

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 = ± 0.5%
 F = ± 1%
 J = ± 5%

(3) PACKAGING TYPE

K = Embossed taping reel

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

F = ± 100 ppm/°C
 M = ± 75ppm/°C
 E = ± 50ppm/°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 mΩ to 100 mΩ

(7) DEFAULT CODE

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

| Resistance code rule | Example |
|----------------------|--------------|
| XUXX | 0U5 = 0.5mΩ |
| 0RXXX | 0R001 = 1 mΩ |
| (1 to 100 mΩ) | 0R05 = 50 mΩ |

ORDERING EXAMPLE

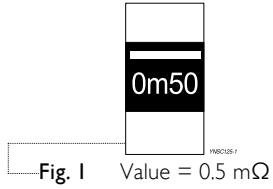
The ordering code of a PA2512 1W chip resistor, TC100, value 0.003Ω with ±1% tolerance, supplied in 7-inch tape reel is: **PA2512FKF070R003E**

NOTE

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

MARKING

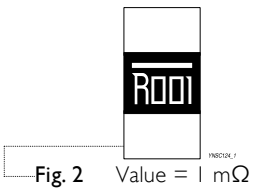
PA2512



4 digits

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

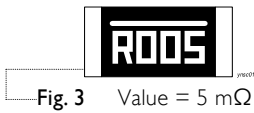
PA2512: 0.5mΩ and 0.75mΩ



4 digits

The "R" is used as a decimal point; the other 3 digits are significant

PA2512: 1 mΩ 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

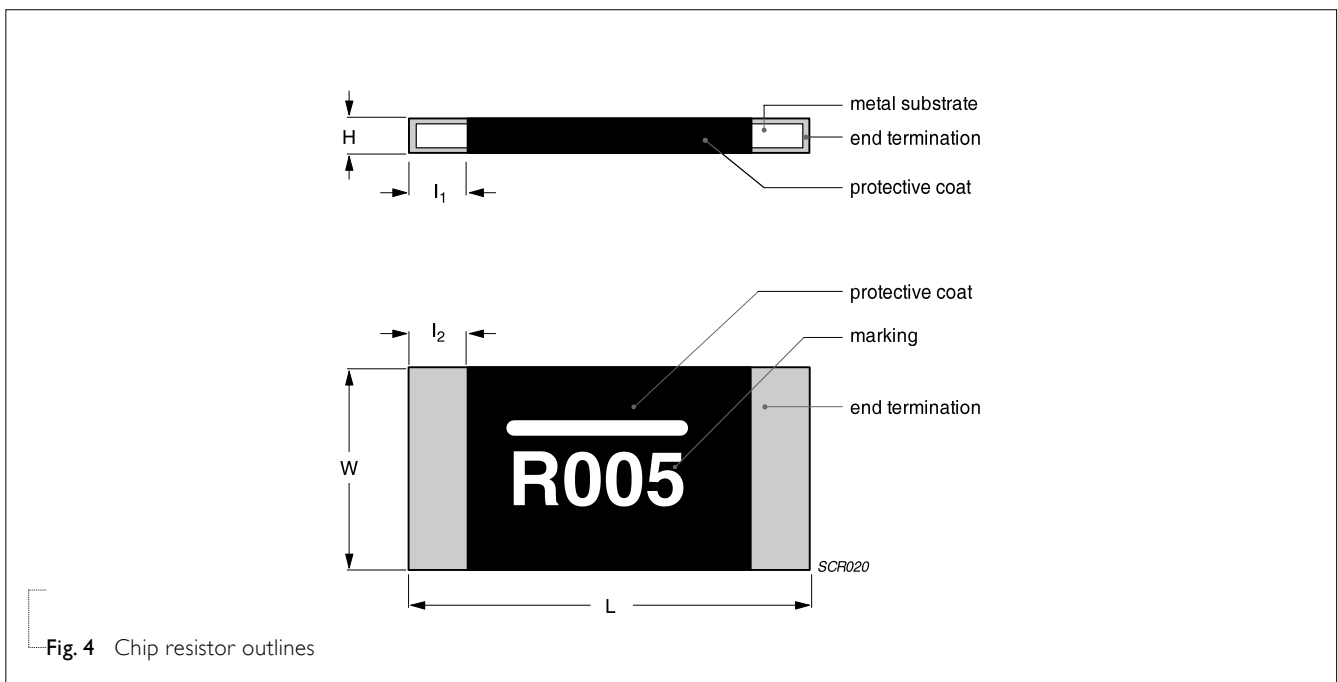
CONSTRUCTION

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



DIMENSION

Table 1 For outlines, please refer to Fig. 4

| TYPE | RESISTANCE RANGE | L (mm) | W (mm) | H (mm) | l ₁ (mm) | l ₂ (mm) |
|--------|--------------------|-----------|-----------|-----------|---------------------|---------------------|
| PA2512 | 0.5mΩ ≤ R ≤ 0.75mΩ | 6.35±0.25 | 3.18±0.25 | 0.63±0.25 | 2.72±0.25 | 2.72±0.25 |
| | 1mΩ ≤ R ≤ 4mΩ | 6.35±0.25 | 3.18±0.25 | 0.63±0.25 | 2.21±0.25 | 2.21±0.25 |
| | 5mΩ ≤ R ≤ 6mΩ | 6.35±0.25 | 3.18±0.25 | 0.63±0.25 | 1.19±0.25 | 1.19±0.25 |
| | 7mΩ ≤ R ≤ 100mΩ | 6.35±0.25 | 3.18±0.25 | 0.63±0.25 | 0.76±0.25 | 0.76±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 | ±0.5% | 0.5mΩ ≤ R ≤ 100mΩ | ±50ppm/°C |
| | | 2W | ±1% | | ±75ppm/°C |
| | | 3W | ±5% | | ±100ppm/°C |

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)

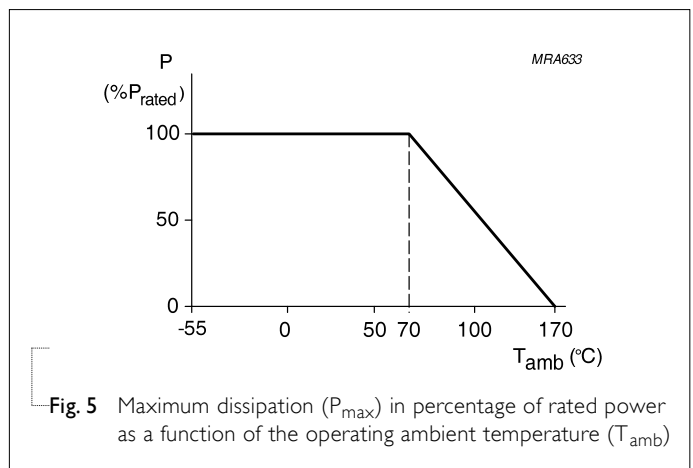


Fig. 5 Maximum dissipation (P_{max}) in percentage of rated power as a function of the operating ambient temperature (T_{amb})

