LR Series Metal Alloy Low-Resistance Resistor Product Specifications

1 Scope

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

1.2 The product is for general purpose.

2 Explanation Of Part Numbers

LR **2512** - **2** **1** **R001** **F** **4**

Type	Size (inch)	Number of Terminals	Rated Power	Resistance (4~6 Digits)	Tolerance	Packaging
Metal Alloy Low Resistance Resistor	● 1206 ● 1210 ● 2010 ● 2512 ● 2512H ● 2725 ● 2728 ● 4527 ● 4527S	2: 2 terminals	● 1=1 W ● 2=2W ● 3=3W ● 4=4W ● 5=5W ● A=1.5W ● B=3.5W ● C=0.5W	EX: R001 = 1mΩ R010 = 10mΩ R100 = 100mΩ R00025 = 0.25mΩ	D=± 0.5% F=± 1.0% G=± 2.0% J=± 5.0%	A=500pcs 1=1,000pcs 2=2,000pcs 4=4,000pcs

3 Product Specifications

Type	# of Terminals	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%)	
1206	2	0.5W	$Ir=\sqrt{P/R}$	$Io=\sqrt{5P/R}$	0.5~0.6 mΩ: ≦±175 1~1.5 mΩ: ≦±75 2~4 mΩ: ≦±75 5~15 mΩ: ≦±75 15.1~50 mΩ: ≦±50	5 ~ 50	0.5 ~ 50	-55~170°C
		1W			0.5~0.6 mΩ: ≦±175 1~1.5 mΩ: ≦±75 2~4 mΩ: ≦±75 5~15 mΩ: ≦±75 15.1~50 mΩ: ≦±50	5 ~ 50	0.5 ~ 50	
		1.5W			0.5~0.6 mΩ: ≦±175 1~1.5 mΩ: ≦±75 2~4 mΩ: ≦±75 5 mΩ: ≦±75	5	0.5 ~ 5	
		2W			0.5~0.6 mΩ: ≦±175 1~1.5 mΩ: ≦±75 2~4 mΩ: ≦±75 5 mΩ: ≦±75	5	0.5 ~ 5	
1210		1.5W			2~10 mΩ: ≦±75	2 ~10	2 ~ 10	
2010		1W			0.5~0.9 mΩ: ≦±100 1~1.9 mΩ: ≦±75 2~6.9 mΩ: ≦±50 7~100 mΩ: ≦±25	7 ~ 49	0.5~100	
		1.5W			0.5~0.9 mΩ: ≦±100 1~1.9 mΩ: ≦±75 2~6.9 mΩ: ≦±50 7~40 mΩ: ≦±25	7 ~ 40	0.5~40	
		2W			0.5~0.9 mΩ: ≦±100 1~1.9 mΩ: ≦±75 2~6.9 mΩ: ≦±50 7~12 mΩ: ≦±25	7 ~ 12	0.5~12	
2512	2	1W			0.3 mΩ: ≦±150 0.5~0.7 mΩ: ≦±75 0.75 mΩ: ≦±75 0.8~1 mΩ: ≦±75 1.1~3 mΩ: ≦±50 3.1~100 mΩ: ≦±25 101~300 mΩ: ≦±50 301~500 mΩ: ≦±50	1 ~ 50	0.3 ~ 500	
		1.5W			0.3 mΩ: ≦±150 0.5~0.7 mΩ: ≦±75 0.75 mΩ: ≦±75 0.8~1 mΩ: ≦±75 1.1~3 mΩ: ≦±50 3.1~100 mΩ: ≦±25 101~220 mΩ: ≦±50	1 ~ 50	0.3 ~ 220	

LR Series Metal Alloy Low-Resistance Resistor
Product Specifications

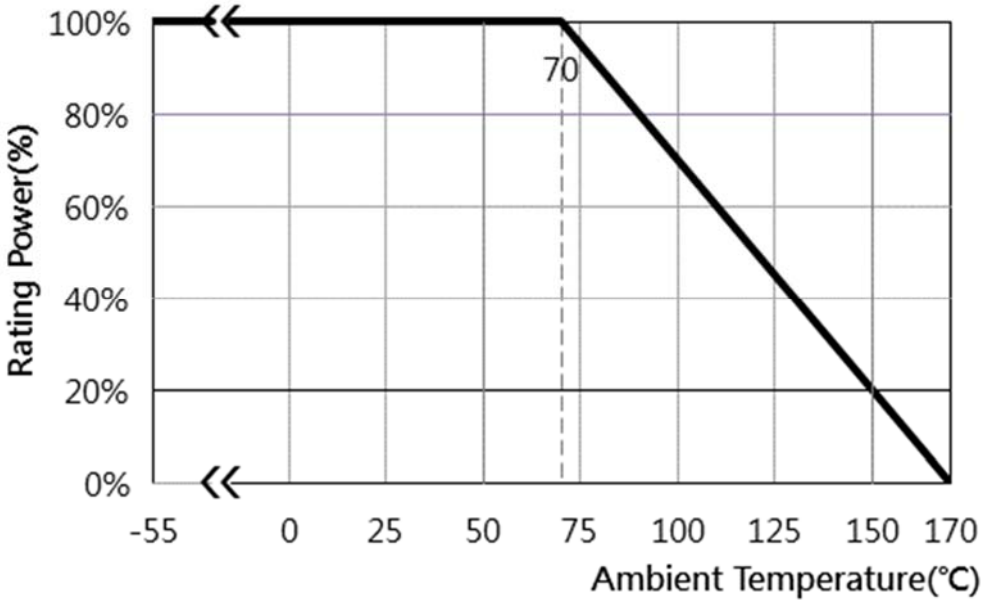
Type	# of Terminals	Rating Power	Rating Current	Overload Current	T.C.R. (ppm/°C)	Resistance Range (mΩ)		Operating Temperature Range
						D (±0.5%)	F (±1%) G (±2%) J (±5%)	
2512	2	2W	$Ir=\sqrt{P/R}$	$Io=\sqrt{5P/R}$	0.3 mΩ: ≦±150 0.5~0.7 mΩ: ≦±75 0.75 mΩ: ≦±75 0.8~1 mΩ: ≦±75 1.1~3 mΩ: ≦±50 3.1~75 mΩ: ≦±25 80~100 mΩ: ≦±25 101~150 mΩ: ≦±50 151~299 mΩ: ≦±75 300~500 mΩ: ≦±50	1 ~ 50	0.3 ~ 500	
		3W			0.3 mΩ: ≦±150 0.5~0.7 mΩ: ≦±75 0.75 mΩ: ≦±75 0.8~1 mΩ: ≦±75 1.1~2.5 mΩ: ≦±50 2.6~10 mΩ: ≦±25 50~150 mΩ: ≦±50	1 ~ 10	0.3 ~ 10 50 ~ 150	
2512H (with heat sink)		2W			80~200 mΩ: ≦±50	--	80 ~ 200	
		3W			10.1~100 mΩ: ≦±50	10.1 ~ 50	10.1 ~ 100	
2725		4W			0.20 mΩ: ≦±100 0.25~3 mΩ: ≦±50	--	0.20 ~ 3	
		5W			0.20 mΩ: ≦±100 0.25~0.5 mΩ: ≦±50	--	0.20 ~ 0.5	
2728		3W			4~200 mΩ: ≦±25	4 ~ 19	4 ~ 200	
		3.5W			4~100 mΩ: ≦±25	4 ~ 19	4 ~ 100	
		4W			4~80 mΩ: ≦±25	4 ~ 19	4 ~ 80	
4527S (without heat sink)		2W			0.5 mΩ: ≦±75 0.6~1 mΩ: ≦±75 1.1~3 mΩ: ≦±50 4~5 mΩ: ≦±50 5.1~200 mΩ: ≦±50	7 ~ 100	0.5 ~ 200	
		3W			0.5 mΩ: ≦±75 0.6~1 mΩ: ≦±75 1.1~3 mΩ: ≦±50 4~5 mΩ: ≦±50 5.1~27 mΩ: ≦±50	7 ~ 27	0.5 ~ 27	
		5W			0.5 mΩ: ≦±75 0.6~1 mΩ: ≦±75 1.1~3 mΩ: ≦±50 4~5 mΩ: ≦±50 5.1~7.5 mΩ: ≦±50	7 ~ 7.5	0.5~7.5	
4527		5W			0.5 mΩ: ≦±75 0.6~1 mΩ: ≦±75 1.1~3 mΩ: ≦±50 4~5 mΩ: ≦±50 5.1~200 mΩ: ≦±50	7 ~ 120	0.5 ~ 200	

