

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, taping 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 = ±0.5% (for 5mΩ ~ 20mΩ)
 F = ±1%
 J = ±5%

(3) PACKAGING TYPE

R = Paper taping reel (PA0201~PA1206)
 K = Embossed taping reel (PA2010)

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

E = ± 50ppm/°C
 M = ± 75ppm/°C
 F = ± 100ppm/°C
 L = ± 150ppm/°C
 G = ± 200ppm/°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 mΩ to 20 mΩ

(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 code rule | Example |
|-----------------------|------------------------------|
| 0RXXX (1 to 20 mΩ) | 0R001 = 1 mΩ 0R02 = 20 mΩ |

ORDERING EXAMPLE

The ordering code for a PA0805 0.125W chip resistor,TC50 value 0.01Ω (10mR) with ±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



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

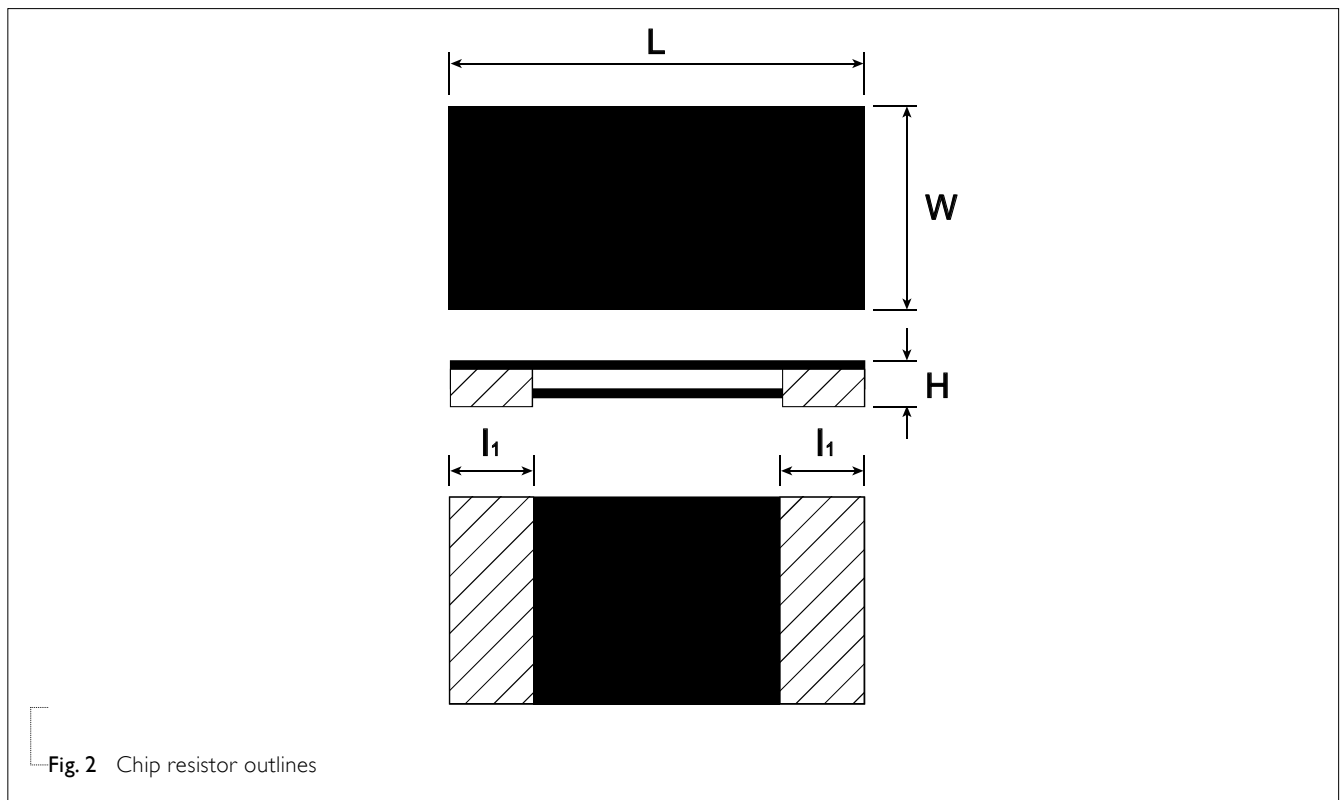


Fig. 2 Chip resistor outlines

DIMENSION

Table 1 For outlines, please refer to Fig. 2

| TYPE | RESISTANCE RANGE | L (mm) | W (mm) | H (mm) | ll (mm) |
|--------|------------------|-----------|-----------|-----------|-----------|
| PA0201 | 5mΩ ≤ R ≤ 20mΩ | 0.60±0.03 | 0.31±0.04 | Max. 0.30 | 0.15±0.06 |
| PA0402 | 2mΩ ≤ R ≤ 20mΩ | 1.00±0.10 | 0.55±0.10 | Max. 0.40 | 0.25±0.10 |
