Reference Spec No.: JEMK4132-0412

Reference Specification

Chip Monolithic Ceramic Capacitor specific application

(GR4 Series X7R Char. Test Voltage DC3kV)

Product Engineering Section
High Voltage Capacitor Group
Izumo Murata Manufacturing Co., Ltd.

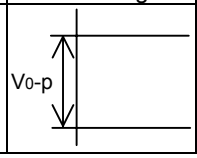
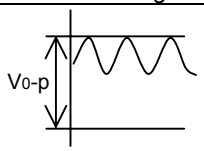
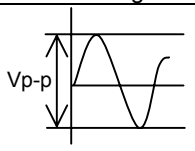
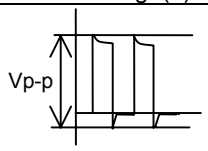
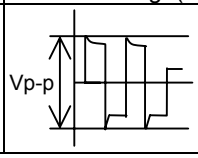
Reference only

⚠ CAUTION

1.OPERATING VOLTAGE

When DC-rated capacitors are to be used in AC or ripple current circuits, be sure to maintain the Vp-p value of the applied voltage or the Vo-p which contains DC bias within the rated voltage range. When the voltage is started to apply to the circuit or it is stopped applying, the irregular voltage may be generated for a transit period because of resonance or switching. Be sure to use a capacitor within rated voltage containing these irregular voltage.

When DC-rated capacitors are to be used in input circuits from commercial power source (AC filter), be sure to use Safety Recognized Capacitors because various regulations on withstand voltage or impulse withstand established for each equipment should be taken into considerations.

Voltage	DC Voltage	DC+AC Voltage	AC Voltage	Pulse Voltage(1)	Pulse Voltage(2)
Positional Measurement					

2.OPERATING TEMPERATURE AND SELF-GENERATED HEAT

Keep the surface temperature of a capacitor below the upper limit of its rated operating temperature range. Be sure to take into account the heat generated by the capacitor itself. When the capacitor is used in a high-frequency current, pulse current or the like, it may have the self-generated heat due to dielectric-loss. Applied voltage should be load such as self-generated heat is within 20°C on the condition of atmosphere temperature 25°C. When measuring, use a thermocouple of small thermal capacity-K of ϕ0.1mm and be in the condition where capacitor is not affected by radiant heat of other components and wind of surroundings. Excessive heat may lead to deterioration of the capacitor's characteristics and reliability. (Never attempt to perform measurement with the cooling fan running. Otherwise, accurate measurement cannot be ensured.)

3.TEST CONDITION FOR AC WITHSTANDING VOLTAGE

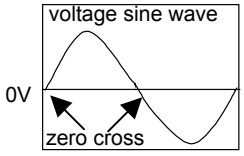
(1)TEST EQUIPMENT

Test equipment for AC withstanding voltage shall be used with the performance of the wave similar to 50/60 Hz sine wave. If the distorted sine wave or overload exceeding the specified voltage value is applied, the defective may be caused.

(2)VOLTAGE APPLIED METHOD

When the withstanding voltage is applied, capacitor's lead or terminal shall be firmly connected to the out-put of the withstanding voltage test equipment, and then the voltage shall be raised from near zero to the test voltage. If the test voltage without the raise from near zero voltage would be applied directly to capacitor, test voltage should be applied with the *zero cross. At the end of the test time, the test voltage shall be reduced to near zero, and then capacitor's lead or terminal shall be taken off the out-put of the withstanding voltage test equipment. If the test voltage without the raise from near zero voltage would be applied directly to capacitor, the surge voltage may arise, and therefore, the defective may be caused.

*ZERO CROSS is the point where voltage sine wave pass 0V.
- See the right figure -



4.FAIL-SAFE

When capacitor would be broken, failure may result in a short circuit. Be sure to provide an appropriate fail-safe function like a fuse on your product if failure would follow an electric shock, fire or fume.

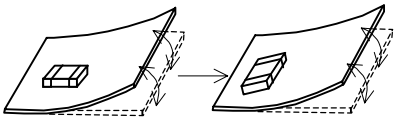
5. VIBRATION AND IMPACT

Do not expose a capacitor or its leads to excessive shock or vibration during use.

6.LAND LAYOUT FOR CROPPING PC BOARD

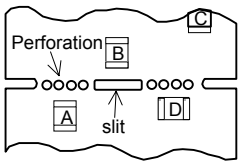
Choose a mounting position that minimizes imposed on the chip during flexing or bending of the board.

[Component direction]



Locate chip horizontal to the direction in which stress acts.

[Chip Mounting Close to Board Separation Point]



Chip arrangement
Worst A>C>B~D Best

7. CIRCUIT BOARD MATERIAL

In case that ceramic chip capacitor is soldered on the metal board, such as Aluminum board, the stress of heat expansion and contraction might cause the crack of ceramic capacitor, due to the difference of thermal expansion coefficient between metal board and ceramic chip.

Reference only

8. SOLDERING

8-1. Reflow Soldering

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

(2) 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.

