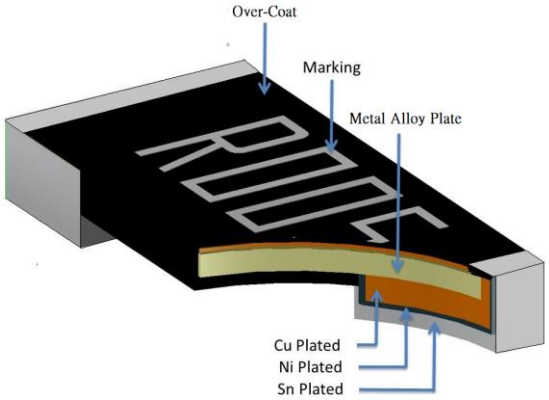
■ Metal Alloy Low Resistance Chip Resistor — MAL Series



■ Application

— Entertainment product

— Power supply

— Measuring instrument

— Industrial product

— Battery management system

■ Features

— Low Resistance / Low TCR/Low Inductance(≦5nH)

— Excellent long term stability

— RoHs compliant and halogen free.

— Lead free.

— High precision current sensing and voltage division.

— AEC-Q200 compliant

■ Parts Number Explanation

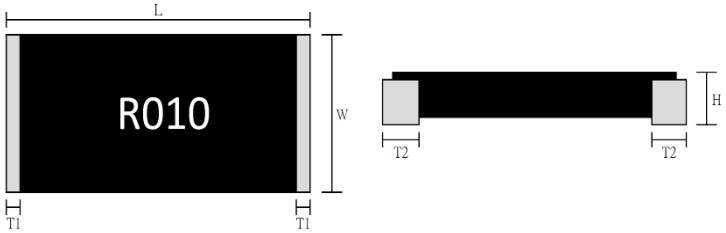
Example:

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：±1% J：±5%	0m50=0.5mR 2m50=2.5mR R005=5.0mR R250=250mR	S：MnCuSn M：MnCu R：NiCrAl	Z：Default code

■ 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)		
MAL1206	1W	≦±50	31.62	63.24	7~10 20~25	1~10 20~25	R001：MnCuSn R002~R010:MnCu R020~R025:NiCrAl	- 55 ~ + 170
MAL2512	1W 1.5W	≦±75	54.77	109.54	-	0.5~0.8	R0005~R0008：MnCuSn R001~R015：MnCu R016~R250：NiCrAl	
		≦±50	38.72	77.45	7~250	1~250		
	2W	≦±75	63.24	126.49	-	0.5~0.8		
		≦±50	44.72	89.44	7~120	1~120		
	3W	≦±75	77.45	154.91	-	0.5~0.8		
		≦±50	54.77	109.54	7~20	1~20		
MAL4527	2W	≦±75	63.24	141.42	-	0.5	R0005：MnCuSn R001~R040：MnCu	
		≦±50	44.72	100.0	7~40	1~40		
	3W	≦±75	77.45	173.20	-	0.5		
		≦±50	54.77	122.47	7~40	1~40		
	5W	≦±75	100.00	200.00	-	0.5		
		≦±50	70.71	141.42	7~40	1~40		

