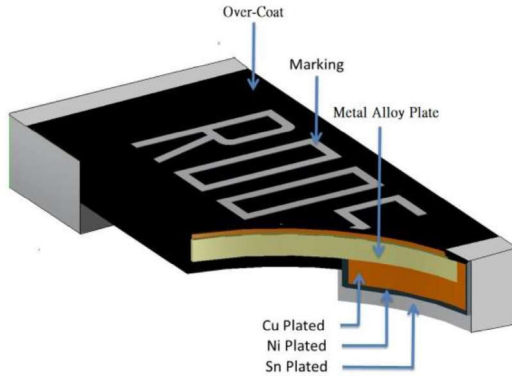




MAL Series Metal Alloy Low-Resistance Resistor Product Specifications

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■ Metal Alloy Low Resistance Chip Resistor — MAL Series



■ Application

- Entertainment product
- Power supply
- Measuring instrument
- Industrial product
- Battery management system

■ Features

- Low Resistance / Low TCR/Low Inductance($\leq 5nH$)
- Excellent long term stability
- RoHs compliant and halogen free.
- Lead free.
- High precision current sensing and voltage division.

■ Parts Number Explanation

■ Example:

MAL	2512	20	F	R001	M	Z
Product Type	Size (Inch)	Rated Power	Tolerance	Resistance	Material	Optional
Low-Inductance Metal Alloy Low Resistance Resistor	1206 2512 4527	10=1.00W 15=1.50W 20=2.00W 30=3.00W 50=5.00W	F : $\pm 1\%$ J : $\pm 5\%$	0m50=0.5mR 2m50=2.5mR R005=5.0mR R250=250mR	S : MnCuSn M : MnCu R : NiCrAl	Z : Default code



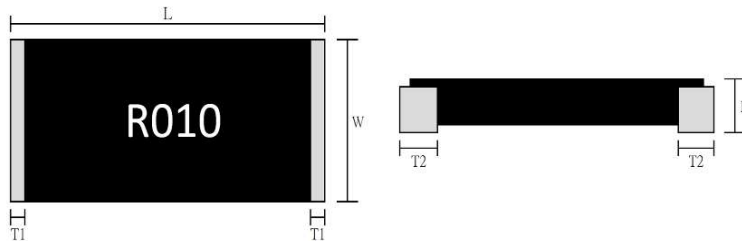
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Standard Electrical Specifications

TYPE	Rating Power at 70°C	T.C.R. (ppm/°C)	Max. Rating Current	Max. Overload Current	Resistance Range (mΩ)		Material	Operating Temperature Range (°C)
					0.5% (D)	1.0% (F) 2.0% (G) 5.0% (J)		
MAL1206	1W	$\leq \pm 50$	31.62	63.24	7~10	1~10	R001 : MnCuSn R002~R010: MnCu	- 55 ~ + 170
MAL2512	1W	$\leq \pm 75$	54.77	109.54	-	0.5~0.75	R0005~R00075 : MnCuSn R001~R015 : MnCu R016~R250 : NiCrAl	
	1.5W	$\leq \pm 50$	38.72	77.45	7~250	1~250		
	2W	$\leq \pm 75$	63.24	126.49	-	0.5~0.75		
		$\leq \pm 50$	44.72	89.44	7~100	1~100		
	3W	$\leq \pm 75$	77.45	154.91	-	0.5~0.75		
		$\leq \pm 50$	54.77	109.54	7~20	1~20		
MAL4527	2W	$\leq \pm 75$	63.24	141.42	-	0.5	R0005 : MnCuSn R001~R040 : MnCu	
		$\leq \pm 50$	44.72	100.0	7~40	1~40		
	3W	$\leq \pm 75$	77.45	173.20	-	0.5		
		$\leq \pm 50$	54.77	122.47	7~40	1~40		
	5W	$\leq \pm 75$	100.00	200.00	-	0.5		
		$\leq \pm 50$	70.71	141.42	7~40	1~40		