| PA0603 | 1 mΩ | 1.60±0.20 | 0.80±0.20 | 0.55±0.15 | 0.38±0.12 |
| | 2mΩ ≤ R ≤ 20mΩ | 1.60±0.20 | 0.80±0.20 | 0.45±0.15 | 0.38±0.12 |
| PA0805 | 1mΩ | 2.03±0.20 | 1.27±0.20 | 0.55±0.15 | 0.60±0.15 |
| | 1.5/ 2mΩ | 2.03±0.20 | 1.27±0.20 | 0.45±0.15 | 0.50±0.15 |
| | 2.5mΩ ≤ R ≤ 20mΩ | 2.03±0.20 | 1.27±0.20 | 0.30±0.15 | 0.35±0.20 |
| PA1206 | 1mΩ | 3.20±0.25 | 1.60±0.25 | 0.65±0.25 | 0.51±0.25 |
| | 2mΩ | 3.20±0.25 | 1.60±0.25 | 0.55±0.25 | 0.60±0.25 |
| | 2.5/ 3mΩ | 3.20±0.25 | 1.60±0.25 | 0.40±0.25 | 0.80±0.30 |
| | 4mΩ ≤ R ≤ 20mΩ | 3.20±0.25 | 1.60±0.25 | 0.40±0.25 | 0.60±0.30 |
| PA2010 | 1mΩ ≤ R ≤ 3mΩ | 5.08±0.25 | 2.54±0.25 | 0.50±0.25 | 1.40±0.25 |
| | 4mΩ ≤ R ≤ 20mΩ | 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 | -- | ±0.5% ±1% ±5% | 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 | | 10mΩ | 1/ 1.5mΩ 2mΩ ≤ R ≤ 20mΩ | ±150 ppm/°C ±50 ppm/°C |
| 1206 | 1/4W | 1/2W | -- | 1W | -- | -- | ±0.5% ±1% ±5% | 5mΩ ≤ R ≤ 20mΩ | 1/ 2mΩ 3mΩ ≤ R ≤ 20mΩ | ±100 ppm/°C ±50 ppm/°C |
| 2010 | 0.5W | 1W | 1.5W | - | - | - | | 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:

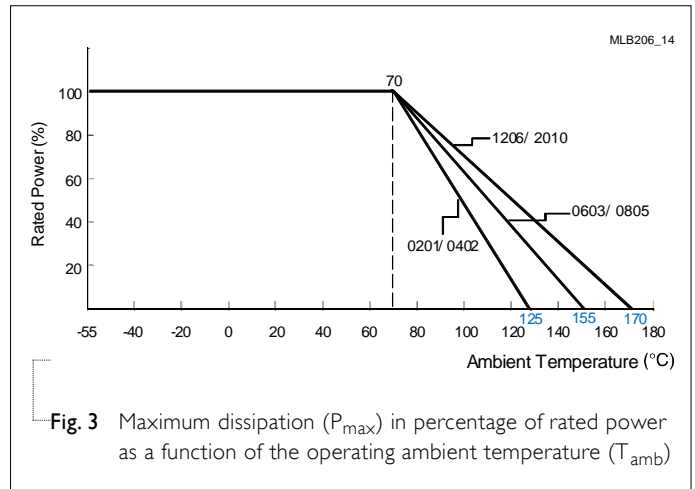
$$V = \sqrt{(P \times R)}$$

Where

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

P = Rated power (W)

