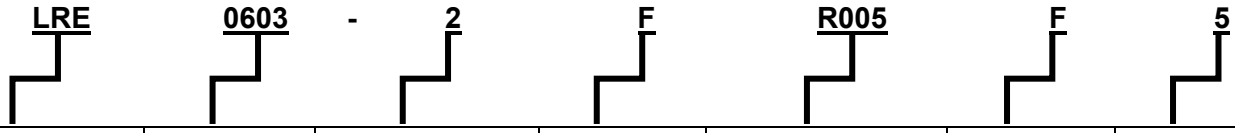
1 Scope:

1.1 This specification is applicable to lead free and halogen free of RoHS directive for LRE series metal alloy low-resistance resistor.

1.2 The product is for general electronic purpose.

2 Explanation Of Part Numbers:



Type	Size (inch)	Type of Terminal	Rated Power	Resistance (4~5 Digits)	Tolerance	Packaging
Metal Alloy Low Resistance Resistor	0402 0603 0805 1206	2：2 terminals T：wrap around	P=1/6W H=1/5W G=1/4W F=1/3W E=3/4W C=1/2W 1=1.0W A=1.5W	EX: R0025 = 2.5 mΩ R005 = 5mΩ R010 = 10mΩ	D=±0.5% F=± 1.0% G=± 2.0% J=± 5.0%	5=5,000pcs TH=10,000pcs

3 Product Specifications:

Type	Type of Terminal	Rating Power	Rating Current	Overload Current	T.C.R. (ppm/°C)	Resistance Range (mΩ)		Operating Temperature Range
						D (±0.5%)	F (±1%) G (±2%) J (±5%)	
0402	2	1/6W	$Ir=\sqrt{P/R}$	$Io=\sqrt{4P/R}$	≦±600	--	1.5≦ R ＜3	-55~+150°C
					≦±200	--	3	
					≦±125	--	4~5	
					≦±50	--	10	
		1/5W			≦±600	--	1.5≦ R ＜3	
					≦±200	--	3	
					≦±125	--	4~5	
					≦±50	--	10	
		1/4W			≦±200	--	3	
					≦±125	--	4~5	
					≦±50	--	10	
		1/3W			≦±50	--	10	
0603	2	1/3W			≦±450	--	1≦ R ＜4	
					≦±50	10≦ R ≦60	4≦ R ≦60	
		1/2W			≦±450	--	2≦ R ＜4	
					≦±50	10≦ R ≦15	4≦ R ≦15	

Type	Type of Terminal	Rating Power	Rating Current	Overload Current	T.C.R. (ppm/°C)	Resistance Range (mΩ)		Operating Temperature Range
						D (±0.5%)	F (±1%) G (±2%) J (±5%)	
0805	2	1/2W	$Ir=\sqrt{P/R}$	$Io=\sqrt{4P/R}$	≦±100	--	1.5≦ R <3	-55~+150°C
					≦±75	--	3≦ R <5	
					≦±50	5≦ R ≦70	5≦ R ≦70	
		3/4W			≦±100	--	1.5≦ R <3	
					≦±75	--	3≦ R <5	
					≦±50	5≦ R ≦50	5≦ R ≦50	
1206	2	1/2 W			≦±400	--	1≦ R <2	
					≦±75	--	2≦ R <4	
					≦±50	4≦ R ≦56	4≦ R ≦56	
		1 W			≦±400	--	1≦ R <2	
					≦±75	--	2≦ R <4	
					≦±50	4≦ R ≦56	4≦ R ≦56	
0805	T	1/2W			≦±100	--	1.5≦ R <3	
					≦±75	--	3≦ R <5	
					≦±50	5≦ R ≦70	5≦ R ≦70	
		3/4W			≦±100	--	1.5≦ R <3	
					≦±75	--	3≦ R <5	
					≦±50	5≦ R ≦50	5≦ R ≦50	
		1W			≦±100	--	1.5≦ R <3	
					≦±75	--	3≦ R <5	
					≦±50	R=5	R=5	
1206	T	1/2W			≦±400	--	1≦ R <2	
					≦±75	--	2≦ R <4	
					≦±50	4≦ R ≦56	4≦ R ≦56	
		1W			≦±400	--	1≦ R <2	
					≦±75	--	2≦ R <4	
					≦±50	4≦ R ≦56	4≦ R ≦56	

