

DATA SHEET

CURRENT SENSOR - LOW TCR

AUTOMOTIVE GRADE

PA series

5%, 1%, 0.5%

sizes 0201/0402/0603/0805/1206/2010

RoHS compliant & Halogen free



SCOPE

This specification describes
PA0201/0402/0603/0805/1206/2010
series current sensor - low TCR
with lead-free terminations metal
substrate.

APPLICATIONS

- Smart Phone
- Batteries
- Computer
- Telecom / Datacom
- Industrial / Power supply
- 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
- Moisture sensitivity level: MSL 1

ORDERING INFORMATION - GLOBAL PART NUMBER

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

GLOBAL PART NUMBER

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

(1) SIZE

0201/0402/0603/0805/1206/2010

(2) TOLERANCE

D = $\pm 0.5\%$ (for 5m Ω ~ 20m Ω)

F = $\pm 1\%$

J = $\pm 5\%$

(3) PACKAGING TYPE

R = Paper taping reel (PA0201~PA1206)

K = Embossed taping reel (PA2010)

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

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

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

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

L = $\pm 150\text{ppm}/^\circ\text{C}$

G = $\pm 200\text{ppm}/^\circ\text{C}$

(5) TAPING REEL

07 / 7W / 7T / 47 / 57 / 87 inch dia. Reel and specific rated power

Detailed power rating are shown in the Table 2.

(6) RESISTANCE VALUE

1 m Ω to 20 m Ω

(7) DEFAULT CODE

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

L is for 0201/0402/0603/0805

Z is for only 1206/2010

Resistance rule of global part number	
Resistance code rule	Example
0RXXX	0R001 = 1 m Ω
(1 to 20 m Ω)	0R02 = 20 m Ω

ORDERING EXAMPLE

The ordering code for a PA0805

0.125W chip resistor, TC50 value 0.01 Ω

(10mR) with $\pm 1\%$ tolerance, supplied in 7-inch tape reel with 5Kpcs quantify is:

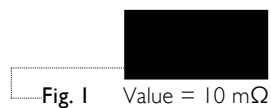
PA0805FRE070R01L.

NOTE

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

MARKING

PA0201/0402/0603/0805/1206/2010



No Marking

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. Finally, the three external terminations (Cu / Ni / matte Tin) are added, as shown in Fig. 2.

