

# DATA SHEET

**CURRENT SENSOR - LOW TCR  
AUTOMOTIVE GRADE**

PA\_E series

5%, 1%, 0.5%

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**

- AEC-Q200 qualified
- 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
- Anti-sulfur

**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 E  
(1) (2) (3) (4) (5) (6) (7)

**(1) SIZE**

2512

**(2) TOLERANCE**

D =  $\pm 0.5\%$

F =  $\pm 1\%$

J =  $\pm 5\%$

**(3) PACKAGING TYPE**

K = Embossed taping reel

**(4) TEMPERATURE COEFFICIENT OF RESISTANCE**

F =  $\pm 100 \text{ ppm}/^\circ\text{C}$

M =  $\pm 75 \text{ ppm}/^\circ\text{C}$

E =  $\pm 50 \text{ ppm}/^\circ\text{C}$

**(5) TAPING REEL**

07 = 7 inch dia. Reel & standard power (1W)

7W = 7 inch dia. Reel & 2 x standard power (2W)

7T = 7 inch dia. Reel & 3 x standard power (3W)

**(6) RESISTANCE VALUE**

0.5 m $\Omega$  to 100 m $\Omega$

**(7) DEFAULT CODE**

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

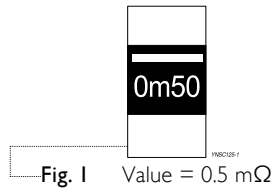
Resistance rule of global part number	
Resistance code rule	Example
XUXX	0U5 = 0.5m $\Omega$
0RXXX	0R001 = 1 m $\Omega$
(1 to 100 m $\Omega$ )	0R05 = 50 m $\Omega$

**ORDERING EXAMPLE**

The ordering code of a PA2512 1W chip resistor, TC100, value 0.003 $\Omega$  with  $\pm 1\%$  tolerance, supplied in 7-inch tape reel is: PA2512FKF070R003E

**NOTE**

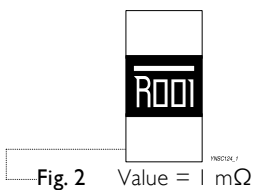
1. All our RChip products are RoHS compliant. "LFP" of the internal 2D reel label mentions "Lead-Free Process"

**MARKING****PA2512**

4 digits

The "m" is used as decimal point; the other 3 digits are significant and the unit is milliohm

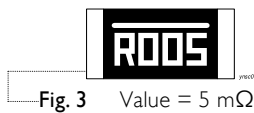
PA2512: 0.5mΩ and 0.75mΩ



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 to 100 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.

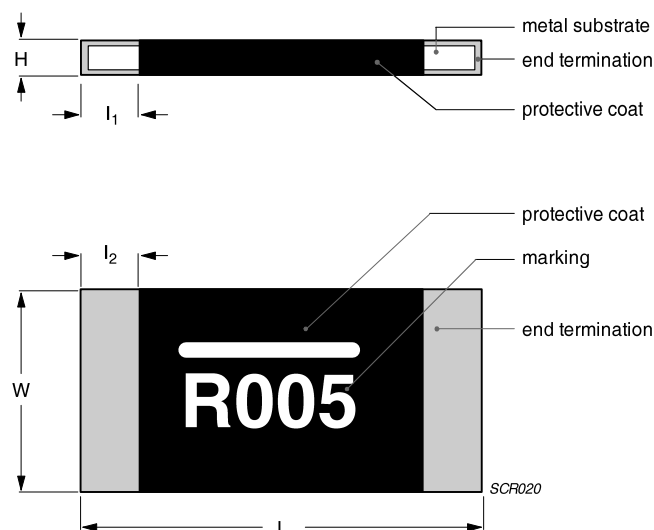
**Outlines**

Fig. 4 Chip resistor outlines

**DIMENSION**

Table 1 For outlines, please refer to Fig. 4

TYPE	RESISTANCE RANGE	L (mm)	W (mm)	H (mm)	L <sub>1</sub> (mm)	L <sub>2</sub> (mm)
PA2512	$0.5\text{m}\Omega \leq R \leq 0.75\text{m}\Omega$	$6.35 \pm 0.25$	$3.18 \pm 0.25$	$0.63 \pm 0.25$	$2.72 \pm 0.25$	$2.72 \pm 0.25$
	$1\text{m}\Omega \leq R \leq 4\text{m}\Omega$	$6.35 \pm 0.25$	$3.18 \pm 0.25$	$0.63 \pm 0.25$	$2.21 \pm 0.25$	$2.21 \pm 0.25$
	$5\text{m}\Omega \leq R \leq 6\text{m}\Omega$	$6.35 \pm 0.25$	$3.18 \pm 0.25$	$0.63 \pm 0.25$	$1.19 \pm 0.25$	$1.19 \pm 0.25$
	$7\text{m}\Omega \leq R \leq 100\text{m}\Omega$	$6.35 \pm 0.25$	$3.18 \pm 0.25$	$0.63 \pm 0.25$	$0.76 \pm 0.25$	$0.76 \pm 0.25$