Ir= Rating Current(A) Io= Overload Current(A) P= Rating Power(W) R= Resistance(Ω)

3.1 Power Derating Curve

Operating Temperature Range： - 55 ~+170℃

For resistors operated in ambient temperatures 70°C, power rating shall be derated in accordance with the curve below：



3.2 Rating Current

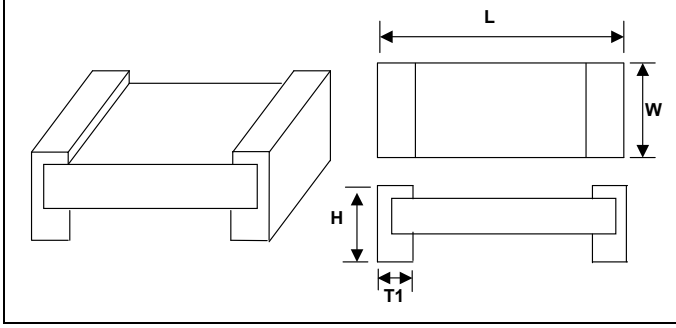
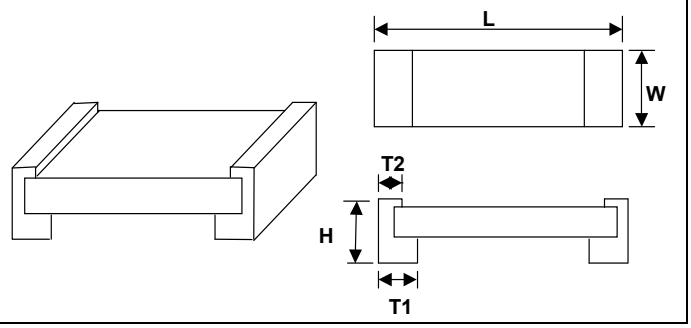
The following equation may be used to determine the DC (Direct Current) or AC (Alternating Current) currents (RMS, root mean square value) of normal rated power. However, if the result value exceeds the highest current of regulated standards, the highest normal rated power is to be used.

Remark:

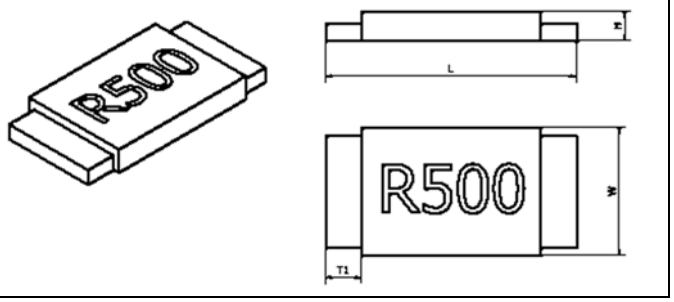
$$I = \sqrt{P/R}$$

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

4 Physical Dimensions

1206 / 1210 / 2010 / 2512/ 2725 / 2728	2512H/4527/4527S
	

2512(2W) 101mR~500mR
2512(3W) 50mR~150mR



Type	Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in inches (millimeters)				
			L	W	H	T1	T2
1206	0.5 1	0.5 ~ 0.6	0.126±0.010 (3.200±0.254)	0.063±0.010 (1.600±0.254)	0.039±0.010 (1.000±0.254)	0.029±0.010 (0.725±0.254)	
		1 ~ 1.5			0.025±0.010 (0.645±0.254)	0.020±0.010 (0.508±0.254)	
		2 ~ 4			0.022±0.010 (0.545±0.254)		
		5				0.024±0.010 (0.600±0.254)	
		6 ~ 50				0.020±0.010 (0.508±0.254)	
	1.5 2	0.5 ~ 0.6			0.039±0.010 (1.000±0.254)	0.029±0.010 (0.725±0.254)	
		1.0 ~ 1.5			0.025±0.010 (0.645±0.254)	0.020±0.010 (0.508±0.254)	
		2. ~ 4			0.022±0.010 (0.545±0.254)		
		5				0.024±0.010 (0.600±0.254)	
1210	1.5	2 ~ 10	0.126±0.010 (3.20±0.254)	0.100±0.010 (2.54±0.254)	0.035±0.010 (0.88±0.254)	0.024±0.010 (0.60±0.254)	
2010	1 1.5 2	0.5 ~ 0.9	0.200±0.010 (5.080±0.254)	0.100±0.010 (2.540±0.254)	0.031±0.010 (0.787±0.254)	0.057±0.010 (1.440±0.254)	
		1 ~ 3				0.051±0.010 (1.295±0.254)	
		3.1 ~ 4			0.025±0.010 (0.645±0.254)	0.031±0.010 (0.787±0.254)	
		4.1 ~100					