R = Resistance value (Ω)

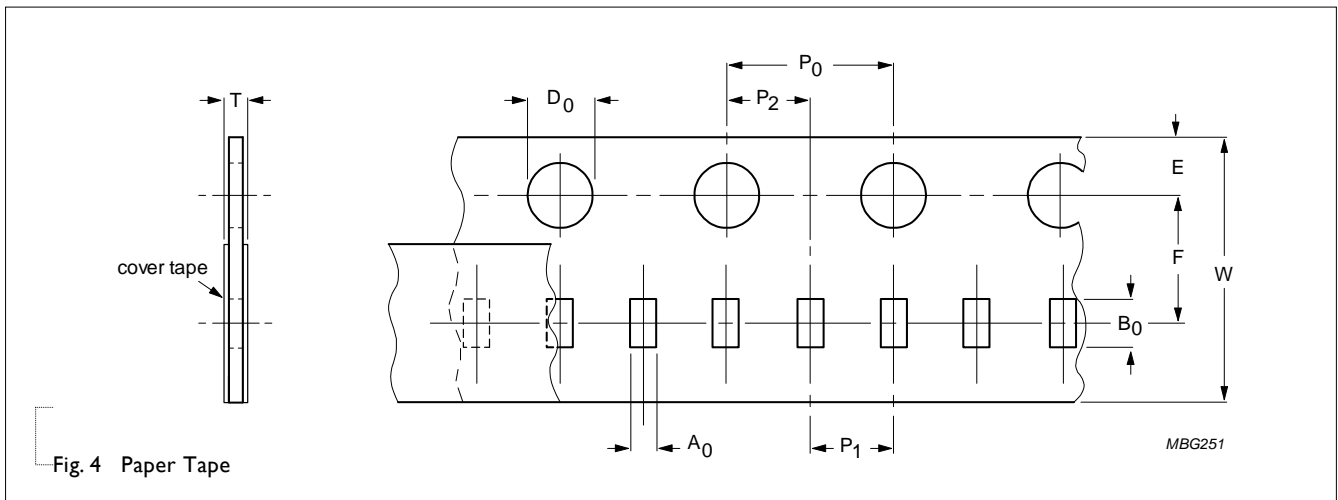


PACKING STYLE AND PACKAGING QUANTITY

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

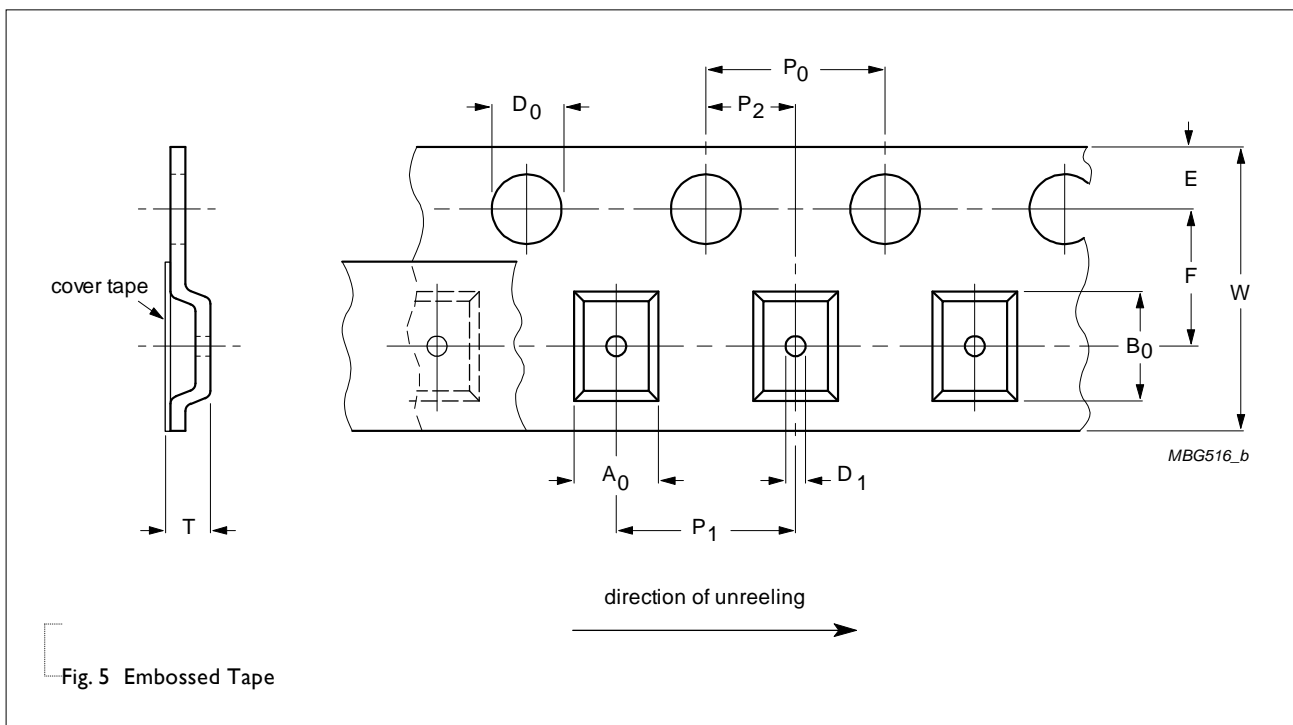


Fig. 5 Embossed Tape

