Operation Notes

Applications

• Chip resistors are designed for general electronic devices such as home appliances, computer, mobile communications, digital circuit, etc. If you require our products with high reliability-performing at more than 125℃ or below -55℃- for medical equipments, aircrafts, high speed machines, military usage, and items that can affect human life or if you need to use in specific conditions (corrosive gas atmosphere like H_2S etc.), please contact us beforehand.

• Normal operation temperature ranges (℃) as follows.
-1608, 2012, 3216(general, precision) : -55℃~+155℃
-Others (rectangular, array, trimmable) : -55℃~+125℃

• Although resistor body is coated, sharp excessive impact should be avoided to prevent damages and adverse effects on characteristics (resistor value, open circuited, T.C.R.).

Mounting

Please give more attention not to press the chip owing to the nozzle's improper height when it is mounted on PCB.
(Excessive pressure may cause exterior damage, change in resistance, circuit open, etc.)

Safety precautions

• These products are designed and produced for applying to the ordinary electronic equipments.
(AV equipment, OA equipment,Telecommunication equipment, etc)
• Consult with our sales department before applying in the devices that require extremely high reliability such as medical equipments, transport equipments, aircrafts/spacecrafts, nuclear power controllers, fuel controllers, car equipments including car accessories and other safety devices.
• Following special environments, and such environmental conditions may affect the performance of the product. Please verify the performance and reliability thoroughly prior to use.

a) Using in various type of Liquid including water, oil, organic solvent and other chemicals.
b) Using in the places where the products are exposed to direct sunlight, sea wind, corrosive gases (including Cl_2, H_2S, NH_3, SO_2, NO_2), static electricity, electromagnetic waves and dusty air.
c) Using close to heat generating components or other flammable items.
d) Using in the places that is sealed or coated with resins or other coating materials after soldering.
e) Using in places subject to dew condensation.

• These products are not radiation resistant.
• The company is not responsible for any problems resulting from using of the products under the conditions not recommended herein.
• The company should notify any safety issues of the products to the customer. And the safety of the products should be monitored by the customer periodically.

Storage

To maintain proper quality of chip components, the following precautions are required for storage environment, method and period.

•Storage Environment
- Make sure that the ambient temperature is within 5℃~40℃ and the ambient humidity is within 20~70%RH.
- Chip components may be deformed, if the temperature of packaged components exceeds 40℃.
- Do not store where the soldering properties can be deteriorated by harmful gas such as sulphurous gas, chlorine gas, etc.
- Bulk packed chip components should be used as soon as the seal is opened, thus preventing the solderability from deteriorating.
- The remaining unused chips should be put in the original bag and sealed again or store in a desiccator containing a desiccating agent.

•Storage Time Period
Stored chip components should be used within 6 months after receiving the components. If 6 months or more have elapsed, please check the solderability before actually using.

Cleaning

After Soldering Cleaning, soldering flux & Ionic cleaning liquid should be avoided on product.
If any possibility on product, please take a test before usage.

Caution for Chip Resistor Seperation from PCB.

Chip resistor installation on PCB is a similar phenomenon on to a chocolate chip on top of a cake.
PCB has enough flexibility on outer force but Chip resistor can be defected without any bending.
(By chip resistor use of Ceramic, solder, metal)
Therefore, when separating a Chip resistor from a PCB, beware of any crack on the chip.

Others

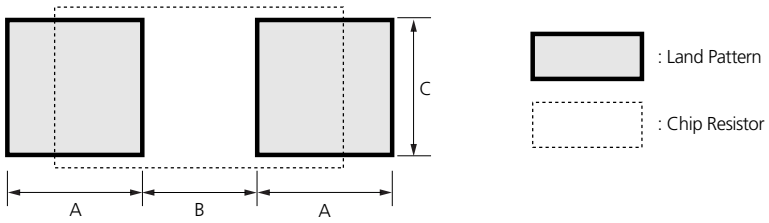
• Manual work
Whenever separating chip resistor from PCB, do not re-use the chip resistor for circuit safety.
Electrical specification of chip resistors can be changed by soldering iron after separation.
Re-use of separated chip resistor should be prohibited.