■ Type Dimension



■ Dimension

Unit：mm

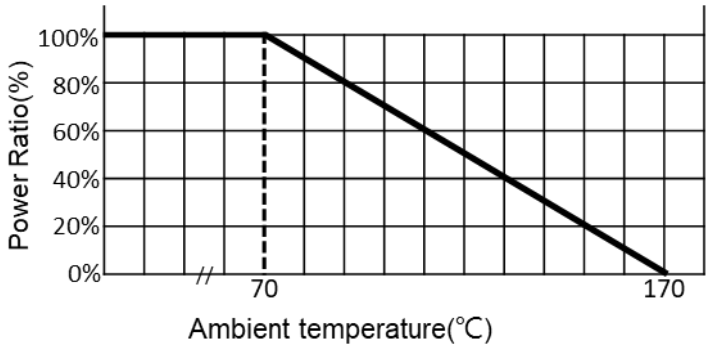
Type	Power Rating	Resistance Range	L	W	H	T1	T2
MAL1206	1W	1 mΩ	3.200±0.254	1.650±0.254	0.770±0.254	0.508±0.254	0.508±0.254
		2 mΩ			0.650±0.254		
		3~10 mΩ			0.550±0.254		
		20~25mΩ			0.400±0.254		
MAL2512	1W 1.5W	121~200 mΩ	6.350±0.254	3.050±0.254	0.400±0.254	0.75±0.254	1.100±0.254
		201~250 mΩ					0.850±0.254
	1W 1.5W 2W	0.5 mΩ		3.200±0.200	0.820±0.254	1.980±0.254	2.000±0.254
		0.6mΩ			0.700±0.254		2.100±0.254
		0.75 mΩ		3.050±0.254		1.150±0.254	1.980±0.254
		0.80 mΩ					1.860±0.254
		1 mΩ			0.720±0.254		2.200±0.254
		1.5 mΩ					1.400±0.254
		2~5 mΩ					1.150±0.254
		6 mΩ			0.550±0.254		1.100±0.254
		7~15 mΩ				0.75±0.254	
		16~100 mΩ			0.500±0.254		
		101~120 mΩ			0.400±0.254		
	3W	0.5 mΩ		3.200±0.200	0.820±0.254	1.980±0.254	2.000±0.254
		0.6mΩ			0.700±0.254		2.100±0.254
		0.75 mΩ		3.050±0.254		1.150±0.254	1.980±0.254
		0.80 mΩ					1.860±0.254
		1 mΩ			0.720±0.254		2.200±0.254
		1.5 mΩ					1.400±0.254
		2~5 mΩ					1.150±0.254
		6 mΩ			0.550±0.254	0.75±0.254	1.100±0.254
		7 ~15 mΩ					
		16~20 mΩ			0.500±0.254		
MAL4527	2W 3W	0.5 mΩ	11.30±0.50	6.60±0.50	0.770±0.254	0.90±0.254	3.000±0.254
		1 mΩ			0.650±0.254		
		1.5~20 mΩ					2.000±0.254
		21~40 mΩ			0.550±0.254		
	5W	0.5 mΩ			0.800±0.254	0.65±0.254	3.000±0.254
		1 mΩ			0.680±0.254		
		1.5~20 mΩ					2.000±0.254
		21~40 mΩ			0.580±0.254		

■ 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: ≦5nH(Circuit frequency is below 1MHz)

■ 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℃ /+150℃, 25℃ 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 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	● MAL4527: ΔR/R1≦±2.0% ● Other: ΔR/R1≦±1.0%
High Temperature Exposure	JIS C 5201-1 clause 4.23.2 IEC 60068-2-2	1,000hrs at + 170 °C	● MAL4527: ΔR/R1≦±2.0% ● Other: ΔR/R1≦±1.0%
Soldering Heat	JIS C 5201-1 clause 4.18 IEC-60115-1 4.18	260±5℃ for 10 seconds.	ΔR/R1≦± 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	ΔR/R1≦± 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.	ΔR/R1≦± 0.5%
Load Life (Endurance)	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1	70±2℃, RCWV or Max. working voltage whichever is less for 1000 hrs with 1.5 hrs〝ON〞and 0.5 hr〝OFF〞.	● MAL4527 & MAL2512 2W 101~120 mΩ: ΔR/R1≦±2.0% ● Other: ΔR/R1≦±1.0%
Solderability	JIS-C-5201-1 4.17 IEC-60115-1 4.17	245±5℃ 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	ΔR/R1≦± 0.5% No broken
Moisture Resistance	MIL-STD 202 Method 106	T=24 hours / Cycle ,10Cycles . Steps 7a& 7b not required. Unpowered . (Figure 1)	ΔR/R1≦± 0.5%