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 | T | |
| 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 | T | |
| 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

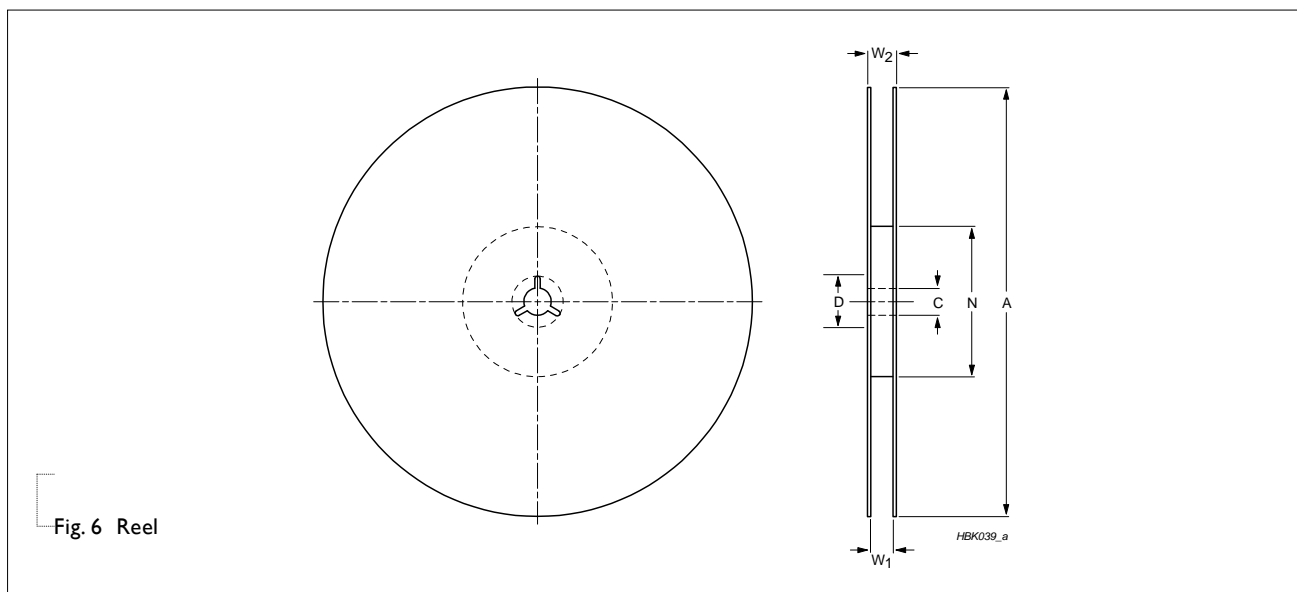
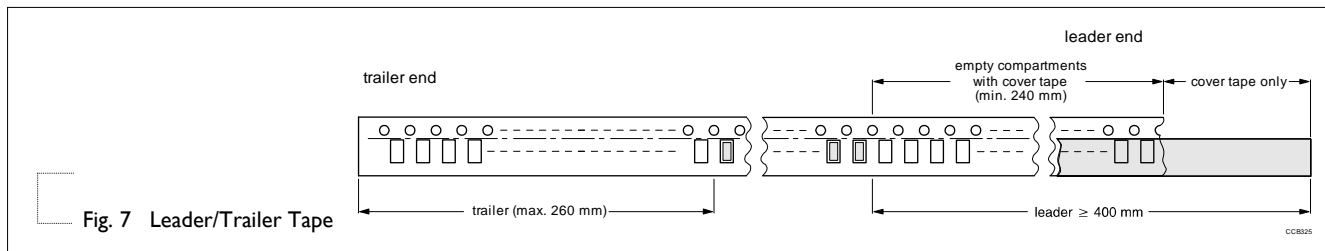