LR Series Metal Alloy Low-Resistance Resistor Product Specifications

IE-SP-022

Type	Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in inches (millimeters)				
			L	W	H	T1	T2
2512	1	0.3	0.246±0.010 (6.248±0.254)	0.126±0.010 (3.202±0.254)	0.040±0.010 (1.000±0.254)	0.079±0.010 (2.02±0.254)	
		0.5 ~ 0.7			0.031±0.010 (0.787±0.254)	0.079±0.010 (2.02±0.254)	
		0.75				0.054±0.010 (1.374±0.254)	
		0.8 ~ 3				0.074±0.010 (1.880±0.254)	
		3.1 ~ 4				0.074±0.010 (1.880±0.254)	
		4.1 ~79			0.025±0.010 (0.645±0.254)	0.044±0.010 (1.118±0.254)	
		80~ 200				0.034±0.010 (0.868±0.254)	
		201 - 300			0.0236±0.010 (0.600±0.254)	0.034±0.010 (0.868±0.254)	
		301 ~ 500			0.0283±0.010 (0.720±0.254)		
2512	1.5	0.3	0.246±0.010 (6.248±0.254)	0.126±0.010 (3.202±0.254)	0.040±0.010 (1.000±0.254)	0.079±0.010 (2.02±0.254)	
		0.5 ~ 0.7			0.031±0.010 (0.787±0.254)	0.079±0.010 (2.02±0.254)	
		0.75				0.054±0.010 (1.374±0.254)	
		0.8 ~ 3				0.074±0.010 (1.880±0.254)	
		3.1 ~ 4				0.074±0.010 (1.880±0.254)	
		4.1 ~ 79			0.025±0.010 (0.645±0.254)	0.044±0.010 (1.118±0.254)	
		80 ~ 200				0.034±0.010 (0.868±0.254)	
		201 ~ 220			0.0236±0.010 (0.600±0.254)	0.034±0.010 (0.868±0.254)	
	2	0.3			0.040±0.010 (1.000±0.254)	0.079±0.010 (2.02±0.254)	
		0.5 ~ 0.7			0.031±0.010 (0.787±0.254)	0.079±0.010 (2.02±0.254)	
		0.75				0.054±0.010 (1.374±0.254)	
		0.8 ~ 3				0.074±0.010 (1.880±0.254)	
		3.1 ~ 4				0.074±0.010 (1.880±0.254)	
		4.1 ~ 75			0.025±0.010 (0.645±0.254)	0.044±0.010 (1.118±0.254)	
		80 ~ 100				0.024±0.010 (0.624±0.254)	
		101 ~ 500			0.0283±0.010 (0.720±0.254)	0.034±0.010 (0.868±0.254)	
	3	0.3			0.040±0.010 (1.000±0.254)	0.079±0.010 (2.02±0.254)	
		0.5			0.031±0.010 (0.787±0.254)	0.079±0.010 (2.02±0.254)	
		0.6 ~ 0.7				0.074±0.010 (1.880±0.254)	
		0.75				0.054±0.010 (1.374±0.254)	
		0.8 ~ 2.9				0.044±0.010 (1.118±0.254)	
		3 ~ 3.5				0.074±0.010 (1.880±0.254)	
		3.6 ~ 4				0.066±0.010 (1.676±0.254)	

LR Series Metal Alloy Low-Resistance Resistor
Product Specifications

IE-SP-022

Type	Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in inches (millimeters)				
			L	W	H	T1	T2
2512	3	4.1~10	0.246±0.010 (6.248±0.254)	0.126±0.010 (3.202±0.254)	0.025±0.010 (0.645±0.254)	0.044±0.010 (1.118±0.254)	
		50~150			0.0283±0.010 (0.720±0.254)	0.034±0.010 (0.868±0.254)	
2512H (with heat sink)	2	80 ~ 200	0.246±0.010 (6.248±0.254)	0.126±0.010 (3.202±0.254)	0.039±0.010 (1.00±0.254)	0.034±0.010 (0.868±0.254)	0.0039~0.0394 (0.1~1.0)
	3	10.1 ~ 79				0.044±0.010 (1.118±0.254)	
		80 ~ 100				0.034±0.010 (0.868±0.254)	
2725	4	0.2 ~ 0.3	0.268±0.010 (6.807±0.254)	0.254±0.010 (6.452±0.254)	0.039±0.010 (0.991±0.254)	0.085±0.010 (2.159±0.254)	
		0.35				0.075±0.010 (1.90±0.254)	
		0.4 ~ 0.45				0.051±0.010 (1.30±0.254)	
		0.5				0.085±0.010 (2.159±0.254)	
		0.6				0.071±0.010 (1.803±0.254)	
		0.75				0.059±0.010 (1.504±0.254)	
		1	0.268±0.010 (6.807±0.254)	0.254±0.010 (6.452±0.254)	0.043±0.010 (1.092±0.254)	0.085±0.010 (2.159±0.254)	
		1.5			0.039±0.010 (0.991±0.254)		
		2			0.035±0.010 (0.889±0.254)	0.071±0.010 (1.803±0.254)	
		2.25 ~ 2.5				0.065±0.010 (1.651±0.254)	
		3				0.051±0.010 (1.30±0.254)	
	5	0.2 ~ 0.3	0.268±0.010 (6.807±0.254)	0.254±0.010 (6.452±0.254)	0.039±0.010 (0.991±0.254)	0.085±0.010 (2.159±0.254)	
		0.35				0.075±0.010 (1.90±0.254)	
		0.4 ~ 0.45				0.051±0.010 (1.30±0.254)	
		0.5				0.085±0.010 (2.159±0.254)	
2728	3	4 ~ 200	0.264±0.010 (6.706±0.254)	0.283±0.010 (7.188±0.254)	0.039±0.010 (0.991±0.254)	0.045±0.010 (1.143±0.254)	
	3.5	4 ~ 100					
	4	4 ~ 80					

Type	Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in inches (millimeters)				
			L	W	H	T1	T2
4527S (without heat sink)	2	0.5	0.450±0.010 (11.430±0.254)	0.270±0.010 (6.850±0.254)	0.055±0.010 (1.400±0.254)	0.136±0.010 (3.465±0.254)	0.038±0.010 (0.965±0.254)
		0.6 ~ 3				0.127±0.010 (3.215±0.254)	
		4 ~ 5					
		5.1 ~ 200				0.071±0.010 (1.815±0.254)	
	3	0.5				0.136±0.010 (3.465±0.254)	
		0.6 ~ 3				0.127±0.010 (3.215±0.254)	
		4 ~ 5					
		5.1 ~ 27				0.071±0.010 (1.815±0.254)	
	5	0.5				0.136±0.010 (3.465±0.254)	
		0.6 ~ 3				0.127±0.010 (3.215±0.254)	
		4 ~ 5					
		5.1 ~ 7.5				0.071±0.010 (1.815±0.254)	
4527	5	0.5	0.450±0.010 (11.430±0.254)	0.270±0.010 (6.850±0.254)	0.059±0.010 (1.500±0.254)	0.136±0.010 (3.465±0.254)	0.038±0.010 (0.965±0.254)
		0.6 ~ 3				0.127±0.010 (3.215±0.254)	
		4 ~ 5				0.127±0.010 (3.215±0.254)	
		5.1 ~ 200				0.071±0.010 (1.815±0.254)	

4.1 Material of Alloy

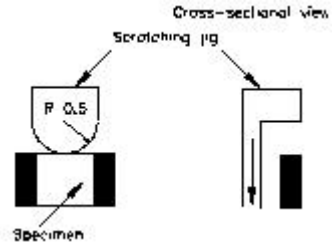
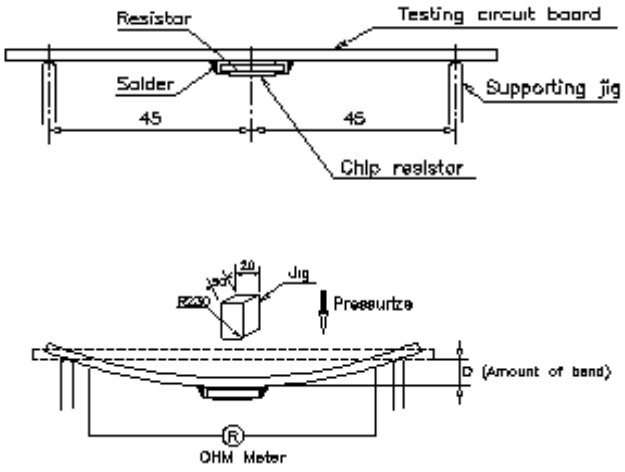
Type	Watts	Material	Resistance(R)
1206	0.5 1.0 1.5 2.0	Copper-Manganese Alloy	≦4.0mΩ
		Iron-Chromium Aluminium Alloy	＞4.0mΩ
1210	1.5	Copper-Manganese Alloy	≦2.0mΩ
		Iron-Chromium Aluminium Alloy	＞2.0mΩ
2010	1.0 1.5 2.0	Copper-Manganese Alloy	≦4.0mΩ
		Iron-Chromium Aluminium Alloy	＞4.0mΩ
2512	1.0	Copper-Manganese Alloy	＜3.5mΩ
		Iron-Chromium Aluminium Alloy	3.5 mΩ≦R≦500mΩ
	1.5	Copper-Manganese Alloy	＜3.5mΩ
		Iron-Chromium Aluminium Alloy	3.5 mΩ≦R≦220mΩ
	2.0	Copper-Manganese Alloy	＜3.5mΩ
		Iron-Chromium Aluminium Alloy	3.5 mΩ≦R≦100mΩ
		Nickel-Copper Alloy	101 mΩ≦R≦150mΩ
		Nickel-Chromium Aluminium Alloy	151 mΩ≦R≦299mΩ
		Iron-Chromium Aluminium Alloy	300 mΩ≦R≦500mΩ
	3.0	Copper-Manganese Alloy	≦2.5mΩ
		Iron-Chromium Aluminium Alloy	3mΩ≦R≦10mΩ
		Nickel-Copper Alloy	50mΩ≦R≦150mΩ
2512H	2.0 3.0	Iron-Chromium Aluminium Alloy	＞10mΩ
2725	4.0 5.0	Copper-Manganese Alloy	≦0.5mΩ
		Iron-Chromium Aluminium Alloy	＞0.5mΩ
2728	3.0 3.5 4.0	Iron-Chromium Aluminium Alloy	All
4527	2.0 3.0 5.0	Copper-Manganese Alloy	≦3.0mΩ
		Iron-Chromium Aluminium Alloy	≧4.0mΩ