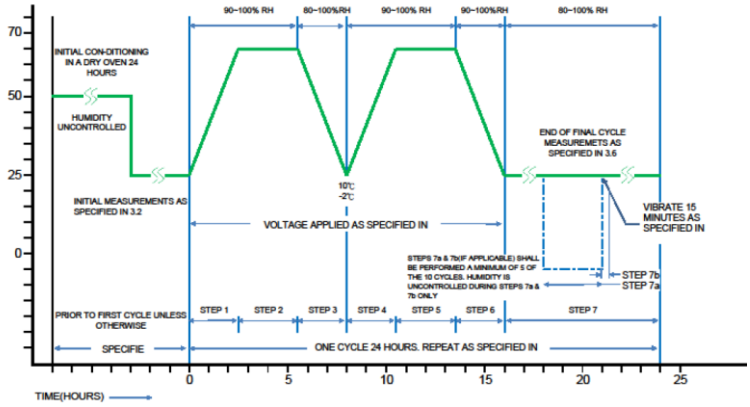
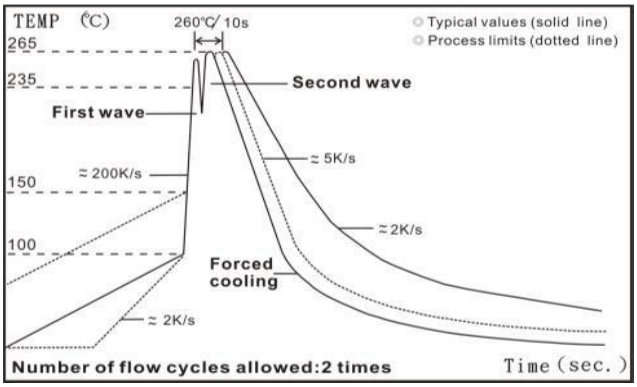


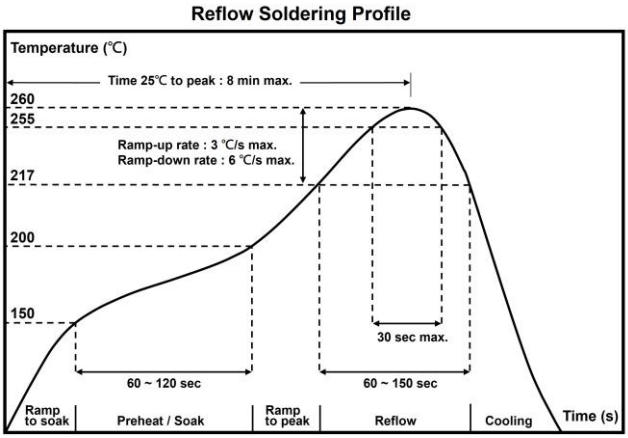
Figure 1

■ Recommended Customer Soldering Parameters

■ Wave solder Temperature condition



■ Solder reflow Temperature condition



The peak temperature of soldering heat is 260 for 10S

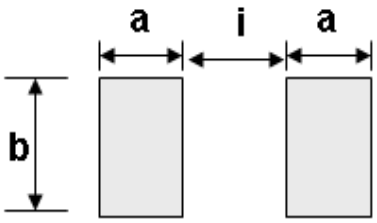
■ Soldering Iron: temperature 350℃±10℃ , dwell time shall be less than 3 sec

■ Recommend reflow methods

IR, vapor phase oven, hot air oven

If reflow temperatures exceed the recommended profile, devices may not meet the performance requirements

■ Recommend Land Pattern Design



■ Dimension

Unit：mm

Type	Resistance Range	a	b	i
MAL1206-1W	1 mΩ~10 mΩ/20mΩ~25 mΩ	1.46	2.15	1.68
MAL2512 -1,1.5, 2W,3W	0.5 mΩ~1 mΩ	3.24	3.68	1.27
	1.5 mΩ	3.20	3.68	1.35
	2~5 mΩ	2.60	3.68	2.55
	6 mΩ~200 mΩ	2.30	3.68	3.15
	201 mΩ~250 mΩ	2.05	3.68	3.65
MAL4527 -2W,3W,5W	0.5 mΩ~1 mΩ	4.50	8.74	4.50
	1.5 mΩ~40 mΩ	3.50	8.74	6.50

