1. Scope

This specification applies to fixed metal film chip resistors rectangular type.
[High precision and reliability]

2. Type Designation

Example; RG (1) 1608 (2) P (3) - 102 (4) - B (5) - T5 (6)

(1) Product Type
RG : Fixed metal film chip resistors rectangular type (Reliability type)

(2) Size
1005 : 1.0 x 0.5mm
1608 : 1.6 x 0.8mm
2012 : 2.0 x 1.25mm

(3) Temperature coefficient of resistance
V : ±5ppm/°C
N : ±10ppm/°C
P : ±25ppm/°C

(4) Rated resistance
E24 series : Three digits of number
E96 series : Four digits of number

Example : 103 = 10×10^3 = 10kΩ
Example : 4992 = 499×10^2 = 49.9kΩ
Example : 49R9 = 49.9Ω

(5) Tolerance on rated resistance
P : ±0.02%
W : ±0.05%
B : ±0.1%
C : ±0.25%

Note : however following resistance value in E96 series are appropriated as value of E24 series.
$10\times10^X\Omega$、 $11\times10^X\Omega$、 $13\times10^X\Omega$、
$15\times10^X\Omega$、 $20\times10^X\Omega$、 $75\times10^X\Omega$

(6) Quantity in taping
T1 : 1,000pcs. /reel
T5 : 5,000pcs. /reel
T10 : 10,000pcs. /reel

3. Physical Dimensions and Construction

See Fig.1.

REV	CHANG.NO NOTE.	DATE	DRAWN	APPD
		/ /		
		/ /		
		/ /		
		/ /		
		/ /		
0	Newly released	/ /		

APPD M.Mori 2003/9/17
CHKD M.Chow 2003/9/17
DRAWN T.Komatsu 2003/9/5

SSM

SUSUMU CO.,LTD

TITLE: Specification for Chip resistor RG series

SPEC.NO: RG00-4012

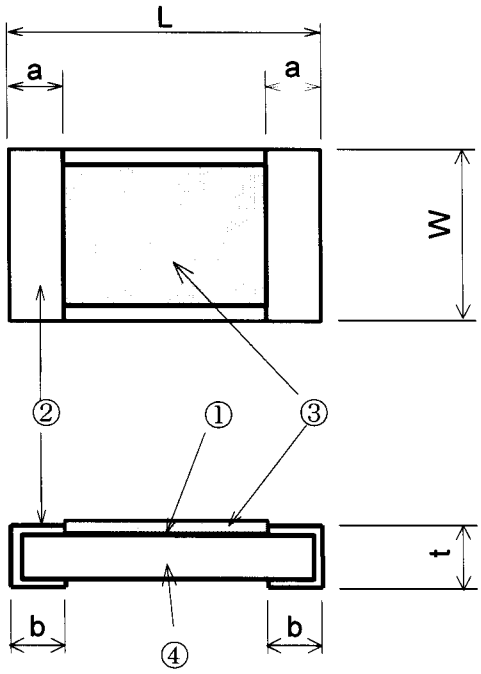


Fig 1. Construction and dimensions

Dimensions Unit: mm

Type / Code letter	RG1005	RG1608	RG2012
L	1.0±0.05	1.6±0.2	2.0±0.2
W	0.5±0.05	0.8±0.2	1.25±0.2
t	0.35±0.05	0.4±0.1	0.4±0.1
a	0.20±0.10	0.3±0.2	0.4±0.2
b	0.25±0.05	0.3±0.2	0.4±0.2

① Resistive element	:	Thin film resistive element
② Electrode	:	Tin plating
③ Protective coat		
④ Substrate		

4. Ratings

4.1. Rated resistance, Tolerance on rated resistance and Temperature coefficient of resistance

	Type	Resistance range and Ratings		
(1) Rated resistance	RG1005	47 ~ 97.6Ω	100 ~ 2.94kΩ	3k ~ 100kΩ
	RG1608	47 ~ 97.6Ω	100 ~ 4.99kΩ	5.1k ~ 270kΩ
	RG2012	47 ~ 97.6Ω	100 ~ 10kΩ	11k ~ 470kΩ
(2) Tolerance on rated resistance			±0.02% (Code:P)	
		±0.05% (Code:W)		
		±0.1% (Code:B)		
		±0.25% (Code:C)		
(3) Temperature coefficient of resistance			±5ppm/°C (Code:V)	
		±10ppm/°C (Code:N)		
		±25ppm/°C (Code:P)		