5 Reliability Performance

5.1 Electrical Performance

<table>
<tr><th>Test Item</th><th>Conditions of Test</th><th>Test Limits</th></tr>
<tr><td>Temperature Coefficient of Resistance (TCR)</td><td>• TCR(ppm/℃)=$\frac{(R2-R1)}{R1(T2-T1)}\times10^6$
• 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</td><td>Refer to Paragraph 3. general specifications</td></tr>
<tr><td rowspan="2">Short Time Overload</td><td>Applied Overload for 5 seconds and release the load for about 30 minutes, then measure its resistance variance rate. (Overload condition refer to below):
<table>
<tr><th>Type</th><th>Power (W)</th><th># of rated power</th></tr>
<tr><td rowspan="4">1206</td><td>0.5</td><td rowspan="4">5 times</td></tr>
<tr><td>1.0</td></tr>
<tr><td>1.5</td></tr>
<tr><td>2.0</td></tr>
<tr><td>1210</td><td>1.5</td><td>5 times</td></tr>
<tr><td rowspan="3">2010</td><td>1.0</td><td rowspan="3">5 times</td></tr>
<tr><td>1.5</td></tr>
<tr><td>2.0</td></tr>
<tr><td rowspan="4">2512</td><td>1.0</td><td rowspan="4">5 times</td></tr>
<tr><td>1.5</td></tr>
<tr><td>2.0</td></tr>
<tr><td>3.0</td></tr>
<tr><td rowspan="2">2512H</td><td>2.0</td><td rowspan="2">5 times</td></tr>
<tr><td>3.0</td></tr>
<tr><td rowspan="2">2725</td><td>4.0</td><td rowspan="2">5 times</td></tr>
<tr><td>5.0</td></tr>
<tr><td rowspan="3">2728</td><td>3.0</td><td rowspan="3">5 times</td></tr>
<tr><td>3.5</td></tr>
<tr><td>4.0</td></tr>
<tr><td rowspan="3">4527S</td><td>2.0</td><td rowspan="3">5 times</td></tr>
<tr><td>3.0</td></tr>
<tr><td>5.0</td></tr>
<tr><td>4527</td><td>5.0</td><td>5 times</td></tr>
</table>
Refer to JIS C 5201-1 4.13</td><td>≦±0.5%
≦±2.0% (4527 & 4527S series)</td></tr>
<tr><td>Insulation Resistance</td><td>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</td><td>≧$10^9\Omega$</td></tr>
<tr><td>Dielectric Withstanding Voltage</td><td>Applied 500VAC for 1 minute, and Limit surge current 50 mA (max.)
Refer to JIS-C5201-1 4.7</td><td>No short or burned on the appearance.</td></tr>
</table>

5.2 Mechanical /Constructional Performance Test

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
Solder ability	Add flux into tested resistors, immersion into solder bath in temperature 245±5℃ for 3±1 secs. Refer to JIS-C5201-1 4.17	Solder coverage over 95%
Core Body Strength	Applied R0.5 test probe at its central part then pushing 5N force on the sample for 10 sec. Refer to JIS-C5201-1 4.15	≦±0.5% No evidence of mechanical damage
Joint Strength of Solder	Preconditioning Put tested resistor in the apparatus of PCT, at a temperature of 105℃, humidity of 100% RH, and pressure of 1.22×105 Pa for a duration of 4 hours. Then after left the specimen in a temperature for 2 hours or more. Test method: ◎Test item 1 (Adhesion): A static load using a R0.5 scratch tool shall be applied on the core of the component and in the direction of the arrow and held for 10 seconds and under load measured its resistance variance rate. Load:17.7N  Refer to JIS-C5201-1 4.32	Test item 1: (1) ≦±0.5% (2) No evidence of mechanical damage. No terminal peeling off. Test item 2: (1) ≦±0.5% (2) No evidence of mechanical damage. No terminal peeling off and core body cracked.
	◎Test item 2 (Bending Strength): Solder tested resistor on to PC board add force in the middle down, and under load measured its resistance variance rate. D:2mm  Refer to JIS-C5201-1 4.33	

Test Item	Conditions of Test	Test Limits
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
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

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% ≦±1% for 2512(1W) 301~500mΩ ≦±1% for 2512(2W) 101~500mΩ ≦±1% for 2512(3W) 50~150mΩ No evidence of mechanical damage
High Temperature Exposure (Storage)	Put tested resistor in chamber under temperature 170±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 consecutively. Then leaving the tested resistor in the room temperature for 60 minutes, and measure its resistance variance rate. Refer to JESD22-A104	≦±0.5% ≦±1% for 2512(1W) 301~500mΩ ≦±1% for 2512(2W) 101~500mΩ ≦±1% for 2512(3W) 50~150mΩ 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% ≦±1% for 2512(1W) 301~500mΩ ≦±1% for 2512(2W) 101~500mΩ ≦±1% for 2512(3W) 50~150mΩ 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 Power 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 MIL-STD 202 Method 103	≦±0.5% ≦±1% for 2512(1W) 301~500mΩ ≦±1% for 2512(2W) 101~500mΩ ≦±1% for 2512(3W) 50~150mΩ No evidence of mechanical damage

	Testing Condition
Lowest Temperature	-55 +0/-10℃
Highest Temperature	150 +10/-0℃
Dwell time	30min maximum

Test Item	Conditions of Test	Test Limits
Whisker Test	◎Test item (Thermal Shock test): Testing Condition Minimum storage temperature: -55+0/-10℃ Maximum storage temperature: 85+10/-0℃ Temperature-retaining time: 10 min. Number of temperature cycles: 1,500 ◎Inspection: Inspect for whisker formation on specimens that underwent the acceleration test specified in subciause 4.2, with a magnifier (stereo microscope) of about 40 or higher magnification. If judgment is hard in this method, use a scanning electron microscope (SEM) of about 1,000 or higher magnification. By JESD Standard NO.22A121 class 2.	Max. 50μm