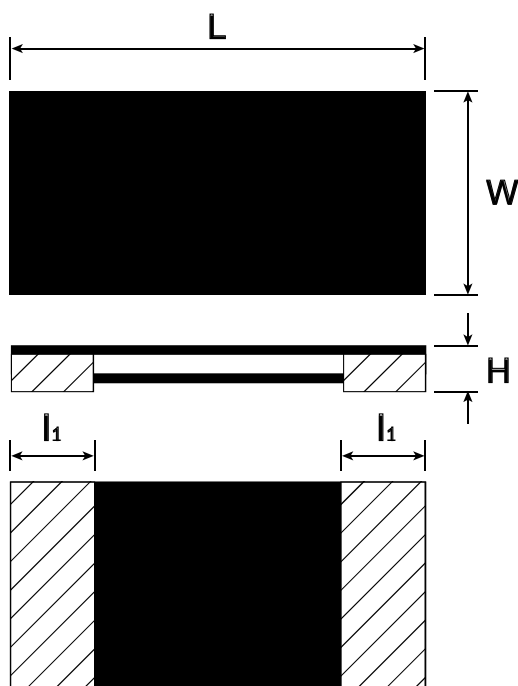
Outlines

Fig. 2 Chip resistor outlines

DIMENSION**Table 1** For outlines, please refer to Fig. 2

TYPE	RESISTANCE RANGE	L (mm)	W (mm)	H (mm)	ll (mm)
PA0201	$5\text{m}\Omega \leq R \leq 20\text{m}\Omega$	0.60 ± 0.03	0.31 ± 0.04	Max. 0.30	0.15 ± 0.06
PA0402	$2\text{m}\Omega \leq R \leq 20\text{m}\Omega$	1.00 ± 0.10	0.55 ± 0.10	Max. 0.40	0.25 ± 0.10
PA0603	1 m Ω	1.60 ± 0.20	0.80 ± 0.20	0.55 ± 0.15	0.38 ± 0.12
	$2\text{m}\Omega \leq R \leq 20\text{m}\Omega$	1.60 ± 0.20	0.80 ± 0.20	0.45 ± 0.15	0.38 ± 0.12
PA0805	1 m Ω	2.03 ± 0.20	1.27 ± 0.20	0.55 ± 0.15	0.60 ± 0.15
	1.5/ 2 m Ω	2.03 ± 0.20	1.27 ± 0.20	0.45 ± 0.15	0.50 ± 0.15
	$2.5\text{m}\Omega \leq R \leq 20\text{m}\Omega$	2.03 ± 0.20	1.27 ± 0.20	0.30 ± 0.15	0.35 ± 0.20
PA1206	1 m Ω	3.20 ± 0.25	1.60 ± 0.25	0.65 ± 0.25	0.51 ± 0.25
	2 m Ω	3.20 ± 0.25	1.60 ± 0.25	0.55 ± 0.25	0.60 ± 0.25
	2.5/ 3 m Ω	3.20 ± 0.25	1.60 ± 0.25	0.40 ± 0.25	0.80 ± 0.30
	$4\text{m}\Omega \leq R \leq 20\text{m}\Omega$	3.20 ± 0.25	1.60 ± 0.25	0.40 ± 0.25	0.60 ± 0.30
PA2010	$1\text{m}\Omega \leq R \leq 3\text{m}\Omega$	5.08 ± 0.25	2.54 ± 0.25	0.50 ± 0.25	1.40 ± 0.25
	$4\text{m}\Omega \leq R \leq 20\text{m}\Omega$	5.08 ± 0.25	2.54 ± 0.25	0.40 ± 0.25	0.70 ± 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**

SIZE	POWER RATING (I)						TOLERANCE	RESISTANCE RANGE	TEMPERATURE COEFFICIENT OF RESISTANCE	
	07	7W	7T	47	57	87				
0201	1/20W	1/10W	3/20W	1/4W	--	--	±1% ±5%	5mΩ ≤ R ≤ 20mΩ	±150 ppm/°C	
0402	1/16W	1/8W	1/6W	1/4W	1/3W	--		2mΩ ≤ R ≤ 20mΩ	±150 ppm/°C	
0603	1/10W	1/5W	1/3W	2/5W	1/2W	--		1mΩ ≤ R ≤ 20mΩ	1mΩ 2/ 2.5mΩ 3mΩ ≤ R ≤ 10mΩ	±200 ppm/°C ±150 ppm/°C ±50 ppm/°C, ±75 ppm/°C
0805	1/8W	1/4W	--	1/2W	--	1W	±0.5%	10mΩ	1/ 1.5mΩ 2mΩ ≤ R ≤ 20mΩ	±150 ppm/°C ±50 ppm/°C
							±1% ±5%	1mΩ≤ R ≤ 20mΩ		
1206	1/4W	1/2W	--	1W	--	--	±0.5%	5mΩ ≤ R ≤ 20mΩ	1/ 2mΩ 3mΩ ≤ R ≤ 20mΩ	±100 ppm/°C ±50 ppm/°C
							±1% ±5%	1mΩ ≤ R ≤ 20mΩ		
2010	0.5W	1W	1.5W	-	-	-	±1% ±5%	1mΩ ≤ R ≤ 20mΩ	±50 ppm/°C	
	0.5W	1W	1.5W	2W	-	-		1mΩ ≤ R ≤ 10mΩ		

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

FUNCTIONAL DESCRIPTION

OPERATING TEMPERATURE RANGE

PA0201/ 0402 Range: -55°C to +125°C

PA0603/ 0805 Range: -55°C to +155°C

PA1206/ 2010 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:

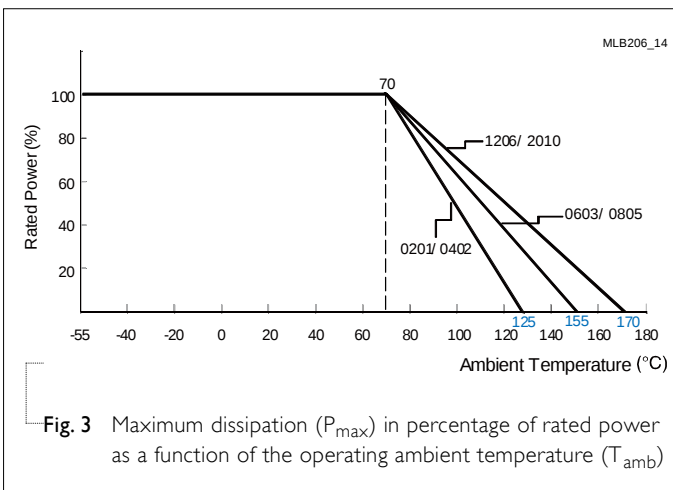
$$V = \sqrt{(P \times R)}$$

Where

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

P = Rated power (W)

R = Resistance value (Ω)

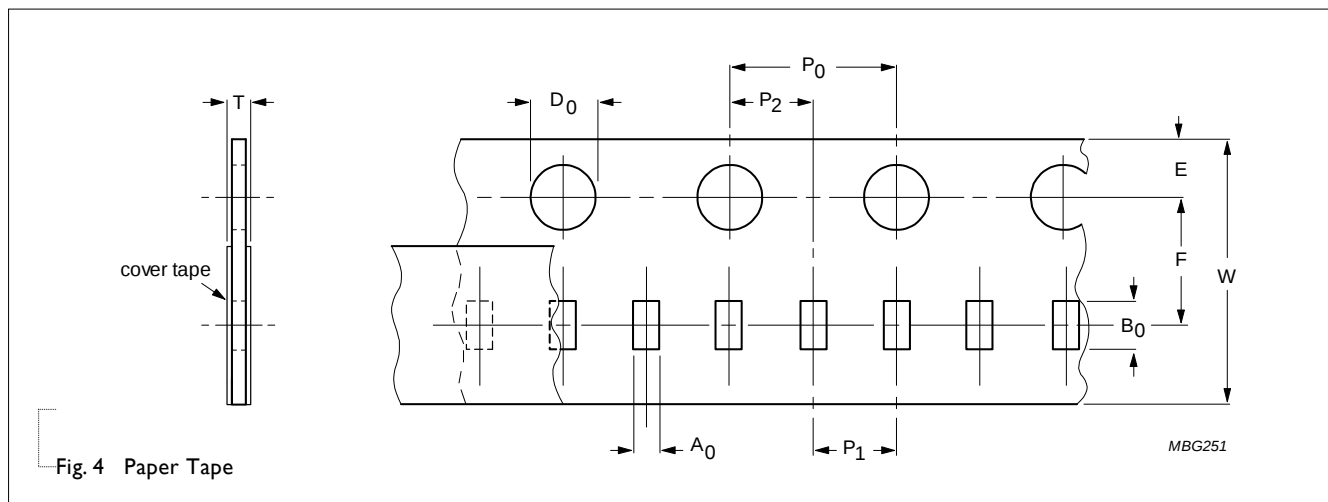


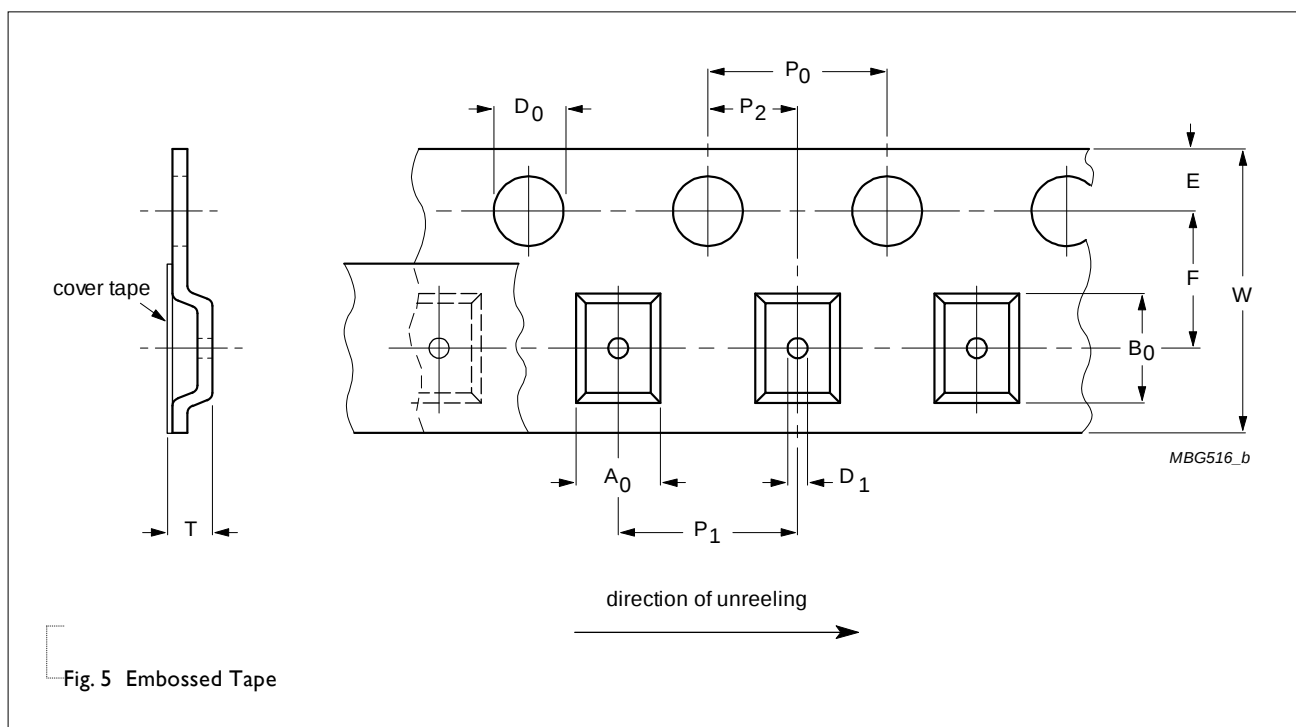
PACKING STYLE AND PACKAGING QUANTITY

Table 3 Packing style and packaging quantity

PACKING STYLE	REEL DIMENSION	PA0201	PA0402	PA0603	PA0805	PA1206	PA2010
Paper Taping Reel (R)	7" (178 mm)	10,000	10,000	5,000	5,000	4,000	-
Embossed Taping Reel (K)	7" (178 mm)	-	-	-	-	-	4,000

PAPER TAPE



EMBOSSED TAPE

Table 4 Dimensions of paper tape for relevant chip resistors size

SIZE	SYMBOL									Unit: mm