4.2. Ratings

(1) Rated dissipation

Type / Stability	RG1005	RG1608	RG2012
A	0.063W	0.1W	0.125W
B	0.032W	0.063W	0.1W

The performance value which can be assured depends on rated power. See No.10 and 11in Table.1.

Rated dissipation is based on continuous full load operation at rated ambient temperature of 85°C. For resistors operated at ambient temperature in excess of 85°C, the maximum load shall be derated in accordance with the following curve.

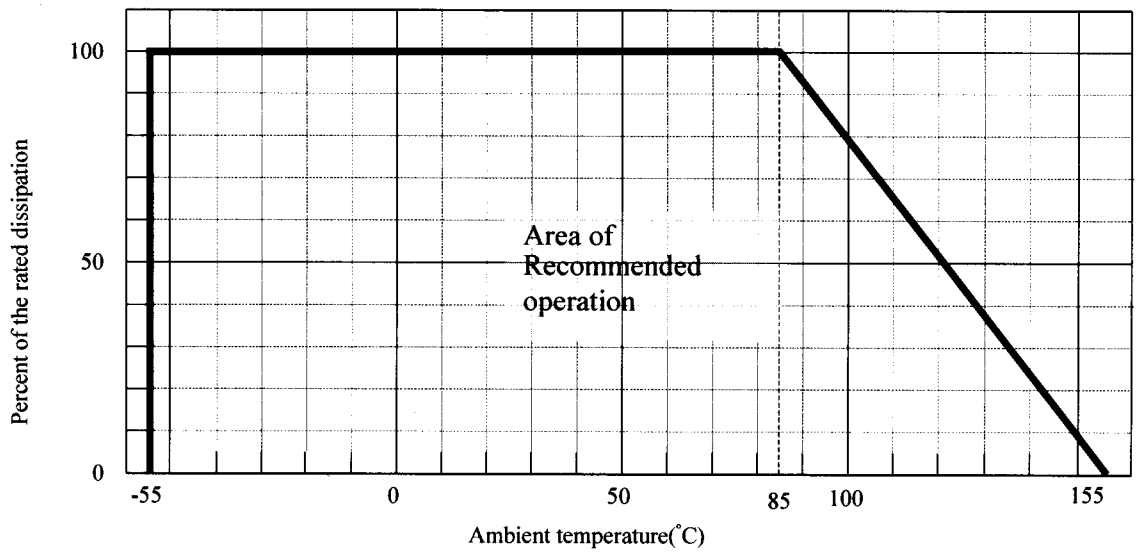


Fig. 2 Derating curve

(2) Rated voltage

The d.c. or a.c. r.m.s voltage shall be calculated from the following expression.

When the rated voltage exceeds the limiting element voltage, the limiting element voltage shall be the rated voltage.

$E=\sqrt{R \times P}$ Where E: Rated voltage (V)
R: Rated resistance (Ω)
P: Rated dissipation (W)

Type	RG1005	RG1608	RG2012
(3) Limiting element voltage	25V	75V	100V
(4) Maximum overload voltage	50V	150V	200V

4.3. Category temperature range

Range of ambient temperature for witch a resistor has been designed to operate continuously, defined by the temperature limits of its appropriate category.

(1) Upper category temperature : +155 ˚C
(2) Lower category temperature : -55 ˚C

5. Performance

See Table 1.

The test method shall be as specified in IEC 60115-1 or JIS C 5201-1.