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 current 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% ≦±2.0% (4527 & 4527Sseries) No evidence of mechanical damage

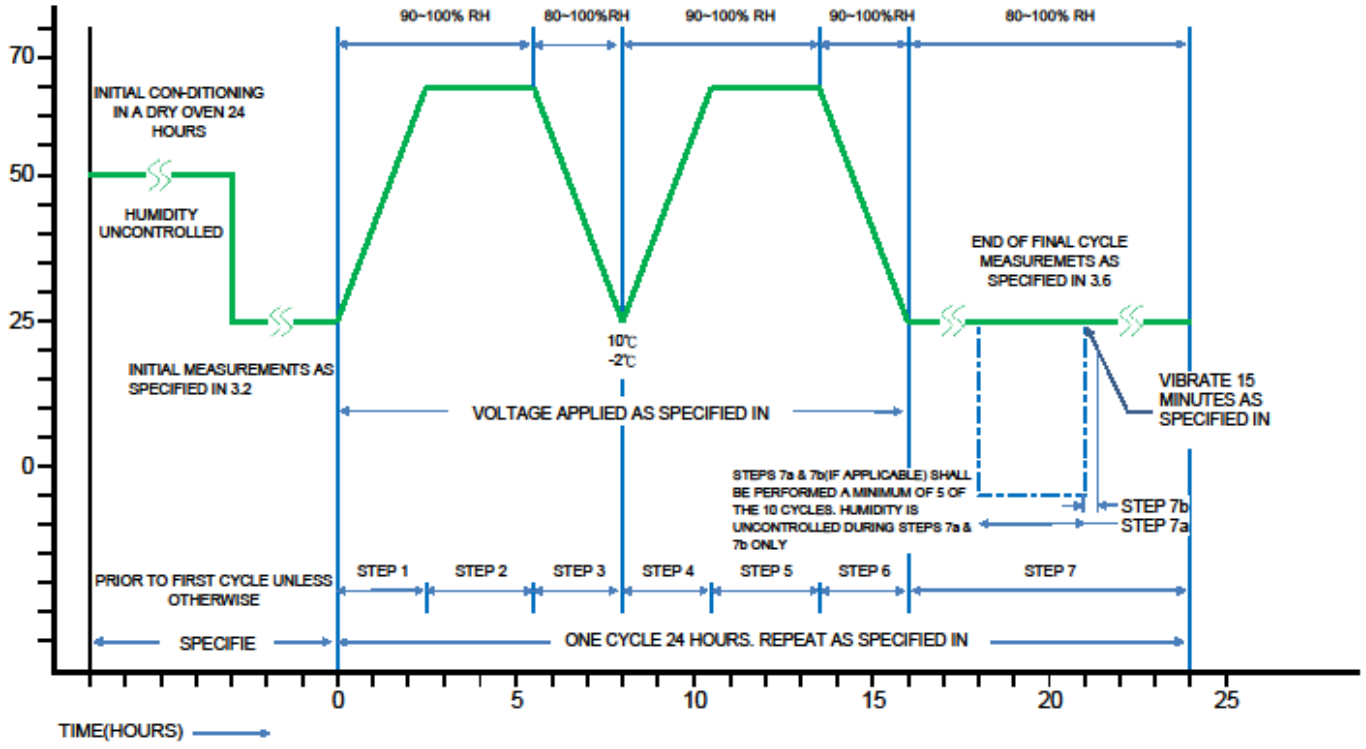


Figure 1

6 Marking Format

6.1 Product resistance is indicated by using two marking notation styles：

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

- For 5mΩ the product marking is R005;
- For 25mΩ the product marking is R025;
- For 100mΩ the product marking is R100.

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

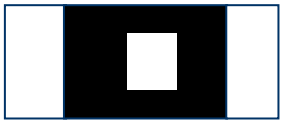
- For 5.5mΩ the product marking is 5m50;
- For 25.5mΩ the product marking is 25m5.

6.2 1206 Series：(4-digits marking)

6.2.1 Above 1.0mΩ

Ex. Resistance 10mΩ (for all LR1206 products)

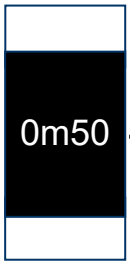
6.2.2 0.5~0.6 mΩ:(Square marking)
Recogize Top/Bottom side.



6.3 1210 Series:(4-digits marking)

Ex. Resistance 7mΩ

6.4 2010 Series:(4-digits marking)



Ex. Resistance 0.5mΩ (when resistance below than 1mΩ)

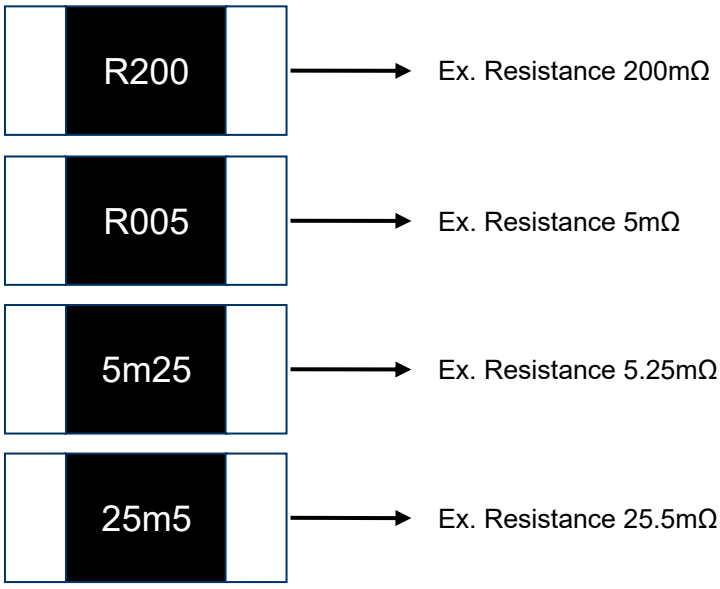
Ex. Resistance 2mΩ (when resistance greater than 3mΩ)

Ex. Resistance 5mΩ (when resistance greater than 3mΩ)

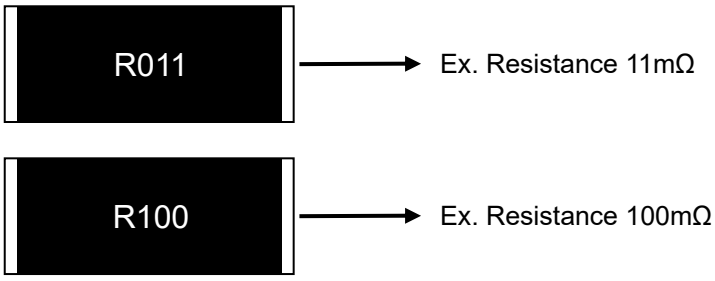
6.5 2512 Series：(3-digits marking / 4-digits marking)

6.5.1 ≦4.0mΩ (3-digits marking)

6.5.2 ＞4.0mΩ (4-digits marking)



6.6 2512H Series：(4-digits marking)

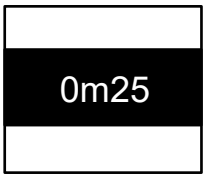


6.7 2512 Series 2Watts, 80~100mΩ(4-digits marking)

Ex. Resistance 80mΩ

Ex. Resistance 100mΩ

6.8 2725 Series： (4-digits marking)

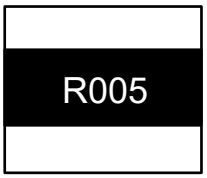


Ex. Resistance 0.25mΩ (or 0.25mΩ only)

Ex. Resistance 2.5mΩ (for 1.5mΩ and 2.5mΩ only)

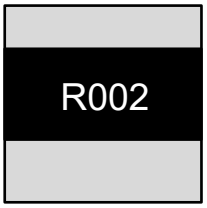
Ex. Resistance 3mΩ (for 1m、2m and 3mΩ only)

6.9 2728 Series： (4-digits marking)

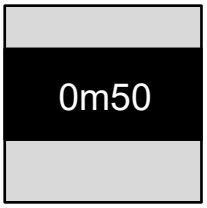


Ex. Resistance 5mΩ (for all LR2728 products)

6.10 4527 Series： (4-digits marking)



Ex: Resistance 2mΩ.