■ Packing Quantity

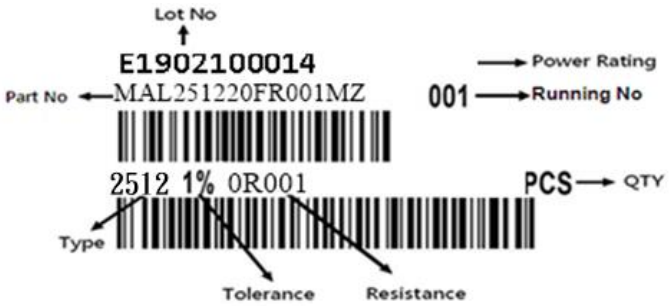
Type	PCS / Reel	Parts Number Explanation
MAL1206	5000	Z: 5000PCS
MAL1206 R001	4000	Z: 4000PCS
MAL2512	4000	Z: 4000PCS
MAL4527	1000 / 500	Z: 1000PCS 0: 500PCS

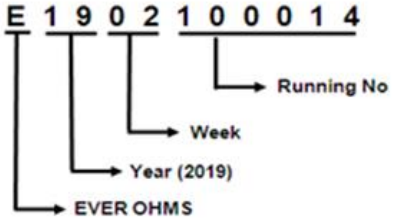
■ Plating Thickness:

Ni:≧2μm

Sn(Tin):≧3μm

■ Label：

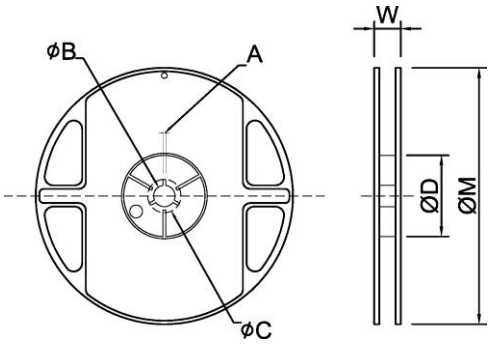




■ Appendix For SMD Chip Resistor

● Packaging Information

■ Reel Dimensions

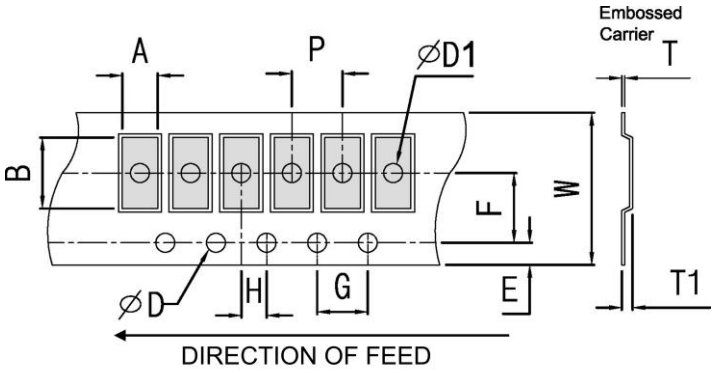


■ Dimension

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(mΩ)	W	P	E	F	ϕD	ϕD1	G	H	A	B	T1	T
MAL1206	1mΩ	8.0±0.30	4.0±0.10	1.75±0.10	3.5±0.10	$1.50^{+0.1}_{-0}$	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	2~10 mΩ 20~25 mΩ	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	0.5/1mΩ	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	0.6~0.8mΩ 2~500mΩ	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	0.5~40mΩ	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

Storage time at the environment temp: 25±5℃& humidity: 60±20% is valid for two years.