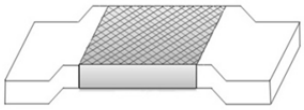
1 Scope:

1.1 This specification is applicable to lead free and halogen free of RoHS directive for LRS Series metal alloy low-resistance shunt resistor.

1.2 This product is for automotive electronic application.

1.3 AEC-Q200 qualified, grade 1.



2 Explanation Of Part Numbers:

ACMS 3921 - 2 7 R001 F 1

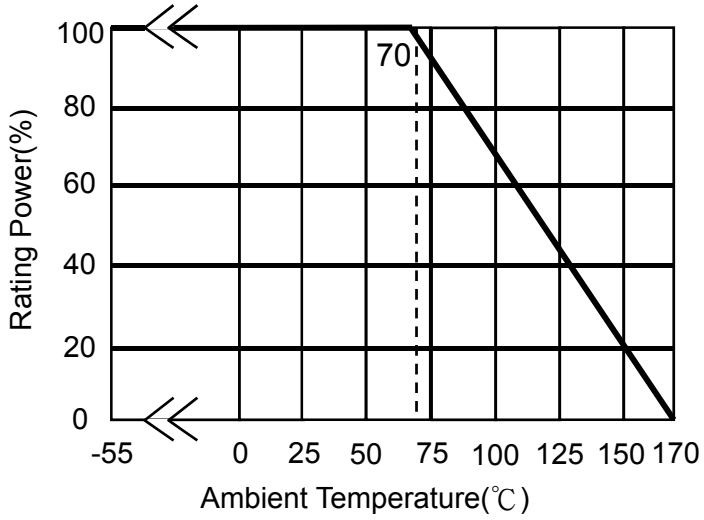
Type	Size (inch)	Number of Terminals	Rated Power	Resistance (4~6 Digits)	Tolerance	Packaging
Metal Alloy Low-Resistance Shunt Resistor	• 2512 • 3921 • 5931	2: 2 terminals	• 2=2.0W • 3=3.0W • 4=4.0W • N=4.5W • 5=5.0W • 6=6.0W • 7=7.0W • 8=8.0W • 9=9.0W • 10=10W • 12=12W • 15=15W	EX: R001 = 1mΩ R003 = 3mΩ R005 = 5mΩ R0002 = 0.2mΩ R0005 = 0.5mΩ	F=± 1.0% J=± 5.0%	A=500pcs 1=1,000pcs 2=2,000pcs 4=4,000pcs

3 Product Specifications:

Type	# of Terminals	Max. Rating Power	Max. Rating Current	Max. Overload Current	T.C.R. (ppm/°C)	Resistance Range (mΩ) F (±1%); J (±5%)	Operating Temperature Range
ACMS2512	2	6W	Ir=$\sqrt{P/R}$ Ir：Rating Current (A) P：Rating Power (W) R：R value(Ω)	Io=$\sqrt{5P/R}$ Io：Overload Current (A) P：Rating Power (W) R：R value(Ω)	±100	0.3、0.5	-55~170°C
		5W			±100	0.3、0.5 1、2	
		4W			±100	0.3、0.5 1、2、3	
		3W			±100	0.3、0.5 1、2、3	
		2W			±100	3	
ACMS3921	2	12W			±150	0.2	-55~170°C
		10W			±100	0.3	
		9W			±150	0.2	
					±100	0.3	
					±70	0.5	
		7W			±50	1.0、1.5	
		6W			±50	2.0	
		5W			±150	0.2	
					±100	0.3	
					±70	0.5	
					±50	1.0、1.5、2.0 3.0、4.0、5.0	
		4.5W			±50	1.5	
		4W			±50	1.0、2.0、4.0	
		3W			±50	3.0、4.0、5.0	
		2W			±50	5.0	
ACMS5931	2	15W			±100	0.2	
		10W			±100	0.2、0.3	
		9W			±50	1.0	
		8W			±75	0.5	
		7W			±100	0.2、0.3	
					±50	1.0、2.0	
		6W			±75	0.5	
					±50	3.0	
		5W			±50	1.0、2.0、3.0	
		4W			±50	3.0	

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

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



3.2 Rating Current:

The following equation may be used to determine the DC (Direct Current) or AC (Alternating Current) currents (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.

