

# DATA SHEET

## THIN FILM CHIP RESISTORS AUTOMOTIVE GRADE

AT series

0.01% TO 1%, TC5 TO TC50

sizes 0402/0603/0805/1206

RoHS compliant



**YAGEO**

Product specification – April 15, 2021 V.6



## SCOPE

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

## APPLICATIONS

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

## FEATURES

- AEC-Q200 qualified
- Total lead free without RoHS exemption
- Halogen free epoxy
- Superior resistance against sulfur containing atmosphere
- Moisture sensitivity level: MSL 1
- Reducing environmentally hazardous wastes
- High component and equipment reliability
- Non-forbidden materials used in products/production

## 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 =  $\pm 0.1\%$   
C =  $\pm 0.25\%$   
D =  $\pm 0.5\%$   
F =  $\pm 1\%$   
L =  $\pm 0.01\%$   
P =  $\pm 0.02\%$   
W =  $\pm 0.05\%$

#### (3) PACKAGING TYPE

R = Paper taping reel

#### (4) TEMPERATURE COEFFICIENT OF RESISTANCE

A =  $\pm 5 \text{ ppm}/^{\circ}\text{C}$   
B =  $\pm 10 \text{ ppm}/^{\circ}\text{C}$   
C =  $\pm 15 \text{ ppm}/^{\circ}\text{C}$   
D =  $\pm 25 \text{ ppm}/^{\circ}\text{C}$   
E =  $\pm 50 \text{ ppm}/^{\circ}\text{C}$

#### (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 =  $100\Omega$   
1K =  $1,000\Omega$

#### (7) DEFAULT CODE

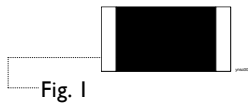
Letter L is the system default code for ordering only. (NOTE)

## ORDERING EXAMPLE

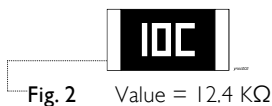
The ordering code of a AT0402 chip resistor, TC 25 value  $56\Omega$  with  $\pm 0.5\%$  tolerance, supplied in 7-inch tape reel is: AT0402DRD0756RL.

## NOTE

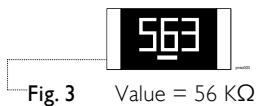
1. All our Rchip products meet RoHS compliant and Halogen Free. "LFP" of the internal 2D reel label mentions "Lead Free Process".
2. On customized label, "LFP" or specific symbol can be printed.

**MARKING****AT0402**

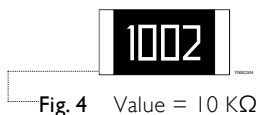
No marking

**AT0603**

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

Value = 12.4 K $\Omega$ 

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

Value = 56 K $\Omega$ **AT0805 / AT1206**

Both E-24 and E-96 series: 4 digits

First three digits for significant figure and 4th digit for number of zeros

Value = 10 K $\Omega$ **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.

