AT Series

Automotive Grade Thin Film High Accuracy Chip Resistors

Version. B

FEATURE

- AEC-Q200 qualified.
- High accuracy up to ±0.05%.
- Narrow TCR to ±5PPM/℃.
- Total lead-free without RoHS exemptions (7C-1).
- High reliability and stability.
- Meet application requirements for high temperature and high humidity with 85℃ and 85%RH.
- Superior anti-sulfur performance.
- RoHS complaint.
- Applications:
  - Automotive Electronics
  - Electric door and window, electric seat control unit
  - Reversing radar
  - Automotive lighting control unit
  - Medical devices
  - Industrial control system
  - etc.

MANUFACTURER PART NO.

For example: AT1206D49K9T5K25 - AT1206 ±0.5% 49.9KΩ T/R-5000 1/4W 25PPM/℃

Series	Size	Tol.	Nominal Resistance Value	PKG	SPQ	Power	TCR
2 codes	4 codes	1 code	2~5 codes	1 code	1 code	1 code	2 codes
AT	1206	D	49K9	T	5	K	25
Automotive Grade Thin Film High Accuracy Chip Resistors	0402 0603 0805 1206 1210 2010 2512	A=0.05% B=0.1% C=0.25% D=0.5% F=1%	1R①=1Ω 4R7=4.7Ω 4K7=4.7KΩ 100K②=100KΩ 1M2③=1.2MΩ	T=T/R④	4=4K 5=5K A=10K	C=1/16W D=1/10W E=1/8W J=1/5W K=1/4W L=1/3W N=1/2W P=3/4W	05=5PPM/℃ 10=10PPM/℃ 25=25PPM/℃ 50=50PPM/℃ 00=Refer to table as below.

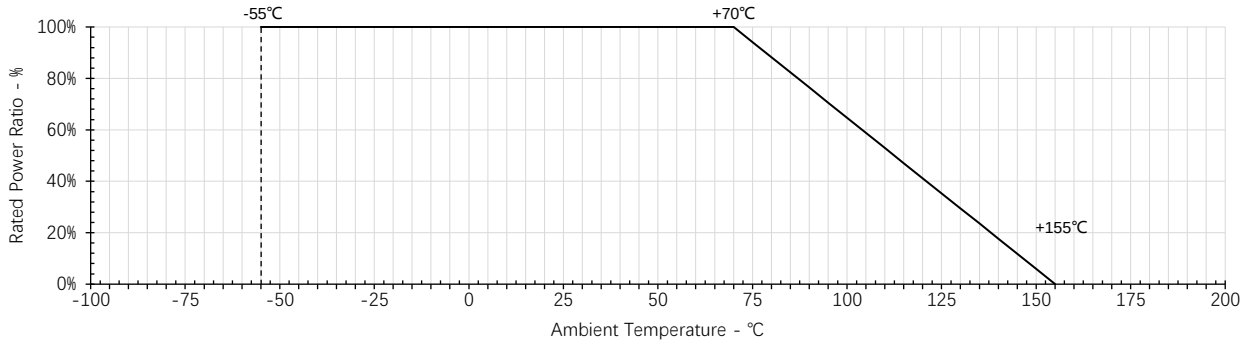
Note: ① R=Radix, 10^0, Ω. ② K=Kilo, 10^3, KΩ. ③ M=Mega, 10^6, MΩ.
④ T/R=Taping in Reel package type. ⑤ P.C.: Personal and Customized.

CHARACTERISTICS

Type	Rated Power	MWV①	MOV②	TCR(PPM/℃)	Resistance Range		
					±0.05%	±0.1%, ±0.25%	±0.5%, ±1%
AT0402	1/16W	25V	50V	±5	100Ω-2KΩ	100Ω-2KΩ	100Ω-2KΩ
				±10	10Ω-12KΩ	10Ω-12KΩ	10Ω-12KΩ
				±25, ±50	10Ω-330KΩ	10Ω-330KΩ	10Ω-330KΩ
AT0603	1/10W	75V	150V	±5	100Ω-4KΩ	100Ω-4KΩ	100Ω-4KΩ
				±10	10Ω-50KΩ	10Ω-50KΩ	10Ω-50KΩ
				±25, ±50	10Ω-1MΩ	1Ω-1MΩ	1Ω-1MΩ
AT0805	1/8W	150V	300V	±5	100Ω-15KΩ	100Ω-15KΩ	100Ω-15KΩ
				±10	10Ω-100KΩ	10Ω-100KΩ	10Ω-100KΩ
				±25, ±50	4.7Ω-511KΩ	1Ω-2MΩ	1Ω-2MΩ
AT1206	1/4W	200V	400V	±5	100Ω-15KΩ	100Ω-15KΩ	100Ω-15KΩ
				±10	10Ω-200KΩ	10Ω-200KΩ	10Ω-200KΩ
				±25, ±50	4.7Ω-1MΩ	1Ω-3MΩ	1Ω-3MΩ
AT1210	1/3W	200V	400V	±5	100Ω-15KΩ	100Ω-15KΩ	100Ω-15KΩ
				±10	10Ω-200KΩ	10Ω-200KΩ	10Ω-200KΩ
				±25, ±50	4.7Ω-1MΩ	1Ω-3MΩ	1Ω-3MΩ
AT2010	1/2W	200V	400V	±5	100Ω-25KΩ	100Ω-25KΩ	100Ω-25KΩ
				±10	10Ω-200KΩ	10Ω-200KΩ	10Ω-200KΩ
				±25, ±50	4.7Ω-3MΩ	1Ω-3MΩ	1Ω-3MΩ
AT2512	3/4W	200V	400V	±5	100Ω-25KΩ	100Ω-25KΩ	100Ω-25KΩ
				±10	10Ω-200KΩ	10Ω-200KΩ	10Ω-200KΩ
				±25, ±50	4.7Ω-3MΩ	1Ω-3MΩ	1Ω-3MΩ