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

Table 1

Part Number	Temperature Differential
G□□18/21/31	ΔT≦190°C
G□□32/42/43/52/55	ΔT≦130°C

Recommended Conditions

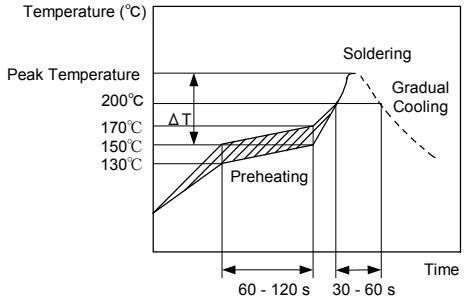
	Pb-Sn Solder		Lead Free Solder
	Infrared Reflow	Vapor Reflow	
Peak Temperature	230-250°C	230-240°C	240-260°C
Atmosphere	Air	Air	Air or N2

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

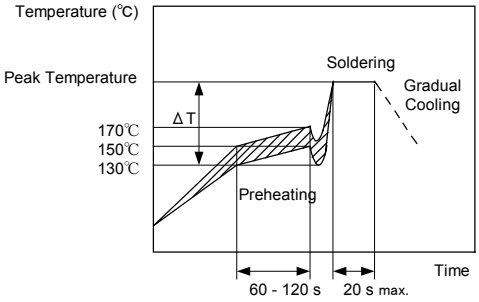
(4) Optimum Solder Amount for Reflow Soldering
- Overly thick application of solder paste results in excesive fillet height solder. This makes the chip more susceptible to mechanical and thermal stress on the board and may cause cracked chips.
- Too little solder paste results in a lack of adhesive strength 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.

[Standard Conditions for Reflow Soldering]

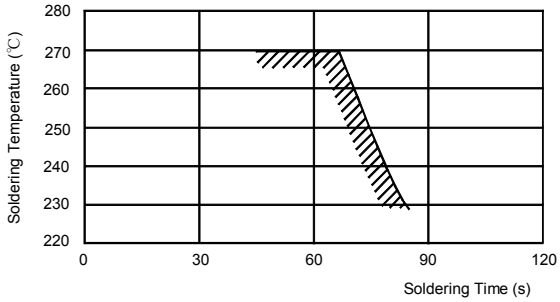
Infrared Reflow



Vapor Reflow

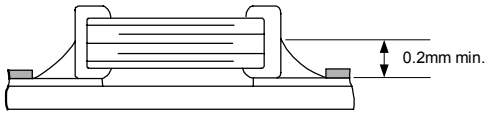


[Allowable Soldering Temperature and Time]



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

[Optimum Solder Amount for Reflow Soldering]



Inverting the PCB

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

Reference only

8-2. Flow Soldering

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

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

Table 2

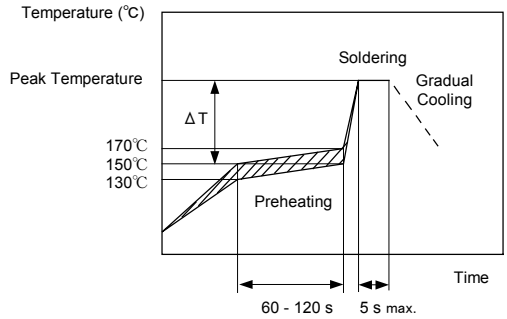
Part Number	Temperature Differential
G□□18/21/31	ΔT≦150°C

Recommended Conditions

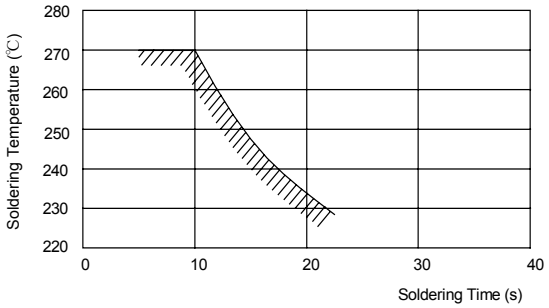
	Pb-Sn Solder	Lead Free Solder
Peak Temperature	240-250°C	250-260°C
Atmosphere	Air	N2

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

[Standard Conditions for Flow Soldering]



[Allowable Soldering Temperature and Time]

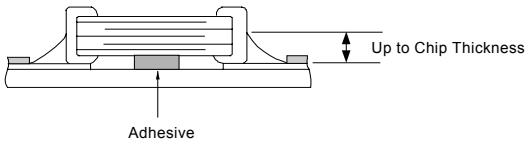


In case of repeated soldering, the accumulated soldering time must be within the range shown above.

(3) Optimum Solder Amount for Flow Soldering

Please refer to right figure.

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



8-3. Correction with a Soldering Iron

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

Reference only

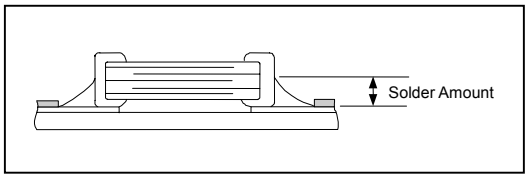
Table 3

Part Number	Temperature of Soldering Iron tip	Preheating Temperature	Temperature Differential (ΔT)	Atmosphere
G□□18/21/31	350°C max.	150°C min.	ΔT≦190°C	air
G□□32/42/43/52/55	280°C max.	150°C min.	ΔT≦130°C	air

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

(2) Optimum Solder Amount when re-working Using a Soldering Iron

In case of smaller sizes than G□□18, the top of the solder fillet should be lower than 2/3's of the thickness of the component or 0.5mm whichever is smaller.
In case of larger sizes than G□□21, the top of the solder fillet should be lower than 2/3's of the thickness of the component. If the solder amount is excessive, the risk of cracking is higher during board bending or under any other stressful conditions. Soldering iron ϕ 3mm or smaller should be used. It is also necessary to keep the soldering iron from touching the components during the re-work. Solder wire with ϕ 0.5mm or smaller is required for soldering.



