

# DATA SHEET

## THIN FILM CHIP RESISTORS AUTOMOTIVE GRADE

AT series

0.1% TO 1%, TC 15 TO TC50

sizes 0402/0603/0805/1206

RoHS compliant



**SCOPE**

This specification describes AT0402 to AT1206 high precision-high stability chip resistors with lead-free terminations made by thin film process.

**APPLICATIONS**

- Automotive electronics
- Industrial and medical equipment
- Test and measuring equipment
- Telecommunications

**FEATURES**

- AEC-Q200 qualified
- Superior resistance against sulfur containing atmosphere
- Moisture sensitivity level: MSL I
- Products with lead free terminations meet RoHS requirements
- Reducing environmentally hazardous wastes
- High component and equipment reliability
- Non-forbidden materials used in products/production
- Halogen free epoxy

**ORDERING INFORMATION - GLOBAL PART NUMBER**

Part number is identified by the series name, size, tolerance, packaging type, temperature coefficient, taping reel and resistance value.

**GLOBAL PART NUMBER**

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

**(1) SIZE**

0402 / 0603 / 0805 / 1206

**(2) TOLERANCE**

- B = ±0.1%
- C = ±0.25%
- D = ±0.5%
- F = ±1%

**(3) PACKAGING TYPE**

R = Paper taping reel

**(4) TEMPERATURE COEFFICIENT OF RESISTANCE**

- C = ± 15 ppm/°C
- D = ± 25 ppm/°C
- E = ± 50 ppm/°C

**(5) TAPING REEL**

07 = 7 inch dia. Reel

**(6) RESISTANCE VALUE**

There are 2~4 digits indicated the resistor value.  
 Letter R/K/M is decimal point  
 Example: 100R = 100Ω  
 1K = 1,000Ω

**(7) DEFAULT CODE**

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

**ORDERING EXAMPLE**

The ordering code of a AT0402 chip resistor, TC 25 value 56Ω with ± 0.5% tolerance, supplied in 7-inch tape reel is: AT0402DRD0756RL.

**NOTE**

1. All our Rchip products meet RoHS compliant and Halogen Free. "LFP" of the internal 2D reel label mentions "Lead Free Process".
2. On customized label, "LFP" or specific symbol can be printed.

**MARKING**

**AT0402**



No marking

**AT0603**



E-96 series: including values 10/11/13/15/20/75 of E-24 series, 3 digits



E-24 series: exception values 10/11/13/15/20/75 of E-24 series, one short bar under marking letter

**AT0805 / AT1206**



Both E-24 and E-96 series: 4 digits  
First three digits for significant figure and 3rd digit for number of zeros

**NOTE**

For further marking information, please see special data sheet “ Chip resistors marking” .

**CONSTRUCTION**

A metal film layer is deposited on a high grade ceramic body (aluminium oxide). This resistive layer is trimmed to its nominal value and on both ends a contact is made which will guarantee optimum solderability. This is achieved by applying several layers and for ease of soldering the outer layer consists of Ni/matte tin. The resistive layer is covered with a protective coating.

**OUTLINES**



DIMENSIONS

Table 1

| TYPE   | L (mm)     | W (mm)     | H (mm)     | l <sub>1</sub> (mm) | l <sub>2</sub> (mm) |
|--------|------------|------------|------------|---------------------|---------------------|
| AT0402 | 1.00 ±0.10 | 0.50 ±0.05 | 0.30 ±0.05 | 0.20 ±0.10          | 0.25 ±0.10          |
| AT0603 | 1.60 ±0.10 | 0.80 ±0.10 | 0.45 ±0.10 | 0.25 ±0.15          | 0.25 ±0.15          |
| AT0805 | 2.00 ±0.10 | 1.25 ±0.10 | 0.50 ±0.10 | 0.35 ±0.20          | 0.35 ±0.20          |
| AT1206 | 3.10 ±0.10 | 1.60 ±0.10 | 0.55 ±0.10 | 0.45 ±0.20          | 0.40 ±0.20          |