Table 6 Dimensions of reel specification for relevant chip resistors size

| SIZE | QUANTITY PER REEL | REEL SIZE | | SYMBOL | | | | |
|--------|-------------------|----------------|----------------|-----------|-----------|-----------|----------|----------------|
| | | 8mm TAPE WIDE | 12mm TAPE WIDE | A | N | C | D | W ₁ |
| PA0201 | 10,000 | 7" (Φ178mm) | - | 178.0±1.0 | 60.0+1/-0 | 13.50±0.5 | 21.0±0.8 | 9.0±0.5 |
| PA0402 | 10,000 | 7" (Φ178mm) | - | 178.0±1.0 | 60.0+1/-0 | 13.50±0.5 | 21.0±0.8 | 9.0±0.5 |
| PA0603 | 5,000 | 7" (Φ178mm) | - | 178.0±1.0 | 60.0+1/-0 | 13.50±0.5 | 21.0±0.8 | 9.0±0.5 |
| PA0805 | 5,000 | 7" (Φ178mm) | - | 178.0±1.0 | 60.0+1/-0 | 13.50±0.5 | 21.0±0.8 | 9.0±0.5 |
| PA1206 | 4,000 | 7" (Φ178mm) | - | 178.0±1.0 | 60.0+1/-0 | 13.50±0.5 | 21.0±0.8 | 9.0±0.5 |
| PA2010 | 4,000 | - | 7" (Φ178mm) | 178.0±1.0 | 60.0+1/-0 | 13.50±0.5 | 21.0±0.8 | 13.6±0.5 |

