

1. Scope:

This specification is applicable to lead free and halogen free for metal alloy low-resistance resistor by following products:

- LR1206 series
- LR2010 series
- LR2512 series
- LR2725 series
- LR2728 series
- LR4527 series
- LR4527S series

2. Explanation Of Part Numbers:

Type	Size (inch)	Number of Terminals	Rated Power	Resistance (4~6 Digits)	Tolerance	Packaging
Metal Alloy Low Resistance Resistor	<ul style="list-style-type: none"> • 1206 • 2010 • 2512 • 2725 • 2728 • 4527 • 4527S 	2: 2 terminals	<ul style="list-style-type: none"> • C=0.5W • 1=1.0W • A=1.5W • 2=2.0W • 3=3.0W • B=3.5W • 4=4.0W • 5=5.0W 	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

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3. Product Specifications:

Type	# of Terminals	Max. Rating Power	Max. Rating Current	Max. Overload Current	T.C.R. (ppm/°C)	Resistance Range (mΩ)		Operating Temperature Range
						D (±0.5%)	F (±1%); G (±2%); J (±5%)	
LR1206	2	0.5W	22.36A	44.72A	1.0~4.0mΩ: ≤±50 4.1~15.0mΩ: ≤±25 15.1~50.0mΩ: ≤±15	7.0~50.0	1.0~50.0	-55~+170°C
		1W	31.62A	63.25A	1.0~4.0mΩ: ≤±50 4.1~15.0mΩ: ≤±25 15.1~50.0mΩ: ≤±15	7.0~50.0	1.0~50.0	
LR2010		1W	31.62A	63.25A	1.0~3.0mΩ: ≤±50 3.1~6.9mΩ: ≤±25 7.0~100mΩ: ≤±15	7.0~100	1.0~100	
LR2512		1W	44.72A	100.00A	0.5~3.0mΩ: ≤±50 3.1~100mΩ: ≤±25	7.0~100	0.5~100	
		1.5W	54.77A	122.48A				
		2W	63.25A	141.42A	0.5~3.0mΩ: ≤±50 3.1~75mΩ: ≤±25	7.0~75.0	0.5~75.0	
		3W	77.46A	134.16A	0.5~2.5mΩ: ≤±50 2.6~10.0mΩ: ≤±25	7.0~10.0	0.5~10.0	
LR2725		4W	126.49A	252.95A	0.25~3.0mΩ: ≤±50	--	0.25~3.0	
LR2728		3W	27.39A	47.43A	4.0~7.0mΩ: ≤±25 7.1~100mΩ: ≤±15	4.0~100	4.0~100	
		3.5W	29.58A	51.23A	4.0~7.0mΩ: ≤±25 7.1~100mΩ: ≤±15	4.0~100	4.0~100	
	4W	31.62A	63.25A	4.0~7.0mΩ: ≤±25 7.1~50.0mΩ: ≤±15	4.0~50.0	4.0~50.0		
LR4527S (without heat sink)	3W	77.5A	134A	≤±50	7.0~20	0.5~20		
LR4527	5W	100A	173A		7.0~120	0.5~120		

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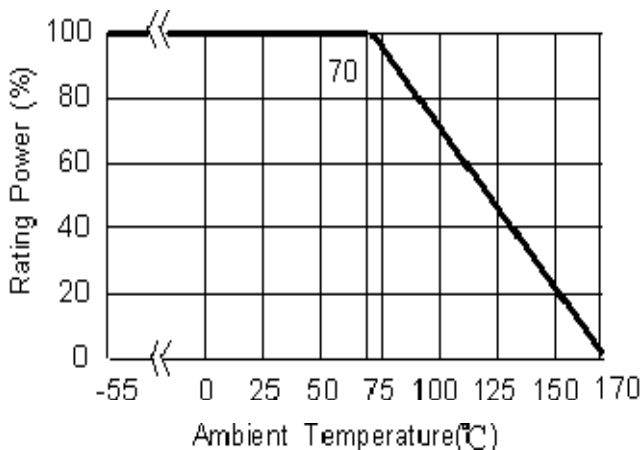
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3.1 Power Derating Curve: Operating Temperature Range : - 55 ~+170 °C