• Do not use more than rated voltage.
(Please check the contents of each product)

Example of Land Pattern Design

• When designing P.C.B, the shape and size of the solder lands must allow for the proper amount of solder under the resistor.
The amount of solder at the end terminations has a direct effect on the probability that the chip will crack.
The greater amount of solder, the amount of stress on the chip, and the more likely that it will break.
Use the following illustrations as guidelines for proper 'solder lands design'.

For Chip Type



• Reflow soldering (UNIT: mm)

Type	A	B	2A+B	C
0402	0.17	0.20	0.54	0.18
0603	0.37	0.28	1.02	0.29
1005	0.6	0.5	1.7	0.5
1608	0.8	0.8	2.4	0.8
2012	0.9	1.4	3.2	1.2
3216	1.3	1.8	4.4	1.5
3225	1.3	1.8	4.4	2.4
5025	1.4	3.3	6.1	2.4
6432	1.4	4.6	7.4	3.0

• Reflow soldering(RU,RUW,RUK) (UNIT: mm)

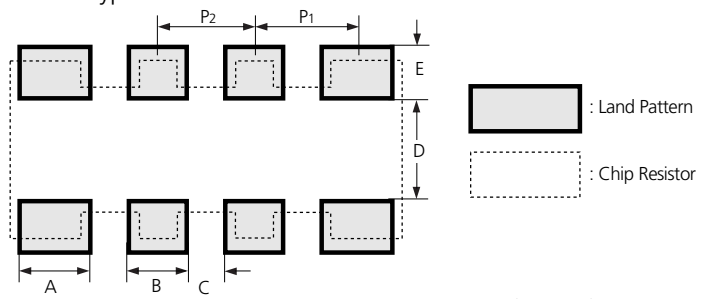
Type	A	B	2A+B	C
1005	0.8	0.5	2.1	0.5
1608	0.8	0.5	2.1	0.8
2012	0.9	0.8	2.6	1.2
3216	1.7	1.2	4.6	1.4
5025	2.15	1.8	6.1	2.6
6432	2.3	3.0	7.6	3.3

• Flow soldering (UNIT: mm)

Type	A	B	2A+B	C
1005	0.7	0.5	1.9	0.5
1608	0.9	0.8	2.6	0.8
2012	1.0	1.4	3.4	1.3
3216	1.4	1.8	4.6	1.6
3225	1.4	1.8	4.6	2.6
5025	1.5	3.3	6.3	2.5
6432	1.5	4.6	7.6	3.2

For Array Type

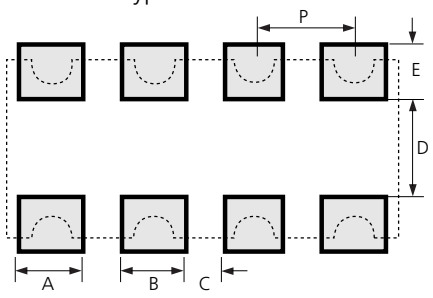
• Convex type



(UNIT: mm)

Type	A	B	C	D	E	P1	P2
062P	0.20	0.20	0.30	0.30	0.30	0.6	-
064P	0.20	0.20	0.20	0.30	0.30	0.5	0.5
10AT	0.4	0.4	0.25	0.5	0.5	0.65	-
102P	0.4	0.4	0.25	0.5	0.5	0.65	
104P	0.7	0.3	0.2	0.5	0.5	0.55	0.5
164P	0.7	0.5	0.3	0.9	0.8	0.9	0.8

• Concave type



(UNIT: mm)