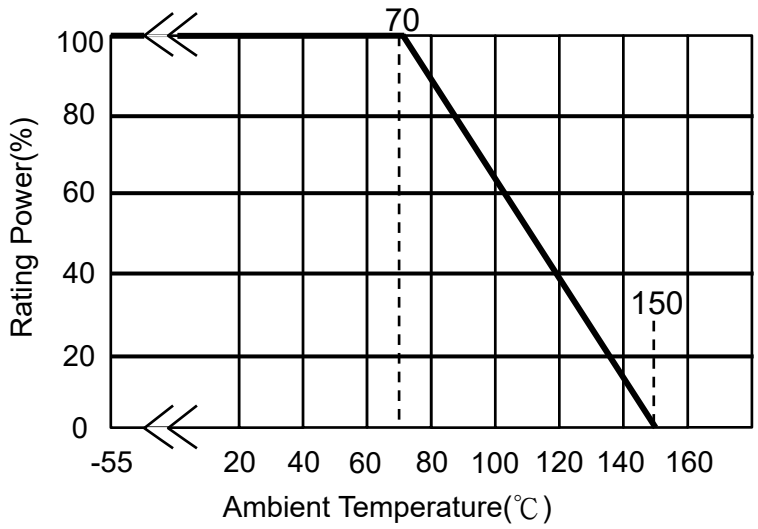
Ir=Rating Current(A)

Io= Overload Current(A)

P= Rating Power(W)

R=Resistance(Ω)

3.1 Power Derating Curve: Operating Temperature Range: - 55 ~+150 ℃
For resistors operated in ambient temperatures 70°C, power rating shall be derated in accordance with the curve below:



3.2 Rating Current:

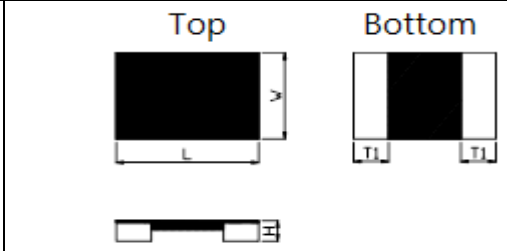
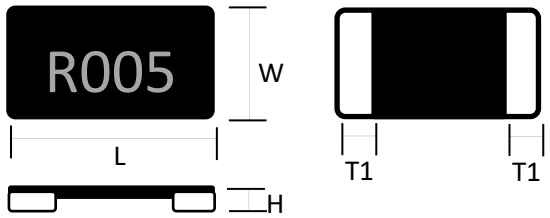
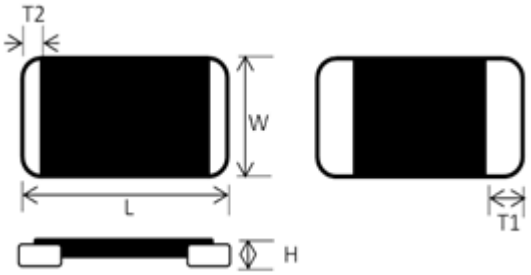
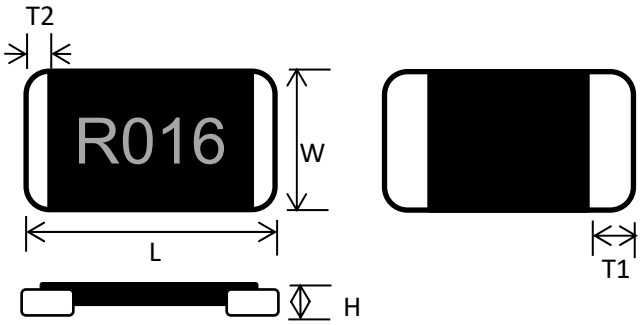
The following equation may be used to determine the DC (Direct Current) or AC (Alternating Current) currents (RMS, root mean square value) of normal rated power. However, if the result value exceeds the highest current of regulated standards, the highest normal rated power is to be used.

Remark:

$$I = \sqrt{P/R}$$

I=Rating Current(A)
P= Rating Power(W)
R=Resistance(Ω)