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



3.2 Rating Current:

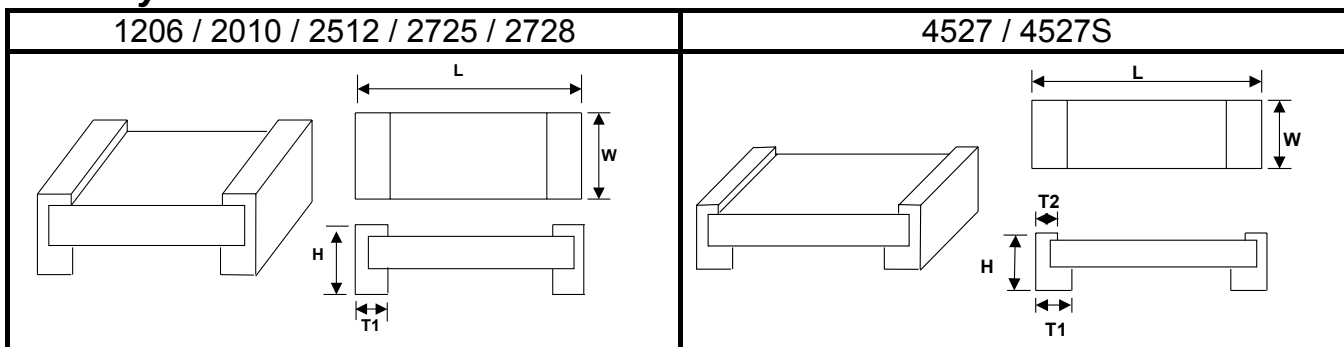
Rated Current: The resistor shall have a DC continuous working current or a RMS(Root Mean Square). AC continuous working current at commercial-line frequency and wave form corresponding to the power rating, as determined from the following:

Remark:

- a. I: Rating Current.(A)
- b. P: Rating Power.(W)
- c. R: Resistance.(Ω)

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

4 Physical Dimensions:



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Type	Maximum Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in inches (millimeters)				
			L	W	H	T1	T2
LR1206	0.5 & 1.0	1.0	0.126±0.010 (3.200±0.254)	0.063±0.010 (1.600±0.254)	0.025±0.010 (0.645±0.254)	0.020±0.010 (0.508±0.254)	
		2.0 ~ 4.0			0.022±0.010 (0.545±0.254)		0.024±0.010 (0.600±0.254)
		5.0				0.020±0.010 (0.508±0.254)	
		6.0 ~50.0					
LR2010	1.0	1.0 ~ 3.0	0.200±0.010 (5.080±0.254)	0.100±0.010 (2.540±0.254)	0.031±0.010 (0.787±0.254)	0.051±0.010 (1.295±0.254)	
		3.1 ~ 4.0			0.025±0.010 (0.645±0.254)	0.031±0.010 (0.787±0.254)	
		4.1 ~100.0					
LR2512	1.0 & 1.5	0.5 ~ 3.0	0.246±0.010 (6.248±0.254)	0.126±0.010 (3.202±0.254)	0.031±0.010 (0.787±0.254)	0.074±0.010 (1.880±0.254)	
		3.1 ~ 4.0			0.025±0.010 (0.645±0.254)	0.044±0.010 (1.118±0.254)	
		4.1 ~75.0			0.025±0.010 (0.645±0.254)	0.034±0.010 (0.868±0.254)	
		75.1 ~ 100.0					
	2.0	0.5 ~ 3.0			0.031±0.010 (0.787±0.254)	0.074±0.010 (1.880±0.254)	
		3.1 ~ 4.0			0.0254±0.010 (0.645±0.254)	0.044±0.010 (1.118±0.254)	
		4.1 ~75.0					
	3.0	0.5			0.031±0.010 (0.787±0.254)	0.074±0.010 (1.880±0.254)	
		0.6 ~ 2.9			0.044±0.010 (1.118±0.254)	0.066±0.010 (1.676±0.254)	
		3.0 ~ 4.0			0.025±0.010 (0.645±0.254)	0.044±0.010 (1.118±0.254)	
		4.1 ~ 10.0					
	LR2725	4.0			0.25 ~ 0.50	0.268±0.010 (6.807±0.254)	0.254±0.010 (6.452±0.254)
1.0			0.043±0.010 (1.092±0.254)				
1.5			0.039±0.010 (0.991±0.254)				
2.0			0.071±0.010 (1.803±0.254)				
2.5			0.065±0.010 (1.651±0.254)				
3.0			0.051±0.010 (1.295±0.254)				
LR2728	3.0, 3.5 & 4.0	4.0~100.0	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)	

