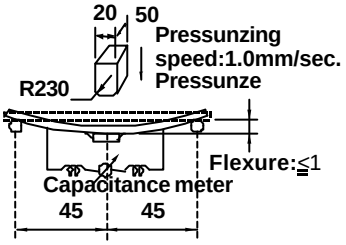


Fig.3

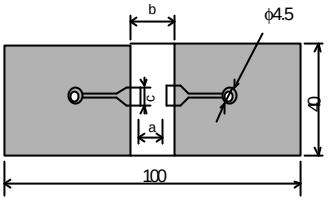


Fig.2 t:1.6mm

(GRP/M03,GRP/M15:0.8mm)

Type	a	b	c
GRP/M03	0.3	0.9	0.3
GRP/M15	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)

13	Solderability of Termination		75% of the terminations is to be soldered evenly and continuously.	Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight propotion) . Preheat at 80 to 120 ºC for 10-to 30 seconds. After preheating, immerse in an eutectic solder solution for 2±0.5 seconds at 230±5°C.
14	Resistance to Soldering Heat		The measured and observed characteristics shall satisfy the specifications in the following table.	Preheat the capacitor at 120 to 150 º C for 1 minute. Immerse the capacitor in a n eutectic solder solution at 270±5ºC for 10±0.5 seconds. Set at room temperature for 48± 4 hours (high dielectric constant type), then measure. · Initial measurement for high dielectric constant type Perform a heat treatment at 150 +0/-10ºC for one hour and then set at room temperature for 48± 4 hours. Perform the initial measurement.
		Appearance	No defects or abnormalities.	
		Capacitance Change	R6,R7:Within ±7.5% F5 :Within ±20%	
		Q/D.F.	[R6,R7,C7] W.V.:100V :0.05max W.V.:35/25/16V :0.035max. W.V.:10V:0.05max.(C< 3.3μF) :0.1max.(C≧ 3.3μF) [F5] W.V.:50V :0.07max.(C < 0.1μF) :0.09max.(C ≧ 0.1μF) W.V.:35/25/16V.:0.125max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)	
		Dielectric Strength	No defects.	

*Preheating for GRM32/43/55

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

■SPECIFICATIONS AND TEST METHODS

No	Item		Specification	Test Method
15	Temperature Cycle		The measured and observed characteristics shall satisfy the specifications in the following table.	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments shown in the following table. Set for or 48±4 hours (high dielectric constant type) at room temperature, then measure.
		Appearance	No defects or abnormalities.	
		Capacitance Change	R6,R7,C7 :Within ±7.5% F5 :Within ±20%	
		Q/D.F.	[R6,R7,C7] W.V.:100V :0.05max W.V.:35/25/16V :0.035max. W.V.:10V :0.05max.(C< 3.3μF) :0.1max.(C ≧ 3.3F) [F5] W.V.:50V :0.07max.(C < 0.1μF) :0.09max.(C ≧ 0.1μF) W.V.:35/25/16Vmax.:0.125max.	
		I.R.	More than 10,000MΩ or 500Ω · F (Whichever is smaller)	· Initial measurement for high dielectric constant type Perform a heat treatment at 150 +0/-10ºC for one hour and then set at room temperature for 48± 4 hours. Perform the initial measurement.
		Dielectric Strength	No defects.	
16	Humidity (Steady State)		The measured and observed characteristics shall satisfy the specifications in the following table.	Sit the capacitor at 40± 2ºC and in 90 to 95% humiduty for 500±12 hours. Remove and set for 48± 4 hours at room temperature, then measure.
		Appearance	No defects or abnormalities.	
		Capacitance Change	R6,R7,C7:Within ±12.5% F5 :Within ±30%	
		Q/D.F.	[R6,R7,C7] W.V.:100V :0.075max W.V.:35/25/16V :0.05max. W.V.:10V:0.075max(C< 3.3μF) :0.125max.(C ≧ 3.3μF) [F5] W.V.:50V :0.1max.(C < 0.1μF) :0.125max.(C ≧ 0.1μF) W.V.:35/25/16V.:0.15max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)	
		Dielectric Strength	No defects.	
17	Humidity Load		The measured and observed characteristics shall satisfy the specifications in the following table.	Apply the rated voltage * at 40±2ºC and 90 to 95% humidity for 500±12 hours. Remove and set for 48±4 hours at room temprature, then muasure. The charge/discharge current is less than 50mA. *GRM188R61A105K:6.3V · Initial measurement for F 5 / 25Vmax. Apply the rated DC voltage for 1 hour at 40± 2ºC. Remove and set for 48±4 hours at room temperature. Perform initial measurement.
		Appearance	No defects or abnormalities.	
		Capacitance Change	R6,F7,C7:Within ±12.5% F5 :Within ±30%	
		Q/D.F.	[R6,R7,C7] W.V.:100V :0.075max W.V.:35/25/16V :0.05max. W.V.:10V:0.075max(C< 3.3μF) :0.125max.(C ≧ 3.3μF) [F5] W.V.:50V :0.1max.(C < 0.1μF) :0.125max.(C ≧ 0.1μF) W.V.:35/25/16Vmax.:0.15max.	
		I.R.	More than 500MΩ or 25Ω · F (Whichever is smaller)	
		Dielectric Strength	No defects.	
18	High Temperature Load		The measured and observed characteristics shall satisfy the specifications in the following table.	Apply 125% of the rated voltage at the maximum operating temperature ±3ºC for 1000±12 hours. Set for or 48±4 hours (high dielectric constant type) at room Temperature, then measure. The charge/discharge current is less than 50mA. · Initial measurement for high dielectric constant type. Apply 125% of the rated DC voltage at the maximun operating temperature ± 3ºC for one hour. Remove and set for 48±4 hours at room temperature. Perform initial measurement.
		Appearance	No defects or abnormalities.	
		Capacitance Change	R6,R7,C7:Within ±12.5% F5 :Within ±30%[Except 25Vmax and C ≧ 1.0. μF]	
		Q/D.F.	[R6,R7,C7] W.V.:100V :0.075max W.V.:35/25/16V :0.05max. W.V.:10V:0.075max(C< 3.3μF) :0.125max.(C ≧3.3μF) [F5] W.V.:50V :0.1max.(C < 0.1μF) :0.125max.(C ≧ 0.1μF) W.V.:35/25/16Vmax.:0.15max.	
		I.R.	More than 1,000MΩ or 50Ω · F (Whichever is smaller)	
		Dielectric Strength	No defects.	