ELECTRICAL CHARACTERISTICS

Table 2

| TYPE   | Operating Temperature Range | Power Rating | Max. Working Voltage | Max. Overload Voltage | Dielectric Withstanding Voltage | Resistance Range (E-24/E-96 series)(Ω ) & Tolerance |       |        |                   |     |
|--------|-----------------------------|--------------|----------------------|-----------------------|---------------------------------|---|-------|--------|-------------------|-----|
|        |                             |              |                      |                       |                                 | T.C.R. (ppm/°C)                                     | ±0.1% | ±0.25% | ±0.5%             | ±1% |
| AT0402 | -55 °C to +155 °C           | 1/16W        | 50 V                 | 100 V                 | 100 V                           | ±15<br>±25, ±50                                     |       |        | 10~11K<br>10~100K |     |
| AT0603 |                             | 1/10W        | 75V                  | 150 V                 | 100 V                           | ±15<br>±25, ±50                                     |       |        | 10~14K<br>10~330K |     |
| AT0805 |                             | 1/8W         | 150 V                | 300 V                 | 300 V                           | ±15<br>±25, ±50                                     |       |        | 10~17K<br>10~1M   |     |
| AT1206 |                             | 1/4W         | 200 V                | 400 V                 | 500 V                           | ±15<br>±25, ±50                                     |       |        | 10~20K<br>10~1M   |     |

FOOTPRINT AND SOLDERING PROFILES

For recommended footprint and soldering profiles, please see the special data sheet “Chip resistors mounting”.

PACKING STYLE AND PACKAGING QUANTITY

Table 3 Packing style and packaging quantity

| PRODUCT TYPE | PATKING STYLE     | REEL DIMENSION | QUANTITY PER REEL |
|--------------|-------------------|----------------|-------------------|
| AT0402       | Paper taping reel | 7" (178 mm)    | 10,000 Units      |
| AT0603       | Paper taping reel | 7" (178 mm)    | 5,000 Units       |
| AT0805       | Paper taping reel | 7" (178 mm)    | 5,000 Units       |
| AT1206       | Paper taping reel | 7" (178 mm)    | 5,000 Units       |

**NOTE:** for paper tape and reel specification/dimensions, please see the special data sheet “packing” document.

FUNCTIONAL DESCRIPTION

**OPERATING TEMPERATURE RANGE**

Range: -55 °C to +155 °C

**POWER RATING**

Each type rated power at 70 °C:

AT0402=1/16 W

AT0603=1/10 W

AT0805=1/8 W

AT1206=1/4 W

**RATED VOLTAGE**

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

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

Or max. working voltage whichever is less

Where

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

P=Rated power

R=Resistance value ( $\Omega$ )



Fig. 10 Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the operating ambient temperature ( $T_{amb}$ )

**TESTS AND REQUIREMENTS**
**Table 4** Test condition, procedure and requirements

| TEST                         | TEST METHOD                                | PROCEDURE   | REQUIREMENTS                                       |
|------------------------------|--|---|--|
| Short Time Overload          | IEC60115-1 4.13                            | 2.5 times of rated voltage or maximum overload voltage, the less of the above, for 5 sec at room temperature  | $\pm(0.05\%+0.05\Omega)$                           |
| High Temperature Exposure    | AEC-Q200 Test 3                            | 1,000 hours at Tamb = 125 °C, unpowered   | $\pm(0.1\%+0.05\Omega)$                            |
|                              | MIL-STD-202 Method 108                     | 1,000 hours at Tamb = 155 °C, unpowered   | $\pm(0.3\%+0.05\Omega)$                            |
| Moisture Resistance          | AEC-Q200 Test 6<br>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<br>Parts mounted on test-boards, without condensation on parts   | $\pm(0.1\%+0.05\Omega)$                            |
| Biased Humidity              | AEC-Q200 Test 7<br>MIL-STD-202 Method 103  | 1,000 hours; 85 °C / 85% RH<br>10% of operating power<br>Measurement at 24±4 hours after test conclusion  | $\pm(0.1\%+0.05\Omega)$                            |
| Operational Life             | AEC-Q200 Test 8<br>MIL-STD-202 Method 108  | 1,000 hours at 70±5 °C, RCWV applied for 1.5 hours on, 0.5 hour off, still air required   | $\pm(0.1\%+0.05\Omega)$                            |
|                              |  | 1,000 hours at 125 °C, derated voltage applied for 1.5 hours on, 0.5 hour off, still air required   | $\pm(0.3\%+0.05\Omega)$                            |
| Resistance to Soldering Heat | AEC-Q200 Test 15<br>MIL-STD-202 Method 210 | Condition B, no pre-heat of samples<br>Lead-free solder, 260±5 °C, 10±1 seconds immersion time<br>Procedure 2 for SMD: devices fluxed and cleaned with isopropanol  | $\pm(0.05\%+0.05\Omega)$                           |
| Thermal Shock                | AEC-Q200 Test 16<br>MIL-STD-202 Method 107 | -55/+125 °C<br>Number of cycles is 300. Devices mounted Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air – Air  | $\pm(0.1\%+0.05\Omega)$<br>No visible damage       |
| Solderability - Wetting      | AEC-Q200 Test 18<br>J-STD-002              | Electrical Test not required Magnification 50X SMD conditions:<br>(a) Method B, aging 4 hours at 155 °C dry heat, dipping at 235±3 °C for 5±0.5 seconds.<br>(b) Method B, steam aging 8 hours, dipping at 215±3 °C for 5±0.5 seconds.<br>(c) Method D, steam aging 8 hours, dipping at 260±3 °C for 7±0.5 seconds | Well tinned<br>(>95% covered)<br>No visible damage |