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Type	Maximum Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in inches (millimeters)				
			L	W	H	T1	T2
LR4527S (without heat sink)	3.0	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)	0.127±0.010 (3.215±0.254)	0.038±0.010 (0.965±0.254)
		0.6 ~ 3.0					
		4.1 ~ 5.0				0.071±0.010 (1.815±0.254)	
		5.1 ~ 20					
LR4527	5.0	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)	0.127±0.010 (3.215±0.254)	0.038±0.010 (0.965±0.254)
		0.6 ~ 3.0					
		4.1 ~ 5.0				0.071±0.010 (1.815±0.254)	
		5.1 ~ 120					

4.1 Material of Alloy

Type	Material	Resistance
1206/2010	Copper-Manganese Alloy	≤ 4mΩ
	Iron-Chromium Aluminium Alloy	> 4mΩ
2512/4527/4527S	Copper-Manganese Alloy	≤ 3mΩ
	Iron-Chromium Aluminium Alloy	> 3mΩ
2725	Copper-Manganese Alloy	≤ 0.5mΩ
	Iron-Chromium Aluminium Alloy	> 0.5mΩ
2728	Iron-Chromium Aluminium Alloy	All

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5 Reliability Performance:

5.1 Electrical Performance:

Test Item	Conditions of Test	Test Limits																											
Temperature Coefficient of Resistance (TCR)	<ul style="list-style-type: none"> TCR (ppm/°C) = $\frac{(R2-R1)}{R1 (T2-T1)} \times 10^6$ 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):	$\leq \pm 0.5\%$ $\leq \pm 2.0\%$ (4527 & 4527S series)																											
	<table border="1"> <thead> <tr> <th>Type</th> <th>Power (W)</th> <th># of rated power</th> </tr> </thead> <tbody> <tr> <td rowspan="2">LR1206</td> <td>0.5</td> <td rowspan="2">4 times</td> </tr> <tr> <td>1.0</td> </tr> <tr> <td>LR2010</td> <td>1.0</td> <td rowspan="3">5 times</td> </tr> <tr> <td rowspan="2">LR2512</td> <td>1.0</td> </tr> <tr> <td>1.5</td> </tr> <tr> <td rowspan="2">LR2725</td> <td>2.0</td> <td>3 times</td> </tr> <tr> <td>3.0</td> <td>4 times</td> </tr> <tr> <td rowspan="3">LR2728</td> <td>3.0</td> <td rowspan="3">3 times</td> </tr> <tr> <td>3.5</td> </tr> <tr> <td>4.0</td> </tr> <tr> <td>LR4527S</td> <td>3.0</td> <td rowspan="2">3 times</td> </tr> <tr> <td>LR4527</td> <td>5.0</td> </tr> </tbody> </table> <p>Refer to JIS C 5201-1 4.13</p>	Type	Power (W)	# of rated power	LR1206	0.5	4 times	1.0	LR2010	1.0	5 times	LR2512	1.0	1.5	LR2725	2.0	3 times	3.0	4 times	LR2728	3.0	3 times	3.5	4.0	LR4527S	3.0	3 times	LR4527	5.0
Type	Power (W)	# of rated power																											
LR1206	0.5	4 times																											
	1.0																												
LR2010	1.0	5 times																											
LR2512	1.0																												
	1.5																												
LR2725	2.0	3 times																											
	3.0	4 times																											
LR2728	3.0	3 times																											
	3.5																												
	4.0																												
LR4527S	3.0	3 times																											
LR4527	5.0																												
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	$\geq 10^9 \Omega$																											
Dielectric Withstanding Voltage	Applied 500VAC for 1 minute, and Limit surge current 50 mA (max.) Refer to JIS-C5201-1 4.7	No short or burned on the appearance.																											