9. Handling

Do not touch the chip capacitor especially ceramic body directly. The short error on the surface might be occurred by the ion ingredient brought from human finger or hand.

10.OPERATING AND STORAGE ENVIROMENT

Do not use or store capacitors in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. And avoid exposure to moisture. Before cleaning, bonding or molding this product, verify that these processes do not affect product quality by testing the performance of a cleaned, bonded or molded product in the intended equipment. Store the capacitors where the temperature and relative humidity do not exceed 5 to 40°C and 20 to 70%. Use capacitors within 6 months after delivered. Check the solderability in case of 6 months or more.

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

11.LIMITATION OF APPLICATIONS

Please contact us before using our products for the applications listed below which require especially high reliability for the prevention of defects which might directly cause damage to the third party's life, body or property.

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

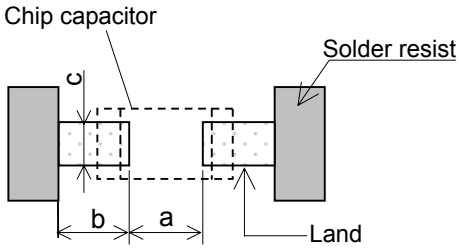
Reference only

♦NOTICE

1.CONSTRUCTION OF BOARD PATTERN

After installing chips, if solder is excessively applied to the circuit board, mechanical stress will cause destruction resistance characteristics to lower. To prevent this, be extremely careful in determining shape and dimension before designing the circuit board diagram.

1-1.Construction and dimensions of pattern (example)



•Reflow soldering

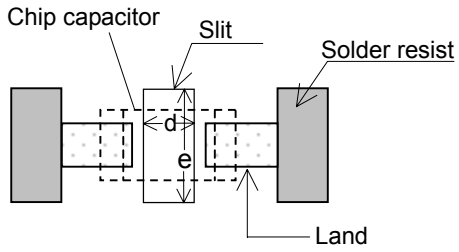
(L × W)	a	b	c
1.6 × 0.8	0.6 to 0.8	0.6 to 0.7	0.6 to 0.8
2.0 × 1.25	1.0 to 1.2	0.6 to 0.7	0.8 to 1.1
3.2 × 1.6	2.2 to 2.4	0.8 to 0.9	1.0 to 1.4
3.2 × 2.5	2.0 to 2.4	1.0 to 1.2	1.8 to 2.3
4.5 × 2.0	2.8 to 3.4	1.2 to 1.4	1.4 to 1.8
4.5 × 3.2	2.8 to 3.4	1.2 to 1.4	2.3 to 3.0
5.7 × 2.8	4.0 to 4.6	1.4 to 1.6	2.1 to 2.6
5.7 × 5.0	4.0 to 4.6	1.4 to 1.6	3.5 to 4.8

•Flow soldering

∗Flow soldering : 3.2×1.6 or less available.

(L × W)	a	b	c
1.6 × 0.8	0.6 to 1.0	0.8 to 0.9	0.6 to 0.8
2.0 × 1.25	1.0 to 1.2	0.9 to 1.0	0.8 to 1.1
3.2 × 1.6	2.2 to 2.6	1.0 to 1.1	1.0 to 1.4

1-2. Dimension of slit (example)

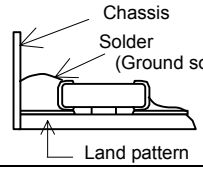
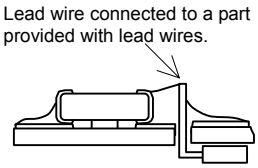
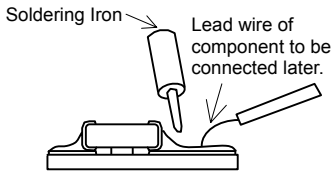
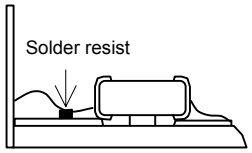
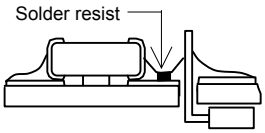
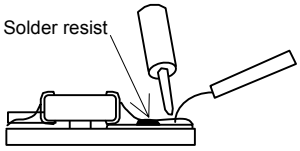


(L × W)	d	e
1.6 × 0.8	-	-
2.0 × 1.25	-	-
3.2 × 1.6	1.0 to 2.0	3.2 to 3.7
3.2 × 2.5	1.0 to 2.0	4.1 to 4.6
4.5 × 2.0	1.0 to 2.8	3.6 to 4.1
4.5 × 3.2	1.0 to 2.8	4.8 to 5.3
5.7 × 2.8	1.0 to 4.0	4.4 to 4.9
5.7 × 5.0	1.0 to 4.0	6.6 to 7.1

∗Preparing slit help flux cleaning and resin coating on the back of the capacitor.
But, the length of slit design should be shorter enough as much as possible to prevent the mechanical damage in the capacitor.
The longer slit design might receive more severe mechanical stress from the PCB.
Recommendable slit design is shown in the Table.