4 Physical Dimensions:

Type of Terminal	0402/0603/0805	1206
2		
T		

Type	Type of Terminal	Power Rating (Watts)	Resistance Range (mΩ)	L	W	H	T1	T2
0402	2	1/6 1/5	1.5~5 10	0.039±0.004 (1.00±0.10)	0.020±0.004 (0.50±0.10)	0.014±0.004 (0.35±0.10)	0.010±0.004 (0.25±0.10)	---
		1/4	3~5 10	0.039±0.004 (1.00±0.10)	0.020±0.004 (0.50±0.10)	0.014±0.004 (0.35±0.10)	0.010±0.004 (0.25±0.10)	
		1/3	10					
0603	2	1/3	1 ~ 60	0.063±0.008 (1.60±0.20)	0.031±0.008 (0.80±0.20)	0.014±0.004 (0.35±0.10)	0.012±0.006 (0.30±0.15)	
		1/2	2 ~ 15					
0805	2	1/2	1.5 / 2 / 2.5	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.02±0.006 (0.50±0.15)	
			3 ~ 70	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.014±0.008 (0.35±0.20)	
		3/4	1.5 / 2 / 2.5	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.02±0.006 (0.50±0.15)	
			3 ~ 50	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.014±0.008 (0.35±0.20)	
1206	2	1/2 1	1≦R<3	0.126±0.008 (3.20±0.20)	0.063±0.008 (1.60±0.20)	0.016±0.008 (0.40±0.20)	0.035±0.008 (0.90±0.20)	---
			3≦R<4				0.028±0.008 (0.70±0.20)	
			4≦R≦13				0.014±0.008 (0.35±0.20)	
			14≦R≦21				0.028±0.008 (0.70±0.20)	
			22≦R≦56				0.014±0.008 (0.35±0.20)	
0805	T	1/2	1.5 / 2 / 2.5	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.02±0.006 (0.50±0.15)	0.010±0.008 (0.25±0.20)
			3 ~ 70	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.014±0.008 (0.35±0.20)	0.010±0.008 (0.25±0.20)

Type	Type of Terminal	Power Rating (Watts)	Resistance Range (mΩ)	L	W	H	T1	T2
0805	T	3/4	1.5 / 2 / 2.5	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.02±0.006 (0.50±0.15)	
			3 ~ 50	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.014±0.008 (0.35±0.20)	
		1	1.5 / 2 / 2.5	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.02±0.006 (0.50±0.15)	
			3 ~ 5	0.08±0.008 (2.032±0.20)	0.05±0.008 (1.270±0.20)	0.014±0.004 (0.35±0.10)	0.014±0.008 (0.35±0.20)	
1206	T	1/2 1	1≦R＜3	0.126±0.008 (3.20±0.20)	0.063±0.008 (1.60±0.20)	0.016±0.008 (0.40±0.20)	0.035±0.008 (0.90±0.20)	0.010±0.008 (0.25±0.20)
			3≦R＜4				0.028±0.008 (0.70±0.20)	
			4≦R≦13				0.014±0.008 (0.35±0.20)	
			14≦R≦21				0.028±0.008 (0.70±0.20)	
			22≦R≦56				0.014±0.008 (0.35±0.20)	

4.1 Material of Alloy

Type	Watts	Material	Resistance
LRE0402	1/6W 1/5W 1/4W 1/3W	Copper-Manganese Alloy	1.5mΩ≤R≤10mΩ
LRE0603	1/3W 1/2W	Copper-Manganese Alloy	1mΩ≤R<25mΩ
		Iron-Chromium Aluminium Alloy	25mΩ≤R≤60mΩ
LRE0805	1/2W 3/4W 1W	Copper-Manganese Alloy	1.5mΩ≤R≤5mΩ
	1/2W 3/4W	Copper-Manganese Alloy	6mΩ≤R≤20mΩ
	1/2W 3/4W	Iron-Chromium Aluminium Alloy	21mΩ≤R≤50mΩ
	1/2W	Iron-Chromium Aluminium Alloy	21mΩ≤R≤70mΩ
LRE1206	1/2W	Copper-Manganese Alloy	1mΩ≤R≤13mΩ
		Iron-Chromium Aluminium Alloy	14mΩ≤R≤56mΩ
	1W	Copper-Manganese Alloy	1mΩ≤R≤13mΩ
		Iron-Chromium Aluminium Alloy	14mΩ≤R≤56mΩ

5 Reliability Performance:

5.1 Electrical Performance:

Test Item	Conditions of Test	Test Limits
Temperature Coefficient of Resistance (TCR)	• TCR (ppm/℃) = $\frac{(R2-R1)}{R1\,(T2-T1)}$ X 10^6 • R1: resistance of room temperature • R2: resistance of 150 °C • T1: Room temperature • T2: Temperature at 150 °C • Refer to JIS C 5201-1 4.8	Refer to Paragraph 3. general specifications
Short Time Overload	Applied Overload for 5 seconds and release the load for about 30 minutes, then measure its resistance variance rate. (Overload condition refer to below): Type / Power (W) / # of rated power 0402 / 1/6 & 1/5 & 1/4 & 1/3 / 4 times 0603 / 1/3 & 1/2 / 4 times 0805 / 1/2 & 3/4 & 1.0 / 4 times 0805-T / 1/2 & 3/4 & 1.0 / 4 times 1206 / 1/2 & 1.0 / 4 times 1206-T / 1/2 & 1.0 / 5 times Refer to JIS C 5201-1 4.13	≤±0.5% No evidence of mechanical damage
Insulation Resistance	Put the resistor in the fixture, add 100 VDC in + ,- terminal for 60secs then measured the insulation resistance between electrodes and insulating enclosure or between electrodes and base material. Refer to JIS-C5201-1 4.6	≧10^8Ω
Dielectric Withstanding Voltage	Applied 300VAC for 1 minute, and Limit surge current 50 mA (max.) Refer to JIS-C5201-1 4.7	No short or burned on the appearance.