Standard atmospheric conditions

Unless otherwise specified, the standard range of atmospheric conditions for making measurements tests is as follows;

Temperature	5 to 35°C
Relative humidity	45 to 85%RH
Air pressure	86 to 106kPa

If there is any doubt about results, measurements shall be made within the following limits;

Temperature	20±2°C
Relative humidity	60 to 70%RH
Air pressure	86 to 106kPa

Table 1

No.	Item	Conditions	Specification
1	Resistance and tolerance	Refer to IEC 60115-1 (JIS C 5201-1), Sub-clause 4.5.	Not exceed the specified tolerance on rated resistance in para.4.1.(2).
2	Temperature characteristic of resistance	Resistance shall be measured under standard atmospheric conditions. When the temperature reaches and is maintained at 100 °C higher than the temperature of standard atmospheric conditions, resistance shall be measured again. Refer to IEC 60115-1 (JIS C 5201-1), Sub-clause 4.8.	Not exceed the specified temperature coefficient of resistance in para.4.1.(3).
3	Overload	A d.c. or a.c. r.m.s. voltage of 2.5 times the rated voltage shall be applied for 5 sec. For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.13.	Change in resistance : ±(0.05%+0.01Ω) Without damage by flash over (spark, arcing), burning or breakdown etc.
4	Insulation resistance	Specimen shall be mounted in a jig specified at Fig.7a in IEC 60115-1(JIS C 5201-1), Sub-clause 4.6.1.4. Pressurization by spring: 1.0±0.2N Test voltage : 100±15Vd.c. For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.6.	(1) Between electrodesand insulating enclosure. 100MΩ or more (2) Between electrodes and base material. 1000MΩ or more
5	Voltage proof	The resistor shall be tested as shown in "Insulation resistance". Test voltage (a.c. r.m.s.)	Change in resistance : ±(0.05%+0.01Ω) Without damage by flash over (spark, arcing), burning or breakdown etc.

RG1005	RG1608	RG2012
100V	100V	200V

For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.7.

Table 1

No.	Item	Conditions	Specification
6	Substrate bending test	Pressurizing jig: Fig.12 in IEC 60115-1(JIS C 5201-1), Sub-clause 4.33. The amount of bend: 3mm Test board A shall be used. For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.33.	Change in resistance : ±(0.05%+0.01Ω) Without mechanical damage such as breaks.
7	Resistance to soldering heat	(1) Solder bath method Preheat 100～110°C 30 s. Temperature 270±5°C 10±1 s. (2) Reflow soldering method Peak temperature 260±5°C 10 sec. or less Temperature 220°C over 60 s. max. Limited reflow times: two times. The temperature shall be board surface temperature. (3) Soldering iron method Bit temperature 350±5°C Time 3 +1／0 s. For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.18.	Change in resistance : ±(0.05%+0.01Ω) Without mechanical damage. Electrical characteristics shall be satisfied.
8	Solderability	Temperature of solder 235±5°C (Solder alloy: Sn-37Pb) 245±5°C (Solder alloy: Sn-3Ag-0.5Cu) Duration of immersion 2±0.5 s. For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.17.	A new uniform coating of solder shall cover minimum of 95% of the surface being immersed.

Table 1

No.	Item	Conditions		Specification
9	Rapid change of temperature	The resistor shall be subjected to 1000 continuous cycles, each as shown in the figure below. 1) −55±3°C : 30 min 2) Standard atmospheric conditions : 2～3 min 3) +125±2°C : 30 min 4) Standard atmospheric conditions : 2～3 min For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.19.		Change in resistance : ±(0.1%+0.01Ω) Without mechanical damage such as breaks and distinct damage in appearance.
10	Endurance (Rated load)	Temperature: 85±2°C Subjected to a voltage cycle consisting of rated d.c. voltage application of 1 hr 30 min and rest of 30 min repeatedly for 1000 +48/0 hrs. However the applied voltage shall not exceed the limited element voltage. For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.25.	Stability(*1) A B	Change in resistance: ±(0.25%+0.05Ω) ±(0.1%+0.01Ω) Without mechanical damage in appearance.
11	Endurance (Temperature Humidity Bias)	Temperature: 85±2°C Humidity: 85±5%RH Subjected to a voltage cycle consisting of 10% rated d.c. voltage application of 1 hr 30 min and rest of 30 min repeatedly for 1000 +48/0 hrs. However the applied voltage shall not exceed the limited element voltage. For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.24.	Stability(*1) A B	Change in resistance: ±(0.25%+0.05Ω) ±(0.1%+0.01Ω) Without mechanical damage in appearance.
12	Endurance at upper category temperature	The specimen shall be placed in the test chamber at 155±2°C with no load for 1000 +48/0 hrs. For other procedures, refer to IEC 60115-1(JIS C 5201-1), Sub-clause 4.25.3.		Change in resistance: ±(0.1%+0.01Ω) Without mechanical damage in appearance.