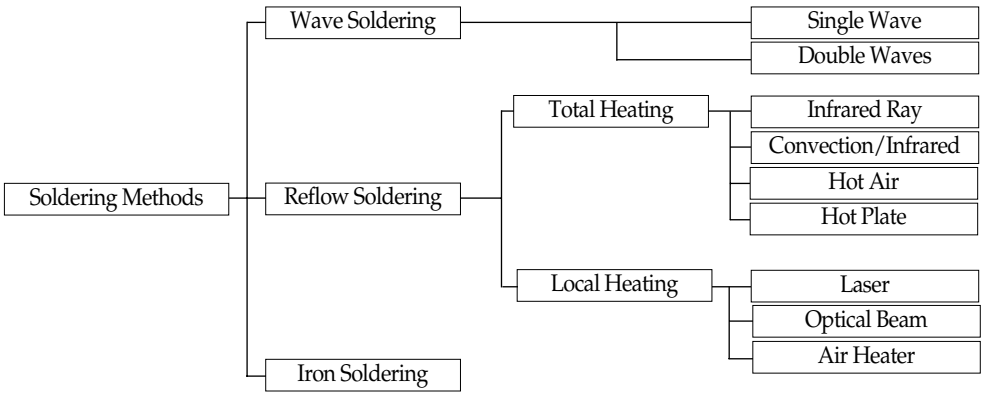
Type	A	B	C	D	E	P
102P	0.3	0.3	0.2	0.5	0.4	0.5
104P	0.3	0.3	0.2	0.5	0.4	0.5

• This is the recommended land pattern for designing PCB.
This pattern does not guarantee any characteristic of other product.

Recommended Soldering Conditions

Abstract

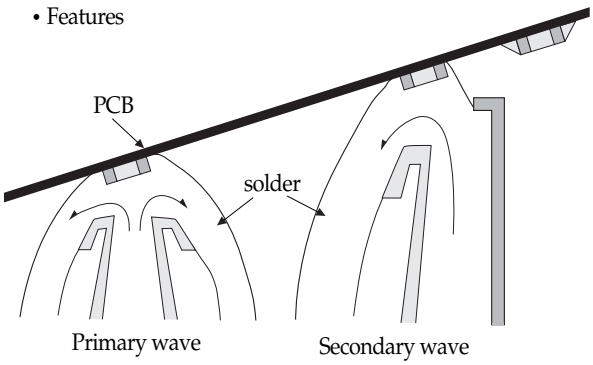
• There are 3 soldering methods.
- Flow(wave) soldering.
- Reflow soldering. (Reflow soldering is broadly divided into the total heating method and local heating method.)
- Iron soldering.



Since Chip resistors come into direct contact with melted solder during soldering, it is exposed to potential mechanical stress caused by the sudden temperature change. The chip resistors may also be subject to silver migration, and to contamination by the flux. Because of these factors, soldering technique is critical.

Flow(wave) Soldering

• Features



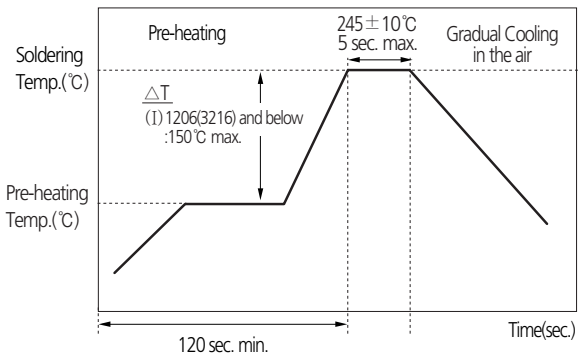
There are two types of soldering methods in flow(wave) soldering. One is single wave soldering, the other is a double waves soldering. However, double waves soldering is mainly used. This method is designed so that the continuous and multiple dipping processes by waves of solder having completely different primary and secondary characteristics and waveforms.
With the primary wave, a comparatively strong jet flow is used to remove the flux gas and to solder.
With the secondary wave, it is used to remove excessive solder.
With the primary wave, the solder flows into a very small gap between components and air bubbles remaining on the soldered joint are removed.
With the secondary wave, the peel back is used to prevent bridging.

• Preheating

If a chip component is heated suddenly during soldering, it may be cracked by the thermal shock caused by the temperature difference between the surface and the inside of the chip. To prevent this, a full preheating is necessary. In case of wave soldering, the temperature difference between solder and surface of the component is kept within 150℃. Also when cooling is done by dipping into solvent, care should be taken to keep the temperature difference within 150℃.

• Standard Soldering Condition

Soldering must be carried out without exceeding the approved soldering temperature and time shown within the shaded area of the right graph. An excessively long soldering time or high soldering temperature results in leaching of the outer terminations. When a PCB is warped, mechanical stress applied to the chip will be increased and might be a cause of chip crack, especially if there is big amount of solder on the chip. So, care should be taken not to use excessive amount of solder on the PCB. For the flow(wave) soldering, the solder amount can be controlled by land size.

