

Metal Alloy Low Resistance Chip

(RMAL Series)

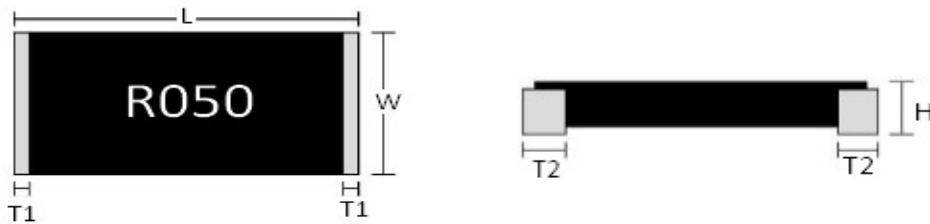
Features

- Low Resistance/Low TCR
- Excellent long term stability
- RoHs compliant and halogen free
- Lead free
- High precision current sensing & voltage division

Applications

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

Dimensional Specifications



TYPE	Power Rating	Resistance Range	Dimension				
			L	W	H	T1	T2
RMAL-18 1206	0.5W 0.75W	1mΩ	3.20±0.254	1.65±0.254	0.82±0.254	0.508±0.254	0.508±0.254
		2mΩ			0.70±0.254		
		3mΩ			0.60±0.254		
		4~20mΩ			0.55±0.254		
		21~50mΩ			0.47±0.254		
		51~75mΩ			0.40±0.254		
	1W	1mΩ			0.82±0.254		
		2mΩ			0.70±0.254		
		3mΩ			0.60±0.254		
		4~20mΩ			0.55±0.254		
		21~50mΩ			0.47±0.254		
	1.5W	1mΩ			0.82±0.254		
		2mΩ			0.70±0.254		
		3mΩ			0.60±0.254		
		4~10mΩ			0.55±0.254		
RMAL-24 2512	1W	451~500mΩ	3.05±0.254	0.35±0.254	0.75±0.254	0.85±0.254	
	1W / 2W	0.5mΩ	3.20±0.200	0.82±0.254	1.98±0.254	2.00±0.254	
		0.6mΩ			1.15±0.254	2.10±0.254	
		0.75mΩ				1.98±0.254	
		0.8mΩ	3.05±0.254	0.72±0.254	1.86±0.254		
		1mΩ			2.20±0.254		
		1.1mΩ			1.90±0.254		
		1.5mΩ			1.40±0.254		
		2~5mΩ			1.15±0.254		
		6mΩ	1.10±0.254	0.55±0.254			
		7~10mΩ		0.60±0.254			
		11~75mΩ		0.60±0.254			
		1.05±0.254					



TYPE	Power Rating	Resistance Range	Dimension				mm			
			L	W	H	T1	T2			
RMAL-24 2512	1W / 2W	76~100mΩ	6.35±0.254	3.05±0.254	0.55±0.254	0.75±0.254	1.10±0.254			
		101~135mΩ			0.47±0.254					
		136~200mΩ			0.400±0.254					
		201~450mΩ						0.85±0.254		
	3W	0.5mΩ	6.35±0.254	3.20±0.200	0.82±0.254	1.98±0.254	2.00±0.254			
		0.6mΩ					2.10±0.254			
		0.75mΩ			0.70±0.254		1.98±0.254			
		0.8mΩ					1.86±0.254			
		1mΩ					2.20±0.254			
		1.1mΩ			3.05±0.254		0.72±0.254	1.15±0.254	1.90±0.254	
		1.5mΩ		1.40±0.254						
		2~5mΩ		1.15±0.254						
		6mΩ		0.55±0.254		0.75±0.254		1.10±0.254		
		7~10mΩ		0.60±0.254		1.15±0.254				
		11~75mΩ		0.55±0.254		0.75±0.254				
		76~100mΩ								
		RMAL-25 2725		4W	0.2mΩ	6.90±0.254	6.35±0.254	1.10±0.254	1.20±0.254	2.150±0.254
0.25mΩ	2.287±0.254									
0.3mΩ	1.975±0.254									
0.35mΩ	1.710±0.255									
0.4mΩ	1.440±0.256									
0.5mΩ	2.080±0.257									
0.6mΩ	0.85±0.254		1.780±0.258							
0.8mΩ	1.300±0.259									
1mΩ	6.80±0.254		0.65±0.254		1.15±0.254	1.800±0.254				
1.5~1.6mΩ						1.500±0.254				
2~3mΩ						0.55±0.254				
RMAL-29 2728						4W		4~450mΩ	6.60±0.254	6.70±0.254
		RMAL-45 4527		2W		11.30±0.50	6.60±0.50	0.77±0.254	0.90±0.254	3.00±0.254
1mΩ								0.65±0.254		2.00±0.254
1.5~20mΩ										
21~100mΩ	0.5500.254									
3W	0.5mΩ		0.77±0.254	0.90±0.254	3.00±0.254					
	1mΩ		0.65±0.254		2.00±0.254					
	1.5~20mΩ									
	21~60mΩ		0.55±0.254							
5W	0.5mΩ	0.80±0.254	0.65±0.254	3.00±0.254						
	1mΩ	0.68±0.254		2.00±0.254						
	1.5~20mΩ									
	21~500mΩ	0.58±0.254								