(*1) : See Para. 4.2 Ratings

Mounting method

(1) Mounting method according to solder bath method

Epoxy based adhesive agent shall be applied in the middle between the lands of the test board and the resistor shall be mounted in such a way that resistor's electrodes will be evenly placed in the land area and then the adhesive agent shall be hardened. Then a methanol medium of 25% colophony by specific weight is used as flux (if non-deviant test results are assurable over the counter colophony based flux may be used) and is soldered by dipping in a molten solder bath of 260±5 °C and immersed for 3 to 5 s.

(2) Mounting method according to reflow soldering method

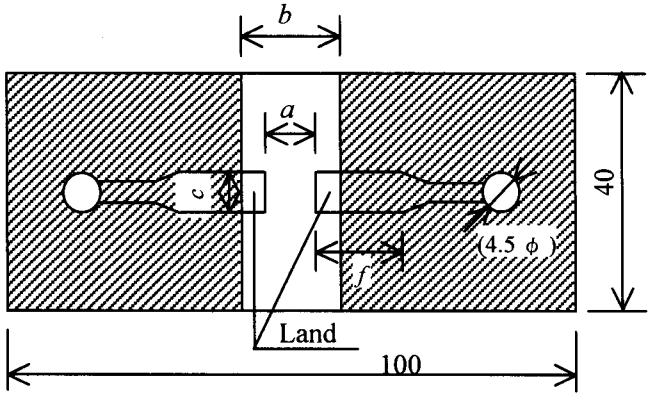
About 100~150 μm of Sn-3Ag-0.5Cu solder cream is applied in the land portion of the test boards and the resistor shall be mounted in such a way so that the resistor's electrodes will be evenly placed on the land. It is soldered under the conditions of board surface temperature 240±5°C (peak temperature) for 5 to 10 s. in an upper-portion heated oven.

Test board

Test board A (For substrate banding, adhesion test, see Fig.3)

Material: Glass fabric base epoxy resin 1.6mm

Copper foil, thickness 0.035 mm, Solder resist coated.



Unit : mm

Type	a	b	c	f
1005	0.5	1.6	0.6	(1.5)
1608	1	3	1.2	(2)
2012	1.2	4	1.65	(3)

Fig.3 Test board A

Test board B (For another test, see Fig.4)

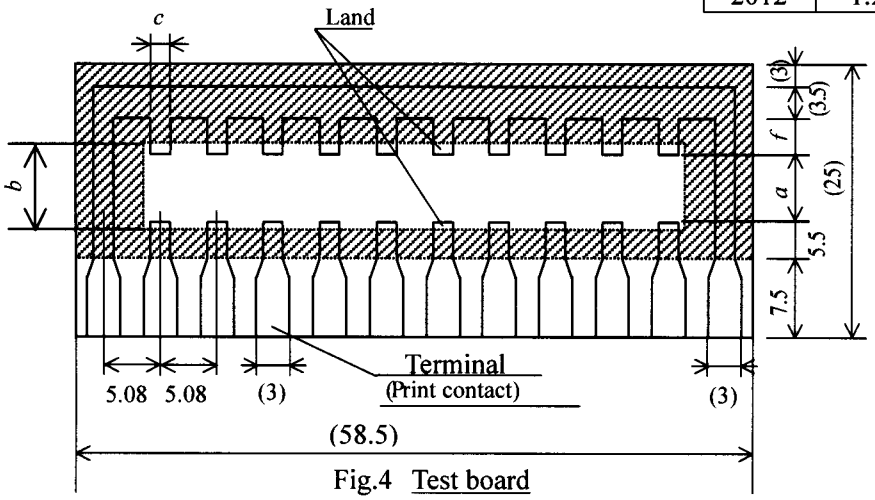
Material: Glass fabric base epoxy resin 1.6mm

Copper foil, thickness 0.035 mm

Solder resist coated.