LEADER/TRAILER TAPE SPECIFICATION



FOOTPRINT AND SOLDERING PROFILES

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

FOOTPRINT

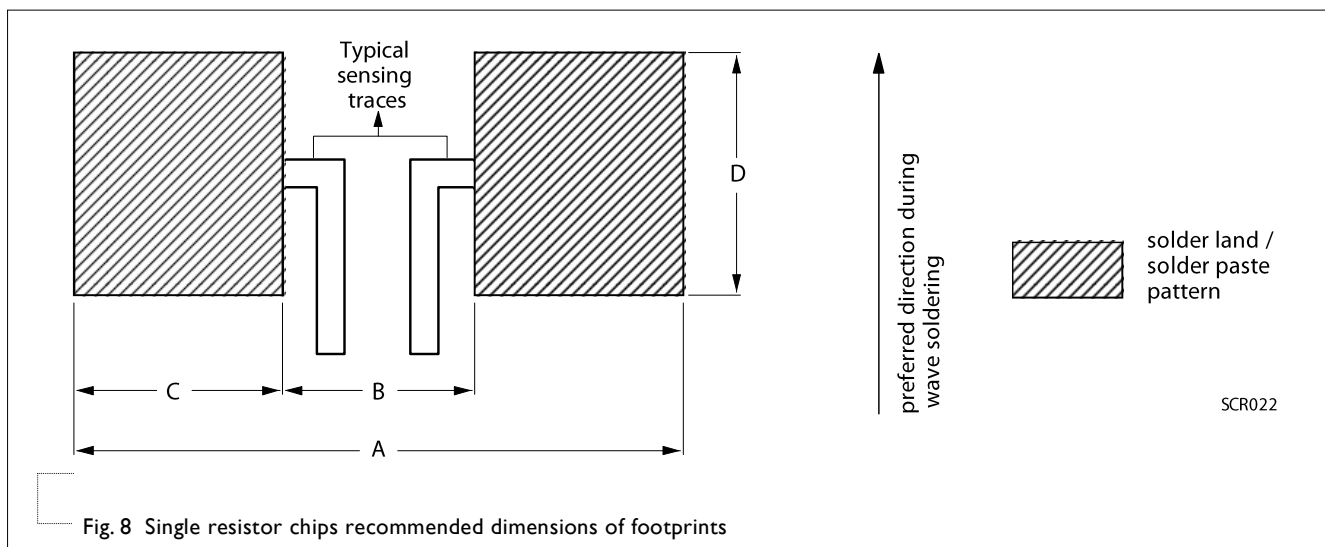


Table 7 Footprint dimensions

| | | | | | | Unit: mm |
|--------|------------------------------------|------|------|------|------|----------|
| TYPE | RESISTANCE RANGE | A | B | C | D | |
| PA0201 | $5m\Omega \leq R \leq 20m\Omega$ | 1.00 | 0.30 | 0.35 | 0.40 | |
| PA0402 | $2m\Omega \leq R \leq 20m\Omega$ | 2.00 | 0.40 | 0.80 | 0.60 | |
| PA0603 | $1m\Omega$ | 2.20 | 0.50 | 0.70 | 0.90 | |
| | $1m\Omega < R \leq 20m\Omega$ | 2.20 | 0.80 | 0.70 | 0.90 | |
| PA0805 | $1m\Omega$ | 4.10 | 0.50 | 1.80 | 2.18 | |
| | $1.5m\Omega \leq R \leq 20m\Omega$ | 4.60 | 1.00 | 1.80 | 2.18 | |
| PA1206 | $1m\Omega / 2m\Omega$ | 4.20 | 1.00 | 1.60 | 1.84 | |
| | $2.5m\Omega / 3m\Omega$ | 4.80 | 1.00 | 1.90 | 1.84 | |
| | $4m\Omega \leq R \leq 20m\Omega$ | 4.80 | 1.20 | 1.80 | 1.84 | |
| PA2010 | $1m\Omega \leq R \leq 3m\Omega$ | 6.00 | 1.40 | 2.30 | 3.00 | |
| | $4m\Omega \leq R \leq 20m\Omega$ | 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: $125\pm 3^{\circ}\text{C}$ 0603/0805: $155\pm 3^{\circ}\text{C}$ 1206/2010: $170\pm 3^{\circ}\text{C}$ | $\pm(1.0\%+0.0005\Omega)$ |
| Temperature Cycling | JESD22-A104C | 1,000 cycles, $-55/+125^{\circ}\text{C}$ for 1 cycle per hour | $\pm(1.0\%+0.0005\Omega)$ |
| 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 $25^{\circ}\text{C} / 65^{\circ}\text{C}$ 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 | $\pm(1.0\%+0.0005\Omega)$ |
| 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 power applied for 1.5 hours on, 0.5 hour off, still-air required | $\pm(1.0\%+0.0005\Omega)$ |
| | | 1,000 hours at $70\pm 2^{\circ}\text{C}$ 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 | ±(1.0%+0.0005Ω) No visible damage |
| Electrostatic Discharge | AEC-Q200-002 | Human Body Model, 1 pos + 1 neg. 0805/ 1206/ 2010 : 2KV 0402/ 0603 : 1KV 0201: 500V | ±(1.0%+0.0005Ω) 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 | ±(1.0%+0.0005Ω) |
| Terminal Strength (SMD) | AEC-Q200-006 | Applied 0201: 3N 0402: 5N 0603/ 0805/ 1206/ 2010: 17.7N for 60±1 seconds. | ±(1.0%+0.0005Ω) 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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