Step	1	2	3	4
Temp. (ºC)	Min. Operating Temp.+0/-3	Room Temp.	Max. Operating Temp.+3/-0	Room Temp.
Time (min)	30±3	2to3	30±3	2to3

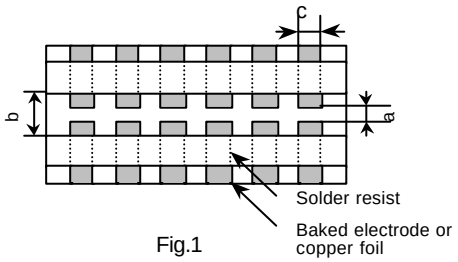
<table>
<tr><th>No</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>R6: -55°C to +85°C</td><td></td></tr>
<tr><td>2</td><td>Rated Voltage</td><td>See the previous pages.</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td>No defects or abnormalities.</td><td>Visual inspection.</td></tr>
<tr><td>4</td><td>Dimensions</td><td>Within the specified dimension.</td><td>Using calipers.</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td>No defects or abnormalities.</td><td>No failure shall be observed when 250% of the rated voltage is applied
between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td>50Ω· F min.</td><td>The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25 °C and 75%RH max. and within 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. shall be measured at 25 °C at the frequency and voltage shown in the table.
<table><tr><th>Capacitance</th><th>Frequency</th><th>Voltage</th></tr><tr><td>C≦10μF (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></td></tr>
<tr><td>8</td><td>Dissipation Factor (D.F.)</td><td>0.125 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></table></td><td>The capacitance change shall be measured affter 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.</td></tr>
<tr><td>10</td><td>Adhesive Strength of Termination</td><td>No removal of the terminations or other defects shall occur.
 

Fig.1</td><td>Solder the capacitor 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 shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.
*5N (GR□15, GRM18)/2N (GR□03)
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></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><table><tr><td>Appearance</td><td>No defects or abnormalities.</td></tr><tr><td>Capacitance</td><td>Within the specified tolerance.</td></tr><tr><td>D.F</td><td>0.125 max.</td></tr></table></td><td>Solder the capacitor to the test jig (glass epoxy board) in the same manner and under the same conditions as (10). The capacitor shall be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between
the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, shall be traversed in approximately 1 minute.
This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).</td></tr>
</table>

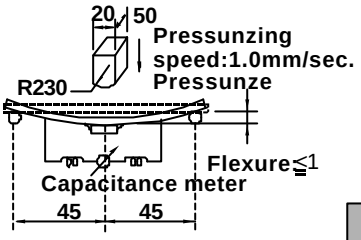
<table>
<tr><th>No</th><th>Item</th><th colspan="2">Specification</th><th>Test Method</th></tr>
<tr><td>12</td><td>Deflection</td><td colspan="2">No cracking or marking defects shal occur.
 