5.2 Mechanical /Constructional Performance:

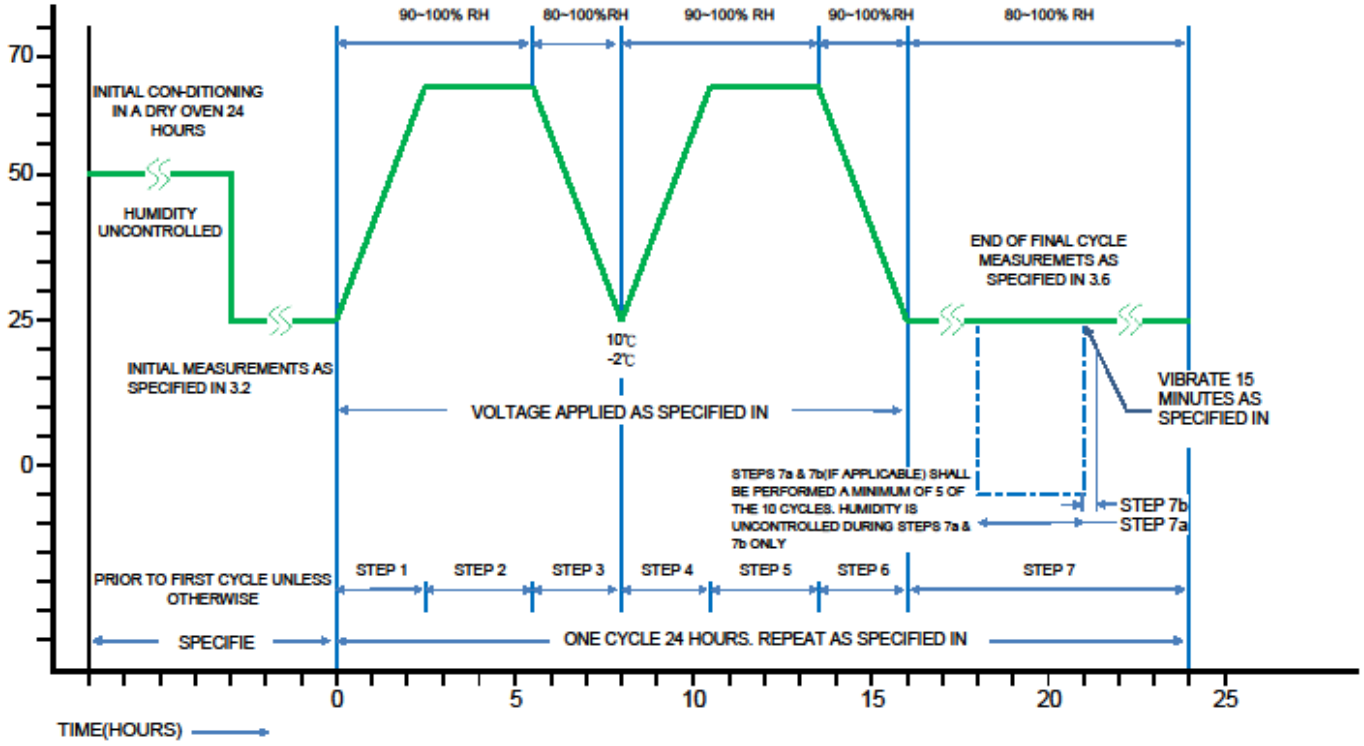
Test Item	Conditions of Test	Test Limits
Resistance to Solder Heat	The tested resistor be immersed 25 mm/sec into molten solder of 260±5℃ for 10±1secs. Then the resistor is left in the room for 1 hour, and measured its resistance variance rate. Refer to JIS-C5201-1 4.18	≤±0.5% No evidence of mechanical damage
Solderability	Add flux into tested resistors, immersion into solder bath in temperature 245±5℃ for 3±0.5secs. Refer to JIS-C5201-1 4.17	Solder coverage over 95%
Vibration	The resistor shall be mounted by its terminal leads to the supporting terminals on the solid table. The entire frequency range :from 10 Hz to 55 Hz and return to 10 Hz, shall be transferred in 1 min. Amplitude : 1.5mm This motion shall be applied for a period of 4 hours in each 3 mutually perpendicular directions (a total of 12hrs) Refer to JIS-C5201-1 4.22	≤±0.5% No evidence of mechanical damage
Resistance to solvent	The tested resistor be immersed into isopropyl alcohol of 20~25℃ for 60secs, then the resistor is left in the room for 48 hrs. Refer to JIS-C5201-1 4.29	≤±0.5% No evidence of mechanical damage