Ex: Resistance 0.5mΩ.

6.11 4527S Series:(4-digits marking)

6.12 Marking Style

Type \ Marking	R	m	1	2	3	4	5	6	7	8	9	0
1206 1210 2010 2512 2512H 2725 2728 4527 4527S												

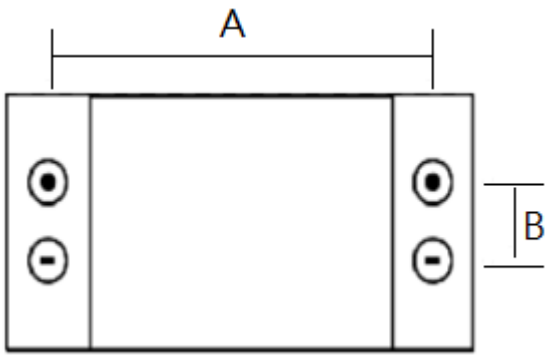
7 Plating Thickness

7.1 Ni>=2um

7.2 Sn(Tin)>=3um

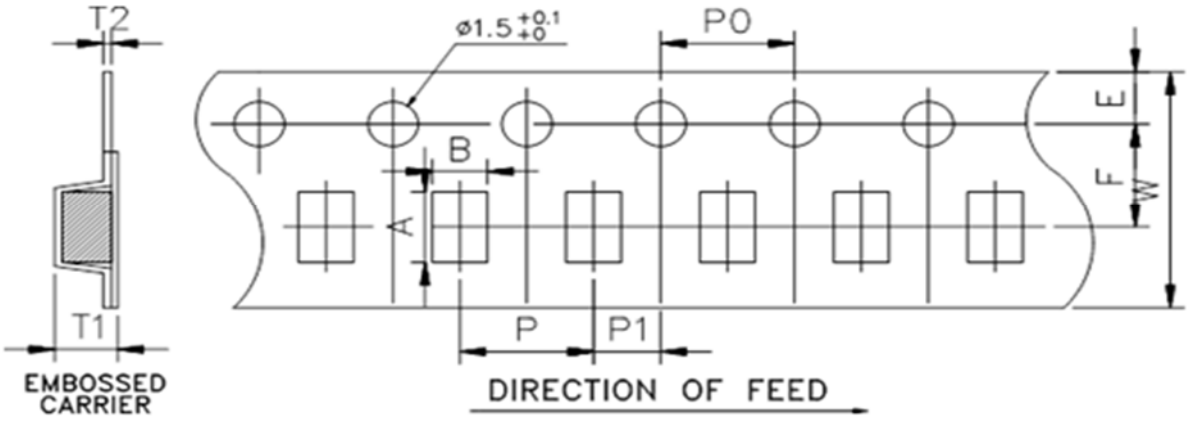
7.3 Sn(Tin):Matte Sn

8 MEASURE POINT

Bottom Side	Type	A	B
	LR1206	2.95±0.25	1.00±0.25
	LR1210	2.70±0.10	1.30±0.10
	LR2010	4.35±0.25	1.60±0.25
	LR2512	5.25±0.25	2.25±0.25
	LR2512H	5.25±0.25	2.25±0.25
	LR2725	5.10±0.05	5.10±0.05
	LR2728	5.60±0.05	5.60±0.05
	LR4527	4.50±0.05	9.00±0.05
	Unit：mm		

9 Taping specification

9.1 Tape Dimensions：



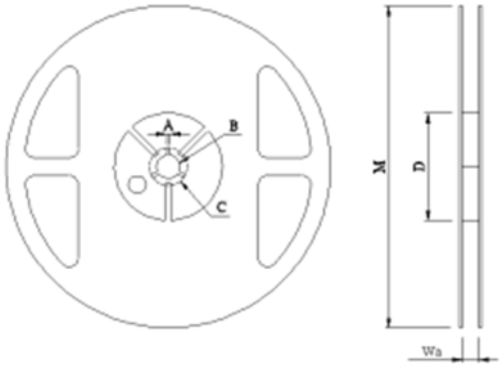
Unit: mm

DIM / Item	A	B	W	E	F	T1	T2	P	P0	10*P0	P1
1206 (0.5~0.6mΩ)	3.50±0.10	1.90±0.10	8.0±0.15	1.75±0.10	3.5±0.10	1.27±0.10	0.23±01.0	4.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
1206 (≥1.0mΩ)	3.48±0.10	1.83±0.10	8.0±0.15	1.75±0.10	3.5±0.10	1.10±0.10	0.20±0.05	4.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
1210	3.5±0.1	3.0±0.1	8.0±0.2	1.75±0.1	3.5±0.1	1.10±0.1	0.22±0.05	4.0±0.1	4.0±0.1	40.0±0.2	2.0±0.1
2010	5.45±0.10	2.90±0.10	12.0±0.15	1.75±0.10	5.5±0.10	1.33±0.10	0.23±0.05	4.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
2512 (0.3mΩ)	6.74±0.10	3.50±0.10	12.0±0.15	1.75±0.10	5.5±0.10	1.60±0.10	0.24±0.05	8.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
2512	6.75±0.10	3.50±0.10	12.0±0.15	1.75±0.10	5.5±0.10	1.30±0.10	0.20±0.05	4.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
2512H	6.75±0.10	3.55±0.10	12.0±0.30	1.75±0.10	5.5±0.10	1.60±0.10	0.20±0.10	4.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
2725	7.15±0.10	6.75±0.10	12.0±0.15	1.75±0.10	5.5±0.10	1.95±0.10	0.25±0.05	8.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
2728	7.15±0.10	7.70±0.10	12.0±0.15	1.75±0.10	5.5±0.10	1.45±0.10	0.25±0.05	12.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
4527	11.80±0.10	7.20±0.10	24.0±0.15	1.75±0.10	11.5±0.10	2.00±0.10	0.30±0.10	12.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10
4527S	11.80±0.10	7.20±0.10	24.0±0.15	1.75±0.10	11.5±0.10	2.00±0.10	0.30±0.10	12.0±0.10	4.0±0.10	40.0±0.20	2.0±0.10

9.2 Packaging model：

Type	Tape width	Max. Packaging Quantity (pcs/reel)		
		Embossed Plastic Type		
		4mm pitch	8mm pitch	12mm pitch
1206(0.5~0.6mΩ)	8mm	2,000pcs	--	--
1206(≥1.0mΩ)		4,000pcs		
1210	8mm	4,000pcs	--	--
2010	12mm	2,000pcs/4,000pcs	--	--
2512(0.3mΩ)		--	1,000pcs	--
2512		4,000pcs	--	--
2512H		2,000pcs	--	--
2725		--	1,000pcs	--
2728		--	--	1,000pcs
4527 4527S	24mm	--	--	500pcs