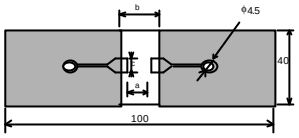
Fig.3
 

Fig.2</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig.2 using a eutectic solder. Then apply a force in the direction shown in Fig.3. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.
<table>
<tr><th>Type</th><th>a</th><th>b</th><th>c</th></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>13</td><td>Solderability of Termination</td><td colspan="2">75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion). Preheat at 80 to 120 °C
for10 to 30 seconds. After preheating, immerse in eutectic solder solution for2 ±0.5 seconds at 230 ± 5°C.</td></tr>
<tr><td>14</td><td>Resistance to Soldering Heat</td><td>Appearance
Capacitance Change
D.F.
I.R.
Dielectric Strength</td><td>No marking defects.
R6 : Within ± 15%
0.125 max.
50Ω·F min.
No failure</td><td>Preheat the capacitor at 120 to 150 °C for 1 minute. Immerse the capacitor in a eutectic solder solution at 270 ± 5 °C for 10 ±0.5 seconds. Let sit at room temperature for 48 ± 4 hours, then measure.
·Initial measurement
Perform a heat treatment at 150 $^{0}_{-10}$°C for one hour and then let sit for 48 ±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>15</td><td>Temperature Sudden Change</td><td>Appearance
Capacitance Change
D.F.
I.R.
Dielectric Strength</td><td>No marking defects.
R6 : Within ±7.5%
0.125 max.
50Ω·F min.
No failure</td><td>Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments listed in the following table. Let sit for 48 ±4 hours at room temperature, then measure.
<table>
<tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Temp.(°C)</td><td>Min. Operating Temp.± $^{0}_{3}$</td><td>Room Temp.</td><td>Max. Operating Temp.± $^{3}_{0}$</td><td>Room Temp.</td></tr>
<tr><td>Time(min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr>
</table>
· Initial measurement
Perform a heat treatment at 150 ± $^{0}_{10}$°C for one hour and then let sit for 48 ±4 hours at room temperature. Perform the initial measurement.</td></tr>
<tr><td>16</td><td>High Temperature High Humidity (Steady)</td><td>Appearance
Capacitance Change
D.F.
I.R.
Dielectric Strength</td><td>No marking defects.
R6 : Within ±12.5%
0.25max.
12.5Ω·F min.
No failure</td><td>Apply the rated voltage at 40 ± 2 °C and 90 to 95% humidityfor 500 ±12hours.
The charge/discharge current is less than 50mA.
· Initial measurement
Perform a heat treatment at 150 $^{0}_{-10}$ °C for one hour and then let sit for 48 ±4 hours at room temperature. Perform the initial measurement.
· Measurement after test
Perform a heat treatment at 150 $^{0}_{-10}$ °C for one hour and then let sit for 48 ±4 hours at room temperature, then measure</td></tr>
<tr><td>17</td><td>Durability</td><td>Appearance
Capacitance Change
D.F.
I.R.
Dielectric Strength</td><td>No marking defects.
R6 : Within ±12.5%
0.25max.
25Ω·F min.
No failure</td><td>Apply 100% of the rated voltage for 1000 ±12 hours at the maximum operating temperature ± 3°C.
The charge/ discharge current is less than 50mA.
· Initial measurement
Perform a heat treatment at 150 $^{0}_{-10}$ °C for one hour and then let sit for 48 ±4 hours at room temperature. Perform the initial measurement.
· Measurement after test
Perform a heat treatment at 150 $^{0}_{-10}$°C for one hour and then let sit for 48 ±4 hours at room temperature, then measure</td></tr>
</table>

P A C K A G I N G
G R P / M T y p e

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 GRM43S, GRM55E/F : 500(pcs./bag)

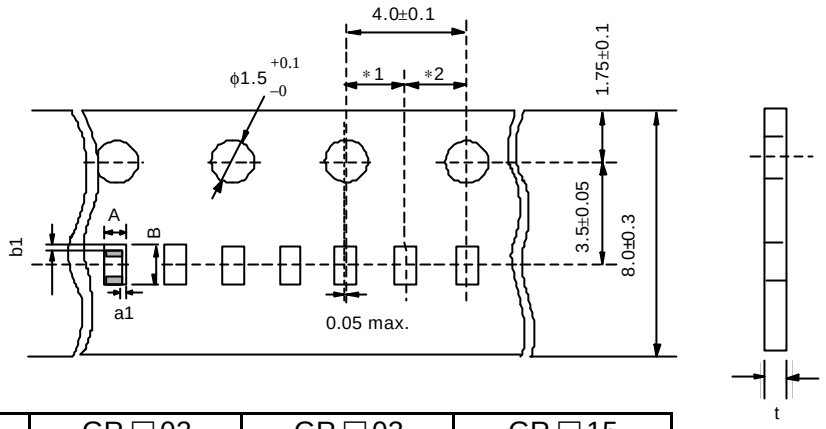
2.Tape Carrier Packaging(Packaging Code:D/E/F/L/J/K)

2.1 Minimum Quantity(pcs./reel)

Type		ϕ178 reel		ϕ330 reel	
		Paper Tape	Plastic Tape	Paper Tape	Plastic Tape
		Code:D/E	Code:L	Code:F/J	Code:K
GR □02		20000			
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 □02/03/15

(in : mm)