	A ₀	B ₀	W	E	F	P ₀	P ₁	P ₂	ΦD ₀	
PA0201	0.39±0.10	0.70±0.10	8.0±0.30	1.75±0.10	3.50±0.10	4.00±0.10	2.00±0.10	2.00±0.10	1.55±0.05	0.43±0.10
PA0402	0.59±0.10	1.10±0.10	8.0±0.30	1.75±0.10	3.50±0.10	4.00±0.10	2.00±0.10	2.00±0.10	1.55±0.05	0.53±0.10
PA0603	1.08±0.10	1.90±0.10	8.0±0.30	1.75±0.10	3.50±0.10	4.00±0.10	4.00±0.10	2.00±0.10	1.55±0.05	0.60±0.10
PA0805	1.60±0.10	2.35±0.10	8.0±0.30	1.75±0.10	3.50±0.10	4.00±0.10	4.00±0.10	2.00±0.10	1.55±0.05	0.60±0.10*
	1.60±0.10	2.35±0.10	8.0±0.30	1.75±0.10	3.50±0.10	4.00±0.10	4.00±0.10	2.00±0.10	1.55±0.05	0.53±0.10**
PA1206	1.90±0.10	3.50±0.10	8.0±0.30	1.75±0.10	3.50±0.10	4.00±0.10	4.00±0.10	2.00±0.10	1.55±0.05	0.85±0.15