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

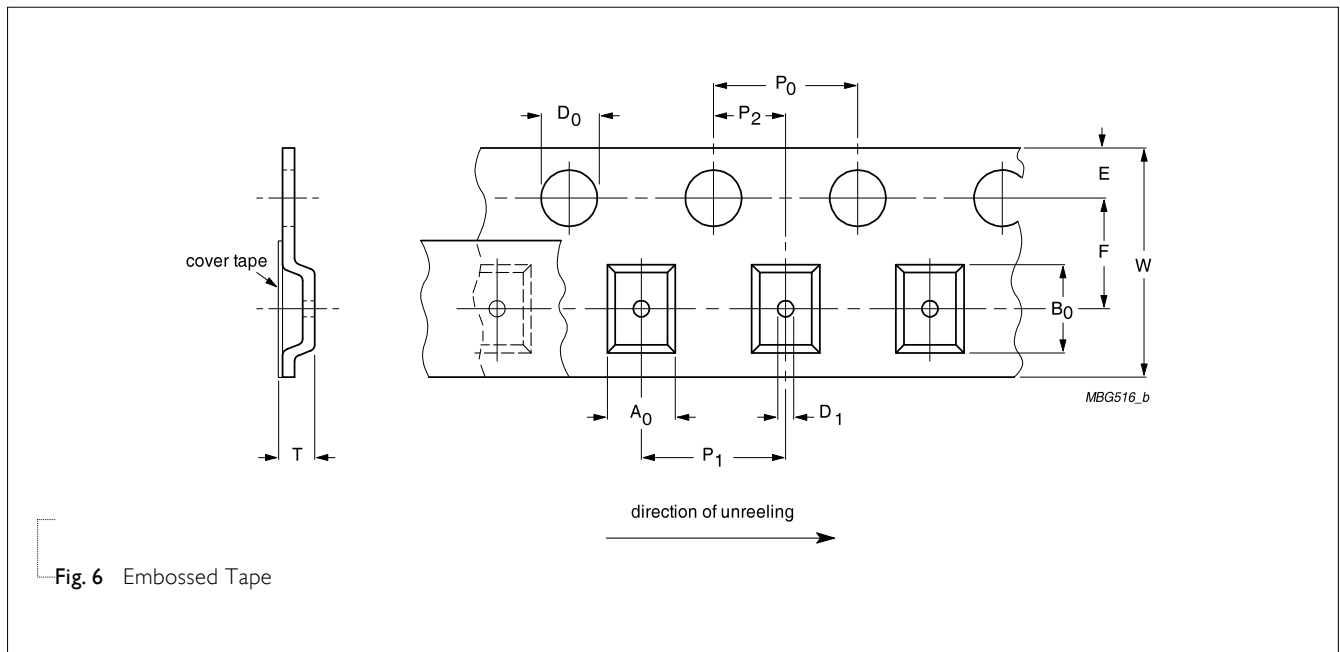


Fig. 6 Embossed Tape

Table 4 Dimensions of embossed tape for relevant chip resistors size

| SIZE | SYMBOL | | | | | | | | | | | Unit: mm |
|--------|----------------|----------------|------------|-----------|-----------