

# DATA SHEET

**CURRENT SENSOR - LOW TCR  
AUTOMOTIVE GRADE**

PA series

5%, 1%

sizes 2512

RoHS compliant & Halogen free



**SCOPE**

This specification describes PA series current sensor - low TCR with lead-free terminations made by metal substrate.

**APPLICATIONS**

- Consumer goods
- Computer
- Telecom / Datacom
- Industrial / Power supply
- Alternative Energy
- Car electronics

**FEATURES**

- Comply with AEC-Q200 standard
- Halogen-free Epoxy
- RoHS compliant
- Reduce environmentally hazardous wastes
- High component and equipment reliability
- Non-forbidden materials used in products/production
- Low resistances applied to current sensing

**ORDERING INFORMATION - GLOBAL PART NUMBER**

Global part numbers are identified by the series, size, tolerance, packing type, temperature coefficient, taping reel and resistance value.

**GLOBAL PART NUMBER**

**PA    XXXX    X    X    X    XX    XXXX    L**  
(1)    (2)    (3)    (4)    (5)    (6)    (7)

**(1) SIZE**

2512

**(2) TOLERANCE**

F = ±1%  
 J = ±5%

**(3) PACKAGING TYPE**

K = Embossed taping reel

**(4) TEMPERATURE COEFFICIENT OF RESISTANCE**

F = ±100 ppm/°C  
 H = ±275 ppm/°C

**(5) TAPING REEL**

07 / 7W / 7T = 7 inch dia. Reel and specific rated power  
 Detailed power rating are shown in the Table 2.

**(6) RESISTANCE VALUE**

1 mΩ to 5 mΩ

**(7) DEFAULT CODE**

Letter L is the system default code for ordering only. (Note)

Resistance code rule	Example
0RXXXX <small>(0.1 to 5 mΩ)</small>	0R001 = 1 mΩ

**ORDERING EXAMPLE**

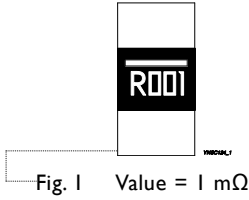
The ordering code of a PA2512 1W chip resistor, TC100, value 0.003Ω with ±1% tolerance, supplied in 7-inch tape reel is: PA2512FKF070R003L

**NOTE**

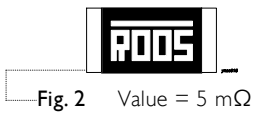
1. All our RChip products are RoHS compliant. "LFP" of the internal 2D reel label mentions "Lead-Free Process"

**MARKING**

**PA2512**



4 digits  
The “R” is used as a decimal point; the other 3 digits are significant  
PA2512: 1mΩ to 4 mΩ



4 digits  
The “R” is used as a decimal point; the other 3 digits are significant  
PA2512: 5 mΩ

**CONSTRUCTION**

The resistors are constructed using outstanding TCR level material, which makes Yageo PA resistors excellent for current sensing application in battery charger circuit & DC-DC converter.

The composition of the resistive material is adjusted to give the approximate required resistance and is covered with a protective coating. Marking is printed on the top side of the resistor.

Finally, the three external terminations (Cu / Ni / matte Tin) are added, as shown in Fig. 4.