Note:

* 1~2mΩ

** 2.5~20mΩ

Table 5 Dimensions of embossed tape for relevant chip resistors size

SIZE	SYMBOL									Unit: mm
	A ₀	B ₀	W	E	F	P ₀	P ₁	P ₂	ΦD ₀	
PA2010	3.40±0.15	6.70±0.15	12.0±0.30	1.75±0.10	5.50±0.10	4.00±0.10	4.00±0.10	2.00±0.10	1.55±0.10	0.85±0.15

REEL SPECIFICATION

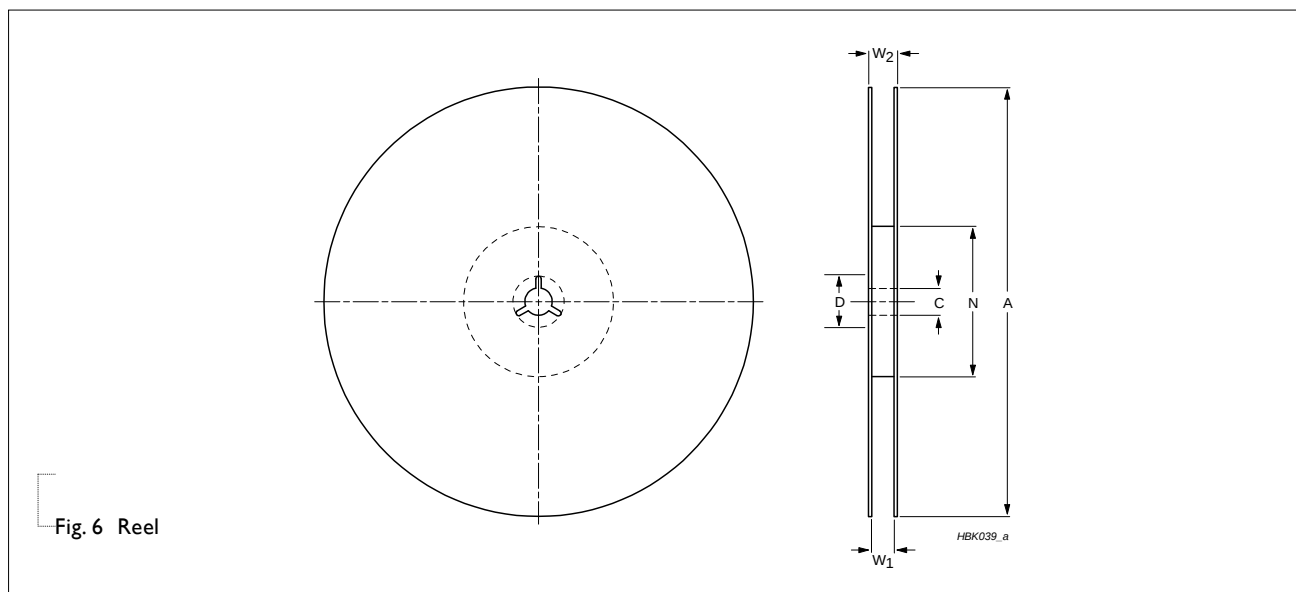
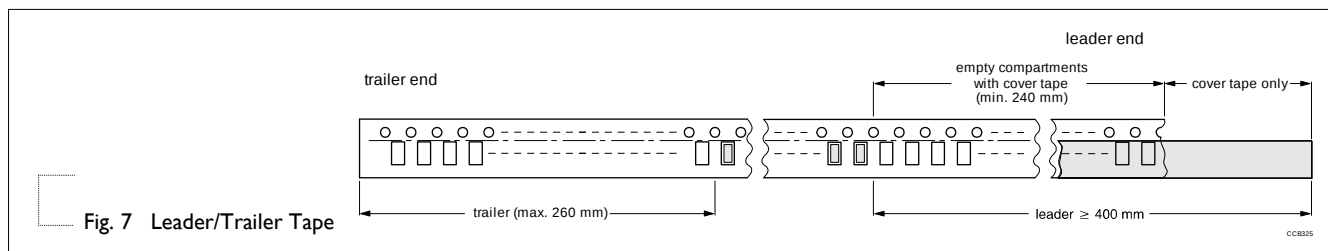