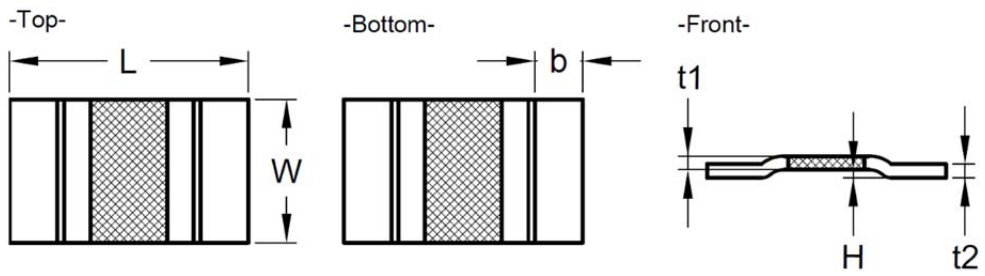
Remark:

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

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

4 Physical Dimensions:

ACMS2512/ 3921/ 5931



Type	Maximum Power Rating (Watts)	Resistance Range (mΩ)	Dimensions - in inches (millimeters)					
			L	W	H	b	t1	t2
ACMS2512	3W/4W/5W/6W	0.3	0.254±0.01 (6.35±0.25)	0.127±0.01 (3.18±0.25)	0.014±0.006 (0.35±0.15)	0.045±0.01 (1.14.±0.25)	0.038±0.006 (0.95±0.15)	0.038±0.006 (0.95±0.15)
	3W/4W/5W/6W	0.5					0.034±0.006 (0.85±0.15)	0.034±0.006 (0.85±0.15)
	3W/4W/5W	1.0					0.017±0.006 (0.42±0.15)	0.017±0.006 (0.42±0.15)
	3W/4W/5W	2.0					0.026±0.006 (0.66±0.15)	0.026±0.006 (0.66±0.15)
	2W/3W/4W	3.0					0.018±0.006 (0.44±0.15)	0.018±0.006 (0.44±0.15)
ACMS3921	12W/9W/5W	0.2	0.394±0.010 (10.00±0.254)	0.205±0.010 (5.20±0.254)	0.0197±0.004 (0.50±0.1)	0.0709±0.024 (1.80.±0.6)	0.056±0.006 (1.42±0.15)	0.056±0.006 (1.42±0.15)
	10W/9W/5W	0.3					0.056±0.006 (1.42±0.15)	0.056±0.006 (1.42±0.15)
	9W/5W	0.5					0.033±0.006 (0.84±0.15)	0.033±0.006 (0.84±0.15)
	7W/5W	1.0					0.017±0.006 (0.43±0.15)	0.017±0.006 (0.43±0.15)
		1.5					0.036±0.006 (0.91±0.15)	0.036±0.006 (0.91±0.15)
	6W/5W	2.0					0.027±0.006 (0.69±0.15)	0.027±0.006 (0.69±0.15)
	5W/3W	3.0					0.018±0.006 (0.45±0.15)	0.018±0.006 (0.45±0.15)
	5W/4.5W/4W/3W	4.0					0.014±0.006 (0.35±0.15)	0.014±0.006 (0.35±0.15)
	5W/3W/2W	5.0					0.011±0.006 (0.27±0.15)	0.011±0.006 (0.27±0.15)
ACMS5931	15W/10W/7W	0.2	0.591±0.010 (15.00±0.254)	0.305±0.010 (7.75±0.254)	0.0216±0.004 (0.55±0.1)	0.1575±0.024 (4.00.±0.6)	0.056±0.006 (1.42±0.15)	0.056±0.006 (1.42±0.15)
	10W/7W	0.3					0.037±0.006 (0.94±0.15)	0.037±0.006 (0.94±0.15)
	9W/7W/5W	1.0					0.036±0.006 (0.91±0.15)	0.036±0.006 (0.91±0.15)
	8W/6W	0.5					0.022±0.006 (0.56±0.15)	0.022±0.006 (0.56±0.15)
	7W/5W	2					0.018±0.006 (0.46±0.15)	0.028±0.006 (0.70±0.15)
	6W/5W/4W	3					0.012±0.006 (0.31±0.15)	0.020±0.006 (0.50±0.15)