5.3 Environmental Performance:

Test Item	Conditions of Test	Test Limits
Low Temperature Exposure (Storage)	Put the tested resistor in chamber under temperature -55±2℃ for 1,000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate. Refer to JIS-C5201-1 4.23.4	≤±0.5% No evidence of mechanical damage
High Temperature Exposure (Storage)	Put tested resistor in chamber under temperature 150±5℃ for 1,000 hours. Then leaving the tested resistor in room temperature for 60 minutes , and measure its resistance variance rate. Refer to JIS-C5201-1 4.23.2	≤±1.0% No evidence of mechanical damage
Temperature Cycling (Rapid Temperature Change)	Put the tested resistor in the chamber under the temperature cycling which shown in the following table shall be repeated 1,000 times (0603 & 0402 for 300 times)consecutively. Then leaving the tested resistor in the room temperature for 60 minutes, and measure its resistance variance rate. Testing Condition: Lowest Temperature -55 +0/-10℃; Highest Temperature 150 +10/-0℃ Refer to JIS-C5201-1 4.19	≤±1.0% No evidence of mechanical damage
Moisture Resistance (Climatic Sequence)	Put the tested resistor in chamber and subject to 10 cycles of damp heat and without power. Each one of which consists of the steps 1 to 7 (Figure 1). Then leaving the tested resistor in room temperature for 24 hr, and measure its resistance variance rate. Refer to MIL-STD 202 Method 106	≤±0.5% No evidence of mechanical damage
Bias Humidity	Put the tested resistor in chamber under 85± 5℃and 85± 5%RH with 10% bias and load the rated voltage for 90 minutes on, 30 minutes off, total 1,000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate. Refer to JIS-C5201-1 4.24	≤±1.0% No evidence of mechanical damage

5.4 Operational Life Endurance:

Test Item	Conditions of Test	Test Limits
Load Life	Put the tested resistor in chamber under temperature 70± 2℃ and load the rated voltage for 90 minutes on 30 minutes off, total 1000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate. Refer to JIS-C5201-1 4.25	≤±1.0% No evidence of mechanical damage


90~100% RH
80~100%RH
90~100% RH
90~100%RH
80~100% RH
70
50
25
0
INITIAL CON-DITIONING IN A DRY OVEN 24 HOURS
HUMIDITY UNCONTROLLED
INITIAL MEASUREMENTS AS SPECIFIED IN 3.2
10℃
-2℃
VOLTAGE APPLIED AS SPECIFIED IN
END OF FINAL CYCLE MEASUREMETS AS SPECIFIED IN 3.6
VIBRATE 15 MINUTES AS SPECIFIED IN
STEPS 7a & 7b(IF APPLICABLE) SHALL BE PERFORMED A MINIMUM OF 5 OF THE 10 CYCLES. HUMIDITY IS UNCONTROLLED DURING STEPS 7a & 7b ONLY
STEP 7b
STEP 7a
PRIOR TO FIRST CYCLE UNLESS OTHERWISE
STEP 1
STEP 2
STEP 3
STEP 4
STEP 5
STEP 6
STEP 7
SPECIFIE
ONE CYCLE 24 HOURS. REPEAT AS SPECIFIED IN
0
5
10
15
20
25
TIME(HOURS)

6 Marking Format: (All the products marking are 4 digits)

6.1 LRE0402、LRE0603、LRE0805 No Marking.

6.2 LRE1206 series:

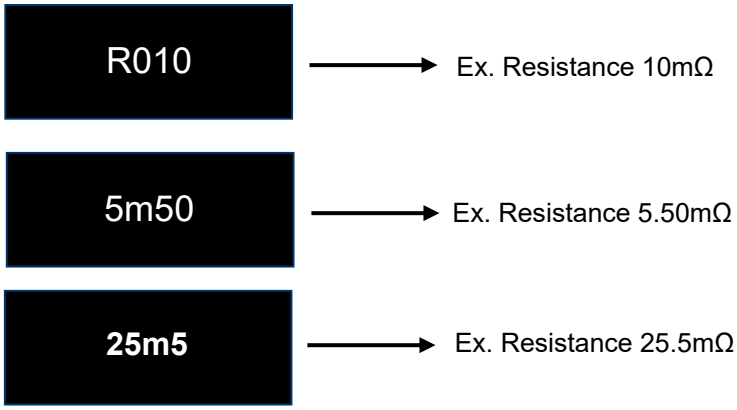
Product resistance is indicated by using two marking notation styles:

a. "**R**" designates the decimal location in ohms, e.g.