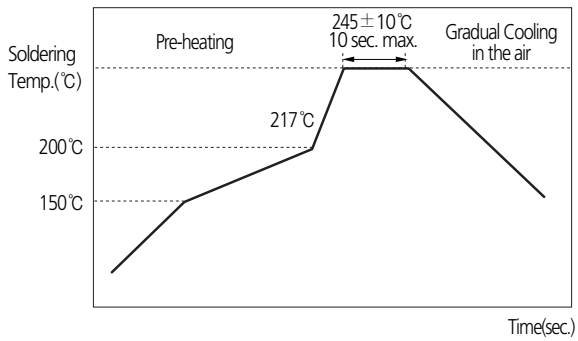


< Flow Soldering>

Reflow Soldering

• Pre-heating and cooling
In the reflow soldering method, a full pre-heating at the proper temperature is necessary to dry and activate solder paste. Tomb-stoning can be reduced by preheating at 150~180℃ for more than 1 minute. Also when cooling is done by dipping into solvent, care should be taken to keep the temperature difference within 150℃.

• Standard Reflow Soldering Condition
Soldering must be carried out without exceeding the approved soldering temperature and time shown within the shaded area of the right graph. This prevents the terminations from leaching and characteristics from deteriorating. When soldering is repeated, the allowed time is the accumulated time.



< Reflow Soldering>

• Standard solder amount
When a PCB is warped, mechanical stress applied to the chip should be reduced, and for doing so, care should be taken not to use excessive amount of solder on the PCB. In case of the reflow method, the thickness of the coated solder paste is controlled to prevent excessive solder. The thickness of solder paste should be 100~300㎛.

• Tombstoning and Prevention
When reflow soldering, or especially vapor phase soldering (VPS), small chip components of less than RC3216 type may break away from solder and stand on end. This is commonly known as tombstoning or the Manhattan phenomenon.

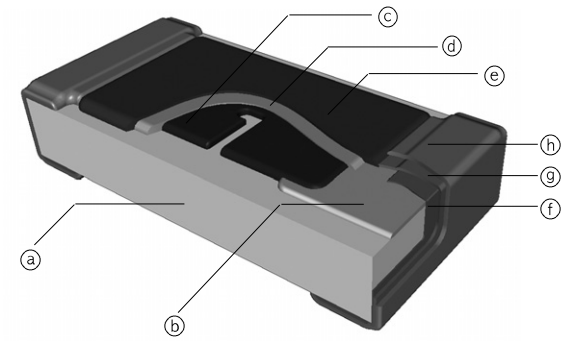
- Preventing tombstoning
Keep land size as small as possible.
Keep the pre-heating conditions properly
(Pre-heating temperature : 150 ~ 180°, Pre-heating time : more than 1 min.)
Keep the solder paste quantity not too much and uniform for every lands.
Keep the position of chips properly.
At around the soldering temperature, keep minimize the difference of the temperature between the electrodes of a chip.

Iron Soldering

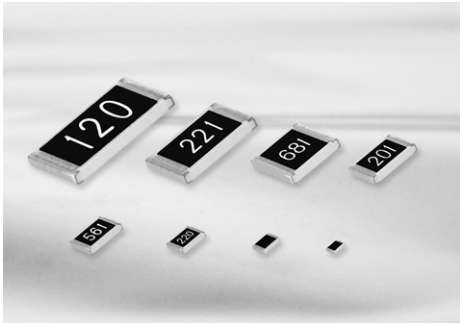
When using a soldering iron or any other soldering operation, the permissible temperature and time should not be exceeded that in the reflow soldering. In other to prevent the external terminations from leaching and characteristics from deteriorating, the tip of the soldering iron should not touch the chip component (ceramic element, resin case, etc.). Soldering with a soldering iron and correcting with a soldering iron can be performed right the following conditions.

Item	Condition
Temperature at tip	350℃ Max.
Soldering iron output	20-Watt Max.
End of soldering iron	ø3mm Max.
Note	Do not directly touch the chip by the tip of the iron.