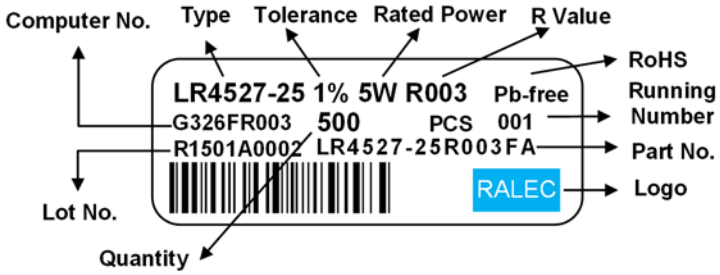
9.3 Reel Dimensions：

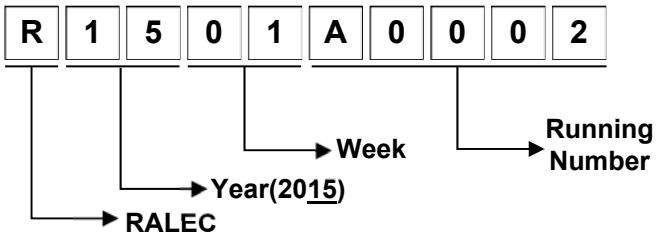


Unit: mm

Reel Type / Tape	W	M	A	B	C	D
7” reel for 8 mm tape	9.0 ± 0.5	178 ± 2.0	2.0 ± 0.5	13.5 ± 0.5	21.0 ± 0.5	60.0 ± 1.0
7” reel for 12 mm tape	13.8 ± 0.5					80.0 ± 1.0
7” reel for 24 mm tape	25.0 ± 1.0			13.2 ± 0.5	17.7 ± 0.5	60.0 ± 1.0

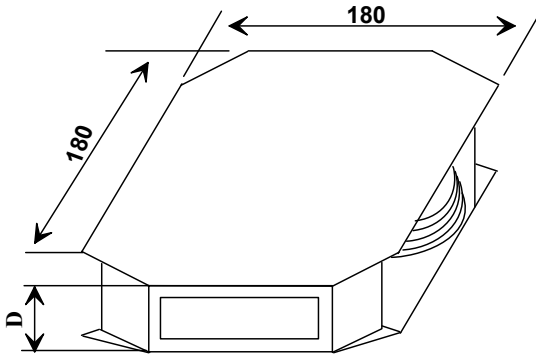
9.4 Label：





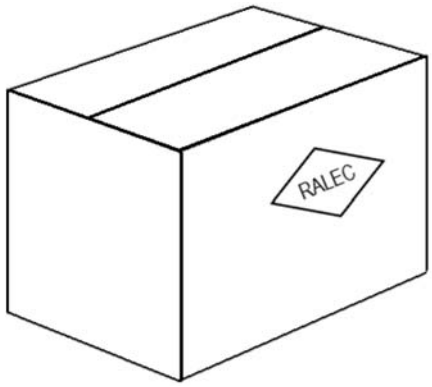
9.5 Inner Box：

Reel Number (for 8 mm tape)	Reel Number (for 12 mm tape)	Reel Number (for 24 mm tape)	D Dimension (mm)
1	-	-	12
2	1	-	24
3	2	1	36
4	-	-	48
5	3	2	60
6	4	-	72
7	-	3	84
8	-	-	96
9	-	-	108
10	-	4	120



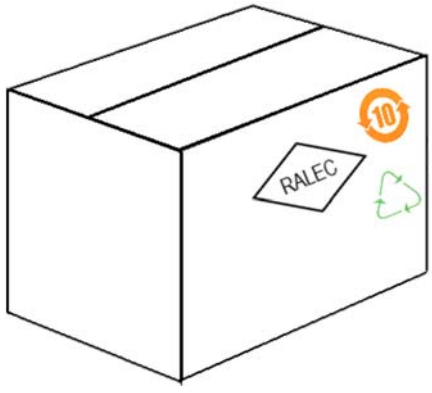
9.6 Box：

9R/10R Inner Box Number	L(mm)	W(mm)	H(mm)
2	272	205	210
4	375	280	210
6	395	380	210
8	544	380	210



9.7 Box(For China)

9R/10R Inner Box Number	L(mm)	W(mm)	H(mm)
2	272	205	210
4	375	280	210
6	395	380	210
8	544	380	210

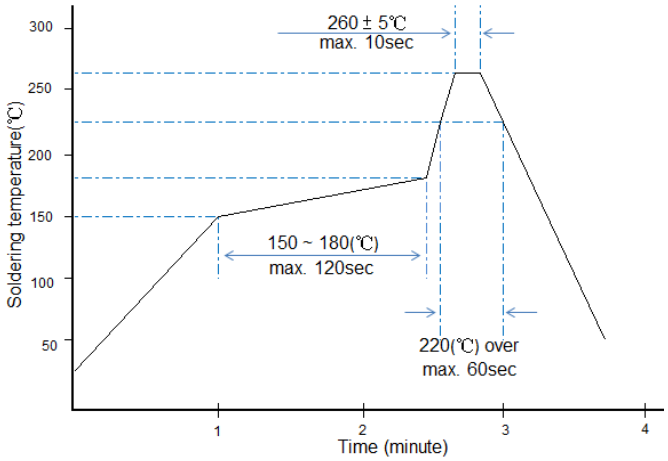


10 Technical note (This is for recommendation, please customer perform adjustment according to actual application)

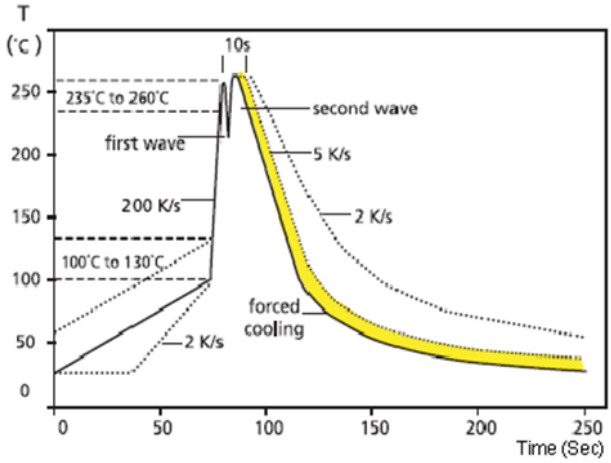
10.1 Recommend Soldering Method

10.1.1 Surface-mount components are tested for solder ability at a temperature of 245 °C for 3 seconds.

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



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

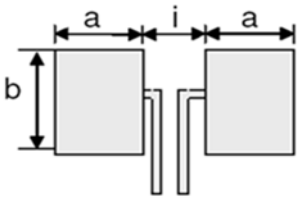


Recommended double-wave Soldering Profile
Typical values (solid line)
Process limits (dotted line)

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

10.2 Recommend Land Pattern

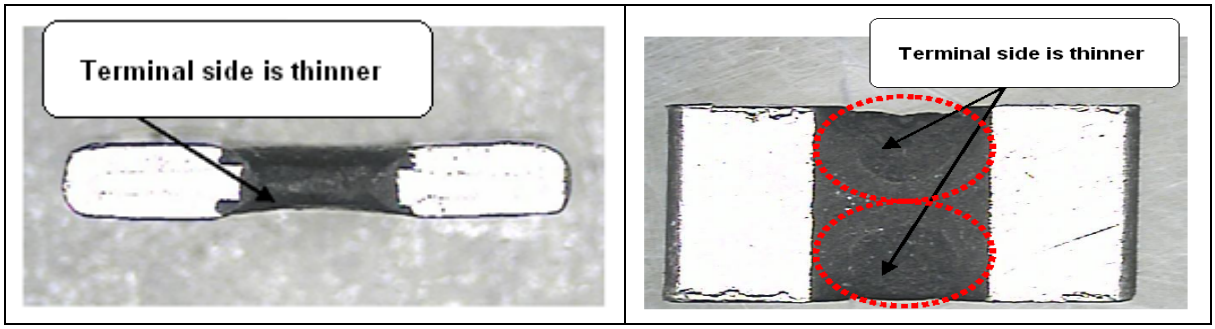
When a component is soldered, the resistance after soldering changes slightly depending on the size of the soldering area and the amount of soldering. When designing a circuit, it is necessary to consider the effect of a decrease or increase in its resistance.