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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°C 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°C 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°C 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

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5.3 Environmental Performance:

Test Item	Conditions of Test	Test Limits						
Low Temperature Exposure (Storage)	Put the tested resistor in chamber under temperature $-55\pm 2^{\circ}\text{C}$ 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	$\leq \pm 0.5\%$ No evidence of mechanical damage						
High Temperature Exposure (Storage)	Put tested resistor in chamber under temperature $170\pm 5^{\circ}\text{C}$ 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	$\leq \pm 1.0\%$ 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. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Testing Condition</th> </tr> </thead> <tbody> <tr> <td>Lowest Temperature</td> <td>$-55 +0/-10^{\circ}\text{C}$</td> </tr> <tr> <td>Highest Temperature</td> <td>$150 +10/0^{\circ}\text{C}$</td> </tr> </tbody> </table> Refer to JIS-C5201-1 4.19	Testing Condition		Lowest Temperature	$-55 +0/-10^{\circ}\text{C}$	Highest Temperature	$150 +10/0^{\circ}\text{C}$	$\leq \pm 0.5\%$ No evidence of mechanical damage
		Testing Condition						
		Lowest Temperature	$-55 +0/-10^{\circ}\text{C}$					
		Highest Temperature	$150 +10/0^{\circ}\text{C}$					
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	$\leq \pm 0.5\%$ No evidence of mechanical damage						
Bias Humidity	Put the tested resistor in chamber under $85\pm 5^{\circ}\text{C}$ and $85\pm 5\%RH$ 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	$\leq \pm 0.5\%$ 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 $70\pm 2^{\circ}\text{C}$ 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	$\leq \pm 1.0\%$ $\leq \pm 2.0\%$ (4527 & 4527S series) No evidence of mechanical damage