Jumper specifications

TYPE	Rating Power at 70°C	Max. Rating Current	Resistance (mΩ)	Material	Operating Temperature
RMAL-18 1206	1W	70.7A	≤ 0.2	Jumper : Cu	-55~+170°C
RMAL-24 2512	2W	100A			
	3W	122A			

Standard Electrical Specifications

TYPE	Rating Power at 70°C	T.C.R. (PPM/°C)	Max. Rating Current	Max. Overload Current	Resistance Range (mΩ)		Material
					0.5% (D)	5% (J), 1% (F)	
RMAL-18 1206	0.5W	≤ ±50	22.36	50.00	5 ~ 75	1 ~ 75	R001: MnCuSn R002 ~ R007: MnCu R008 ~ R075: FeCrAl
	0.75W		27.38	61.23			
	1W		31.62	70.71	5 ~ 50	1 ~ 50	R001: MnCuSn R002~R007: MnCu R008~R050: FeCrAl
	1.5W		38.72	86.60	5 ~ 10	1 ~ 10	R001: MnCuSn R002 ~ R007: MnCu R008 ~ R010: FeCrAl
RMAL-24 2512	1W	≤ ±75	44.72	100	---	0.5 ~ 0.8	R0005 ~ R0008: MnCuSn
		≤ ±50	31.62	70.71	1 ~ 450	1 ~ 500	R001 ~ R006: MnCu R007 ~ R500: FeCrAl
	2W	≤ ±75	63.24	141.42	---	0.5 ~ 0.8	R0005 ~ R0008: MnCuSn
		≤ ±50	44.72	100.00	1 ~ 450	1 ~ 450	R001 ~ R006: MnCu R007 ~ R450: FeCrAl
	3W	≤ ±75	77.45	173.20	---	0.5 ~ 0.8	R0005 ~ R0008: MnCuSn
		≤ ±50	54.77	122.47	1 ~ 100	1 ~ 100	R001 ~ R006: MnCu R007 ~ R100: FeCrAl
RMAL-25 2725	4W	≤ ±100	141.42	282.84	---	0.2	R0002 ~ R0004: MnCuSn
		≤ ±50	126.49	252.98		0.25 ~ 3	R0005 ~ R0025: MnCu R003 : FeCrAl
RMAL-29 2728	4W	≤ ±50	31.62	63.24	7 ~ 450	4 ~ 450	R004 ~ R450: FeCrAl
RMAL-45 4527	2W	≤ ±75	63.24	141.42	---	0.5	R0005: MnCuSn
		≤ ±50	44.72	100.00	5 ~ 100	1 ~ 100	R001 ~ R040: MnCu R041 ~ R100: FeCrAl
	3W	≤ ±75	77.45	173.20	---	0.5	R0005: MnCuSn
		≤ ±50	54.77	122.47	5 ~ 60	1 ~ 60	R001 ~ R040: MnCu R041 ~ R060: FeCrAl
	5W	≤ ±75	100.00	173.20	---	0.5	R0005: MnCuSn
		≤ ±50	70.71	122.47	5 ~ 500	1 ~ 500	R001 ~ R040: MnCu R041 ~ R500: FeCrAl