Reference only

1-3. Land layout to prevent excessive solder

	Mounting close to a chassis	Mounting with leaded components	Mounting leaded Components later
Example of Prohibition			
Examples of improvements by the land division			

2.MOUNTING OF CHIPS

2-1.Thickness of adhesives applied

Keep thickness of achesives applied (50-105μm or more) to re-inforce the adhesive contact considering the thickness of the termination or capacitor (20-70μm) and the land pattern (30-35μm).

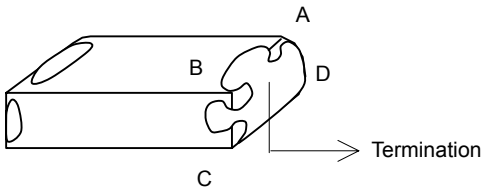
2-2.Mechanical shock of the chip placer

When the positioning claws and pick up nozzle are worn, the load is applied to the chip while positioning is concentrated to one position, thus causing cracks, breakage, faulty positioning accuracy, etc. Careful checking and maintenance are necessary to prevent unexpected trouble. An excessively low bottom dead point of the suction nozzle imposes great force on the chip during mounting, causing cracked chips. Please set the suction nozzle's bottom dead point on the upper surface of the board.

3.SOLDERING

3-1.Limit of losing effective area of the terminations and conditions needed for soldering.

Depending on the conditions of the soldering temperature and/or immersion(melting time), effective areas may be lost in some part of the terminations. To prevent this, be careful in soldering so that any possible loss of the effective area on the terminations will securely remain minimum 25% on all edge length A-B-C-D-A of part with A,B,C,D, shown in the Figure below.



3-2.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 percentage of halide may cause corrosion of the outer electrodes unless sufficient cleaning. Use flux with a halide content of 0.2% max.
- Do not use strong acidic flux.
- Do not use water-soluble flux*.

(*Water-soluble flux can be defined as non rosin type flux including wash-type flux and non-wash-type flux.)

Reference only

4.CLEANING

Please confirm there is no problem in the reliability of the product beforehand when cleaning it with a intended equipment. The residual substance after cleaning might cause the decrease in the surface resistance of the chip and the corrosion of the electrode part, etc. As a result might cause reliability to deteriorate.

Please confirm there is not problem with a intended equipment in the ultrasonic cleansing beforehand.

5.ROSIN COATING

Please use it after confirming there is no influence on the product with a intended equipment beforehand rosin coating or molding. The chip crack might be caused at the thermal unever thickness of the rosin.

When selecting rosin materials, select those with low contraction and low moisture absorption coefficient (generally epoxy rosin is used).

6.CAPACITANCE CHANGE OF CAPACITOR

The capacitor specified in this product specification have an aging characteristic, whereby the capacitor continually decreases its capacitance slightly if the capacitor leaves for a long time. Moreover, capacitance might change greatly depending on a surrounding temperature or an applied voltage. So, it is not likely to be able to use for the time constant circuit. Please contact us if you need a detail information.

⚠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.You are requested not to use our product deviating from this specification.

Reference only

1. Application

This specification is applied to chip monolithic ceramic capacitor GR4 series used for Telecommunication devices (IEEE802.3) in Ethernet LAN and Primary-Secondary Coupling capacitor of DC-DC Converter.

Please contact us when using this product for any other applications than described in the above.

2. Rating

2-1. Operating temperature range -55 to +125°C

2-2. Part name configuration

ex.) GR4 / 42 / Q / R7 / LB / 102 / K / W01 / L

Series	Dimension (L×W)	Dimension (T)	Temperature characteristic	Rated voltage	Capacitance	Capacitance tolerance	Individual specification	Packing style

•Dimension(L×W)

Code	Dimension (mm)		Soldering Method
	L	W	
42	4.5±0.3	2.0±0.2	reflow
43	4.5±0.4	3.2±0.3	reflow
55	5.7±0.4	5.0±0.4	reflow

•Dimension(T)

Code	Dimension (mm)
Q	1.5
D	2.0

•Temperature characteristic

Code	Temperature characteristic
R7	X7R

Please confirm detailed specification on [Specification and test methods].

•Rated voltage

Code	Test voltage
LB	DC3kV

•Capacitance

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

ex.) In case 102.

$10 \times 10^2 = 1000pF$

•Capacitance tolerance

Please refer to [Part number list].

•Individual specification

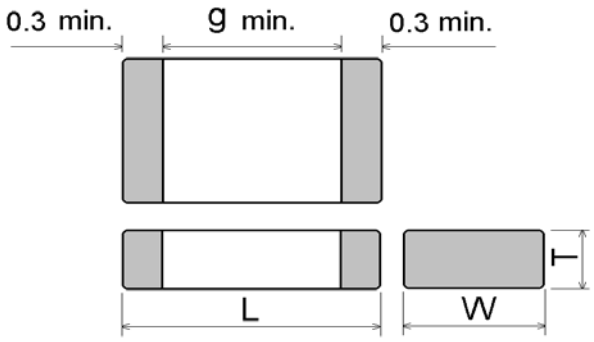
Code	Content
W01	Base metal electrode (Dimension(T) tolerance : +0/-0.3mm)