Type Dimension





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Dimension

Unit : mm

Type	Power Rating	Resistance Range	L	W	H	T1	T2		
MAL1206	1W	1mΩ	3.200±0.254	1.650±0.254	0.770±0.254	0.508±0.254	0.508±0.254		
		2 mΩ			0.650±0.254				
		3~10 mΩ			0.550±0.254				
MAL2512	1W	101~200	6.350±0.254	3.050±0.254	0.400±0.254	0.75±0.254	1.100±0.254		
	1.5W	201~250 mΩ			0.820±0.254		1.980±0.254	2.000±0.254	
	1W	1.5W			0.5mΩ	0.700±0.254	1.150±0.254	1.980±0.254	1.980±0.254
					0.75mΩ	2.200±0.254			
					1mΩ	1.400±0.254			
					1.5mΩ	1.150±0.254			
					2~5mΩ	0.550±0.254			1.100±0.254
					6 mΩ	0.75±0.254			
	7~15 mΩ	0.75±0.254			1.100±0.254				
	16~100 mΩ					0.500±0.254			
	3W	2W			0.5mΩ	0.820±0.254	1.150±0.254	1.980±0.254	2.000±0.254
					0.75mΩ	0.700±0.254			1.980±0.254
					1mΩ	0.720±0.254			2.200±0.254
					1.5mΩ	0.720±0.254			1.400±0.254
					2~5mΩ	0.550±0.254			1.150±0.254
					6 mΩ	0.550±0.254			1.100±0.254
					7 ~15mΩ				
					16~20 mΩ	0.500±0.254			
MAL4527	2W	0.5mΩ	11.30±0.50	6.60±0.50	0.770±0.254	0.90±0.254	3.000±0.254		
		1mΩ			0.650±0.254		2.000±0.254		
		1.5~20mΩ			0.550±0.254		3.000±0.254		
		21~40 mΩ			0.800±0.254				
	5W	5W			0.5mΩ	0.680±0.254	0.65±0.254	3.000±0.254	
					1mΩ	0.580±0.254			2.000±0.254
					1.5~20mΩ				
					21~40 mΩ				



MAL Series Metal Alloy Low-Resistance Resistor Product Specifications

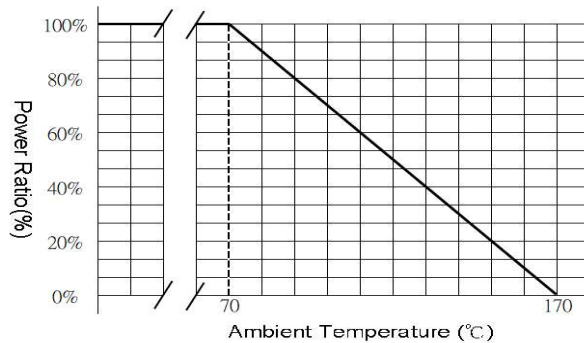
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■ Performance Characteristics

Power Derating Curve

The Operating Temperature Range: -55°C ~+170°C.

For resistors operated in ambient temperatures above 70°C, power rating must be derating in accordance with the curve below.



■ Rating Current

The following equation may be used to determine the DC (Direct Current) or AC (Alternating Current) (RMS, root mean square value) of normal rated power. However, if the result value exceeds the highest current of regulated standards (paragraph 5), the highest normal rated power is to be used

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

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

- Inductance characteristics: $\leq 5\text{nH}$ (Circuit frequency is below 1MHz)

■ Marking Format:

- All the other products marking are 4 digits.
- "R" designates the decimal location in ohms
 - e.g. 1m Ω the product marking is R001.
 - 25m Ω the product marking is R025.
 - 100m Ω the product marking is R100.
- "m" designates the decimal location in milli-ohms
 - e.g. 5.5m Ω the product marking is 5m50.
 - 25.5m Ω the product marking is 25m5.
- The criteria to distinguishing the mark on the surface of products are that characters can be identified.



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■ Reliability test and requirement