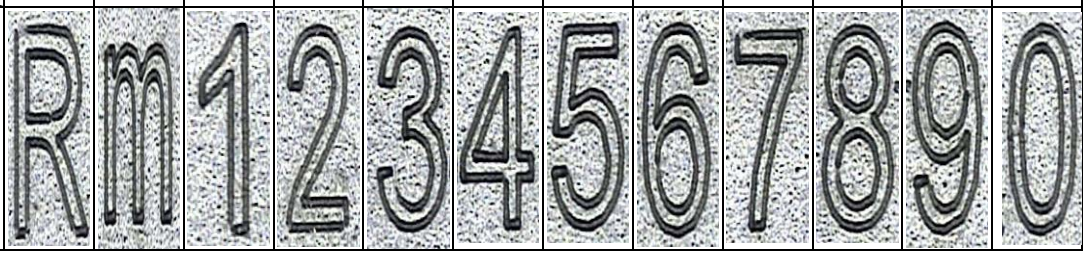
- For 1mΩ the product marking is R001;
- For 25mΩ the product marking is R025;

b. "**m**" designates the decimal location in milliohms, e.g.

- For 0.25mΩ the product marking is 0m25;
- For 0.5mΩ the product marking is 0m50;
- For 5.5mΩ the product marking is 5m50;
- For 25.5mΩ the product marking is 25m5.



6.3 Marking Style by Laser:

Type \ Marking	R	m	1	2	3	4	5	6	7	8	9	0
1206												

《EX》Marking→R005 = 5 mΩ

7 Plating Thickness:

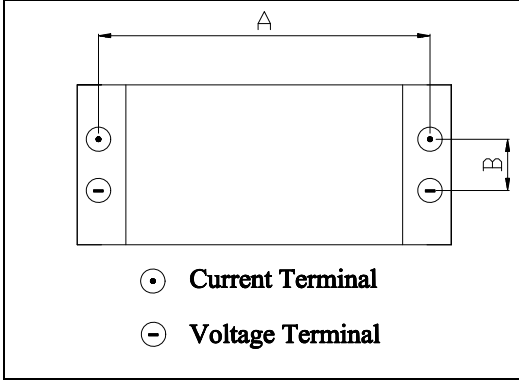
7.1 Ni：≧2μm

7.2 Sn(Tin)：≧3μm

7.3 Sn(Tin)：Matte Sn

8 Measurement Point:

Bottom electrode

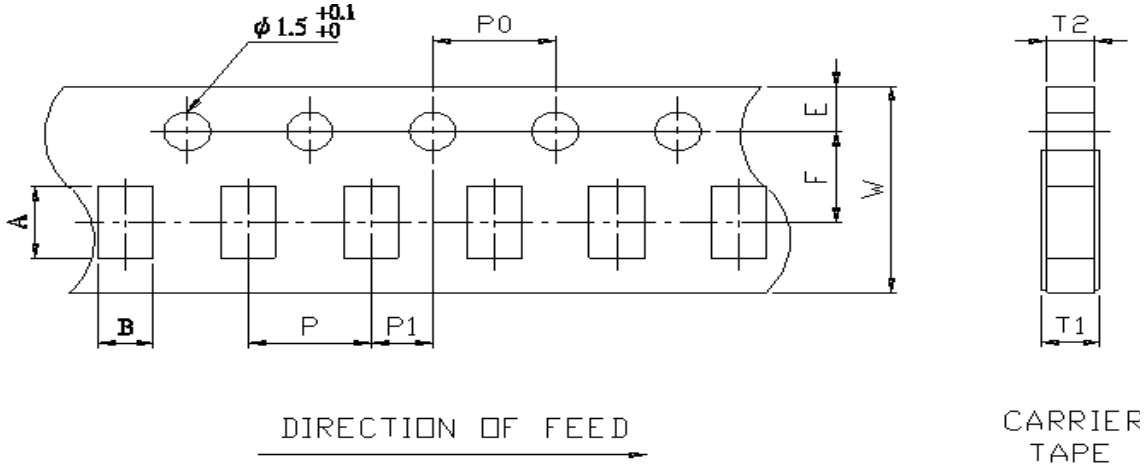


Unit : mm

TYPE \ DIM	A	B
0402	**0.65±0.05**	**0.20±0.05**
0603	**1.25±0.05**	**0.30±0.05**
0805	**1.65±0.05**	**0.70±0.05**
1206	**2.70±0.05**	**0.40±0.05**