•Packing style

Code	Style
L	ϕ180mm reel Plastic taping

Reference only

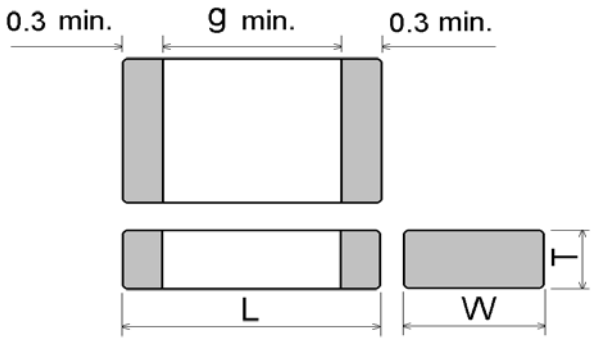
3. Part number list



Unit : mm

T.C.	Cap. (pF)	Cap. Tol.	Customer Part Number	Murata Part Number	DC Test Volt. (V)	Dimension(mm)				Pack Qty. (pcs)
						L	W	T	g	
X7R	100	±10 %		GR442QR7LB101KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	120	±10 %		GR442QR7LB121KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	150	±10 %		GR442QR7LB151KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	180	±10 %		GR442QR7LB181KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	220	±10 %		GR442QR7LB221KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	270	±10 %		GR442QR7LB271KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	330	±10 %		GR442QR7LB331KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	390	±10 %		GR442QR7LB391KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	470	±10 %		GR442QR7LB471KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	560	±10 %		GR442QR7LB561KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	680	±10 %		GR442QR7LB681KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	820	±10 %		GR442QR7LB821KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	1000	±10 %		GR442QR7LB102KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	1200	±10 %		GR442QR7LB122KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	1500	±10 %		GR442QR7LB152KW01L	3000	4.5 ±0.3	2.0 ±0.2	1.5 +0/-0.3	2.5	2000
X7R	1800	±10 %		GR443QR7LB182KW01L	3000	4.5 ±0.4	3.2 ±0.3	1.5 +0/-0.3	2.5	1000
X7R	2200	±10 %		GR443QR7LB222KW01L	3000	4.5 ±0.4	3.2 ±0.3	1.5 +0/-0.3	2.5	1000
X7R	2700	±10 %		GR443QR7LB272KW01L	3000	4.5 ±0.4	3.2 ±0.3	1.5 +0/-0.3	2.5	1000

Reference only



Unit : mm

T.C.	Cap. (pF)	Cap. Tol.	Customer Part Number	Murata Part Number	DC Test Volt. (V)	Dimension(mm)				Pack Qty. (pcs)
						L	W	T	g	
X7R	3300	±10 %		GR443QR7LB332KW01L	3000	4.5 ±0.4	3.2 ±0.3	1.5 +0/-0.3	2.5	1000
X7R	3900	±10 %		GR443QR7LB392KW01L	3000	4.5 ±0.4	3.2 ±0.3	1.5 +0/-0.3	2.5	1000
X7R	4700	±10 %		GR443DR7LB472KW01L	3000	4.5 ±0.4	3.2 ±0.3	2.0 +0/-0.3	2.5	1000

Reference only

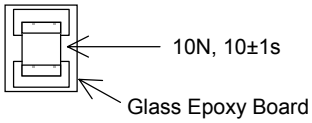
4. Specifications and test methods

No.	Item		Specification	Test method
1	Operating temperature		-55~+125°C	
2	Appearance		No defects or abnormalities	Visual inspection.
3	Dimensions		Within the specified dimension.	Using calipers.
4	Dielectric strength		No defects or abnormalities.	The capacitor shall not be damage when as table is applied between the terminations, provided the charge/discharge current is less than 50mA. Test Voltage: Time DC3000V: 60s AC1.5kV(r.m.s.): 60s
5	Pulse voltage		No self healing break downs or flash-orvers have taken place in the capacitor.	10 impulse of alternating polarity is subjected. (5 impulse for each polarity) The interval between impulse is 60s. Applied Pulse : 1.2/50μs Applied Voltage: 2.5kV$_0$-p
6	Insulation resistance(I.R.)		6000 MΩ or more	The insulation resistance shall be measured with DC500±50V and within 60±5s of charging.
7	Capacitance		Within the specified tolerance.	The capacitance/D.F. shall be measured at the frequency of 1±0.2kHz and a voltage of AC1±0.2V(r.m.s.).
8	Dissipation Factor (D.F.)		0.025 max.	
9	Capacitance Temperature Characteristics		Cap. change within ±15% (Temp. Range : -55 to +125°C)	The capacitance measurement shall be made at each step specified in table. •Pretreatment Perform the heat treatment at 150+0/-10°C for 60±5 min and then let sit for 24±2 h at room condition*.
10	Vibration resistance	Appearance	No defects or abnormalities.	Solder the capacitor to the Test Jig A (glass epoxy board)shown in "Complement of test method". The capacitor shall be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz . The frequency range, from 10 to 55Hz and return to 10Hz, shall be traversed in approximately 1 min. This motion shall be applied for a period of 2 h in each of 3 mutually perpendicular directions (total of 6 h).
		Capacitance	Within the specified tolerance.	
		D.F.	Pass the item No.8.	
11	Solderability of termination		75% of the terminations are to be soldered .	Immerse the capacitor in the solution of ethanol (JIS K 8101) and rosin (JIS K 5902) (25% rosin in weight proportion). Immerse in solder solution for 2±0.5s. Immersing in speed : 25±2.5mm/s Temp. of solder : 245±3°C Lead Free Solder (Sn-3.0Ag-0.5Cu) 235±5°C H60A or H63A (Eutectic Solder)
12	Resistance to soldering heat	Appearance	No marking defects.	Preheat LW ≤ 3.2 x 1.6 : at 120 to 150°C for 1 min. LW ≥3.2 x 1.6 : at 100 to 120°C for 1 min and then at 170 to 200°C for 1 min. Immerse the capacitor in solder solution at 260±5°C for 10±1s. Let sit at room condition* for 24±2 h, then measure. Immersing in speed : 25±2.5mm/s. •Pretreatment Perform the heat treatment at 150+0/-10°C for 60±5 min and then let sit for 24±2 h at room condition*.
		Capacitance change	Within ±10%	
		D.F.	Pass the item No.8.	
		I.R.	1000 MΩ or more	
		Dielectric strength	Pass the item No.4.	