Test Item	Test Method	Procedure	Requirements
Temperature Coefficient of Resistance (T.C.R)	JIS-C-5201-1 4.8 IEC-60115-1 4.8	At 25°C /+150°C, 25°C is the reference temperature	As Spec
Short Time Overload	JIS C 5201-1 clause 4.13 IEC-60115-1 4.13	The number of rated power are as follows: <ul style="list-style-type: none"> • MAL 1206-1W: 4 times of rated power • MAL 2512-1.5W: 5 times of rated power • MAL 2512-2W: 5 times of rated power • MAL 2512-3W: 4 times of rated power • MAL 4527-2W: 5 times of rated power • MAL 4527-3W: 5 times of rated power • MAL 4527-5W: 4 times of rated power Rating power duration: 5secs	<ul style="list-style-type: none"> • MAL4527: $\Delta R/R1 \leq \pm 2.0\%$ • Other: $\Delta R/R1 \leq \pm 1.0\%$
High Temperature Exposure	JIS C 5201-1 clause 4.23.2 IEC 60068-2-2	1,000hrs at + 170 °C	<ul style="list-style-type: none"> • MAL4527: $\Delta R/R1 \leq \pm 2.0\%$ • Other: $\Delta R/R1 \leq \pm 1.0\%$
Soldering Heat	JIS C 5201-1 clause 4.18 IEC-60115-1 4.18	260±5°C for 10 seconds.	$\Delta R/R1 \leq \pm 0.5\%$
Temperature Cycling	JESD22 Method JA-104	1000 Cycles (-55°C to +155°C) Measurement at 24±4 hours after test conclusion. 30min maximum dwell time at each temperature extreme	$\Delta R/R1 \leq \pm 0.5\%$
Bias Humidity	MIL-STD-202 Method 103	1,000 hours; 85°C / 85% RH, 10% of operating power. Measurement at 24±4 hours after test conclusion.	$\Delta R/R1 \leq \pm 0.5\%$
Load Life (Endurance)	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1	70±2°C, RCWV or Max. working voltage whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" .	<ul style="list-style-type: none"> • MAL4527: $\Delta R/R1 \leq \pm 2.0\%$ • Other: $\Delta R/R1 \leq \pm 1.0\%$
Solderability	JIS-C-5201-1 4.17 IEC-60115-1 4.17	245±5°C for 3 seconds.	>95% coverage
Dielectric Withstanding Voltage	JIS-C5201-1 4.7	Applied 500VAC for 1 minute.	No short or burned on the appearance.
Core Body Strength	JIS-C5201-1 4.15	Central part pressurizing force : 5N , 10 seconds	No broken
Terminal Strength (SMD)	AEC Q200-006	Pressurizing force 17.7N for 60 seconds	No broken
Bending Strength	JIS-C-5201-1 4.33 IEC-60115-1 4.33	Bending once 2mm for 10 seconds	$\Delta R/R1 \leq \pm 0.5\%$ No broken
Moisture Resistance	MIL-STD 202 Method 106	T=24 hours / Cycle ,10Cycles . Steps 7a& 7b not required. Unpowered . (Figure 1)	$\Delta R/R1 \leq \pm 0.5\%$



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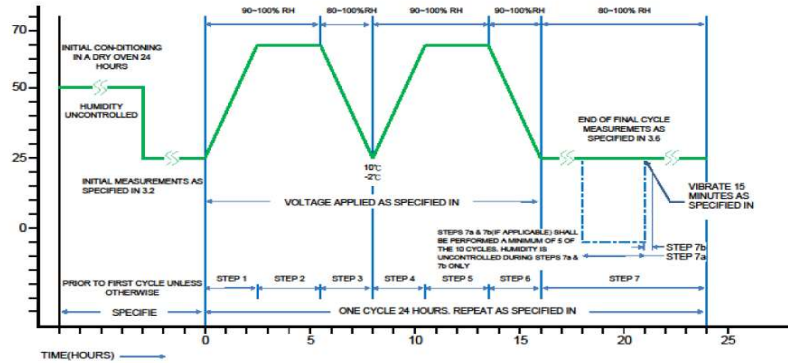
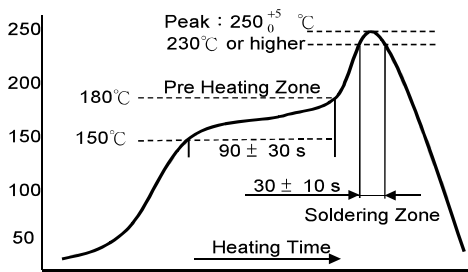
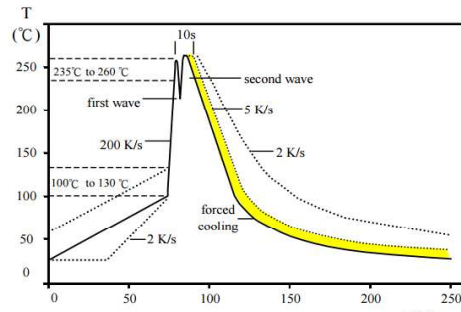


Figure 1

Soldering Profile

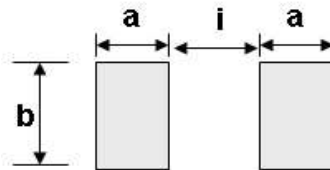


Reflow Soldering



WAVE soldering

Recommend Land Pattern Design



Dimension

Unit: mm

TYPE	Resistance Range	a	b	i
MAL1206-1W	1mΩ~10mΩ	1.46	2.15	1.68
MAL2512 -1.5, 2W,3W	0.5mΩ~1mΩ	3.24	3.68	1.27
	1.5 mΩ	3.20	3.68	1.35
	2~5mΩ	2.60	3.68	2.55
	6mΩ~200mΩ	2.30	3.68	3.15
	201mΩ~250mΩ	2.05	3.68	3.65
MAL4527 -2W,3W,5W	0.5mΩ~1mΩ	4.50	8.74	4.50
	1.5mΩ~40mΩ	3.50	8.74	6.50