**Outlines**

For dimensions, please refer to Table I

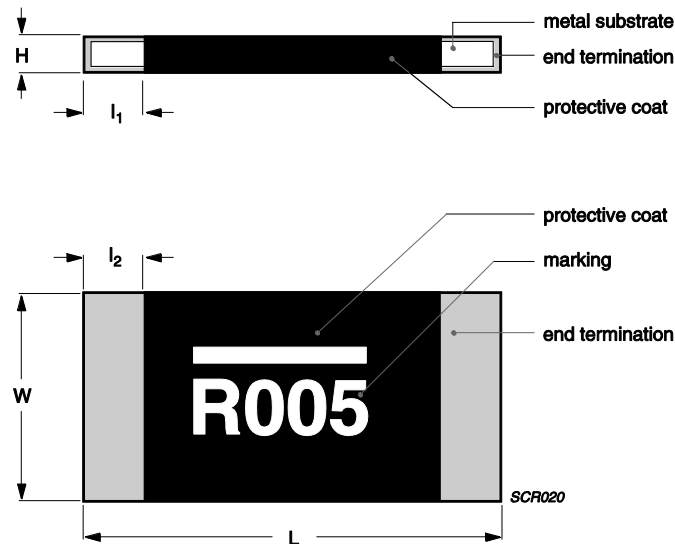


Fig. 3 Chip resistor outlines

DIMENSION

Table 1 For outlines, please refer to Fig. 4

TYPE	RESISTANCE RANGE	POWER RATING	L (mm)	W (mm)	H (mm)	l <sub>1</sub> (mm)	l <sub>2</sub> (mm)
PA2512	$1\text{m}\Omega \leq R \leq 4\text{m}\Omega$	1W	$6.35 \pm 0.25$	$3.18 \pm 0.25$	$0.63 \pm 0.25$	$2.21 \pm 0.25$	$2.21 \pm 0.25$
	$5\text{m}\Omega$	2W 3W	$6.35 \pm 0.25$	$3.18 \pm 0.25$	$0.63 \pm 0.25$	$1.19 \pm 0.25$	$1.19 \pm 0.25$

Note:

1. For relevant physical dimensions, please refer to construction outlines.
2. Please contact with sales offices, distributors and representatives in your region before ordering.

**ELECTRICAL CHARACTERISTICS**

Table 2

SERIES	SIZE	POWER RATING				TOLERANCE	RESISTANCE RANGE	TEMPERATURE COEFFICIENT OF RESISTANCE	
		07	7W	7T	47			1mΩ	±275 ppm/°C
PA	2512	1W	2W	3W	---	±1% ±5%	1 mΩ ≤ R ≤ 5 mΩ		

Note: Please contact with sales offices, distributors and representatives in your region before ordering.

**FUNCTIONAL DESCRIPTION**

**OPERATING TEMPERATURE RANGE**

PA2512 Range: -55°C to +170°C

**POWER RATING**

Standard rated power at 70°C:

For detail power value, please refer to Table 2.

**RATED VOLTAGE**

The DC or AC (rms) continuous working voltage corresponding to the rated power is determined by the following formula:

$$V = \sqrt{P \times R}$$

Where

V = Continuous rated DC or AC (rms) working voltage (V)

P = Rated power (W)

R = Resistance value (Ω)

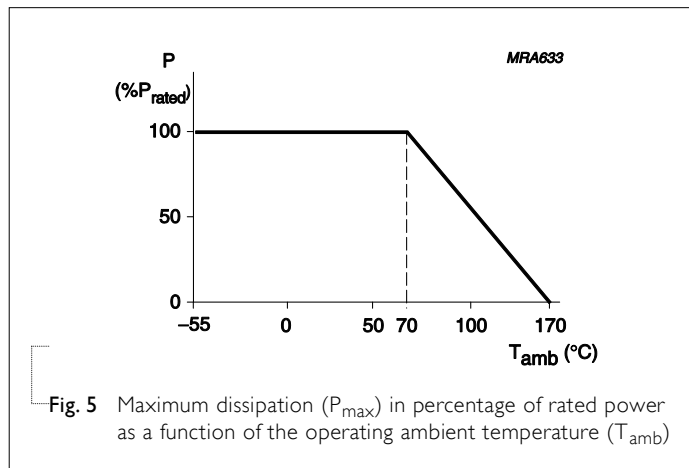


Fig. 5 Maximum dissipation (P<sub>max</sub>) in percentage of rated power as a function of the operating ambient temperature (T<sub>amb</sub>)