Step	1	2	3	4	5
Temp.(°C)	25±2	-55±3	25±2	125±2	25±2

* "room condition" Temperature:15 to 35°C, Relative humidity:45 to 75%, Atmosphere pressure:86 to 106kPa

Reference only

No.	Item		Specification	Test method
13	Adhesive strength of termination		No removal of the terminations or other defects shall occur.	Solder the capacitor to the test Jig A (glass epoxy board) shown in “Complement of Test method”. Then apply 10N force in the direction of the arrow. 
14	Deflection		No cracking or marking defects shall occur.	Solder the capacitor to the Test Jig B (glass epoxy board) shown in “Complement of test method”. Then apply the force in the direction shown in “Test Method of Deflection” of “Complement of test method”. ・Flexure : 1mm ・Hold time : 5s
15	Temperature cycle	Appearance	No marking defects.	Fix the capacitor to the supporting Test Jig A (glass epoxy board) shown in “Complement of test method”. Perform the 5 cycles according to the 4 heat treatments listed the following table. Step / Temp. (°C) / Time (min) 1 / -55±3 / 30±3 2 / Room Temp. / 2 to 3 3 / 125±2 / 30±3 4 / Room Temp. / 2 to 3 Let sit for 24±2 h at room condition*, then measure. •Pretreatment Perform the heat treatment at 150+0/-10°C for 60±5 min and then let sit for 24±2 h at room condition*.
		Capacitance change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	3000 MΩ or more	
		Dielectric strength	Pass the item No.4.	
16	Humidity (Steady state)	Appearance	No marking defects.	Sit the capacitor at 40±2°C and relative humidity 90 to 95% for 500+24/-0 h. Remove and let sit for 24±2h at *room condition, then measure. •Pretreatment Perform the heat treatment at 150+0/-10°C for 60±5 min and then let sit for 24±2 h at room condition*.
		Capacitance change	Within ±15%	
		D.F.	0.05 max.	
		I.R.	1000 MΩ or more	
		Dielectric strength	Pass the item No.4.	
17	Life	Appearance	No marking defects.	Apply DC2.2kV for 1000+48/-0 h at maximum operating temperature±3°C. Remove and let sit for 24±2h at *room condition, then measure. The charge/discharge current is less than 50mA. •Pretreatment Apply test voltage for 60±5 min at test temperature. Remove and let sit for 24±2 h at *room condition.
		Capacitance change	Within ±20%	
		D.F.	0.05 max.	
		I.R.	2000 MΩ or more	
		Dielectric strength	Pass the item No.4.	

* “room condition” Temperature:15 to 35°C, Relative humidity:45 to 75%, Atmosphere pressure:86 to 106kPa

Reference only

5.Complement of Test Method

5-1.Test Jig

The test jig should be Jig A or Jig B as described in “Specifications and Test methods”.

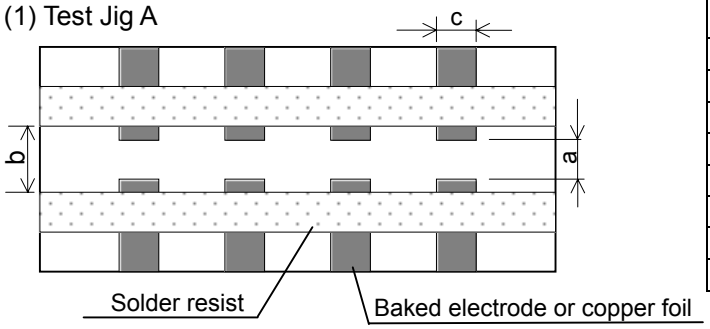
The specimen should be soldered by the conditions as described below.