4.1 Material of Alloy

Type	Watts	Material	Resistance
ACMS2512	6.0	Copper-Manganese Alloy	0.3mΩ、0.5mΩ
	5.0		0.3mΩ、0.5mΩ、1.0mΩ
	4.0		0.3mΩ、0.5mΩ、1.0mΩ
	3.0		0.3mΩ、0.5mΩ、1.0mΩ
	5.0	Iron-Chromium Aluminum Alloy	2.0mΩ
	4.0		2.0mΩ、3.0mΩ
	3.0		2.0mΩ、3.0mΩ
	2.0		3.0mΩ
ACMS3921	12.0	Copper-Manganese Alloy	0.2mΩ
	10.0		0.3mΩ
	9.0		0.2mΩ、0.3mΩ、0.5mΩ
	7.0		1.0mΩ
	5.0		0.2mΩ、0.3mΩ、0.5mΩ、1.0mΩ
	7.0	Iron-Chromium Aluminum Alloy	1.5mΩ
	6.0		2.0mΩ
	5.0		1.5mΩ、2.0mΩ、3.0mΩ、4.0mΩ、5.0mΩ
	4.5		1.5mΩ
	4.0		1.0mΩ、2.0mΩ、4.0mΩ
	3.0		3.0mΩ、4.0mΩ、5.0mΩ
	2.0		5.0mΩ
ACMS5931	15.0	Copper-Manganese Alloy	0.2mΩ
	10.0		0.2mΩ、0.3mΩ
	9.0	Iron-Chromium Aluminum Alloy	1.0mΩ
	8.0	Copper-Manganese Alloy	0.5mΩ
	7.0		0.2mΩ、0.3mΩ
	6.0		0.5mΩ
	7.0	Iron-Chromium Aluminum Alloy	1.0mΩ、2.0mΩ
	6.0		3.0mΩ
	5.0		1.0mΩ、2.0mΩ、3.0mΩ
	4.0		3.0mΩ

5 Reliability Performance:

5.1 Electrical Performance:

Test Item	Conditions of Test	Test Limits
Electrical Characterization (TCR)	• TCR (ppm/℃) = $\frac{(R2-R1)}{R1\ (T2-T1)}$ X 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): Type: ACMS2512, ACMS3921, ACMS5931 — # of rated power: 5 times Refer to JIS C 5201-1 4.13	ΔR±1.0%

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℃ for 10±1secs. Then the resistor is left in the room for 1 hour, and measured its resistance variance rate. Refer to MIL-STD-202 Method 210	ΔR±1.0%
Solderability	Add flux into tested resistors, immersion into solder bath in temperature 245±5℃ for 3±0.5secs. Refer to J-STD-002	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 MIL-STD-202 Method 204	ΔR±1.0%
Mechanical Shock	Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen (18 shocks). Peak value(g's): 100 Duration(ms): 6 waveform: Half-sine Velocity change(ft/sec): 12.3 Refer to MIL-STD-202 Method 213	ΔR ±0.5%