General Structure of the Chip Resistor



No.	Name	Main Substance
ⓐ	Ceramic Substrate	Al_2O_3
ⓑ	Inner Electrode	Ag / Cu
ⓒ	Resistor	Ag-Pd / Cu-Ni
ⓓ	Glass Coat	Bi_2O_3, SiO_2
ⓔ	Protective Coat	Polymer / Glass
ⓕ	Terminal Coat	Ni-Cr Alloy
ⓖ	Ni Plate	Ni
ⓗ	Sn Plate	Sn



Feature

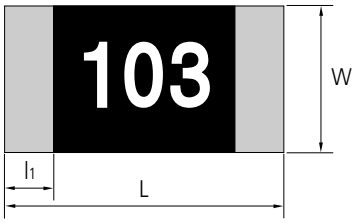
- Very small, thin, and light weight.
- Both flow and reflow soldering are applicable.
- Owing to the reduced lead inductance, the high frequency characteristic is excellent.
- Suitable size and packaging for surface mount assembly.

The product of lead-free terminal is RoHS compliant.
PbO(lead oxide) is included in the glass of our product which is prescribed on RoHS appendix as an exception.

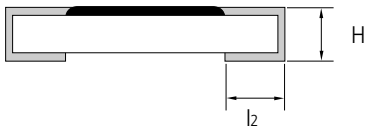
Application

- General purpose
- Home Appliances
  (DVD, Digital TV,CAMCODER, VTR, Digital Camera, Audio,Tunner)
- For Computers & Communications
  (Notebook, Memory Module, Mobile, Network Equipment, etc)

Structure and Dimensions



〈Top View〉



〈Side View〉

(UNIT: mm)

Type	Inch	Power(W)	L	W	H	l_1	l_2	Average Weight
RC0402	01005	1/32	0.40±0.02	0.20±0.02	0.13±0.02	0.10±0.03	0.10±0.03	0.04㎎
RC0603	0201	1/20	0.60±0.03	0.30±0.03	0.23±0.03	0.10±0.05	0.15±0.05	0.15㎎
RC1005	0402	1/16	1.00±0.05	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10	0.6㎎
RC1608	0603	1/10	1.60±0.10	0.80±0.15	0.45±0.10	0.30±0.20	0.35±0.10	2.1㎎
RC2012	0805	1/8	2.00±0.20	1.25±0.15	0.50±0.10	0.40±0.20	0.35±0.20	4.9㎎
RC3216	1206	1/4	3.20±0.20	1.60±0.15	0.55±0.10	0.45±0.20	0.40±0.20	9.5㎎
RC3225	1210	1/3	3.20±0.20	2.55±0.20	0.55±0.10	0.45±0.20	0.40±0.20	16㎎
RC5025	2010	2/3	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20	26㎎
RC6432	2512	1	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20	41㎎

Parts Numbering System

- The part number system shall be in the following format

RC Code Designation	2012 Dimension & Size Code	J Tolerance	100 Resistance Value	CS Packaging Code
RC: Chip Resistor	0402: 0.4×0.2(㎜) - 01005(inch) 0603: 0.6×0.3(㎜) - 0201(inch) 1005: 1.0×0.5(㎜) - 0402(inch) 1608: 1.6×0.8(㎜) - 0603(inch) 2012: 2.0×1.2(㎜) - 0805(inch) 3216: 3.2×1.6(㎜) - 1206(inch) 3225: 3.2×2.5(㎜) - 1210(inch) 5025: 5.0×2.5(㎜) - 2010(inch) 6432: 6.4×3.2(㎜) - 2512(inch)	F: ±1% G: ±2% J: ±5% K: ±10%	3 or 4 digits coding system (IEC coding system) 3digits (E-24 series) 4digits (E-96 series)	GS: Bulk Packaging CS: Tape Packaging 7" ES: Tape Packaging 10" AS: Tape Packaging 13"