Soldering Method : Reflow soldering

Thickness of Metal-mask : 200μm (In case of chip size 1.6 x 0.8mm, 150μm)

Solder : Sn-3.0Ag-0.5Cu

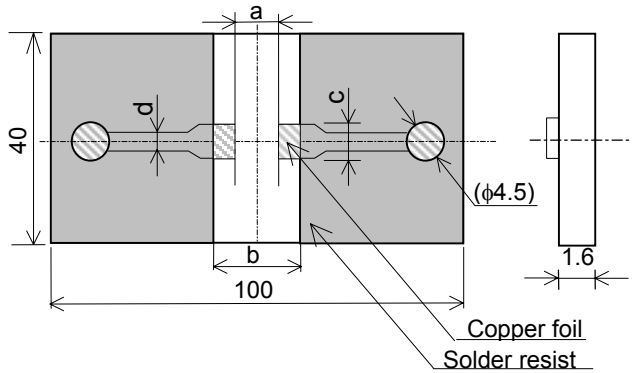
(1) Test Jig A



Dimension of chip [L × W]	Dimension (mm)		
	a	b	c
1.6 × 0.8	1.0	3.0	1.2
2.0 × 1.25	1.2	4.0	1.65
3.2 × 1.6	2.2	5.0	2.0
3.2 × 2.5	2.2	5.0	2.9
4.5 × 2.0	3.5	7.0	2.4
4.5 × 3.2	3.5	7.0	3.7
5.7 × 2.8	4.5	8.0	3.2
5.7 × 5.0	4.5	8.0	5.6

- Material : Glass Epoxy Board
- Thickness : 1.6mm
- Thickness of copper foil : 0.035mm

(2) Test Jig B



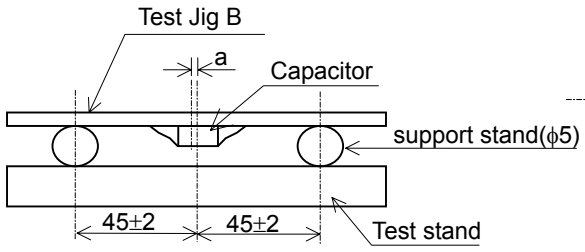
Dimension of chip [L × W]	Dimension of pattern(mm)			
	a	b	c	d
1.6 × 0.8	1.0	3.0	1.2	1.0
2.0 × 1.25	1.2	4.0	1.65	1.0
3.2 × 1.6	2.2	5.0	2.0	1.0
3.2 × 2.5	2.2	5.0	2.9	1.0
4.5 × 2.0	3.5	7.0	2.4	1.0
4.5 × 3.2	3.5	7.0	3.7	1.0
5.7 × 2.8	4.5	8.0	3.2	1.0
5.7 × 5.0	4.5	8.0	5.6	1.0

(unit : mm)

- Material : Glass Epoxy Board
- Thickness of copper foil : 0.035mm

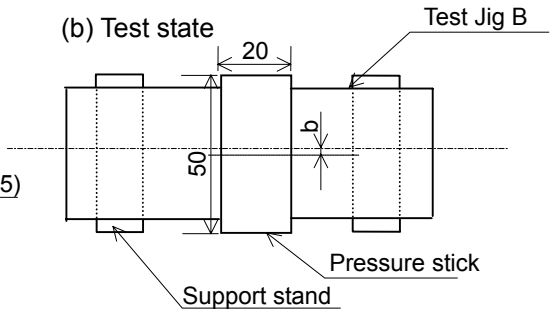
5-2. Test Method of Deflection

(a) Support state



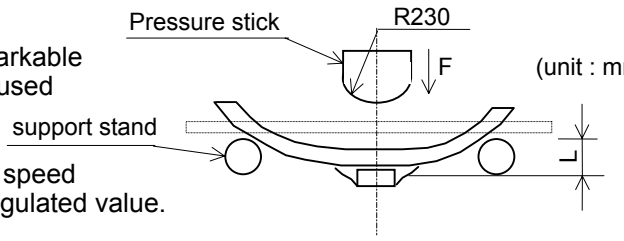
a:±2 gap between support stand center and test stand

(b) Test state



b:±5 gap between support stand center and test stand center

- Material of Test stand and pressure stick
  The material shoud be a metal where a remarkable tran sformation and the distortion are not caused even if it is pressurized.
- Pressurizing speed
  The pressurizing speed is pressurized at the speed of about 1mm/s until the flexure reaches a regulated value.



Reference only

6.Packing (Taping is standard packing method)

(1) Appearance of taping

(a) Paper Tape

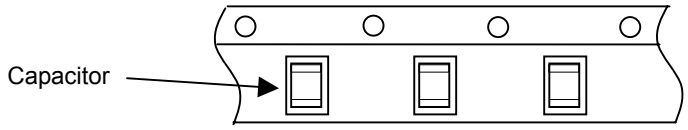
Bottom Tape (Thickness: Around 50μm) is attached below Base Tape with sprocket and put Top Tape (Thickness: Around 50μm) on capacitor.

(b) Plastic Tape

Cover Tape (Thickness: Around 60μm) is put on capacitor on Base Tape (Blister carrier Tape).

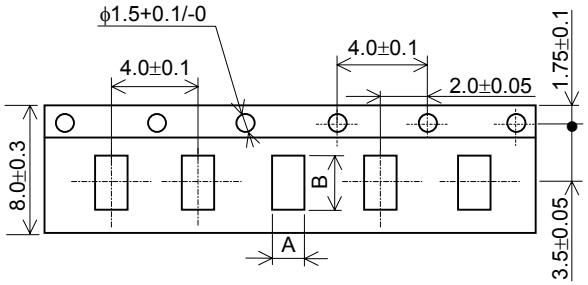
(c) The sprocket holes are to the right as the Tape is pulled toward the user.