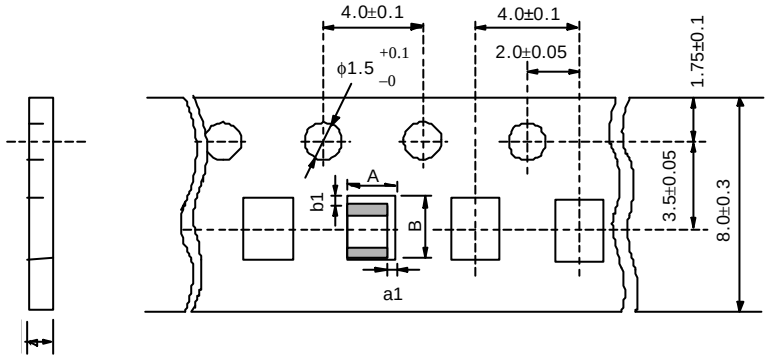


*1,2:2.0±0.05

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

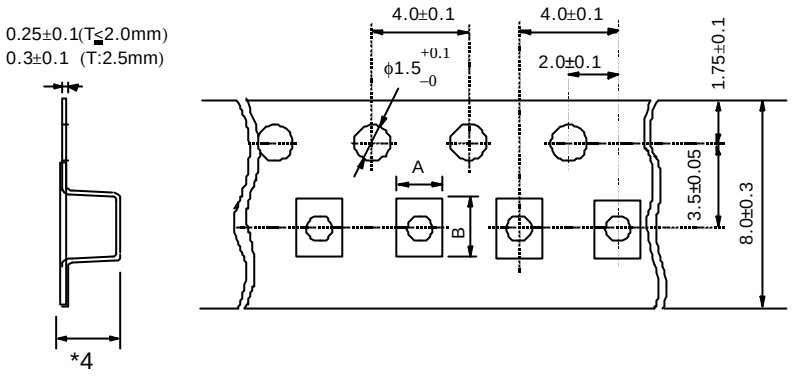
(2)GR□18/21/31/32 T:0.85 max.



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

(3)GR□21/31/32 T:1.0 min.

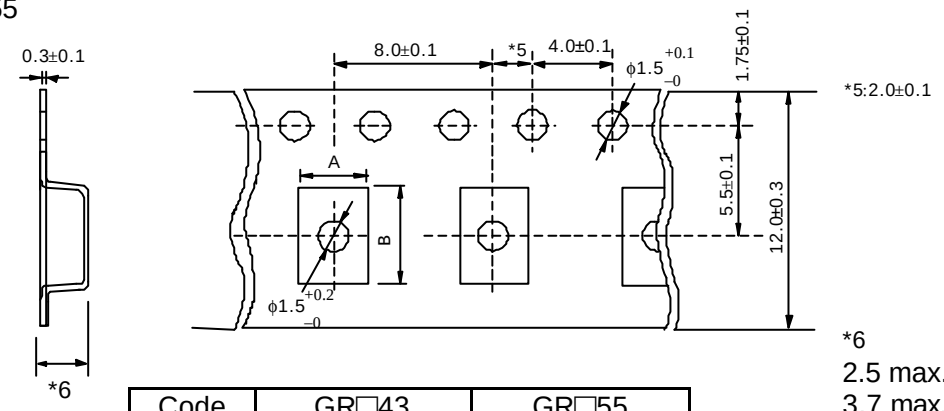
(in : mm)



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

*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)

(4)GR□43/55



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

*7 Nominal value

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

Fig.1 Package Chips

(in : mm)