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

TYPE	SIZE	POWER RATING	TOLERANCE	RESISTANCE RANGE	TEMPERATURE COEFFICIENT OF RESISTANCE
PA	2512	1W	$\pm 0.5\%$	$0.5\text{m}\Omega \leq R \leq 100\text{m}\Omega$	$\pm 50\text{ppm}/^\circ\text{C}$
		2W	$\pm 1\%$		$\pm 75\text{ppm}/^\circ\text{C}$
		3W	$\pm 5\%$		$\pm 100\text{ppm}/^\circ\text{C}$

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

**FUNCTIONAL DESCRIPTION****OPERATING TEMPERATURE RANGE**

PA2512 Range:  $-55^\circ\text{C}$  to  $+170^\circ\text{C}$

**POWER RATING**

Standard rated power at  $70^\circ\text{C}$ :

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 ( $\Omega$ )

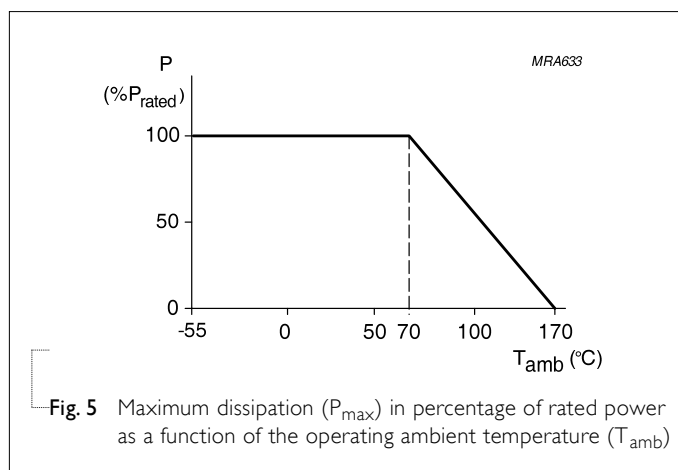


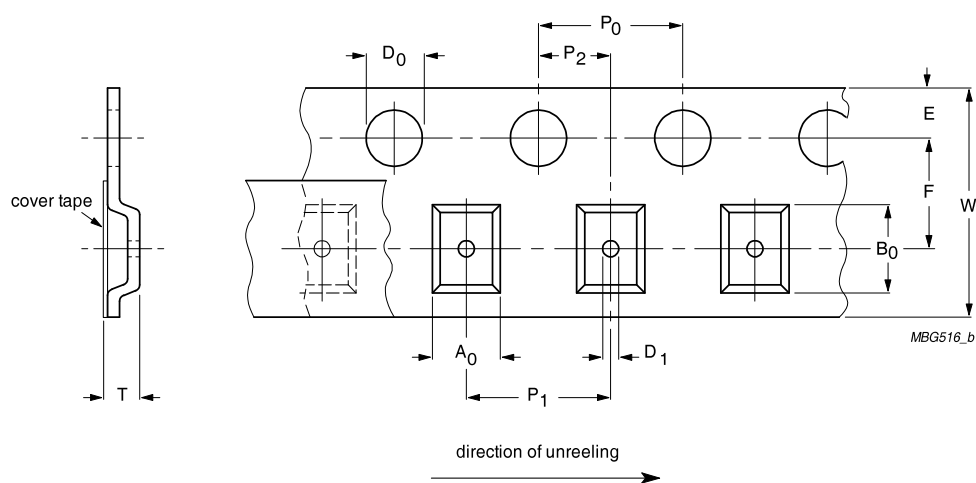
Fig. 5 Maximum dissipation ( $P_{\max}$ ) in percentage of rated power as a function of the operating ambient temperature ( $T_{\text{amb}}$ )