Operating Temperature Range (°C) : -55~+170°C



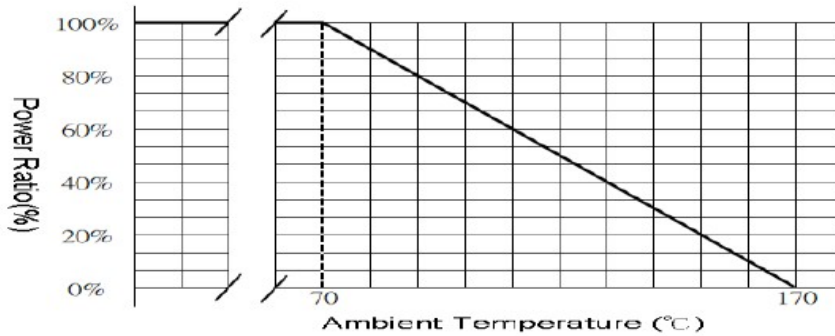
Jumper Dimension

TYPE	Power Rating	Resistance Range	Dimension				
			mm				
			L	W	H	T1	T2
RMAL-18 1206	1W	< 0.2mΩ	3.20±0.254	1.65±0.254	0.65±0.254	0.508±0.254	0.508±0.254
RMA-24 2512	2W/3W	< 0.2mΩ	6.35±0.254	3.05±0.254	0.65±0.254	1.150±0.254	1.100±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 derated 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, the highest normal rated power is to be used.

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

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

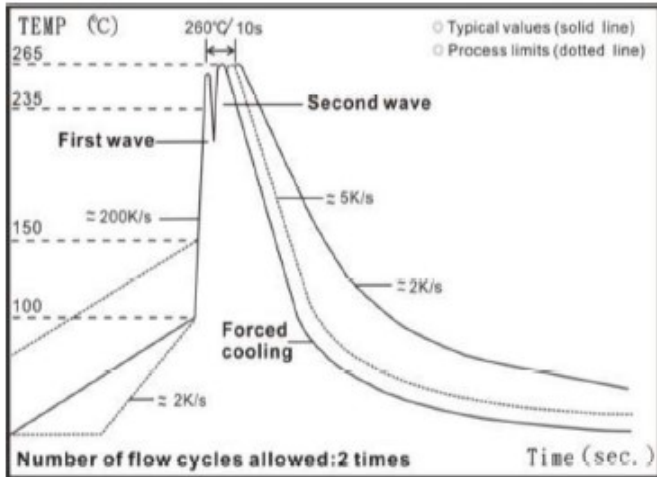
Marking Fomat:

- ⊙ 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. 0.25mΩ the product marking is 0m25.
 - 0.5mΩ the product marking is 0m50.
 - 5.5mΩ the product marking is 5m50.
 - 25.5mΩ the product marking is 25m5.
- ⊙ 0Ω product marking is 0R.
- ⊙ The criteria to distinguishing the mark on the surface of products are that characters can be identified.

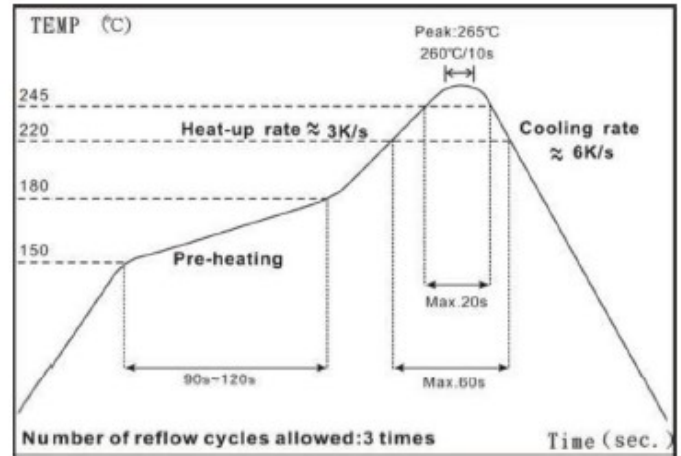


Recommended Customer Soldering Parameters

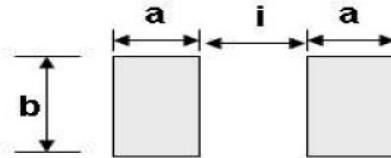
※ Wave Solder Temperature Condition



※ Solder reflow Temperature condition



Recommend Land Pattern Design

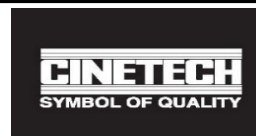


TYPE	RESISTANCE RANGE	Dimension: mm		
		a	b	i
RMAL-18 1206 (0.5W/0.75W/1W/1.5W)	Jumper: $\leq 0.2m\Omega$	1.46	2.15	1.68
	1m Ω ~ 75m Ω	1.46	2.15	1.68
RMAL-24 2512 (1W/2W/3W)	Jumper: $\leq 0.2m\Omega$	2.30	3.68	3.15
	0.5m Ω ~ 1m Ω	3.24	3.68	1.27
	1.5m Ω	3.20	3.68	1.35
	2 ~ 5m Ω	2.60	3.68	2.55
	6m Ω ~ 200m Ω	2.30	3.68	3.15
RMAL-25 2725 (4W)	201m Ω ~ 500m Ω	2.05	3.68	3.65
	0.2m Ω ~ 0.35m Ω	2.90	6.70	1.28
	0.4m Ω ~ 0.8m Ω	3.25	6.85	1.70
RMAL-29 2728 (4W)	1m Ω ~ 3m Ω	2.75	6.85	2.70
	4m Ω ~ 450m Ω	2.05	7.20	3.90
RMAL-45 4527 (2W/3W/5W)	0.5m Ω ~ 1.5m Ω	4.50	8.74	4.50
	2.0m Ω ~ 100m Ω	3.50	8.74	6.50
	101m Ω ~ 500m Ω	3.50	8.74	6.50