**PACKING STYLE AND PACKAGING QUANTITY**

Table 3 Packing style and packaging quantity

PACKING STYLE	REEL DIMENSION	PA2512
Embossed taping reel (K)	7" (178 mm)	4,000

**EMBOSSED TAPE**

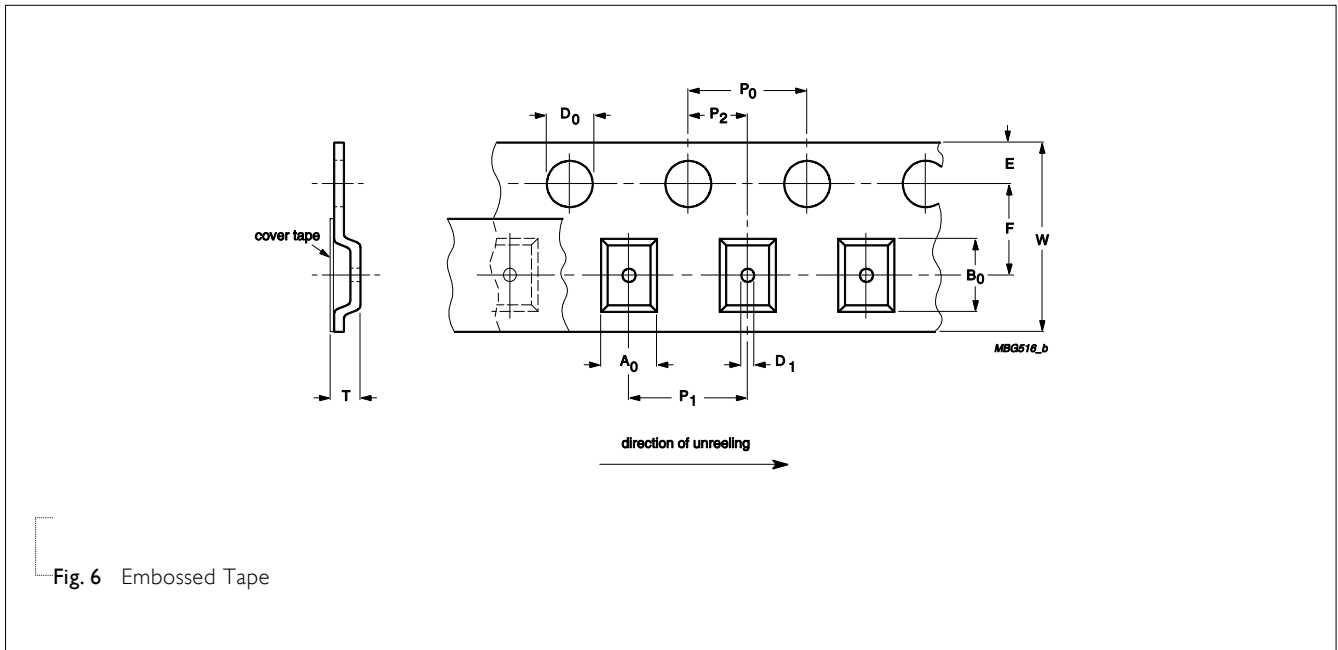


Fig. 6 Embossed Tape

Table 4 Dimensions of embossed tape for relevant chip resistors size

SIZE	SYMBOL										Unit: mm
	A <sub>0</sub>	B <sub>0</sub>	W	E	F	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	ØD <sub>0</sub>	ØD <sub>1</sub>	T
PA2512	3.40±0.15	6.70±0.15	12.00±0.30	1.75±0.10	5.50±0.10	4.00±0.10	4.00±0.10	2.00±0.10	1.55±0.05	1.50±0.10	0.80±0.15