Unit : mm

Type	a	b	c	f
1005	0.5	1.6	0.6	(5)
1608	1	3	1.2	(4.5)
2012	1.2	4	1.65	(4.3)



Unit :mm

Fig.4 Test board

6. Packaging

Resistors shall be in Taping.

6.1. Material and Dimensions

6.1.1. Tape

Using punched paper tape :

1005	: 2mm pitch punched tape	.....	See Fig.5.
1608 and 2012	: 4mm pitch punched tape	.....	See Fig.6.

6.1.2. Reel

Using plastic reel. See Fig.7. Refer to EIAJ ET-7200A

6.2. Specification of taping

Refer to clause 6.1 and IEC 60286-3 (JIS C 0806-3).

6.3. Quantity per reel

Regular quantity per reel:

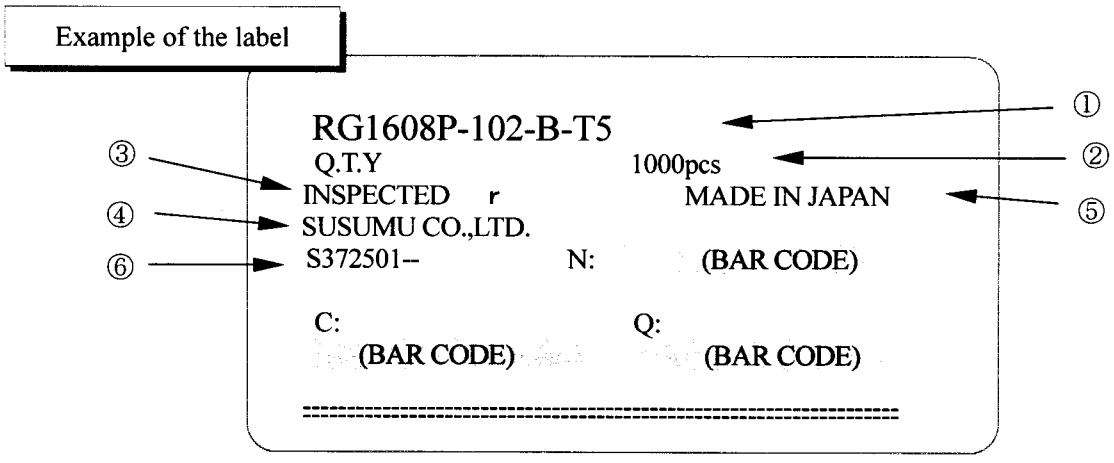
Type / Tolerance	Code	RG1005	RG1608	RG2012
±0.02%, ±0.05%	T1	1,000 pcs.	1,000 pcs.	1,000 pcs.
±0.1%	T5	5,000 pcs.	5,000 pcs.	5,000 pcs.
±0.25%	T5	-	5,000 pcs.	5,000 pcs.
	T10	10,000 pcs.	-	-