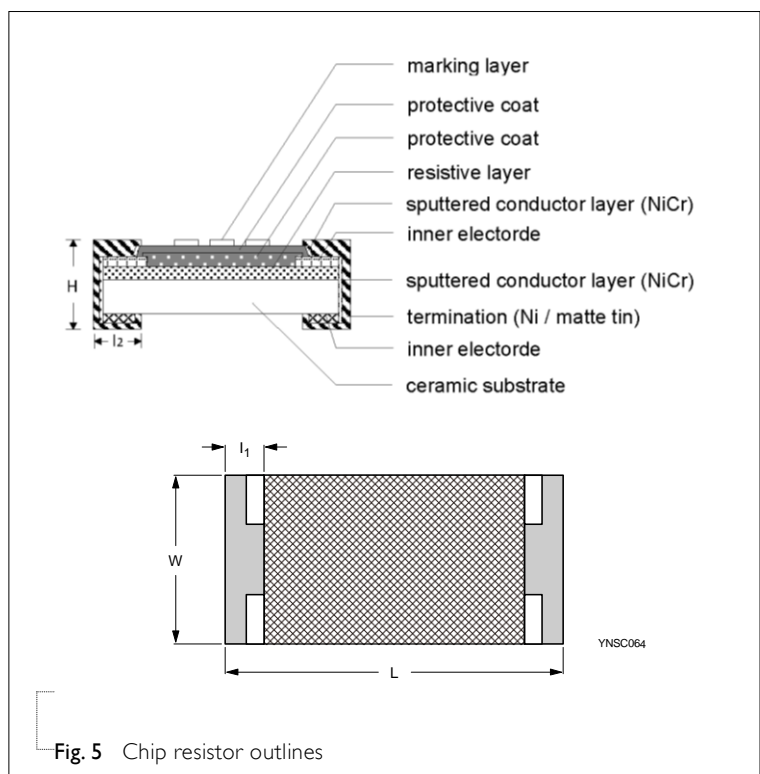
**OUTLINES**

Fig. 5 Chip resistor outlines

**DIMENSIONS**

Table 1

TYPE	L (mm)	W (mm)	H (mm)	I <sub>1</sub> (mm)	I <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 <sup>(1)</sup>								
						T.C.R. (ppm/°C) <sup>(2)</sup>	±0.01% (L)	±0.02% (P)	±0.05% (W)	±0.1% (B)	±0.25% (C)	±0.5% (D)	±1% (F)	
AT0402	-55 °C to +155 °C	1/16W	50 V	100 V	100 V	±50 (E)	50 ≤ R < 11K				10 ≤ R ≤ 100K			
						±25 (D)					10 ≤ R ≤ 100K			
						±15 (C)					10 ≤ R < 11K			
						±10 (B)					50 ≤ R < 11K			
						±5 (A)					50 ≤ R < 11K ---			
AT0603		1/10W	75V	150 V	100 V	±50 (E)	50 ≤ R < 14K				10 ≤ R ≤ 330K			
						±25 (D)					10 ≤ R ≤ 330K			
						±15 (C)					10 ≤ R < 14K			
						±10 (B)					50 ≤ R < 14K			
						±5 (A)					50 ≤ R < 14K ---			
AT0805		1/8W	150 V	300 V	300 V	±50 (E)	50 ≤ R < 17K				10 ≤ R ≤ 1M			
						±25 (D)					10 ≤ R ≤ 1M			
						±15 (C)					10 ≤ R < 17K			
						±10 (B)					50 ≤ R < 17K			
						±5 (A)					50 ≤ R < 17K ---			
AT1206		1/4W	200 V	400 V	500 V	±50 (E)	50 ≤ R < 20K				10 ≤ R ≤ 1M			
						±25 (D)					10 ≤ R ≤ 1M			
						±15 (C)					10 ≤ R < 20K			
						±10 (B)					50 ≤ R < 20K			
						±5 (A)					50 ≤ R < 20K ---			

**NOTE :** 1. Global part number (code 7)  
2. Global part number (code 9)

## 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 AC (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 ( $\Omega$ )

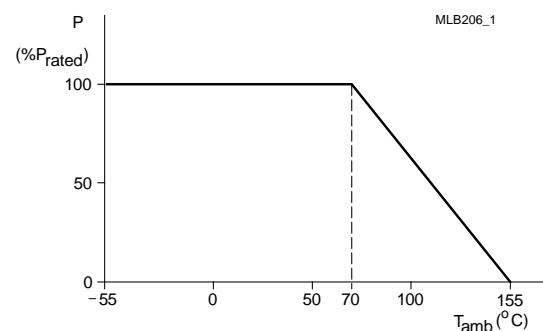


Fig. 6 Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the operating ambient temperature ( $T_{amb}$ )

## 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 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 Parts mounted on test-boards, without condensation on parts	$\pm(0.1\%+0.05\Omega)$
Biased Humidity	AEC-Q200 Test 7 MIL-STD-202 Method 103	1,000 hours; 85 °C / 85% RH 10% of operating power Measurement at 24±4 hours after test conclusion	$\pm(0.1\%+0.05\Omega)$
Operational Life	AEC-Q200 Test 8 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 MIL-STD-202 Method 210	Condition B, no pre-heat of samples Lead-free solder, 260±5 °C, 10±1 seconds immersion time Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	$\pm(0.05\%+0.05\Omega)$
Thermal Shock	AEC-Q200 Test 16 MIL-STD-202 Method 107	-55/+125 °C Number of cycles is 300. Devices mounted Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air – Air	$\pm(0.1\%+0.05\Omega)$ No visible damage
Solderability - Wetting	AEC-Q200 Test 18 J-STD-002	Electrical Test not required Magnification 50X SMD conditions: (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

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Board Flex / Bending	AEC-Q200 Test 2I AEC-Q200-005	Chips mounted on a 90mm glass epoxy resin PCB (FR4) Bending for 0402: 5 mm 0603/0805: 3 mm 1206: 2mm Holding time: minimum 60 second	$\pm(0.1\%+0.05\Omega)$
Temperature Coefficient of Resistance (T.C.R.)	IEC 60115-1 4.8	At +25/-55 °C and +25/+125°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=-55 °C or +125 °C test temperature R1=resistance at reference temperature in ohms R2=resistance at test temperature in ohms	Refer to table 2
Flower of Sulfur	ASTM-B-809-95* * Modified	Sulfur 750 hours, 105°C, unpowered.	$\pm(4.0\%+0.05\Omega)$

**REVISION HISTORY**

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 6	Apr. 15, 2021	-	- Add tol. $\pm 0.01\%$ , $0.02\%$ , $0.05\%$ ; TCR 5ppm & 10ppm
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



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