|----------------|----------------|----------------|-----------------|-----------------|-----------|----------|
| | A ₀ | B ₀ | W | E | F | P ₀ | P ₁ | P ₂ | ØD ₀ | ØD ₁ | 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

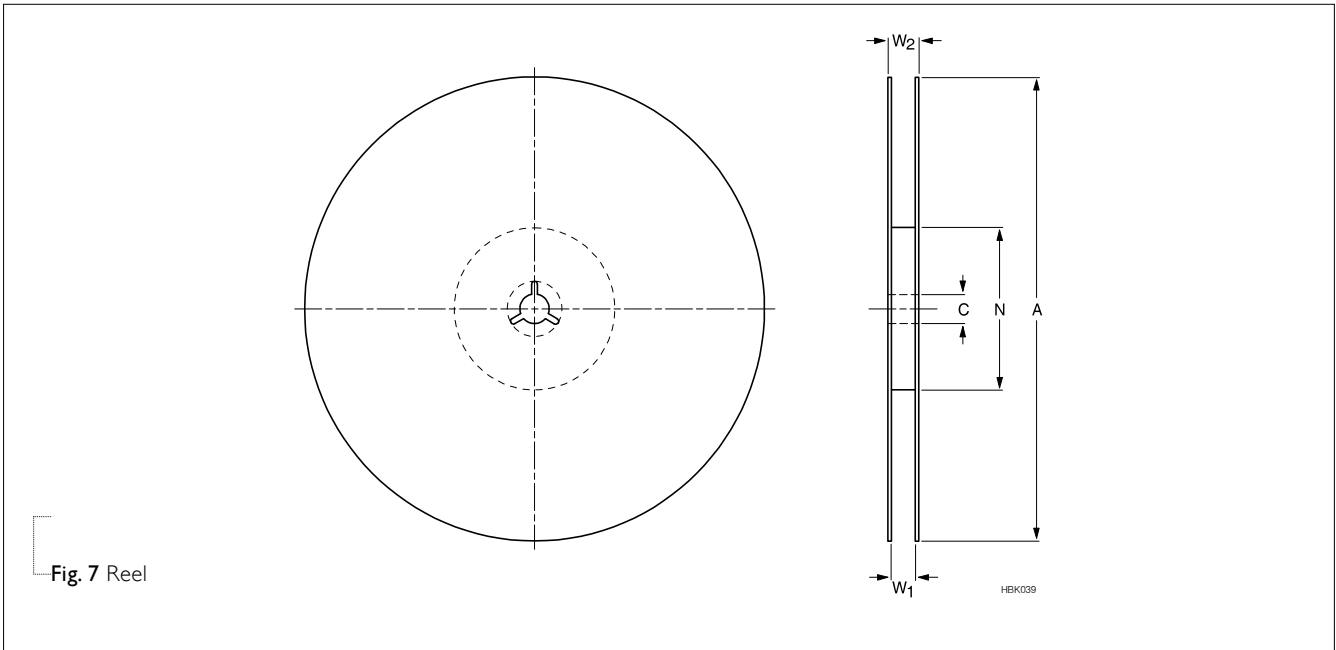
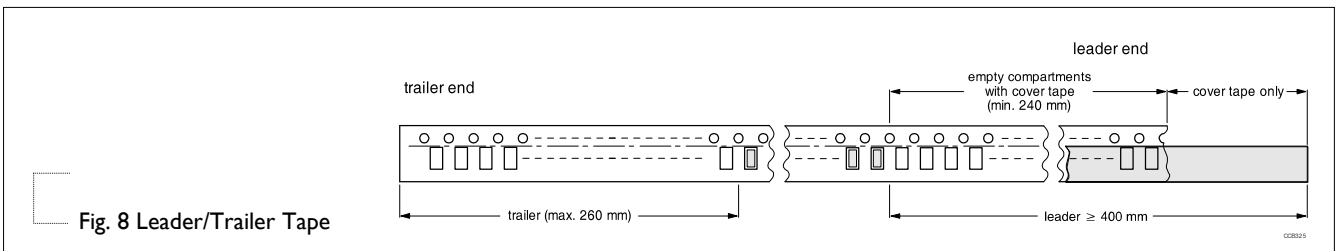


