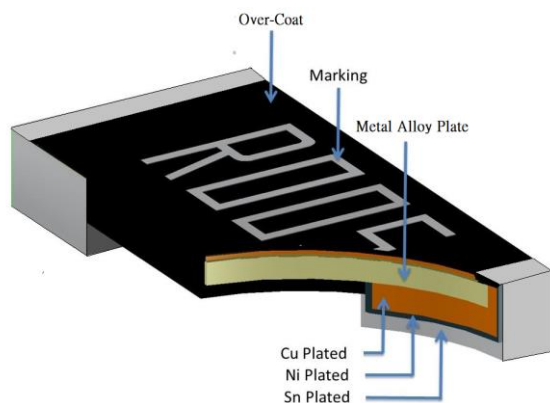


■ Metal Alloy Low Resistance Chip Resistor — MAL Series



■ Application

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

■ Features

- Low Resistance / Low TCR/Low Inductance($\leq 5\text{nH}$)
- 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	2512 4527	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	



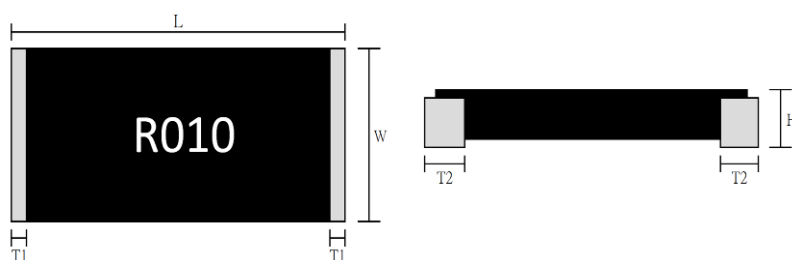
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Standard Electrical Specifications

TYPE	Rating Power at 70℃	T.C.R. (ppm/℃)	Max. Rating Current	Max. Overload Current	Resistance Range (mΩ)		Material	Operating Temperature Range (℃)
					0.5% (D)	1.0% (F) 2.0% (G) 5.0% (J)		
MAL2512	1.5W	$\leq \pm 75$	54.77	109.54	-	0.5~0.75	R0005~R00075 : MnCuSn R001~R015 : MnCu R016~R250 : NiCrAl	- 55 ~ + 170
	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		
	2W	$\leq \pm 50$	44.72	89.44	7~99	1~99		
	3W	$\leq \pm 75$	77.45	154.91	-	0.5~0.75		
	3W	$\leq \pm 50$	54.77	109.54	7~20	1~20		
MAL4527	5W	$\leq \pm 75$	100.00	200.00	-	0.5	R0005 : MnCuSn	
	5W	$\leq \pm 50$	70.71	141.42	7~30	1~30	R001~R030 : MnCu	

Type Dimension





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Dimension

Unit : mm

Type	Power Rating	Resistance Range	L	W	H	T1	T2			
MAL2512	1.5W	100~200 mΩ	6.350±0.254	3.050±0.254	0.400±0.254	0.75±0.254	1.100±0.254			
		201~250 mΩ					0.850±0.254			
	1.5W 2W	0.5mΩ			0.770±0.254	1.15±0.254	2.200±0.254			
		1					0.670±0.254	1.400±0.254		
		1.5mΩ						1.150±0.254		
		2mΩ						0.550±0.254	1.100±0.254	
		2.5~6 mΩ								
		7~15 mΩ					0.75±0.254			
		16~99 mΩ								0.500±0.254
		3W					0.5mΩ	0.770±0.254	1.15±0.254	
	1 mΩ				0.670±0.254	1.400±0.254				
	1.5mΩ					1.150±0.254				
	2mΩ					0.550±0.254	0.75±0.254			
	2.5~6 mΩ									
	7~15mΩ				0.500±0.254					
	16~20 mΩ									
	MAL4527				5W	0.5mΩ	11.30±0.50			6.60±0.50
1mΩ		0.680±0.254	2.000±0.254							
1.5~5mΩ										
6~30 mΩ				0.580±0.254						