9 Taping specifications:

9.1 Tape Dimensions:



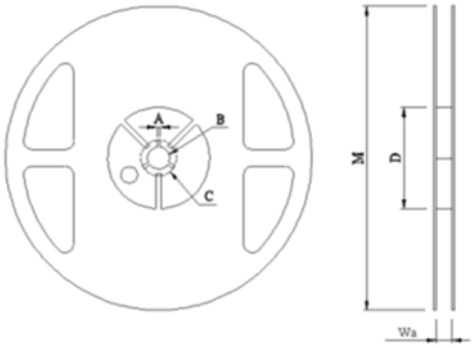
Unit: mm

Item \ DIM	A	B	W	E	F	T1	T2	P	P0	10*P0	P1
0402	1.15±0.05	0.65±0.05	8.00±0.20	1.75±0.10	3.50±0.05	0.40+0.2/-0	0.40±0.05	2.00±0.10	4.00±0.05	40.0±0.20	2.00±0.05
0603	1.80±0.10	1.00±0.10	8.00±0.20	1.75±0.10	3.50±0.05	0.40+0.2/-0	0.40±0.05	4.00±0.10	4.00±0.10	40.0±0.20	2.00±0.05
0805	2.30±0.10	1.55±0.10	8.00±0.20	1.75±0.10	3.50±0.05	0.40+0.2/-0	0.40±0.05	4.00±0.10	4.00±0.10	40.0±0.20	2.00±0.05
1206	3.50±0.20	1.90±0.20	8.00±0.20	1.75±0.10	3.50±0.05	0.60+0.2/-0	0.60±0.05	4.00±0.10	4.00±0.10	40.0±0.20	2.00±0.05

9.2 Packaging model:

Type	Tape width	Max. Packaging Quantity (pcs/reel)	
		2 mm pitch	4 mm pitch
0402	8 mm	10,000pcs	--
0603	8 mm	--	5,000pcs
0805	8 mm	--	5,000pcs
1206	8 mm	--	5,000pcs

9.3 Reel Dimensions:



Unit: mm

Reel Type / Tape	W	M	A	B	C	D
7”reel for 8 mm tape	12.00± 0.5	178 ± 1.0	2.0 ± 0.5	13.2 ± 0.5	17.7 ± 0.5	60.0 ± 1.0

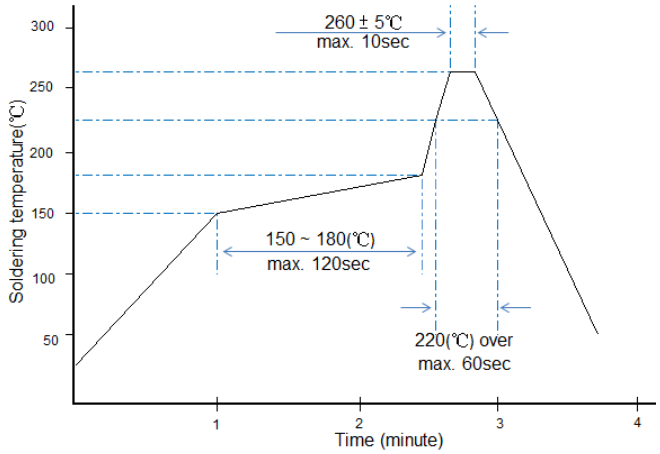
10 Technical application notes: (This is for recommendation, please customer perform adjustment according to actual application)

10.1 Recommend soldering method:

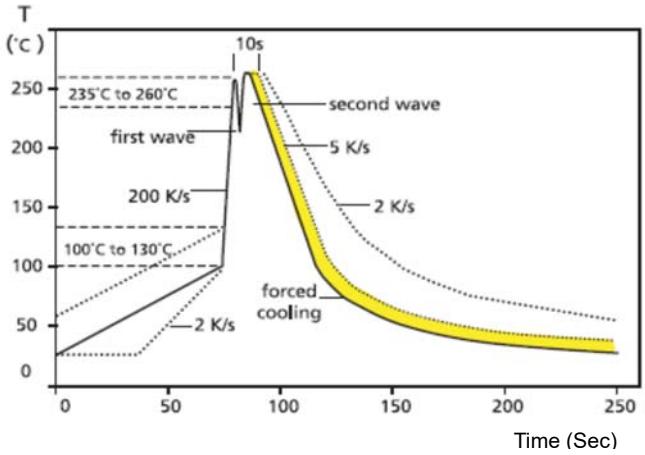
10.1.1 If characteristic is 2 for type of terminal(only bottom terminal), this product is only applicable with Reflow process.(Infrared Reflow)