Table 6 Dimensions of reel specification for relevant chip resistors size

SIZE	QUANTITY PER REEL	REEL SIZE	REEL SIZE	SYMBOL				
		8mm TAPE WIDE	12mm TAPE WIDE	A	N	C	D	W ₁
PA0201	10,000	7" (Φ 178mm)	-	178.0 $\pm$ 1.0	60.0+1/-0	13.50 $\pm$ 0.5	21.0 $\pm$ 0.8	9.0 $\pm$ 0.5
PA0402	10,000	7" (Φ 178mm)	-	178.0 $\pm$ 1.0	60.0+1/-0	13.50 $\pm$ 0.5	21.0 $\pm$ 0.8	9.0 $\pm$ 0.5
PA0603	5,000	7" (Φ 178mm)	-	178.0 $\pm$ 1.0	60.0+1/-0	13.50 $\pm$ 0.5	21.0 $\pm$ 0.8	9.0 $\pm$ 0.5
PA0805	5,000	7" (Φ 178mm)	-	178.0 $\pm$ 1.0	60.0+1/-0	13.50 $\pm$ 0.5	21.0 $\pm$ 0.8	9.0 $\pm$ 0.5
PA1206	4,000	7" (Φ 178mm)	-	178.0 $\pm$ 1.0	60.0+1/-0	13.50 $\pm$ 0.5	21.0 $\pm$ 0.8	9.0 $\pm$ 0.5
PA2010	4,000	-	7" (Φ 178mm)	178.0 $\pm$ 1.0	60.0+1/-0	13.50 $\pm$ 0.5	21.0 $\pm$ 0.8	13.6 $\pm$ 0.5