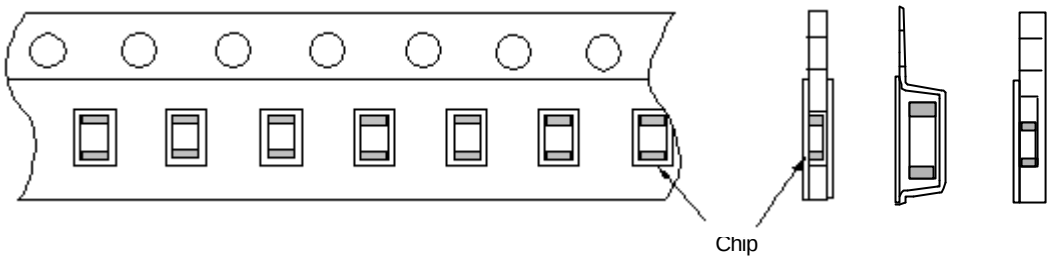


Fig.2 Dimensions of Reel

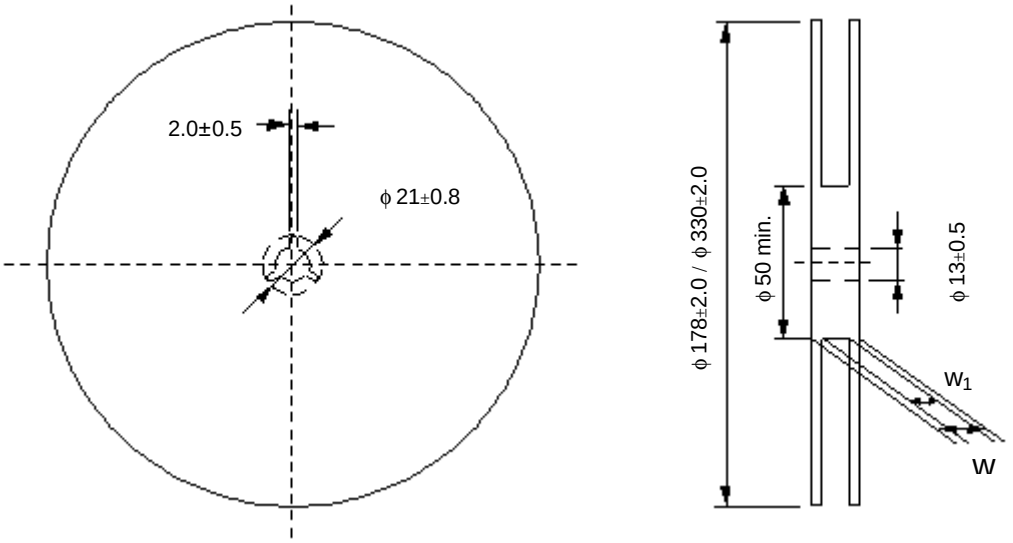
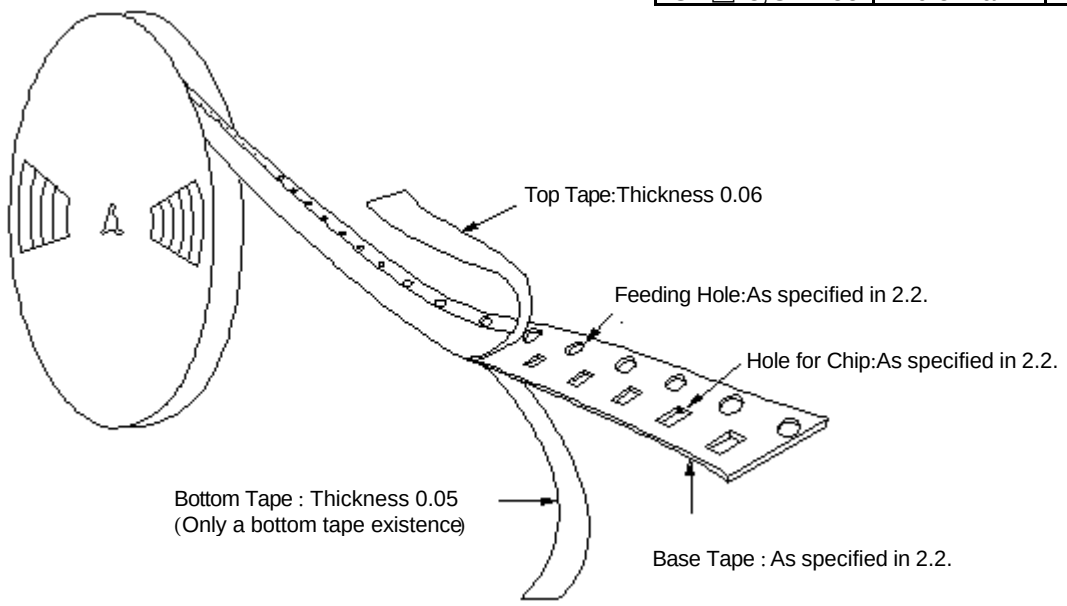


Fig.3 Taping Diagram

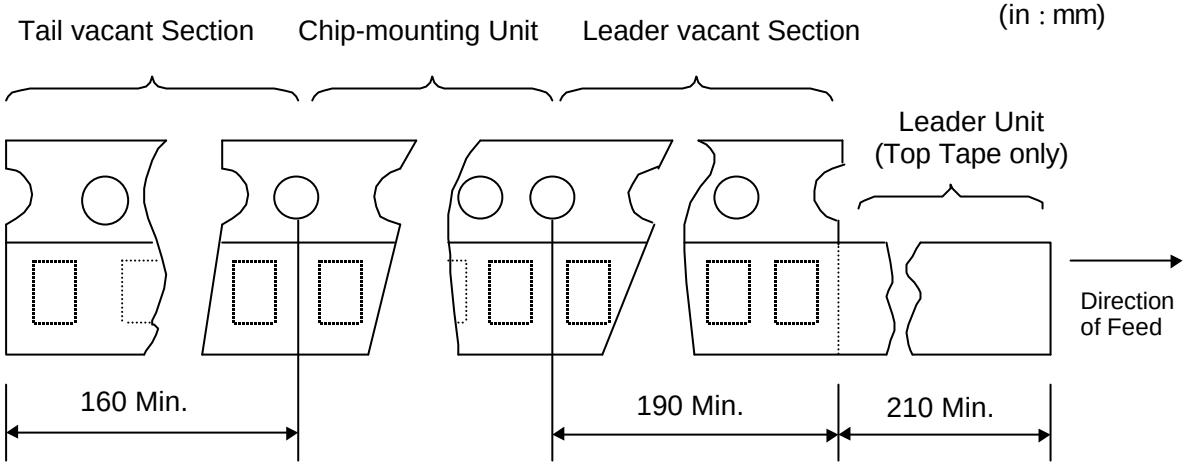
	W	W_1
GR□32 max.	16.5 max.	10±1.5
GR□43,GRM55	20.5 max.	14±1.5



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.

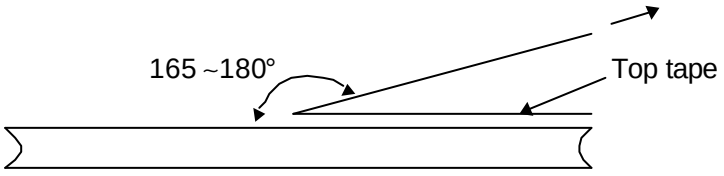
2.9 There are no fuzz in the cavity.