5.3 Environmental Performance:

Test Item	Conditions of Test	Test Limits
High Temperature Exposure	Put tested resistor in chamber under temperature 170±5℃ for 1,000 hours. Then leaving the tested resistor in room temperature for 60 minutes , and measure its resistance variance rate. Refer to MIL-STD-202 Method 108	ΔR±1.0%
Temperature Cycling	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. Lowest Temperature: -55 +0/-10℃ Highest Temperature: 150 +10/-0℃ Refer to JESD22 Method JA-104	ΔR±1.0%
Bias Humidity	Put the tested resistor in chamber under 85± 5℃and 85± 5%RH with 10% bias and load the rated current 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 MIL-STD-202 Method 103	ΔR±1.0%

5.4 Operational Life Endurance:

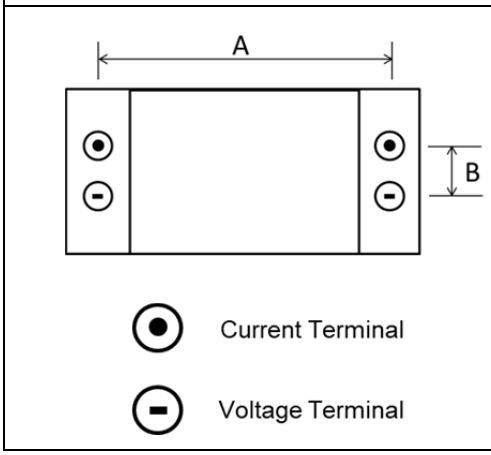
Test Item	Conditions of Test	Test Limits
Operational Life	Put the tested resistor in chamber under temperature 70± 2℃ and load the rated current for 90 minutes on 30 minutes off, total 1000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate. Refer to MIL-STD-202 Method 108	ΔR±1.0%