10.1.2 Surface-mount components are tested for solderability at a temperature of 245 °C for 3 seconds.

10.1.3 Typical examples of soldering processes that provides reliable joints without any damage are given in below:



Recommended IR Reflow Soldering Profile
MEET J-STD-020D

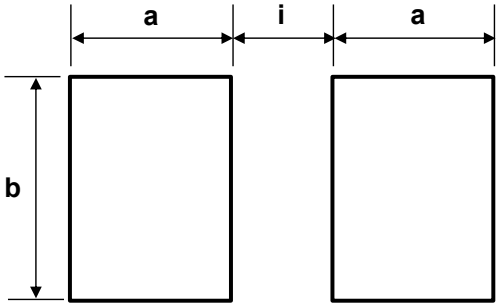


Recommended double-wave Soldering Profile
Typical values (solid line)
Process limits (dotted line)

10.1.4 Soldering Iron: temperature 350℃±10℃, dwell time shall be less than 3 sec.

10.2 Recommend Land Pattern:

When a component is soldered, the resistance after soldering changes slightly depending on the size of the soldering area and the amount of soldering. When designing a circuit, it is necessary to consider the effect of a decrease or increase in its resistance.



Type	Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - millimeters		
			a	b	i
0402	1/6 & 1/5	1.5~5、10	0.65	0.50	0.50
	1/4	3~5、10	0.65	0.50	0.50
	1/3	10	0.65	0.50	0.50
0603	1/3	1~ 60	1.00	1.27	0.50
	1/2	2~15	1.00	1.27	0.50
0805	1/2	1.5 ~ 70	1.45	1.78	0.66
	3/4	1.5 ~ 10	1.45	1.78	0.66
	1.0	1.5 ~ 5	1.45	1.78	0.66
1206	1/2 & 1.0	1≦R＜3	1.65	2.18	0.60
		3≦R＜4			0.90
		4≦R≦56			1.00

10.3 The characteristic of Fe/Cr/Al alloy material:

Because of including magnetism, inductor will be generated under high frequency circuit then to cause value shift and influence customer application. If there is related application shall be noted especially or discuss with original factory.

10.4 Environment Precautions:

This specification product is for general electronic use, RALEC will not be responsible for any damage, cost or loss caused by using this specification product in any special environment. If other applications need to confirm with RALEC.

If consumer intends to use our Company product in special environment or condition (including but not limited to those mentioned below), then will need to make individual recognition of product features and reliability accordingly.

(a) Used in high temperature and humidity environment
(b) Exposed to sea breeze or other corrosive gas, such as Cl2、H2S、NH3、SO2 and NO2.
(c) Used in non-verified liquids including water, oil, chemical and organic solvents.
(d) Using non-verified resin or other coating material to seal or coat our Company product.

After soldering, it is necessary to use water-soluble detergents to clean residual solder fluxes, even though no-clean fluxes are recommended.

10.5 Momentary Overload Precautions:

The product might be out of function when momentary overloaded. Please make sure to avoid momentary overloading while using and preserving.

10.6 Operation and Processing Precautions:

(a) Avoid damage to the edge of resistor and protective layer caused by mechanical stress.
(b) Handle with care when printing circuit board (PCB) is divided or fixed on support body, because bending of printing circuit board (PCB) mounting will make mechanical stress for resistors.
(c) Make sure the power rating is under the limit when using the resistor. When power rating is over the limit, the resister will be overloaded. There might be machinery damage due to the climbing temperature.
(d) If the resister will be exposed under massive impact load (shock wave) in a short period of time, the working environment must be set up well before use.
(e) Please make evaluation and confirmation when the product is well used in your company and have a through consideration of it's fail-safe design to ensure the system safety.

11 Storage and transportation requirement:

11.1 The temperature condition must be controlled at 25±5℃, the R.H. must be controlled at 60±15%. The stock can maintain quality level in two years。

11.2 Please avoid the mentioned harsh environment below when storing to ensure product performance and its' weldability. Places exposed to sea breeze or other corrosive gas, such as Cl2、H2S、NH3、SO2 and NO2.

11.3 When the product is moved and stored, please ensure the correct orientation of the box. Do not drop or squeeze the box. Otherwise, the electrode or the body of the product may be damaged.

12 Attachments:

12.1 Document Revise Record (QA-QR-027)

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