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.

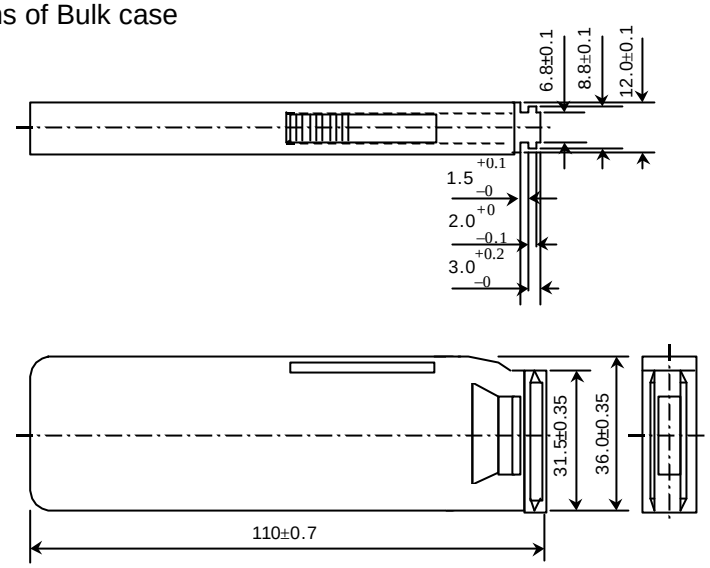
*8 GR □03:0.05N~0.5N



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

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 shall 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.

⚠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

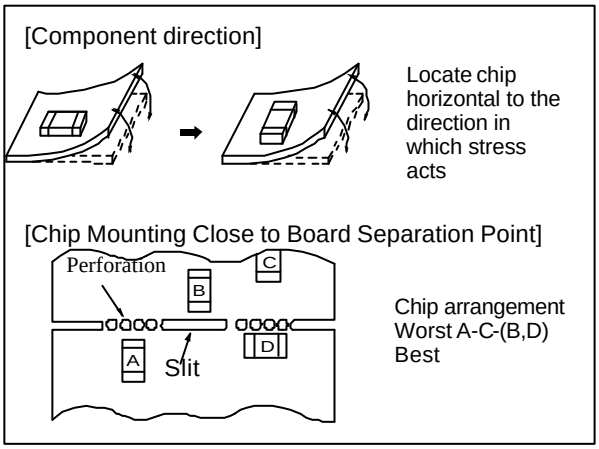
· In the handling of reel and case, please pay attention not to drop it. Please do not use chip of the case which dropped.

⚠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.

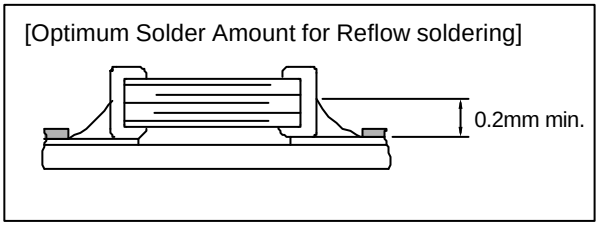


2.Solder Paste Printing

●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.

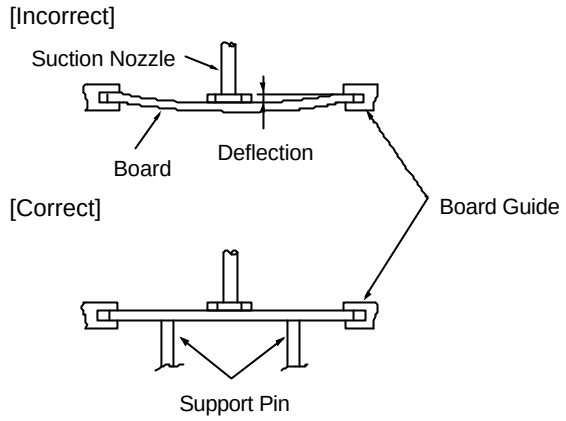
●Make sure the solder has been applied smoothly to the end surface to a height of 0.2mm min.



3.Chip Placing

●An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips. So adjust the suction nozzle's bottom dead point by correcting warp in the board.
Normally, the suction 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, 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.



4.Reflow Soldering

●Sudden heating of the chip results in distortion due to excessive expansion and construction forces within the chip causing cracked chips. So when preheating, keep temperature differential, ΔT, within the range shown in Table 1. The smaller the ΔT, the less stress on the chip.

●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.

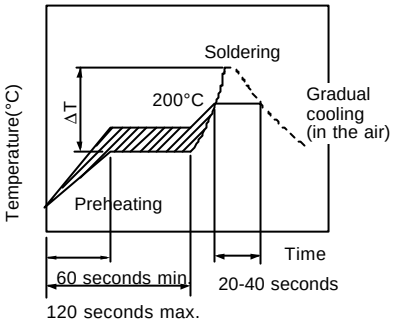
●When components are immersed in solvent after mounting, be sure to maintain the temperature difference (ΔT) between the component and solvent within the range shown in the above table.