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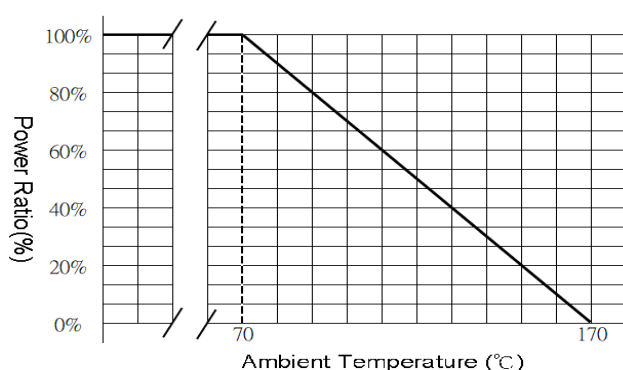
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■ Performance Characteristics

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. 1mΩ the product marking is R001.
25mΩ the product marking is R025.
100mΩ the product marking is R100.
- “m” designates the decimal location in milli-ohms
e.g. 5.5mΩ the product marking is 5m50.
25.5mΩ 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

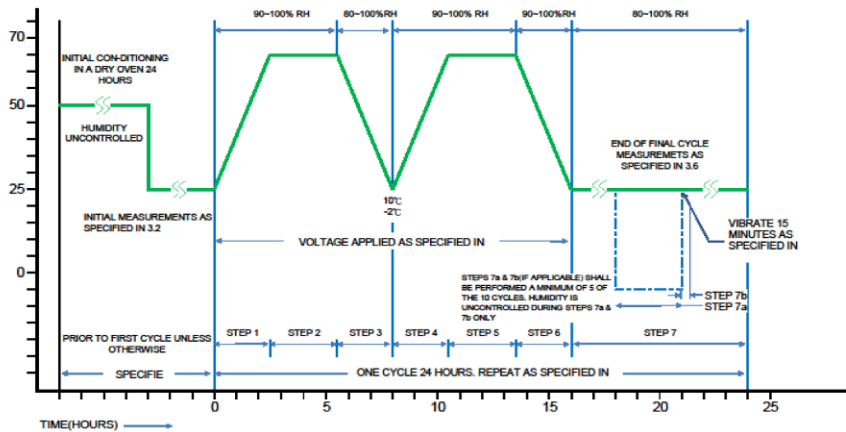
Test Item	Test Method	Procedure	Requirements
Temperature Coefficient of Resistance (T.C.R)	JIS-C-5201-1 4.8 IEC-60115-1 4.8	At 25°C /+150°C, 25°C is the reference temperature	As Spec
Short Time Overload	JIS C 5201-1 clause 4.13 IEC-60115-1 4.13	The number of rated power are as follows: • MAL 2512-1.5W: 4 times of rated power • MAL 2512-2W: 4 times of rated power • MAL 2512-3W: 4 times of rated power • MAL 4527-5W: 4 times of rated power Rating power duration: 5secs	• MAL4527: $\Delta R/R1 \leq \pm 2.0\%$ • MAL2512: $\Delta R/R1 \leq \pm 1.0\%$
High Temperature Exposure	JIS C 5201-1 clause 4.23.2 IEC 60068-2-2	1,000hrs at + 170 °C	• MAL4527: $\Delta R/R1 \leq \pm 2.0\%$ • MAL2512: $\Delta R/R1 \leq \pm 1.0\%$
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" .	• MAL4527: $\Delta R/R1 \leq \pm 2.0\%$ • MAL2512: $\Delta R/R1 \leq \pm 1.0\%$
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)	$\Delta R/R1 \leq \pm 0.5\%$