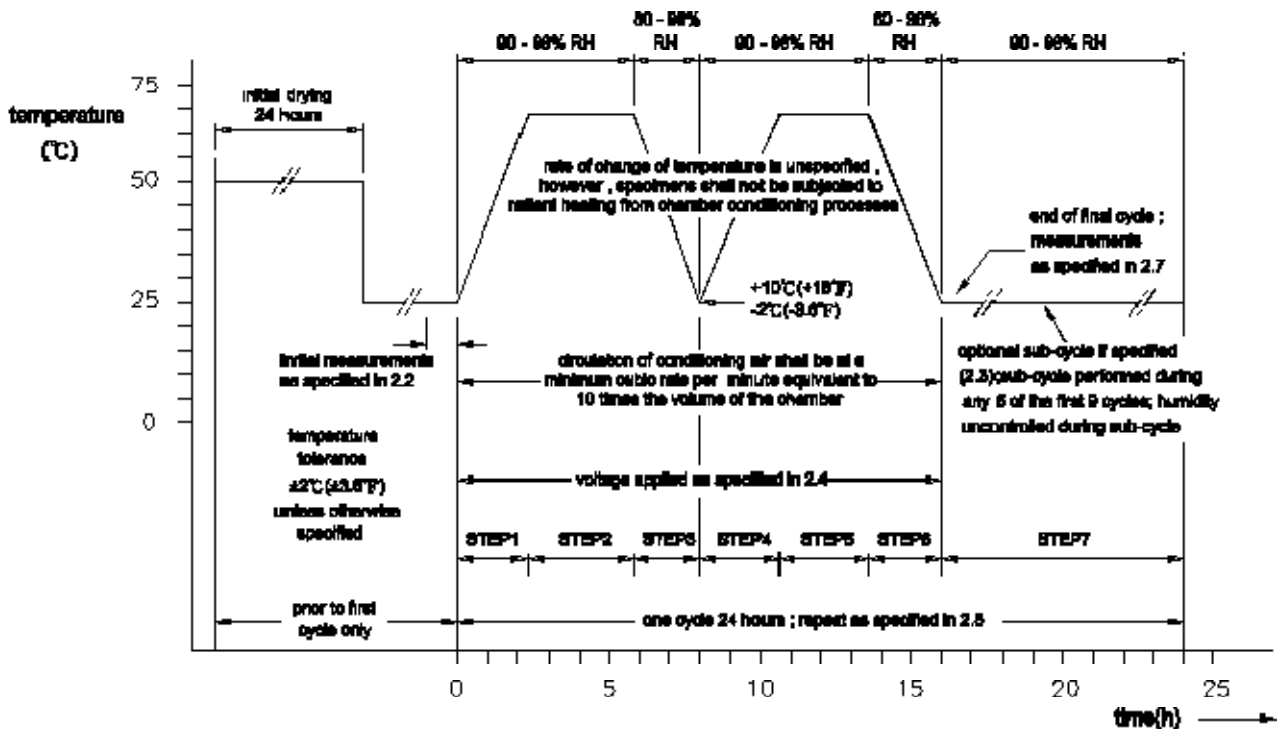
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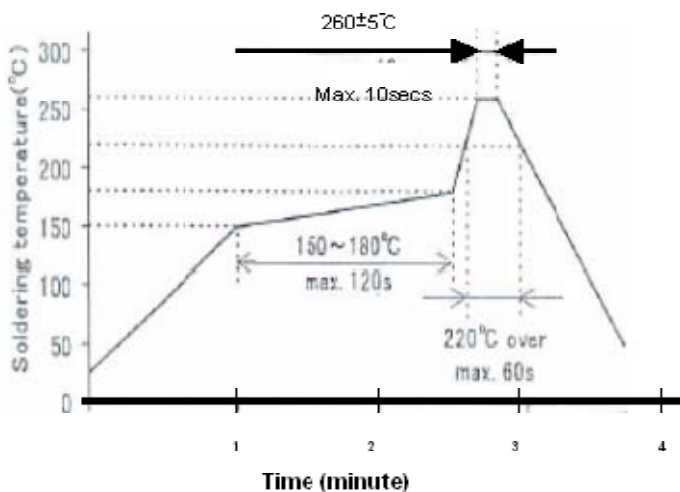
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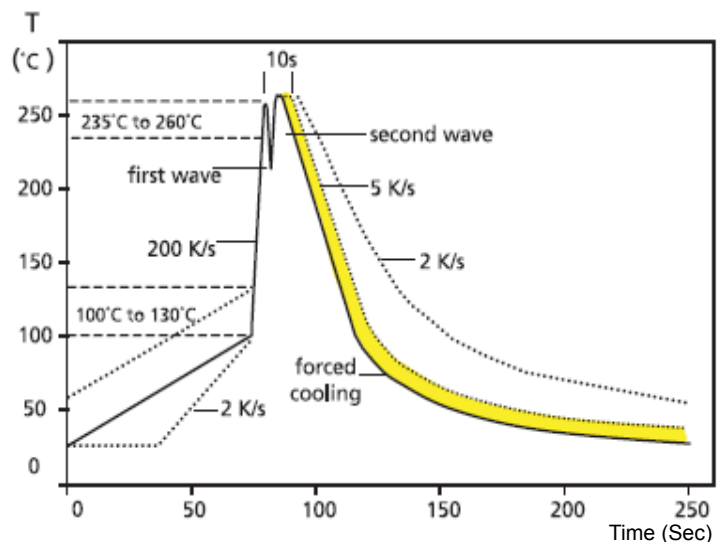
<Figure 1>

6. Recommend Soldering Conditions:

6.1 Surface-mount components are tested for solderability at a temperature of 245 °C for 3 seconds. Typical examples of soldering processes that provide reliable joints without any damage are given in below:



Recommended IR Reflow Soldering Profile



Recommended double-wave Soldering Profile

Typical values (solid line)
Process limits (dotted line)

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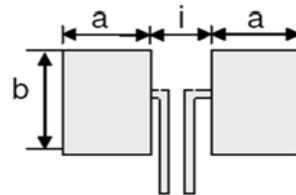
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7. Recommend Land Pattern:



Type	Maximum Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in millimeters		
			a	b	i
LR1206	0.5 & 1.0	1.0 ~ 50.0	1.60	2.18	1.00
LR2010	1.0	1.0 ~ 3.0	2.89	2.92	1.22
		3.1 ~ 100.0	2.29		2.41
LR2512	1.0 & 1.5	0.5 ~ 4.0	3.05	3.68	1.27
		4.1 ~ 100.0	2.11		3.18
	2.0	0.5 ~ 4.0	3.05		1.27
		4.1 ~ 75.0	2.11		3.18
	3.0	0.5	3.05		1.27
		0.6~2.9 & 4.1~10.0	2.19		3.00
3.0~4.0	2.79	1.80			
LR2725	4.0	0.25 ~ 3.0	3.18	6.86	1.32
LR2728	3.0、3.5 & 4.0	4.0 ~ 100.0	2.75	7.82	3.51
LR4527S	3.0	0.5 ~ 5.0	4.80	8.74	5.51
		5.1 ~ 20.0	3.40		8.31
LR4527	5.0	0.5 ~ 5.0	4.80	8.74	5.51
		5.1 ~ 120.0	3.40		8.31

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

8.1 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;
 - For 100mΩ the product marking is R100.
- 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.

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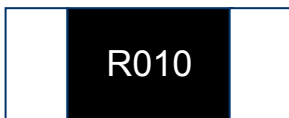
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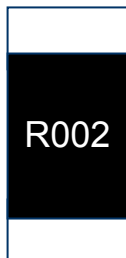
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8.2 LR1206 series:

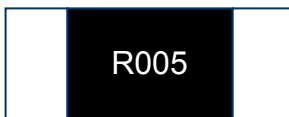


→ Ex. Resistance 10mΩ (for all LR1206 products)

8.3 LR2010 series:



→ Ex. Resistance 2mΩ (when resistance below or equal than 3mΩ)

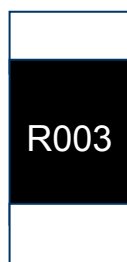


→ Ex. Resistance 5mΩ (when resistance greater than 3mΩ)

8.4 LR2512 series:



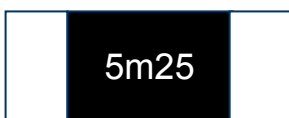
→ Ex. Resistance 0.5mΩ (when resistance below than 1mΩ)



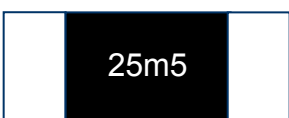
→ Ex. Resistance 3mΩ (when resistance below or equal than 4mΩ)



→ Ex. Resistance 5mΩ (when resistance greater than 4mΩ)



→ Ex. Resistance 5.25mΩ (when resistance greater than 4mΩ)



→ Ex. Resistance 25.5mΩ (when resistance greater than 4mΩ)

Remark

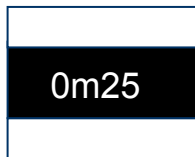
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8.5 LR2725 series:



Ex. Resistance 0.25mΩ (or 0.25mΩ only)

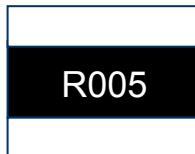


Ex. Resistance 2.5mΩ (for 1.5mΩ and 2.5mΩ only)



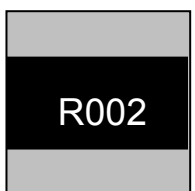
Ex. Resistance 3mΩ (for 1m · 2m and 3mΩ only)

8.6 LR2728 series:

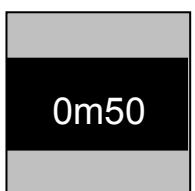


Ex. Resistance 5mΩ (for all LR2728 products)

8.7 LR4527 series:

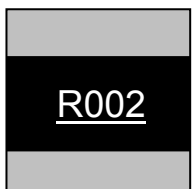


Ex: Resistance 2mΩ.