Reliability test and requirement

Test Item	Test Method	Procedure	Requirements
Temperature Coefficient of Resistance (T.C.R.)	JIS-C 5201-1 4.8 IEC-6115-1 4.8	At 25°C/+150°C, 25°C is the reference temperature	As Spec
Short Time Overload	JIS- C- 5201-1 4.13 IEC-60115-1 4.13	<p>The number of rated power are as follows:</p> <ul style="list-style-type: none"> - RMAL-18-0.5W/0.75W: 5 times of rated power - RMAL-18-1W: 5 times of rated power. - RMAL-18-1.5W: 5 times of rated power. - RMAL-24-1W: 5 times of rated power. - RMAL-24-2W: 5 times of rated power. - RMAL-24-3W: 5 times of rated power. - RMAL-25-4W: 4 times of rated power. - RMAL-29-4W: 4 times of rated power. - RMAL-45-2W: 5 times of rated power. - RMAL-45-3W: 5 times of rated power. - RMAL-45-5W: 3 times of rated power. <p>for 5 seconds</p>	<p>RMAL-45(4527): $\Delta R/R1 \leq \pm 2.0\%$</p> <p>The others: $\Delta R/R1 \leq \pm 0.5\%$</p>
High Temperature Exposure	JIS- C5201-1 4.25 IEC 60068-2-2	At 170°C for 1,000 hours.	<p>RMAL-45(4527): $\Delta R/R1 \leq \pm 2.0\%$</p> <p>The others: $\Delta R/R1 \leq \pm 1.0\%$</p>
Resistance to Soldering Heat	JIS- C- 5201-1 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. 30 min maximum dwell time at each temperature extreme.	$\Delta R/R1 \leq \pm 0.5\%$
Biased Humidity	MIL-STD-202 Method 103	1,000hrs; 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 C5201-1 4.25 IEC-60115-1 4.25.1	70±2°C, RCWV or Max. working voltage whichever is less for 1000 hrs with 1.5hrs"ON" and 0.5 hr "OFF"	<p>RMAL-45(4527): $\Delta R/R1 \leq \pm 2.0\%$</p> <p>The others: $\Delta R/R1 \leq \pm 1.0\%$</p>
Solderability	JIS C 5201-1 4.17 IEC-60115-1 4.17	245±5°C for 3seconds.	>95% coverage
Dielectric Withstanding Voltage	JIS C 5201-1 4.7	Applied 500VAC for 1 minute	No short or burned on the appearance.
Core Body Strength	JIS C 5201-1 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 for 2mm for 10 seconds	$\Delta R/R1 \leq \pm 0.5\%$, No broken
Moisture Resistance	MIL-STD 202 Method 106	T=24 hours/cycle, 10 cycles Steps 7a & 7b not required. Unpowered (Figure 1)	$\Delta R/R1 \leq \pm 0.5\%$



FOR Jumper

Test Item	Test Method	Procedure	Requirements
Short Time Overload	JIS-C- 5201-1 4.13 IEC-60115-1 4.13	4 times of rated power for 5 seconds	$\leq 0.2m\Omega$
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.	$\leq 0.2m\Omega$
High Temperature Exposure	JIS- C 5201-1 4.25 IEC 60068-2-2	At 170°C for 1,000 hours	$\leq 0.2m\Omega$
Biased 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.	$\leq 0.2m\Omega$
Load Life (Endurance)	JIS- C5201-1 4.25 IEC-60115-1 4.25.1	70±2°C RCWV or Max. working voltage whichever is less for 1000hrs with 1.5hrs "ON" and 0.5hr "OFF"	$\leq 0.2m\Omega$
Solderability	JIS-C- 5201-1 4.17 IEC-60115-1 4.17	245±5°C for 3 seconds	>95% coverage

* Note: This test is a destructive experiment. The top protective layer is prone to damage and peculiar smell during, 50mR~100mR resistance test. The resistance change rate can meets the specifications.

Parts Number System