**REEL SPECIFICATION**

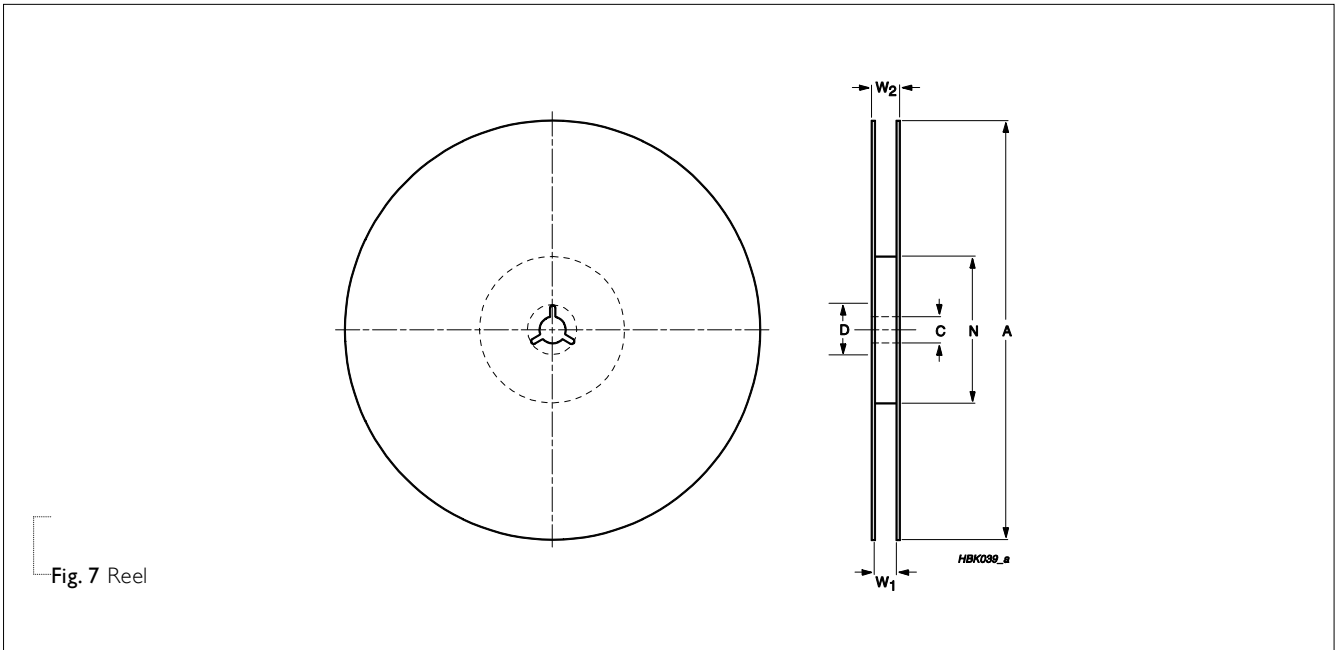
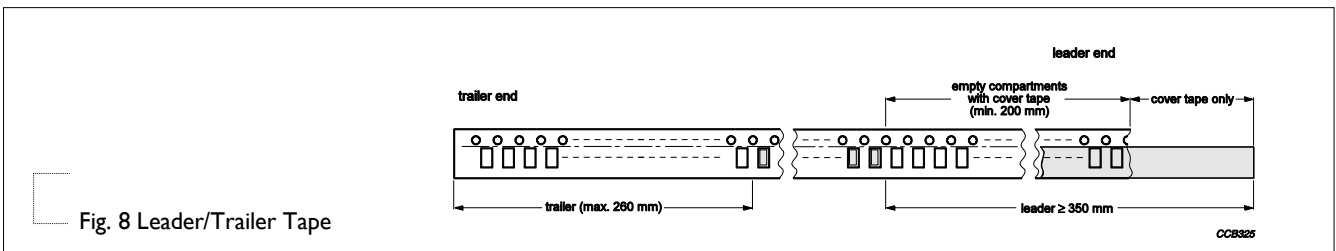


Table 5 Dimensions of reel specification for relevant chip resistors size

SIZE	QUANTITY PER REEL	REEL SIZE		SYMBOL				Unit: mm	
		8 mm TAPE WIDE	12 mm TAPE WIDE	A	N	C	D	W <sub>1</sub>	W <sub>2</sub> MAX.
PA2512	4000	--	7" (Ø178 mm)	178.0±1.0	60.0+1/-0	13.50±0.5	21.0±0.8	13.6±0.5	16.5±0.5

**LEADER/TRAILER TAPE SPECIFICATION**



**FOOTPRINT AND SOLDERING PROFILES**

For recommended soldering profiles, please refer to data sheet “Chip resistors mounting”.