LEADER/TRAILER TAPE SPECIFICATION**FOOTPRINT AND SOLDERING PROFILES**

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

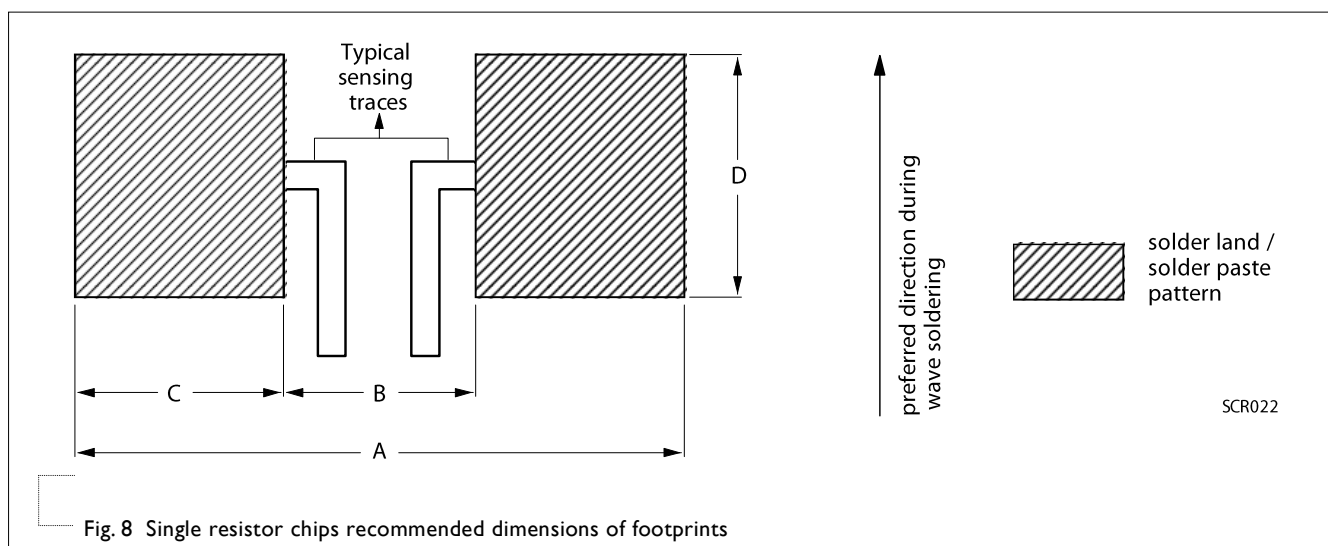
FOOTPRINT

Table 7 Footprint dimensions

						Unit: mm
TYPE	RESISTANCE RANGE	A	B	C	D	
PA0201	$5\text{m}\Omega \leq R \leq 20\text{m}\Omega$	1.00	0.30	0.35	0.40	
PA0402	$2\text{m}\Omega \leq R \leq 20\text{m}\Omega$	2.00	0.40	0.80	0.60	
PA0603	$1\text{m}\Omega$	2.20	0.50	0.70	0.90	
	$1\text{m}\Omega < R \leq 20\text{m}\Omega$	2.20	0.80	0.70	0.90	
PA0805	$1\text{m}\Omega$	4.10	0.50	1.80	2.18	
	$1.5\text{m}\Omega \leq R \leq 20\text{m}\Omega$	4.60	1.00	1.80	2.18	
PA1206	$1\text{m}\Omega / 2\text{m}\Omega$	4.20	1.00	1.60	1.84	
	$2.5\text{m}\Omega / 3\text{m}\Omega$	4.80	1.00	1.90	1.84	
	$4\text{m}\Omega \leq R \leq 20\text{m}\Omega$	4.80	1.20	1.80	1.84	
PA2010	$1\text{m}\Omega \leq R \leq 3\text{m}\Omega$	6.00	1.40	2.30	3.00	
	$4\text{m}\Omega \leq R \leq 20\text{m}\Omega$	6.00	3.50	1.25	3.00	

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	$\pm(1.0\%+0.0005\Omega)$ 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: 0201/0402: $125\pm3^{\circ}\text{C}$ 0603/0805: $155\pm3^{\circ}\text{C}$ 1206/2010: $170\pm3^{\circ}\text{C}$	$\pm(1.0\%+0.0005\Omega)$
Temperature Cycling	JESD22-A104C	1,000 cycles, $-55/+125^{\circ}\text{C}$ for 1 cycle per hour	$\pm(1.0\%+0.0005\Omega)$
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°C / 65°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°C / 85% RH 10% of operating power	$\pm(1.0\%+0.0005\Omega)$
Operational Life/ Endurance	MIL-STD-202G-Method 108A IEC 60115-1 4.25.1	1,000 hours at $125\pm3^{\circ}\text{C}$, de-rated power 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 rated power 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-202G-method 210F	Condition B, no pre-heat of samples Leadfree solder, 260°C , 10 seconds immersion time Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	$\pm(0.5\%+0.0005\Omega)$ No visible damage

TEST	TEST METHOD	PROCEDURE	REQUIREMENT
Thermal Shock	MIL-STD-202 Method 107	-55/+125°C, Number of cycles is 300. Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air -Air	$\pm(1.0\%+0.0005\Omega)$ No visible damage
Electrostatic Discharge	AEC-Q200-002	Human Body Model, 1 pos + 1 neg. 0805/ 1206/ 2010 : 2KV 0402/ 0603 : 1KV 0201: 500V	$\pm(1.0\%+0.0005\Omega)$ 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 30±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 0201: 3mm 0402 and above: 2mm Holding time: Min.60 seconds	$\pm(1.0\%+0.0005\Omega)$
Terminal Strength (SMD)	AEC-Q200-006	Applied 0201: 3N 0402: 5N 0603/ 0805/ 1206/ 2010: 17.7N 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/+125°C Formula: $T.C.R = \frac{R2-R1}{R1(t2-t1)} \times 10^6 \text{ (ppm/°C)}$ Where t1 =+25°C or specified room temperature t2 =+125°C test temperature R1=resistance at reference temperature in ohms R2=resistance at test temperature in ohms	Refer to table 2

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 0	May 07, 2020	-	- New datasheet for automotive grade current sensor – PA0201/0402/0603/0805/1206/2010 series.

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