Table 1

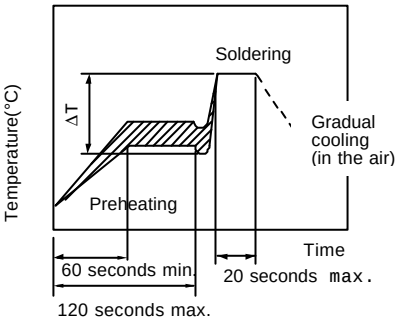
Part Number	Temperature Differential
GR□02/03/15 GR□18/21/31	ΔT ≦ 190°C
GR□32/43/55	ΔT ≦ 130°C

[Standard Conditions for Reflow Soldering]

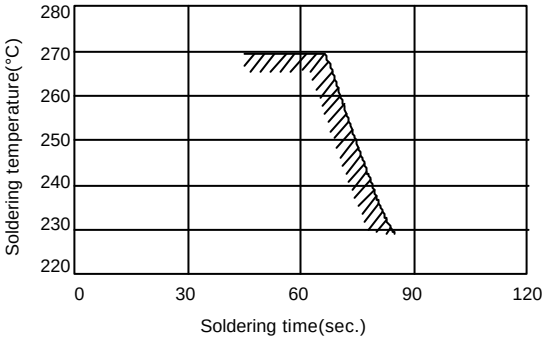
Infrared Reflow



Vapor Reflow



[Allowable Soldering Temperature and Time]



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

Inverting the PCB

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

5.Leaded Component Insertion

If the PCB is flexed when leaded components (such as transformers and ICs) are being mounted, chips may crack and solder joints may break.

Before mounting leaded components, support the PCB using backup pins or special jigs prevent warping.

6.Flow Soldering

- Sudden heating of the chip results in thermal distortion causing cracked chips. And an excessively long soldering time or high soldering temperature results in leaching of the outer electrodes, causing poor adhesion or a reduction in capacitance value due to loss of contact between electrodes and end termination.
- When preheating, keep temperature differential between solder temperature and chip surface temperature, ΔT, within the range shown in Table 2. The smaller the ΔT, the less stress on the chip.

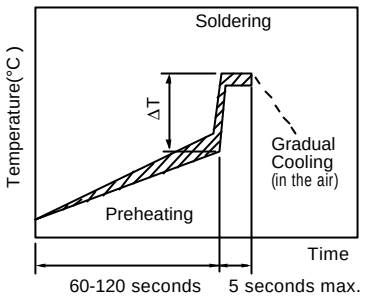
  When components are immersed in solvent after mounting, be sure to maintain the temperature difference between the component and solvent within the range shown in Table 2.

  Don't apply flow soldering to chips not listed in Table 2.

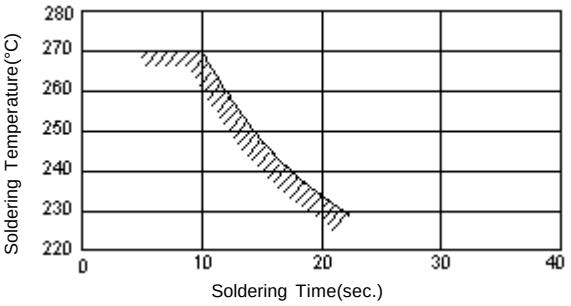
Table 2

Part Number	Temperature Differential
GR□18/21/31	$\Delta T \leqq 150°C$

[Standard Conditions for Flow Soldering]

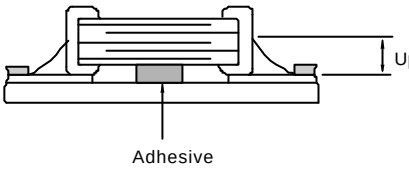


[Allowable Soldering Temperature and Time]



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

- Optimum Solder Amount for Flow Soldering



7.Correction with a Soldering Iron

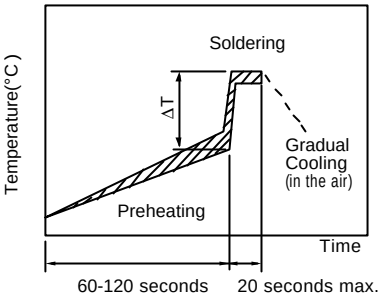
(1)For Chip Type Capacitors

●Sudden heating of the chip results in distortion due to a high internal temperature differential, causing cracked chips. When preheating, keep temperature differential, ΔT, within the range shown in Table 3. The smaller the ΔT, the less stress on the chip.