Type	Maximum Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in millimeters		
			a	b	i
1206	0.5 & 1 & 1.5 & 2	0.5 ~ 0.6	1.65	2.18	0.90
		1 ~ 50	1.60		1.00
1210	1.5	2 ~ 10	1.25	2.92	1.70
2010	1 & 1.5 & 2	0.5 ~ 3	2.89	2.92	1.22
		3.1 ~ 100	2.29		2.41
2512	1	0.3 ~ 0.7	3.05	3.68	1.27
		0.8 ~ 4			
		0.75	2.19		3.00
		4.1 ~ 300	2.11		3.18
		301 ~ 500	2.11		3.18
	1.5	0.3 ~ 0.7	3.05		1.27
		0.8 ~ 4			
		0.75	2.19		3.00
		4.1 ~ 220	2.11		3.18
	2	0.3 ~ 0.7	3.05		1.27
		0.8 ~ 4			
		0.75	2.19		3.00
		4.1 ~ 75	2.11		3.18
		80 ~ 500	2.11		3.18
	3	0.3 ~ 0.5	3.05		1.27
		0.6 ~ 2.9	2.19		3.00
		4.1 ~ 10			
		3 ~ 4	2.79		1.80
		50~150	2.11		3.18
2512H	2	80~ 200	2.11	3.68	3.18
	3	10.1 ~ 100			
2725	4 & 5	0.2 ~ 3	3.18	6.86	1.32
2728	3	4 ~ 200	2.75	7.82	3.51
	3.5	4 ~ 100			
	4	4 ~ 80			
4527S	2	0.5 ~ 5	5.80	8.74	3.51
		5.1 ~ 200	4.15		6.81
	3	0.5 ~ 5	5.80		3.51
		5.1 ~ 27	4.15		6.81
	5	0.5 ~ 5	5.80		3.51
		5.1 ~ 7.5	4.15		6.81
4527	5	0.5 ~ 5	5.80	8.74	3.51
		5.1 ~ 200	4.15		6.81

10.3 Recommend dispensing method

10.3.1 The structure of RALEC metal alloy resistor that both side of main body would be thinner due to process factor (as the photo below).



10.3.2 When customer performs wave solder process shall take note on the dispensing gap. If the gap between two dispensing is over, the red-glue will not adhesive the resistor body and be dropped out (as photo 1). Therefore, we suggest customer to narrow down the dispenser gap (as photo 2), or dispenser on the body center (as photo 3)

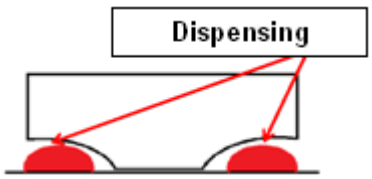
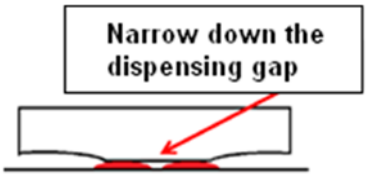
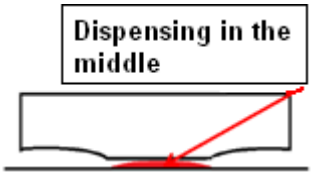
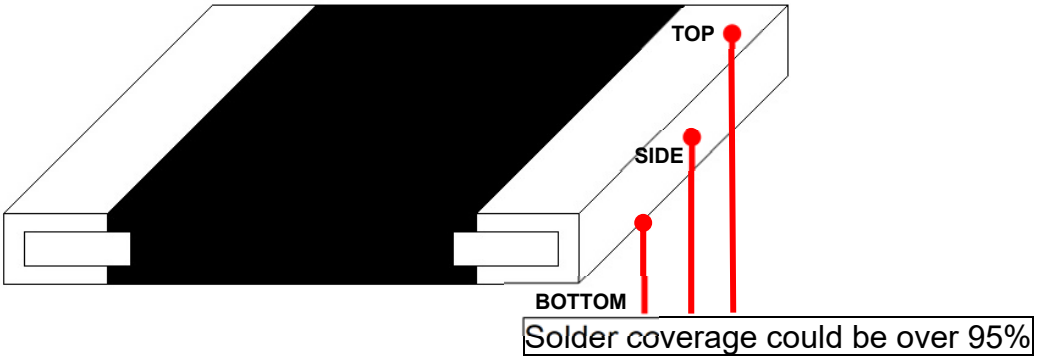
		

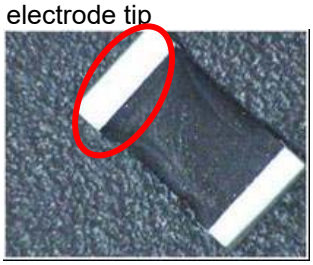
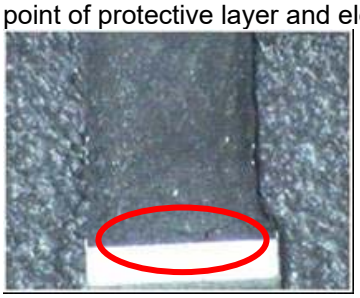
Photo 1	Photo 2	Photo 3

10.4 Product warranted solder area



10.5 Appearance

The metal alloy need more punch for-product, appearance of the product are listed below：

Illustration of qualified protective layer	Illustration of abnormal protective layer
a. Punch mark is allowed but raw material (substrate) can not exposed 	
b. Without cracks are found on the protective layer when looking at product under naked eyes at a distance of 30 cm. 	a. Substance is not to have any fractures that would expose itself. 
c. Dent is allowed at the joining point of protective layer and electrode tip 	
d. Bulging appearance (bulging degree should not exceed height of electrode tip) is allowed at the joining point of protective layer and electrode tip. 	

10.6 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.

10.7 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.
(e) After soldering, it is necessary to use water-soluble detergents to clean residual Solder fluxes, even though no-clean fluxes are recommended.

10.8 Momentary Overload Precautions

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

10.9 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.

10.10 Nickel-Copper Alloy : The small thermal EMF(40uV/V) will be generated then to cause a small voltage shift which maybe influence for some application. If there is related application shall be noted especially or discuss with original factory.

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' weld ability. 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 The carton packaged for electronic-information products is made by the symbol as follows (For China)

	
Marking for control of pollution cause by electronic-information products	Marking for package recovery

13 Attachments

13.1 Document Revise Record(QA-QR-027)

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