## 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

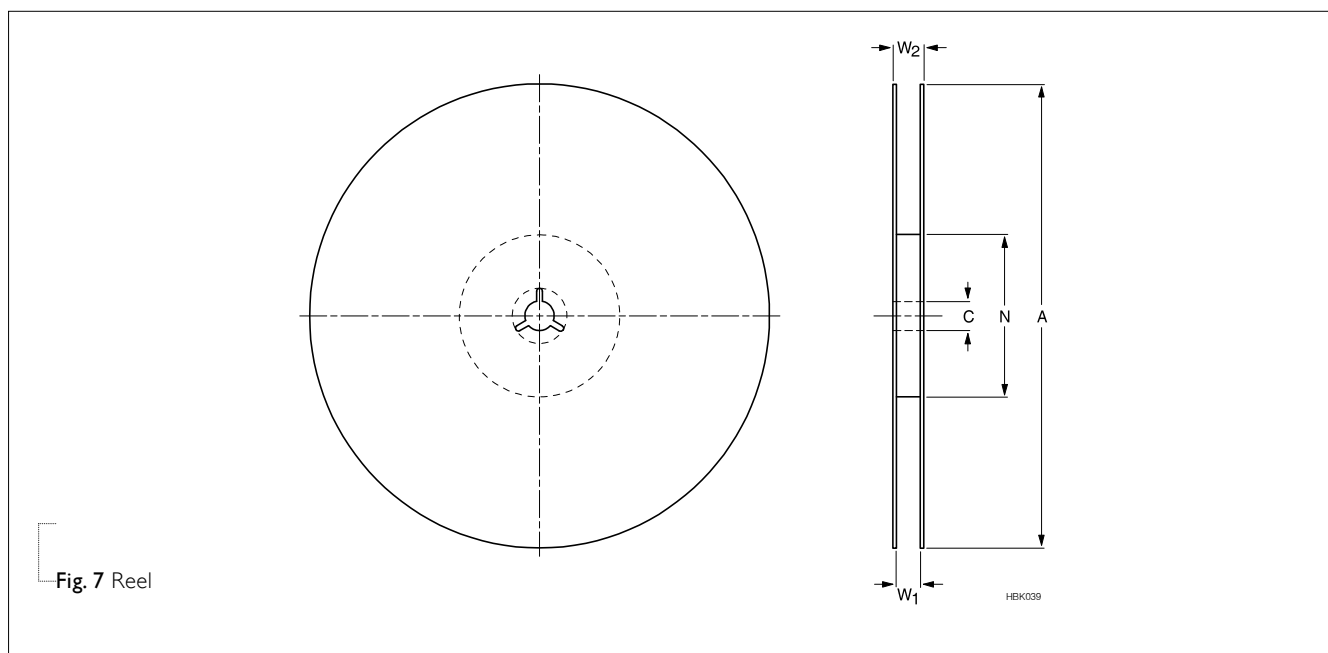


**Fig. 6** Embossed Tape

**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

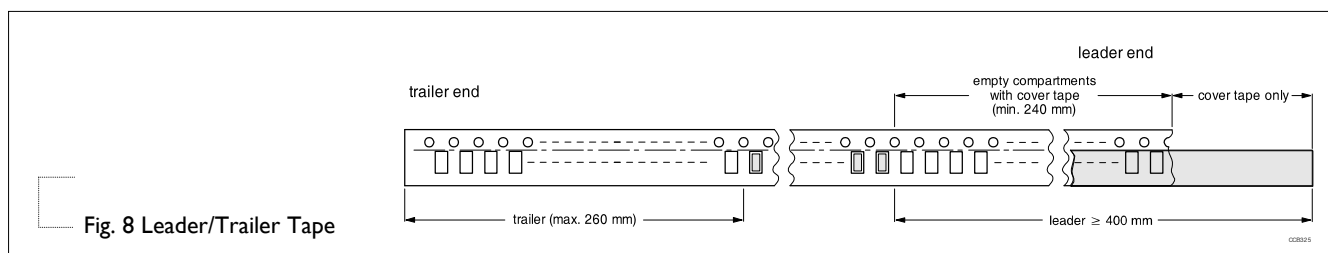
## REEL SPECIFICATION



**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”.

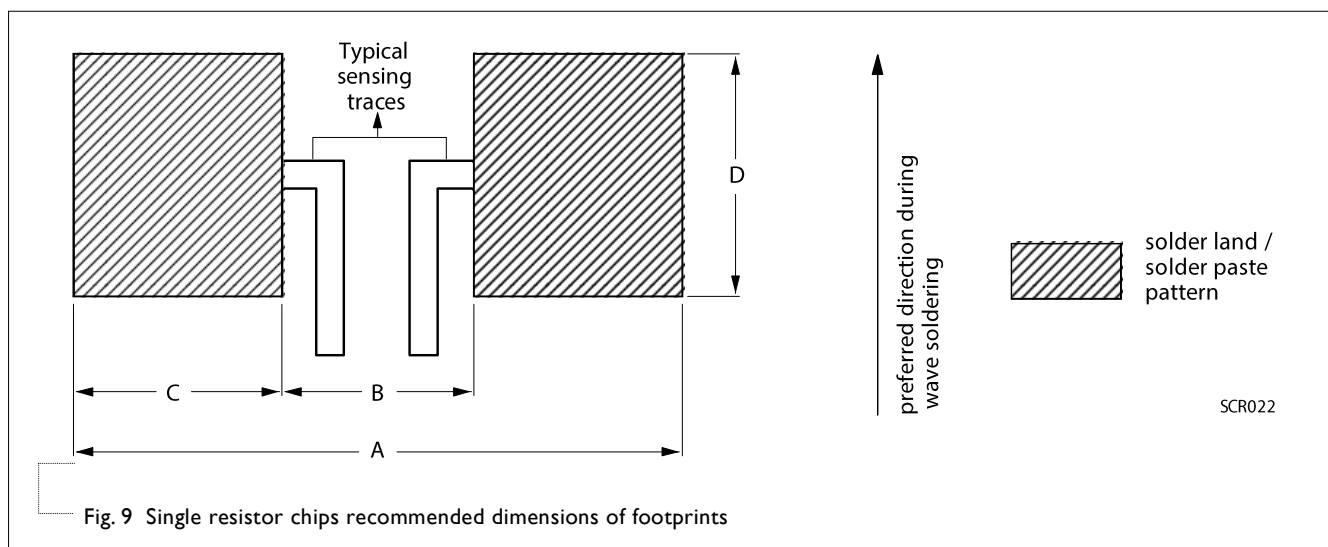
**FOOTPRINT**

Table 6 Footprint dimensions

					Unit: mm
SIZE	RESISTANCE RANGE	A	B	C	D
PA2512	$0.5\text{m}\Omega \leq R < 1\text{m}\Omega$	7.36	0.50	3.43	3.68
	$1\text{m}\Omega \leq R \leq 4\text{m}\Omega$	7.37	1.27	3.05	3.68
	$5\text{m}\Omega \leq R \leq 6\text{m}\Omega$	7.40	3.18	2.11	3.68
	$7\text{m}\Omega \leq R \leq 100\text{m}\Omega$	7.36	4.06	1.65	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	MIL-STD-202-Method 108	1,000 hours at maximum operating temperature depending on specification, unpowered  No direct impingement of forced air to the parts Tolerances: $170\pm3^{\circ}\text{C}$	$\pm(1.0\%+0.0005\Omega)$
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-202-Method 106	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-202-Method 108	1,000 hours at $125\pm3^{\circ}\text{C}$ , de-rated voltage applied for 1.5 hours on, 0.5 hour off, still-air required	$\pm(1.0\%+0.0005\Omega)$
		1,000 hours at $70\pm2^{\circ}\text{C}$ applied RCWV 1.5 hours on, 0.5 hour off, still air required	$\pm(1.0\%+0.0005\Omega)$
Resistance to Solvents	MIL-STD-202 Method 215	Immerse in isopropyl alcohol for 5 min with ultrasonic at room temperature	No Visible damage
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: 100 g's  Duration: 6 ms  Velocity change: 12.3 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-202-method 210	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	$-55/+125^{\circ}\text{C}$ , Number of cycles is 300.  Devices mounted.  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-002B test B	(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.)	MIL-STD-202 Method 304	At +25/+150°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=+150°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 10	Jan. 31, 2018	-	- Extend 0.5% Tolerance
Version 9	Nov. 21, 2017	-	- Extend resistor value for 3W
Version 8	Oct. 23, 2017	-	- Update footprint dimensions
Version 7	Jul. 24, 2017	-	- Add part number coding details for the relationship between taping reel and rated power
Version 6	Apr. 19, 2017	-	- Extend resistor value
Version 5	Nov. 30, 2016	-	- Extend resistor value
Version 4	Oct. 27, 2016	-	- Modify the error of test procedure
Version 3	Mar. 31, 2016	-	- Update TCR
Version 2	Dec. 31, 2015	-	- Extend resistor value
Version 1	Dec. 18, 2015	-	- Update tests and requirements

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