6 Inductance

6.1 Inductance characteristics: <5nH(Circuit frequency is below 1MHz)

7 Measurement Point:

Bottom electrode

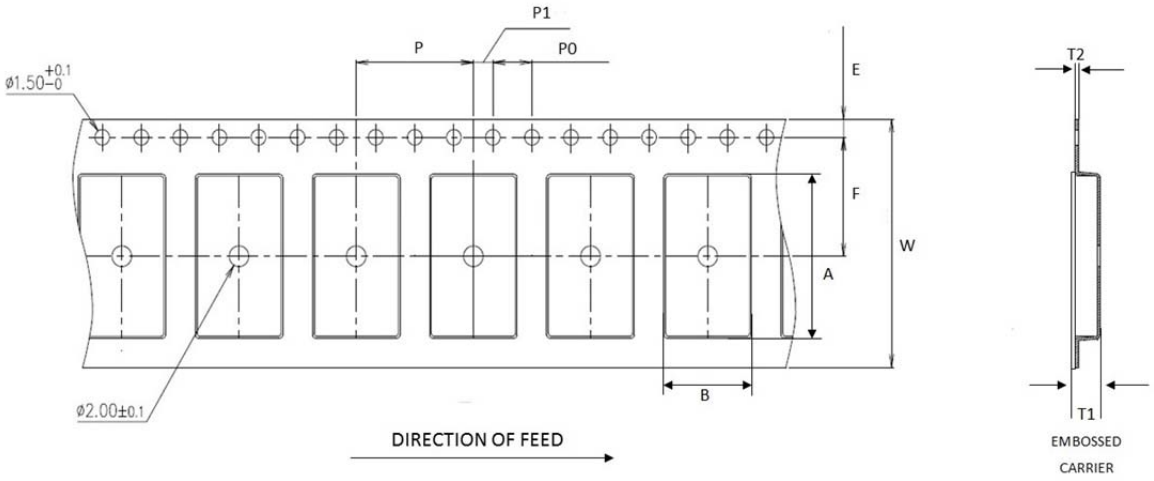


Unit：mm

Type \ DIM	A	B
ACMS2512	5.80 ±0.05	1.40±0.05
ACMS3921	8.00±0.05	2.40±0.05
ACMS5931	11.00±0.05	5.10±0.05

8 Taping specifications:

8.1 Tape Dimensions:



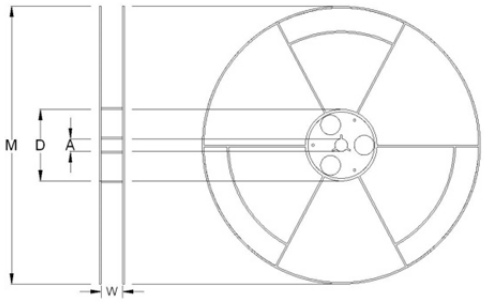
Unit: mm

Item \ DIM	mΩ	A	B	W	E	F	T1	T2	P	P0	10*P0	P1
LRS2512	0.3、0.5、2	6.7±0.1	3.58±0.1	12.3(Max.)	1.75±0.1	5.5±0.1	1.92(Max.)	0.3(Max.)	8.0±0.1	4.0±0.1	40.0±0.2	2.0±0.1
	1、3	6.7±0.1	3.58±0.1	12.3(Max.)	1.75±0.1	5.5±0.1	1.54(Max.)	0.3(Max.)	4.0±0.1	4.0±0.1	40.0±0.2	2.0±0.1
ACMS3921	All	10.5±0.2	5.7±0.2	16.0±0.2	1.75±0.1	7.5±0.1	2.3±0.1	0.28±0.05	8.0±0.1	4.0±0.1	40.0±0.2	2.0±0.1
ACMS5931	All	15.6.±0.2	8.3±0.2	24.0±0.2	1.75±0.1	11.5±0.1	2.3±0.1	0.28±0.05	12.0±0.1	4.0±0.1	40.0±0.2	2.0±0.1

8.2 Packaging model:

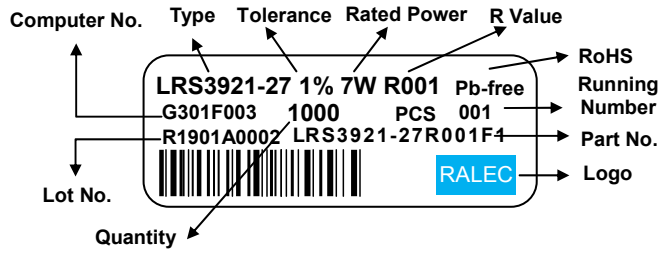
Type	Tape width	Max. Packaging Quantity (pcs/reel)		
		Embossed Plastic Type		
		4mm pitch	8mm pitch	12mm pitch
ACMS2512 (0.3、0.5、2mΩ)	12mm	---	2000	---
ACMS2512 (1、3mΩ)		4000	---	---
ACMS3921	16mm	---	1000	---
ACMS5931	24mm	---	---	500

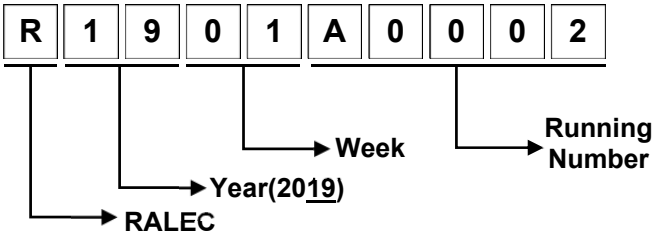
8.3 Reel Dimensions:



Reel Type / Tape	W	M	A	D
7” reel for 12 mm tape	13.8 ± 0.5	178 ± 2.0	13.5 ± 0.5	80.0 ± 1.0
7” reel for 16 mm tape	17.4 ± 1.0	178 ± 2.0	13.20 ± 0.5	60.0 ± 1.0
7” reel for 24 mm tape	25.0 ± 1.0			