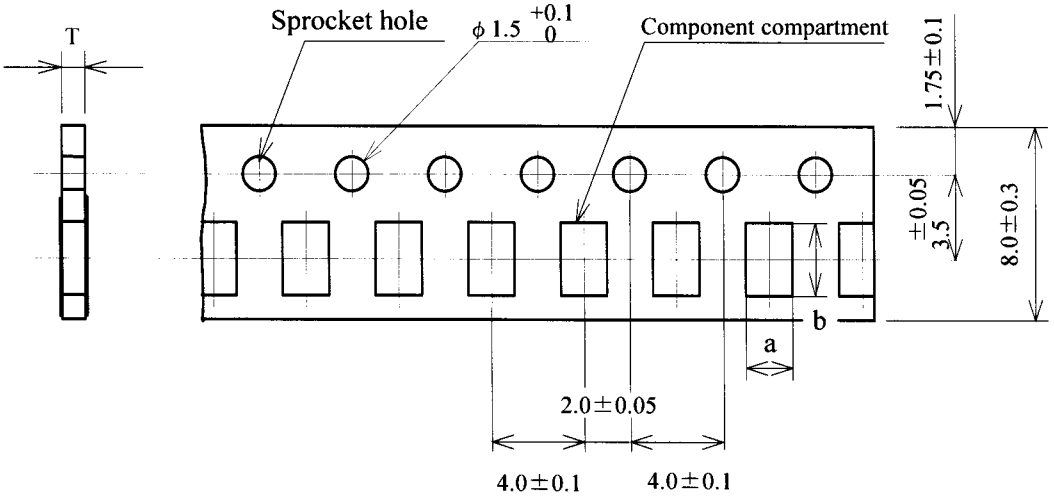
6.4. Marking

The label indicated following items shall be marked on single side of the reel.

① Type designation (See Para. 2)
② Quantity (See Para.6.3)
③ Manufacturing date code
(Month and year are marked. Refer to JIS C 5201-1 Annex 1 Table5.)
④ Manufacturer's name ("SUSUMU CO., LTD.")
⑤ Country of origin
⑥ Shipping inspection code

Example of the label



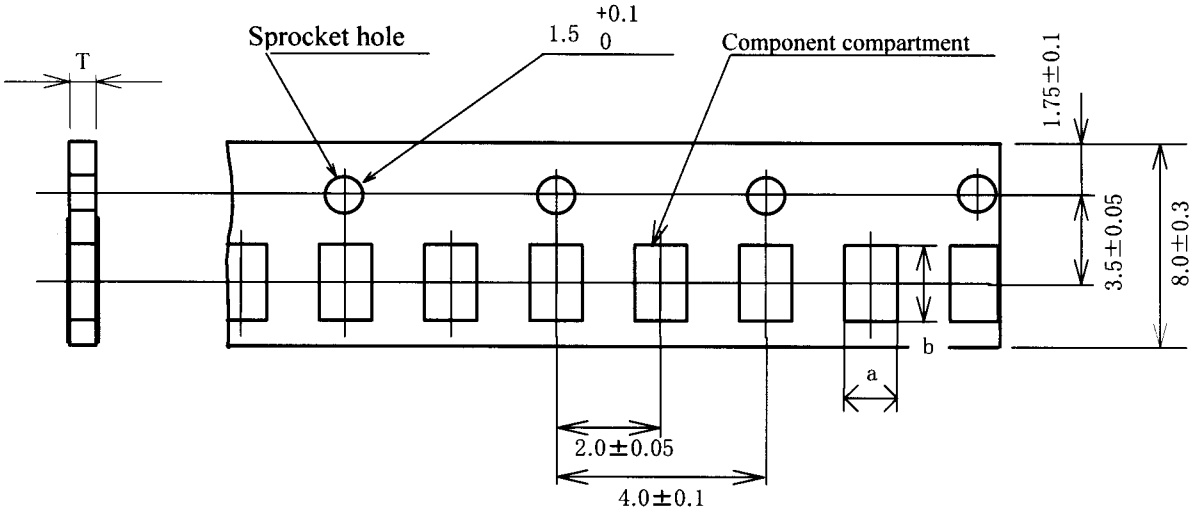


Code letter	RG1005
T	0.43±0.05
a	0.63±0.05
b	1.13±0.05

Unit :mm

* Pre-emptied holes : 150 holes (or 30 cm) or more.

Fig.5 Dimensions of 2mm pitch taping



Code letter	RG1608	RG2012
T	0.6±0.05	0.75±0.05
a	1.1±0.1	1.65±0.2
b	1.9±0.1	2.4±0.2

Unit :mm

* Pre-emptied holes : 75 holes (or 30 cm) or more.