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Packing Quantity

TYPE	PCS /Reel	Parts Number Explanation
MAL1206	5000	Z: 5000PCS
MAL1206 R001	4000	Z: 4000PCS
MAL2512	4000	Z: 4000PCS
MAL4527	1000 / 500	Z: 1000PCS 0: 500PCS

Plating Thickness:

Ni: $\geq 2\mu\text{m}$

Sn(Tin): $\geq 3\mu\text{m}$

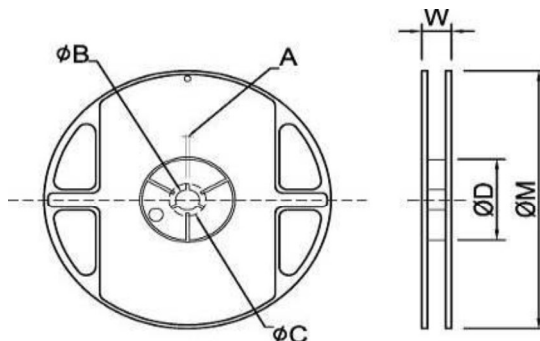
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Appendix For SMD Chip Resistor

● Packaging Information

■ Reel Dimensions





MAL Series Metal Alloy Low-Resistance Resistor Product Specifications

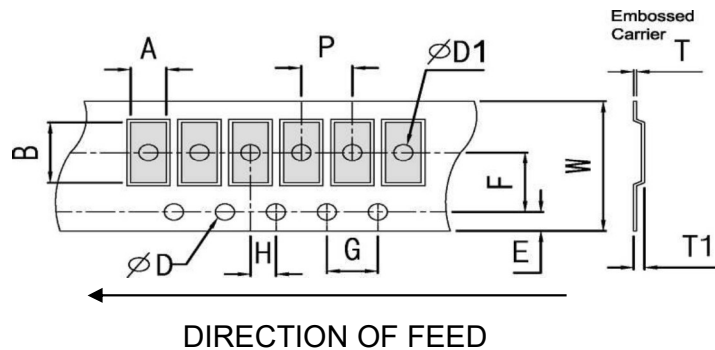
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Dimension

Unit: mm

Reel Type	A	ϕB	ϕC	ϕD	W	ϕM
7" reel for 8 mm embossed (for MA1206)	2.0±0.5	13.2±0.5	17.7±0.5	60.0±0.5	12.0±0.5	178±1.0
7" reel for 12 mm embossed	2.5±0.5	13.5±0.5	17.7±0.5	60.0±0.5	16.2±0.5	178±1.0
7" reel for 24 mm embossed	2.0±0.5	13.2±0.5	17.7±0.5	60.0±0.5	24.4±2.0	178±1.0

Embossed Dimensions



Dimension

Unit: mm

Item	Resistance Range (m Ω)	W	P	E	F	ϕD	$\phi D1$	G	H	A	Bo	T1	T
MAL1206	1m Ω	8.0±0.30	4.0±0.10	1.75±0.10	3.5±0.10	1.50 ^{+0.1}	1.0±0.10	4.0±0.10	2.0±0.10	2.03±0.10	3.55±0.10	1.10±0.10	0.20±0.05
MAL1206	2~10m Ω	8.0±0.30	4.0±0.10	1.75±0.10	3.5±0.10		1.0±0.10	4.0±0.10	2.0±0.10	2.03±0.10	3.55±0.10	0.85±0.10	0.20±0.05
MAL2512	0.5~2m Ω	12.0±0.30	4.0±0.10	1.75±0.10	5.5±0.10		1.55±0.10	4.0±0.10	2.0±0.10	3.50±0.10	6.75±0.10	1.10±0.10	0.20±0.05
MAL2512	2.5~250m Ω	12.0±0.30	4.0±0.10	1.75±0.10	5.5±0.10		1.55±0.10	4.0±0.10	2.0±0.10	3.50±0.10	6.75±0.10	0.90±0.10	0.20±0.05
MAL4527	0.5~40m Ω	24.0±0.30	12.0±0.10	1.75±0.10	11.5±0.10		1.50±0.10	4.0±0.10	2.0±0.10	7.38±0.10	12.0±0.10	1.05±0.10	0.30±0.10

Storage Temperature

Temperature : 25±5°C, Humidity : 60±20%