8.4 Label:



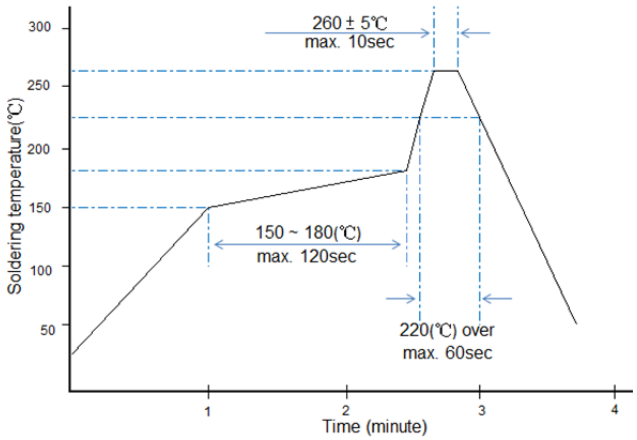


9 Technical note (This is for recommendation, please customer perform adjustment according to actual application)

9.1 Recommend soldering method:

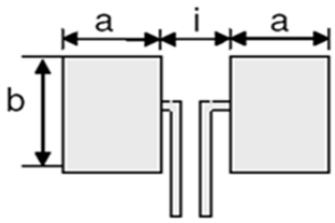
9.1.1 This product is applicable to IR-reflow process only.(Infrared Reflow)

9.2 Typical examples of soldering processes that provides reliable joints without any damage are given in below:



Recommended IR Reflow Soldering Profile
MEET J-STD-020D

9.3 Recommend Land Pattern:



Type	Dimensions - in millimeters		
	a	b	i
ACMS2512	1.8	3.4	3.4
ACMS3921	2.70	6.20	5.60
ACMS5931	5.20	8.75	5.60

9.4 Automobile Electronic Application:

This specification is for automobile electronic use. RALEC will take no responsibility if any damage, cost or loss occurs when the product has been used in any special circumstances.

9.5 Environment Precautions:

If consumer intends to use our company product in special environment or condition (including but not limited to those mentioned below), then will need to make individual recognition of product features and reliability accordingly.

(a) Used in high temperature and humidity environment
(b) Exposed to sea breeze or other corrosive gas, such as Cl2、H2S、NH3、SO2 and NO2.
(c) Used in non-verified liquids including water, oil, chemical and organic solvents.
(d) Using non-verified resin or other coating material to seal or coat our Company product.
(e) After soldering, it is necessary to use water-soluble detergents to clean residual solder fluxes, even though no-clean fluxes are recommended.

9.6 Momentary Overload Precautions:

The product might be out of function when momentary overloaded. Please make sure to avoid momentary overloading while using and preserving.

9.7 Operation and Processing Precautions:

(a) Avoid damage to the edge of resistor and protective layer caused by mechanical stress.
(b) Handle with care when printing circuit board (PCB) is divided or fixed on support body, because bending of printing circuit board (PCB) mounting will make mechanical stress for resistors.
(c) Make sure the power rating is under the limit when using the resistor. When power rating is over the limit, the resister will be overloaded. There might be machinery damage due to the climbing temperature.
(d) If the resister will be exposed under massive impact load (shock wave) in a short period of time, the working environment must be set up well before use.
(e) Please make evaluation and confirmation when the product is well used in your company and have a through consideration of it's fail-safe design to ensure the system safety.

10 Storage and Transportation requirement:

10.1 The temperature condition must be controlled at 25±5℃, the R.H. must be controlled at 60±15%. The stock can maintain quality level in one year.

10.2 Please avoid the mentioned harsh environment below when storing to ensure product performance and its' weldability. Places exposed to sea breeze or other corrosive gas, such as Cl2、H2S、NH3、SO2 and NO2.

10.3 When the product is moved and stored, please ensure the correct orientation of the box. Do not drop or squeeze the box. Otherwise, the electrode or the body of the product may be damaged.

11 Attachments

11.1 Document Revise Record (QA-QR-027)

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