**FOOTPRINT**

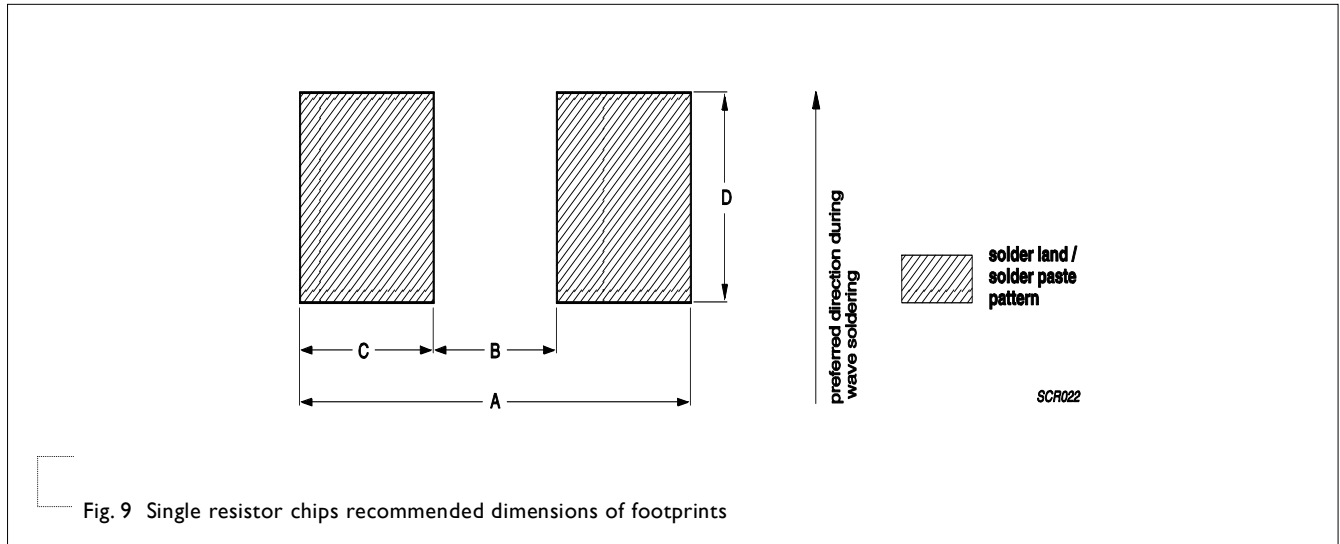


Table 6 Footprint dimensions

SIZE	RESISTANCE RANGE	POWER RATING	Unit: mm			
			A	B	C	D
PA2512	$1\text{m}\Omega \leq R \leq 4\text{m}\Omega$	1W, 2W, 3W	7.37	1.27	3.05	3.68
	$5\text{m}\Omega$		7.40	3.18	2.11	3.68