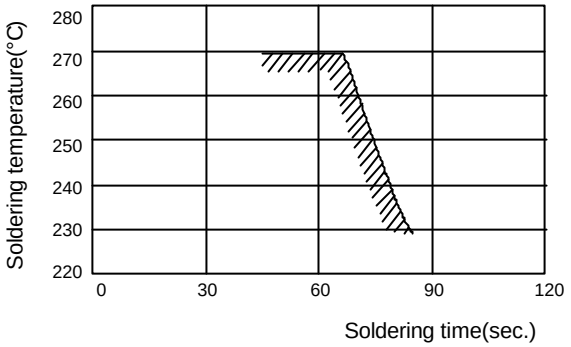
Table 3

Part Number	Temperature Differential
GR□03/15 GR□18/21/31	$\Delta T \leqq 190°C$
GR□32/43/55	$\Delta T \leqq 130°C$

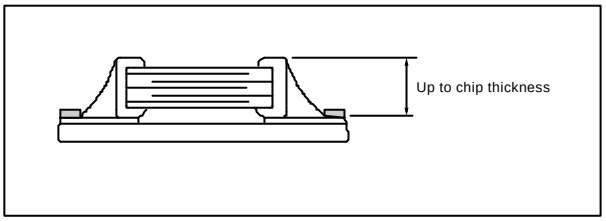
[Standard Conditions for Soldering Iron Temperature]



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



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



8.Washing

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

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

NOTICE

■Soldering and Mounting

1.PCB Design

(1)Notice for Pattern Forms

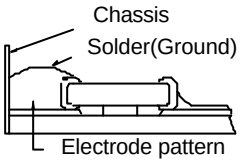
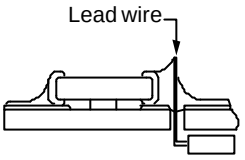
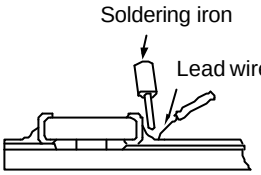
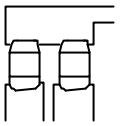
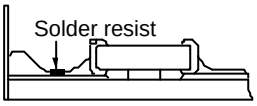
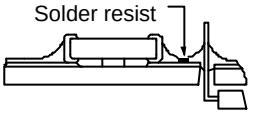
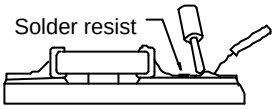
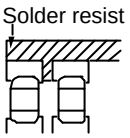
Unlike leaded components, chip components are susceptible to flexing stresses since they are mounted directly on the substrate.

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
Incorrect				
Correct				

(2)Land Dimensions

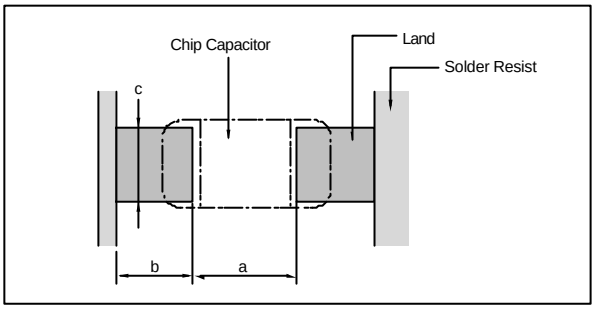


Table 1 Flow Soldering Method

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

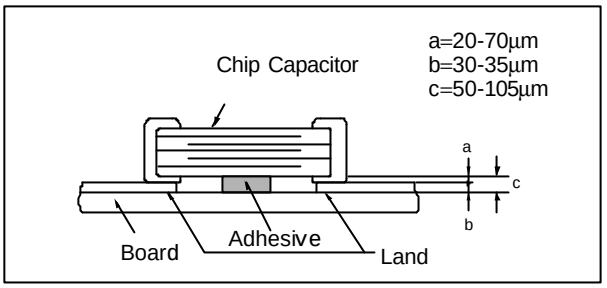
Dimensions / Part Number	Dimensions(L X W)	a	b	c
GR□02	0.4 X 0.2	0.16-0.2	0.12-0.18	0.2-0.23
GR□03	0.6 X 0.3	0.2-0.3	0.2-0.35	0.2-0.4
GR□15	1.0 X 0.5	0.3-0.5	0.35-0.45	0.4-0.6
GR□18	1.6 X 0.8	0.6-0.8	0.6-0.7	0.6-0.8
GR□21	2.0 X 1.25	1.0-1.2	0.6-0.7	0.8-1.1
GR□31	3.2 X 1.6	2.2-2.4	0.8-0.9	1.0-1.4
GR□32	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.

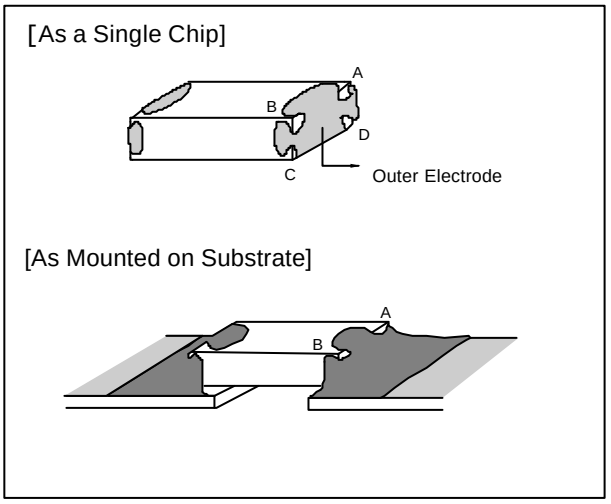
4.Flux Application

●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 cleaned. Use flux with a halide content of 0.2% max.
But do not use strongly acidic flux.
Wash thoroughly because water-soluble flux causes deteriorated insulation resistance between outer electrodes unless sufficiently cleaned.

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.