Specification

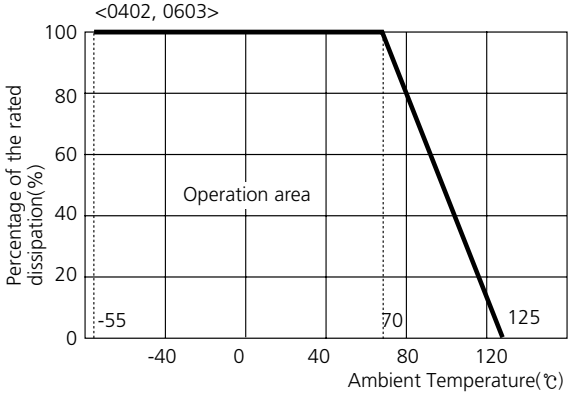
Type	Power Rating (W)	Working Voltage (MAX)	Overload Voltage (MAX)	TCR (ppm/℃)	Resistance Range (Ω)	Rated Ambient Temperature	Rated Working Temperature
RC 0402	1/32	15(V)	30(V)	10~99 Ω : ±300 100~1 MΩ : ±250	10 Ω ~1 MΩ	70℃	-55℃~+125℃
RC 0603	1/20	25(V)	50(V)	1~9.9 Ω : +300,-200 10 Ω ~1 MΩ : ±100 (0603 : ±250) 1.1 MΩ ~10 MΩ : ±300	1 Ω ~10 MΩ		
RC 1005	1/16	50(V)	100(V)				-55℃~+155℃
RC 1608	1/10						
RC 2012	1/8	150(V)	300(V)				
RC 3216	1/4	200(V)	400(V)				
RC 3225	1/3						
RC 5025	2/3						
RC 6432	1						

• Rated voltage (V) = $\sqrt{\text{Rated power(W)} \times \text{Normal resistance value (R)}}$
Rated voltage should be lower than (MAX) working voltage.

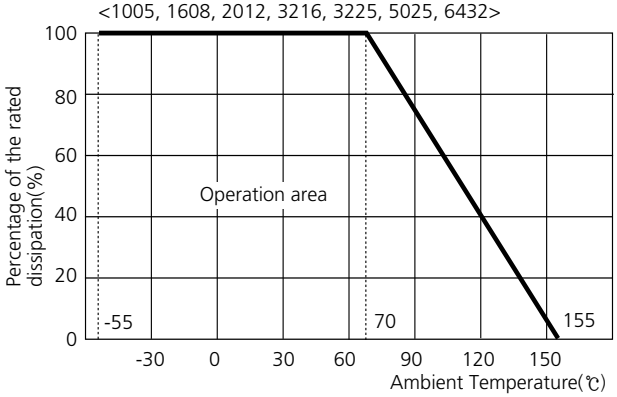
Power Derating Curve

The rated power is the maximum continuous loading power at 70℃ ambient temperature.
For ambient temperature above 70℃, the loading power follows the below power derating curve.
(The load current shall be derated according to derating curve in case of the 'Jumper')

<0402, 0603>



<1005, 1608, 2012, 3216, 3225, 5025, 6432>



Marking

• 3 digits indication (E-24 series)	• 4 digits indication (E-96 series)
- Left 2 digits represent significant figures. - Last 1 digit represents exponential number of 10. - Example: 103 Left 2 digits: 10 Last 1 digit: 3 $103 = 10 \times 10^3 \Omega$ $= 10000 \Omega = 10k\Omega$	- Left 3 digits represent significant figures. - Last 1 digit represents exponential number of 10. - Example: 1002 Left 3 digits: 100 Last 1 digit: 2 $1002 = 100 \times 10^2 \Omega$ $= 10000 \Omega = 10k\Omega$
103	1002
• 0603, 1005 type: No marking.	• 0603, 1005, 1608 type: No marking.

IEC Code System (E-96, E-24)

E-96	E-24	E-96	E-24	E-96	E-24	E-96	E-24
100	10	178		316		562	56
102		182	18	324	33	576	
105		187		332		590	
107		191		340		604	
110	11	196		348		619	
113		200	20	357	36	634	62
115		205		365		649	
118		210		374		665	
121	12	215		383	39	681	68
124		221	22	392		698	
127		226		402		715	
130	13	232		412		732	
133		237		422		750	75
137		243	24	432	43	768	
140		249		442		787	
143		255		453		806	
147		261		464		825	82
150	15	267		475	47	845	
154		274	27	487		866	
158		280		499		887	
162	16	287		511	51	909	
165		294		523		931	91
169		301	30	536		953	
174		309		549		976	