|   |                                  |  |                  |
|---|----------------------------------|--|------------------|
| <b>Board Flex / Bending</b>                           | AEC-Q200 Test 21<br>AEC-Q200-005 | Chips mounted on a 90mm glass epoxy resin PCB (FR4)<br>Bending for 0402: 5 mm<br>0603/0805: 3 mm<br>1206: 2mm<br>Holding time: minimum 60 second   | ±(0.1%+0.05Ω)    |
| <b>Temperature Coefficient of Resistance (T.C.R.)</b> | IEC 60115-1 4.8                  | At +25/-55 °C and +25/+125°C Formula:<br>$R2-R1$<br>$T.C.R = \frac{R2 - R1}{R1 (t2 - t1)} \times 10^6 (\text{ppm}/^\circ\text{C})$<br>Where<br>t1 = +25 °C or specified room temperature<br>t2 = -55 °C or +125 °C test temperature<br>R1 = resistance at reference temperature in ohms<br>R2 = resistance at test temperature in ohms | Refer to table 2 |
| <b>Flower of Sulfur</b>                               | ASTM-B-809-95*<br>* Modified     | Sulfur 750 hours, 105°C, unpowered.  | ±(4.0%+0.05Ω)    |

REVISION HISTORY

| REVISION  | DATE          | CHANGE NOTIFICATION | DESCRIPTION   |
|-----------|---------------|---------------------|---|
| Version 5 | Oct. 24, 2017 |                     | - Add resistance range for $\pm 15$ ppm/ $^{\circ}\text{C}$ |
| Version 4 | Mar. 16, 2016 | -                   | - Remove FOS 90 $^{\circ}\text{C}$ test                     |
| Version 3 | Dec. 11, 2015 | -                   | - Modify Outline  |
| Version 2 | May 11, 2015  | -                   | - Modify FOS test   |
| Version 1 | Jun. 18, 2014 | -                   | - Modify FOS test   |
| Version 0 | May 07, 2014  | -                   | - First issue of this specification                         |



## LEGAL DISCLAIMER

Yageo, its distributors and agents (collectively, “Yageo”), hereby disclaims any and all liabilities for any errors, inaccuracies or incompleteness contained in any product related information, including but not limited to product specifications, datasheets, pictures and/or graphics. Yageo may make changes, modifications and/or improvements to product related information at any time and without notice.

Yageo makes no representation, warranty, and/or guarantee about the fitness of its products for any particular purpose or the continuing production of any of its products. To the maximum extent permitted by law, Yageo disclaims (i) any and all liability arising out of the application or use of any Yageo product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for a particular purpose, non-infringement and merchantability.

Yageo statements regarding the suitability of products for certain types of applications are based on Yageo’s knowledge of typical operating conditions for such types of applications in a generic nature. Such statements are neither binding statements of Yageo nor intended to constitute any warranty concerning the suitability for a specific customer application or use. They are intended for use only by customers with requisite knowledge and experience for determining whether Yageo products are the correct products for their application or use. In addition, unpredictable and isolated cases of product failure may still occur, therefore, customer application or use of Yageo products which requires higher degree of reliability or safety, shall employ additional protective safeguard measures to ensure that product failure would not result in personal injury or property damage.

Yageo products are not designed for application or use in medical, life-saving, or life-sustaining devices or for any other application or use in which the failure of Yageo products could result in personal injury or death. Customers using or selling Yageo products not expressly indicated for above-mentioned purposes shall do so at their own risk and agree to fully indemnify Yageo and hold Yageo harmless.

Information provided here is intended to indicate product specifications only. Yageo reserves all the rights for revising this content without further notification, as long as products are unchanged. Any product change will be announced by PCN.