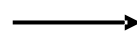
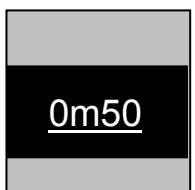


Ex: Resistance 0.5mΩ.

8.8 LR4527S series:



Ex: Resistance 2mΩ.



Ex: Resistance 0.5mΩ.

Remark

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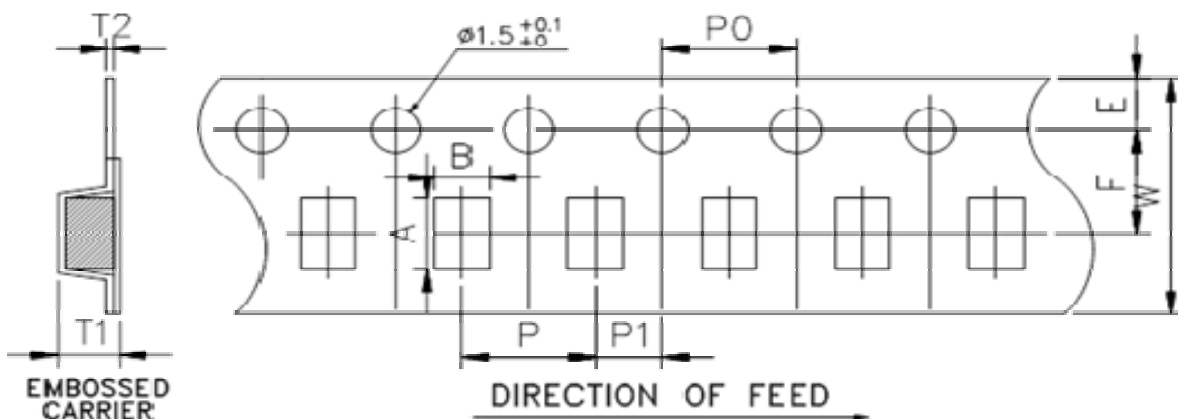
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8.9 Marking Style:

Marking Type	R	m	1	2	3	4	5	6	7	8	9	0
LR1206 LR2010 LR2512 LR2725 LR2728 LR4527 LR4527S	R	m	1	2	3	4	5	6	7	8	9	0

9. Taping specifications:

9.1 Tape Dimensions:



Unit: mm

DIM Item	A	B	W	E	F	T1	T2	P	P0	10*P0	P1
LR1206	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
LR2010	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
LR2512	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
LR2725	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
LR2728	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
LR4527	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
LR4527S	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

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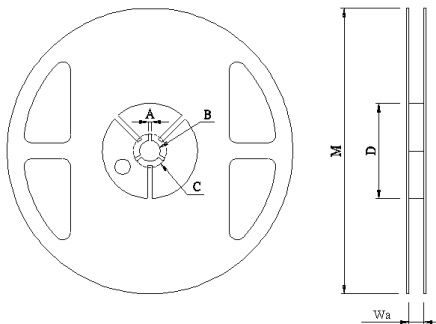
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9.2 Packaging model:

Type	Tape width	Max. Packaging Quantity (pcs/reel)		
		Embossed Plastic Type		
		4mm pitch	8mm pitch	12mm pitch
LR1206	8mm	4,000pcs	--	--
LR2010	12mm	2,000pcs	--	--
LR2512		4,000pcs	--	--
LR2725		--	1,000pcs	--
LR2728		--	--	1,000pcs
LR4527 LR4527S	24mm	--	--	500pcs

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
7" reel for 12 mm tape	16.20 ± 0.5		2.5 ± 0.5	13.5 ± 0.5		
7" reel for 24 mm tape	24.00+2/-0		2.0 ± 0.5	13.2 ± 0.5		

10. Attachments

10.1 Document Revise Record (QA-QR-027)

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