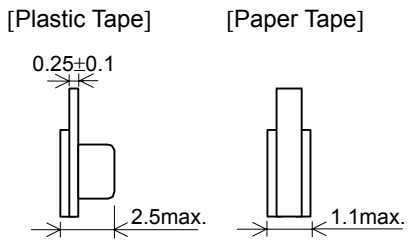
(2) Packed chips



(3) Dimensions of Tape

(a) Type A (Dimensions of chip : Apply to 1.6×0.8 , 2.0×1.25 , 3.2×1.6 , 3.2×2.5)



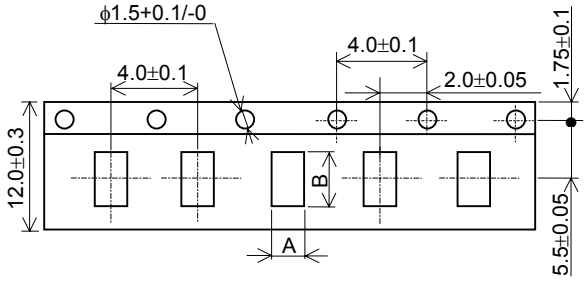


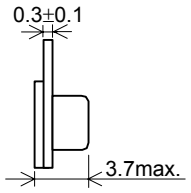
(Unit : mm)

Dimensions of chip [L×W]	A*	B*
1.6×0.8	1.05	1.85
2.0×1.25	1.45	2.25
3.2×1.6	2.0	3.6
3.2×2.5	2.9	3.6

*Dimensions of A,B : Nominal value

(b) Type B (Dimensions of chip : Apply to 4.5×2.0)





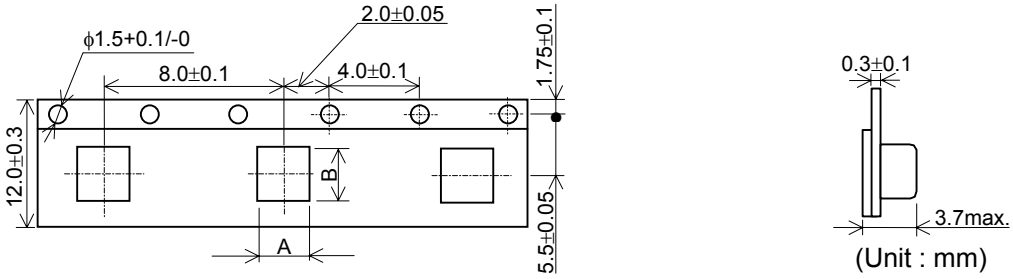
(Unit : mm)

Dimensions of chip [L×W]	A*	B*
4.5×2.0	2.5	5.1

*Dimensions of A,B : Nominal value

Reference only

(c) Type C (Dimensions of chip : Apply to 4.5×3.2 to 5.7×5.0)

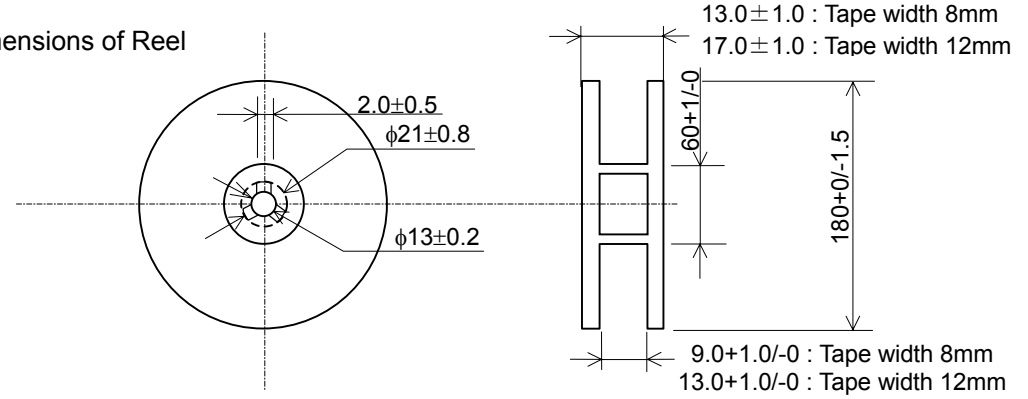


(Unit : mm)

Dimensions of chip [L×W]	A*	B*
4.5×3.2	3.6	4.9
5.7×2.8	3.2	6.1
5.7×5.0	5.4	6.1

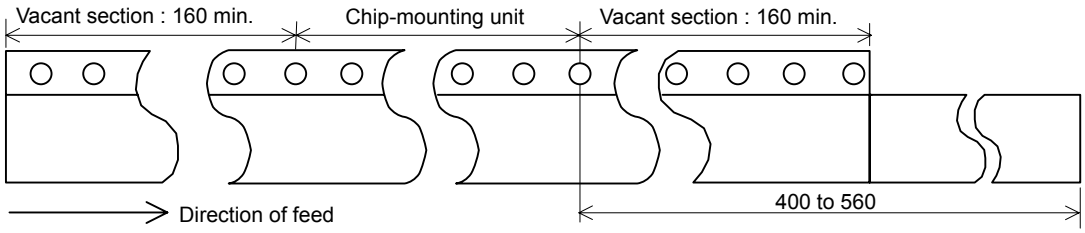
*Dimensions of A,B : Nominal value

(4) Dimensions of Reel



(Unit : mm)

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



(Unit : mm)

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

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

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

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

(10) Peeling off force : 0.1 to 0.6N in the direction shown on the follows.