Fig.6 Dimensions of 4mm pitch taping

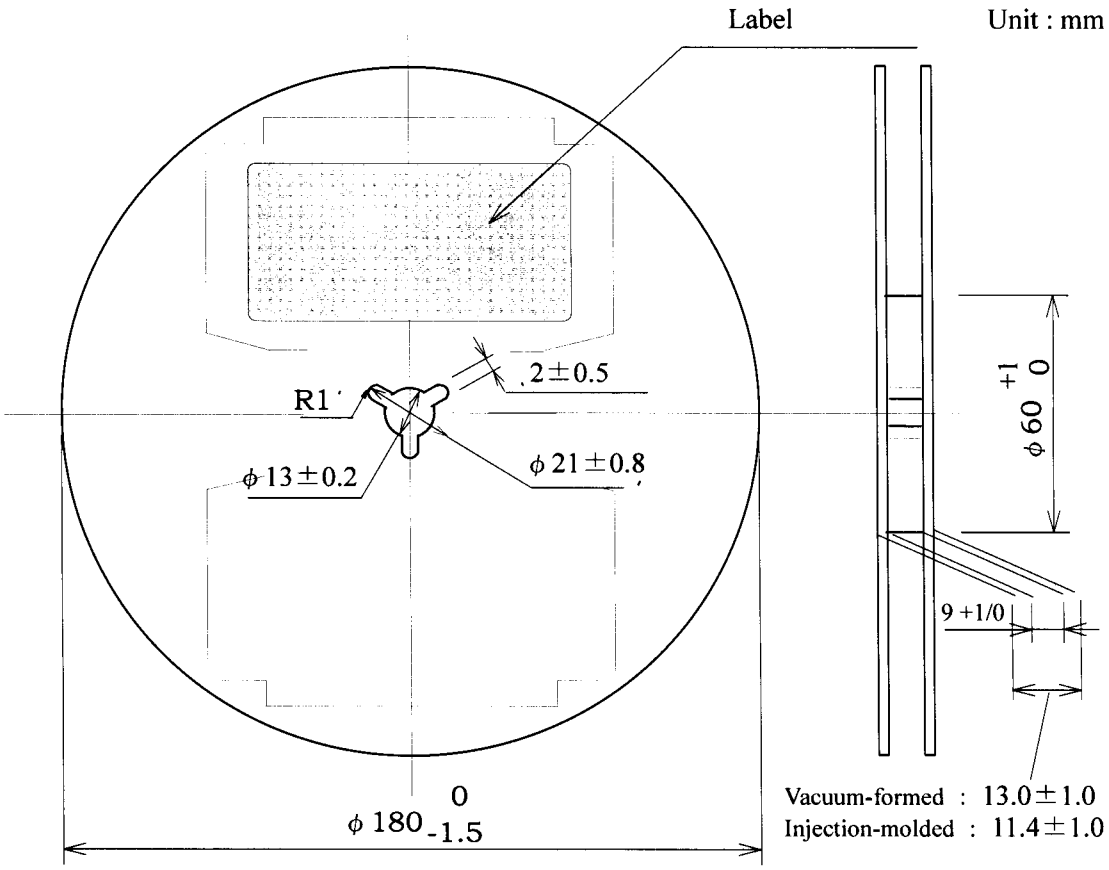


Fig. 7 Dimensions of reel

7. Precautions in use

7.1. Storage

(1) Resistor shall be stored in a room where temperature and humidity must be controlled.
(temperature 5 to 35 deg C, humidity 45 to 85 % RH)
However, humidity keep it low, as it is possible.

(2) Resistor shall be stored as direct sunshine doesn't hit on it.

(3) Resistor shall be stored with no moisture, dust, a material that will make solderbility inferior, and a harmful gas (hydrogen chloride, sulfurous acid gas, and hydrogen sulfide).

(4) Resistor shall be stored with keeping the minimum package unit with uncivilized sealed (Keep the state of the taping).

7.2. Time limit to storage

(1) The storage time limit of the product is reckoned on the day when the product was shipped by our company and made within one year.

(2) Confirm solderbility beforehand when you use the one that the time limit was passed.