Table 5 Dimensions of reel specification for relevant chip resistors size

| SIZE | QUANTITY PER REEL | REEL SIZE | | SYMBOL | | | | Unit: mm | |
|--------|-------------------|----------------|-----------------|-----------|-----------|-----------|----------|----------------|---------------------|
| | | 8 mm TAPE WIDE | 12 mm TAPE WIDE | A | N | C | D | W ₁ | W ₂ 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

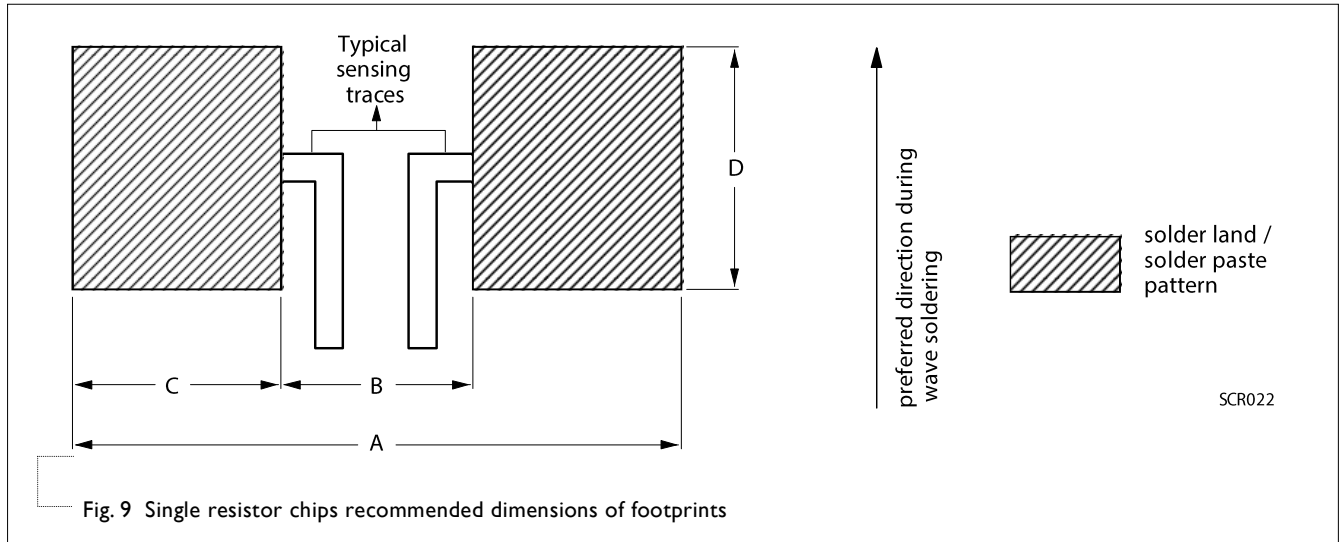


Table 6 Footprint dimensions

| SIZE | RESISTANCE RANGE | A | B | C | D | Unit: mm |
|--------|---|------|------|------|------|----------|
| 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: $170\pm 3^{\circ}\text{C}$ | $\pm(1.0\%+0.0005\Omega)$ |
| 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-202-Method 106 | 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 | $\pm(0.5\%+0.0005\Omega)$ |
| Operational Life/ Endurance | MIL-STD-202-Method 108 | 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 | $\pm(1.0\%+0.0005\Omega)$ |
| | | 1,000 hours at $70\pm 2^{\circ}\text{C}$ applied RCWV 1.5 hours on, 0.5 hour off, still air required | $\pm(1.0\%+0.0005\Omega)$ |
| 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°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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