**TESTS AND REQUIREMENTS**

Table 8 Test condition, procedure and requirements

TEST	TEST METHOD	PROCEDURE	REQUIREMENT
Short time overload	IEC60115-1 4.13	5 times of rated power for 5 seconds at room temperature	$\pm(0.5\%+0.0005\Omega)$ No visible damage
High Temperature Exposure/ Endurance at Upper Category Temperature	MIL-STD-202G-Method 108A	1,000 hours at maximum operating temperature depending on specification, unpowered  No direct impingement of forced air to the parts Tolerances: $170\pm 3^{\circ}\text{C}$	$\pm(1.0\%+0.0005\Omega)$
Temperature Cycling	JESD22-A104C	1,000 cycles, $-55/+125^{\circ}\text{C}$ for 1 cycle per hour	$\pm(0.5\%+0.0005\Omega)$
Moisture Resistance	MIL-STD-202G-Method 106F	Each temperature / humidity cycle is defined at 8 hours (method 106F), 3 cycles / 24 hours for 10d with $25^{\circ}\text{C}$ / $65^{\circ}\text{C}$ 95% R.H, without steps 7a & 7b, unpowered	$\pm(0.5\%+0.0005\Omega)$
Biased Humidity	MIL-STD-202 Method 103	1,000 hours; $85^{\circ}\text{C}$ / 85% RH  10% of operating power	$\pm(0.5\%+0.0005\Omega)$
Operational Life/ Endurance	MIL-STD-202G-Method 108A IEC 60115-1 4.25.1	1,000 hours at $125\pm 3^{\circ}\text{C}$ , de-rated voltage applied for 1.5 hours on, 0.5 hour off, still-air required  1,000 hours at $70\pm 2^{\circ}\text{C}$ applied RCWV  1.5 hours on, 0.5 hour off, still air required	$\pm(1.0\%+0.0005\Omega)$  $\pm(1.0\%+0.0005\Omega)$
Resistance to Solvents	MIL-STD-202 Method 215	Immerse in isopropyl alcohol for 5 min with ultrasonic at room temperature	$\pm(1.0\%+0.0005\Omega)$
Mechanical Shock	MIL-STD-202 Method 213	Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen.  Peak value: 1,500 g's  Duration: 0.5 ms  Velocity change: 15.4 ft/s  Waveform: Half sine	$\pm(0.5\%+0.0005\Omega)$
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 12 cycles each of 3 orientations  Test from 10-2000 Hz.	$\pm(0.5\%+0.0005\Omega)$
Resistance to Soldering Heat	MIL-STD-202G-method 210F	Condition B, no pre-heat of samples  Leadfree solder, $260^{\circ}\text{C}$ , 10 seconds immersion time  Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	$\pm(0.5\%+0.0005\Omega)$  No visible damage
Thermal Shock	MIL-STD-202 Method 107	$-55/+150^{\circ}\text{C}$ , Number of cycles is 300.  Maximum transfer time is 20 seconds.  Dwell time is 15 minutes. Air -Air	$\pm(0.5\%+0.0005\Omega)$  No visible damage

TEST	TEST METHOD	PROCEDURE	REQUIREMENT
Electrostatic Discharge	AEC-Q200-002	Human Body Model, 1 pos + 1 neg. Discharges 2512=2KV	$\pm(1.0\%+0.0005\Omega)$ No visible damage
Solderability - Wetting	J-STD-002	(a) Method B, aging 4 hours at 155°C dry heat, dipping at 235±3°C for 5±0.5 seconds.  (b) Method B, steam aging 8 hours, dipping at 215±3°C for 5±0.5 seconds.  (c) Method D, steam aging 8 hours, dipping at 260±3 °C for 7±0.5 seconds.	Well tinned (>95% covered) No visible damage
Flammability	UL94	Try to inflame a specimen by a needle flame	No ignition of specimen; V-0
Board Flex / Bending	AEC-Q200-005	Chips mounted on a 90mm glass epoxy resin PCB (FR4), Bending for 2512=2 mm Holding time: Min.60 seconds	$\pm(1.0\%+0.0005\Omega)$
Terminal Strength (SMD)	AEC-Q200-006	Applied a 17.7N (1.8Kg) for 60±1 seconds.	$\pm(1.0\%+0.0005\Omega)$ No visible damage
Flame Retardance	AEC-Q200-001	Apply voltage from 9V to 32V to increase the surface temp to 350°C	No flame, no explosion
Temperature Coefficient of Resistance (T.C.R.)	IEC 60115-1 4.8	At +25/-55°C and +25/+125°C Formula: $T.C.R = \frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 (\text{ppm}/^\circ\text{C})$ Where t1=+25°C or specified room temperature t2=-55°C or +125°C test temperature R1=resistance at reference temperature in ohms R2=resistance at test temperature in ohms	Refer to table 2
Flower-of-Sulfur (FOS)	Modified ASTM B809-95	Sulfur 105°C, 750 hours, unpowered.	$\pm(1.0\%+0.0005\Omega)$

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 0	Aug. 22, 2014	-	- New datasheet for automotive grade current sensor -PA series.

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