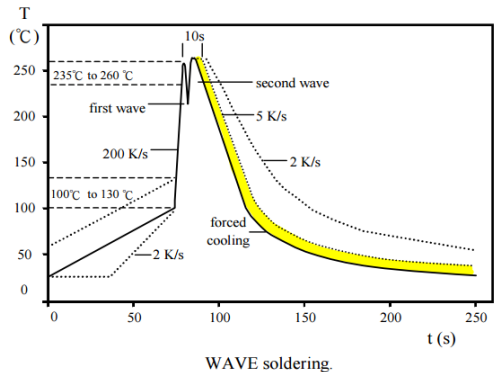
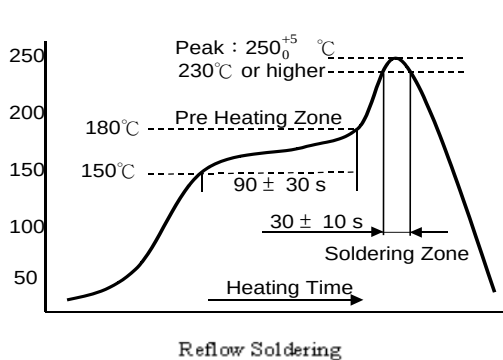
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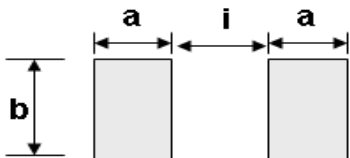
Figure 1



Soldering Profile



Recommend Land Pattern Design





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Dimension

Unit: mm

TYPE	Resistance Range	A	b	i
MAL2512 -1.5, 2W,3W	0.5mΩ~1mΩ	3.40	3.68	0.95
	1.5 mΩ	2.35	3.68	3.05
	2mΩ~200mΩ	2.30	3.68	3.15
	201mΩ~250mΩ	2.05	3.68	3.65
MAL4527 -5W	0.5mΩ~1.5mΩ	4.50	8.74	4.50
	2.0mΩ~30mΩ	3.50	8.74	6.50

Packing Quantity

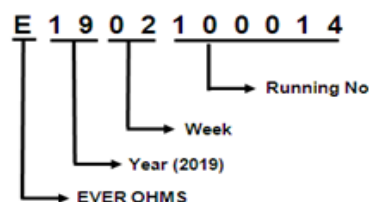
TYPE	PCS /Reel	Parts Number Explanation
MAL2512	4000	Z: 4000PCS
MAL4527	1000 / 500	Z: 1000PCS O: 500PCS

Plating Thickness:

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

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

Lable :





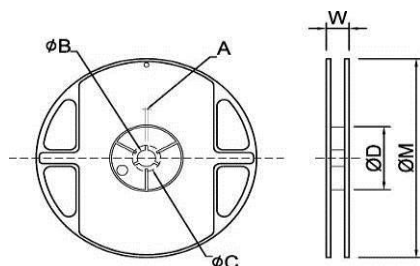
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Appendix For SMD Chip Resistor

● Packaging Information

■ Reel Dimensions

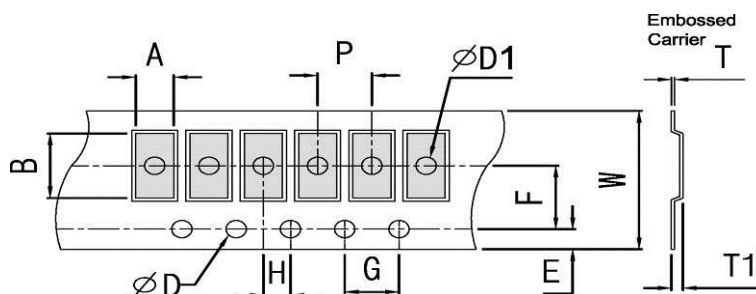


■ Dimension

Unit: mm

Reel Type	A	φB	φC	φD	W	φM
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 (mΩ)	W	P	E	F	φD	φD1	G	H	A	Bo	T1	T
MAL2512	0.5~2mΩ	12.0±0.30	4.0±0.10	1.75±0.10	5.5±0.10	1.50 ^{+0.1} ₋₀	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	2.5~250mΩ	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	0.5~30mΩ	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%