7.3. Chip mounting

(1) When chip are mounted on the PC board, the protection coat of resistors must not be scratched. If it will be scratched, it will make performance for moisture inferior.

(2) In case that resistor will be soldered by soldering iron, heating shall be done on the land, and soldering iron must not hit on the resistor itself.

(3) In case that resin coating or resin seal will be made for a PC board after chip mounting, do washing and drying it enough before coating or sealing. If ion bear or moisture will be sealed in resin coating, it will make performance for moisture inferior sometimes.
For resinous use, it is necessary to set up enough the curing conditions. As it get improper for the condition, change of a resistance value are large and are a case.

(4) According to shape, material, and pressure of clamping in chip mounting machine, there is the case that crack will be appeared on resistor.
Control a shock energy for clamping resistor under 7×10^{-4} J.
With a shock energy around clamping that says here, it is suited to a potential energy, in case that iron block of 25g is dropped naturally to the resistor placed on iron plate for the height of 2.8mm.

(5) The glue to fix a resistor on the PC board around chip mounting, it is needed high insulation resistance and great performance or moisture. And it is needed that these characteristics are not inferior in using temperature range and a hot spot temperature to be acting.

7.4. Using and Handling

(1) Use under the special environment
Performance and reliability are fully researched in advance, and it must be confirmed when a use part under the special environment is used with the special environment. There is the following thing in the special environment.

[1] Water, salt water, oil, the inside of acid, alkali, the liquid such as an organic solvent or the place where it reaches it

[2] The place where direct sunlight hits it, an exposure in the open air, the inside of the dust

[3] The condensation

[4] The place where harmful gas (in such cases as the sea breeze, HCl, Cl2, SO2, H2S, NH3, NOX) is abundant

Water or ion quality sometimes reaches even a resistance body and an electrode by the protection material of the resistor being eroded gradually under the above environment. Then, investigation confirmation is necessary because resistance value may change due to the chemical reaction such as electrolysis.

(2) Use under the high temperature high humidity environment

a) When components are used under the high temperature environment, load electric power must be reduced based on the reduction curve prescribed in every kind.

b) When components are used in the high humidity atmosphere or condensation condition, water sometimes gets into the surface of a resistance skin film through a coating film. A resistance metal film disappears by oxygen which occurred in the electrolysis phenomenon of the water when a direct current load was added under this condition, or hydrogen, and sometimes reaches resistance value height-ization and a breakage. "Ni" or "Cr" witch are used as resistance film of the metal film resistors react with OH- moved to the anode, and it becomes an oxide (nonconductor).

$$Ni + 2OH^- \rightarrow Ni(OH)_2 \rightarrow NiO + H_2O$$
$$2Cr + 6OH^- \rightarrow Cr2(OH)_6 \rightarrow Cr_2O_3 + 3H_2O$$

(3) It is necessary to investigate the performance and reliability enough when using under harsh environment.
Especially, the performance of the product is occasionally damaged when using with the dewy state or ion material adhered.

(4) It is necessary to protect the edge and protection coat of resistors from mechanical stress.

(5) Handle with care when PC board is divided or fixed on support body, because bending of PC board after chip mounting will make mechanical stress for resistors.

(6) Resistors shall be used within rated range shown in specification.
Especially, if voltage more than specified value will be loaded to resistor, there is a case it will make damage for machine because of temperature rise depending on generation of heat, and increase resistance value or breaks.

(7) In case that resistor is loaded a rated voltage, it is necessary to confirms temperature of a resistor and to reduce a load power according to load reduction curve, because a temperature rise of a resistor depends on influence of heat from mounting density and neighboring element.

(8) Observe Limiting element voltage and maximum overload voltage specified in each specification.

(9) If there is a possibility that a large voltage (pulse voltage, shock voltage) charge to resistor, It is necessary that operating condition shall be set up before use, because performance of thin film resistor is affected by a large shock voltage.

7.5. Others

Refer to EIAJ RCR-2121A – Technical Report if Japan Electronics and Information Technology Industries Association "Guideline of notabilia for Fixed resistor for use in electronic equipment (Safety Application Guide for fixed resistors for use in electronic equipment)"