Note: ① MWV=Max. Working Voltage; ② MOV=Max. Overload Voltage.

POWER DERATING CURVE



Note: Working Temperature within -55℃ ~ +155℃.

RATED VOLTAGE

Resistors should have a Rated Voltage DC or AC corresponding to Rated Power which can be calculated by formula as below.

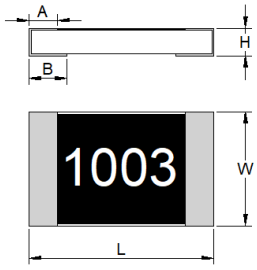
The Rated Voltage of certain resistance value should be the calculated result or Max. Working Voltage of product series whichever lower.

$$E = \sqrt{P \times R}$$

E=Rated voltage(V)
P=Rated power(W)
R=Nominal resistance(Ω)

DIMENSION

Unit: mm

Figure	Type	L	W	H	A	B
	AT0402	1.00±0.10	0.45±0.10	0.30±0.05	0.20±0.10	0.25±0.10
	AT0603	1.50±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.15
	AT0805	1.95±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.15
	AT1206	3.05±0.10	1.50±0.10	0.50±0.10	0.45±0.20	0.35±0.15
	AT1210	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20
	AT2010	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20
	AT2512	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20

RELIABILITY

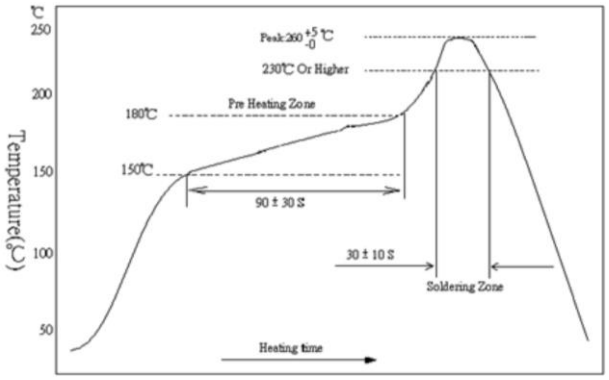
Item	Test Method	Acceptable Criterion
High Temperature Exposure	Put the specimens unpowered in test environment at +155℃ for 1,000 hours, then take them out to measure the resistance value change rate. **Reference: AEC-Q200 Test 3, MIL-STD-202 Method 108**	△R/R=±0.2%
Temperature Cycling	Put the specimens in test environment, rise temperature from -55℃ to +125℃ with speed 10~20 ℃ per minutes, then stabilize for 15 minutes, define these steps as a cycles, totally 1000 cycles. Finally, take them out to measure the resistance value change rate. **Reference: AEC-Q200 Test 4, JESD22 Method JA-104**	△R/R=±0.2%
Biased Humidity	Put the specimens applied 10% of rated power in test environment at 85℃ and 85%RH for 1000 hours. then take them out to stabilize for 24 hours and measure resistance value change rate. **Reference: AEC-Q200 TEST 7, MIL-STD-202 Method 103**	△R/R=±0.2%

Item	Test Method	Acceptable Criterion
Operational Life	Condition D Steady State T_A=+125°C. Put the specimens applied rated voltage in test environment, the maximum rated temperature and rated voltage for the dielectric employed shall be used. Set up 90 minutes power on and 30 minutes power off as a group, totally 1000 hours. Then take them out to stabilize for 24±4 hours and measure the resistance value change rate. **Reference: AEC-Q200 Test 8, MIL-STD -202 Method 108**	△R/R=±0.2%
Resistance to Solvent	Put the specimens in isopropanol solvent at room temperature 23±5℃ for 5 minutes, brush 10 times as a group with a hard toothbrush, 3 times for each group. Then take them out to blow dry, and check their appearance. **Reference: AEC-Q200 Test 12, MIL-STD-202 Method 215**	No visible damage
Resistance to Soldering Heat	Put the specimens in tin furnace at 260^{+5}_{0}℃ for 10^{+1}_{0} seconds. Then take them out to stabilize for 1 hour, and measure the resistance value change rate. **Reference: AEC-Q200 TEST 15, MIL-STD-202 Method 210**	△R/R=±0.1%
ESD	Put the specimens with voltage in test machine, and the voltage shall be set up as following table. Test method: Electro-Static discharges twice which positive and negative polarity once each by human body mode. Size: 0402, 0603 / 0805 and above Voltage: 1,000V / 2,000V **Reference: AEC-Q200 Test 17, AEC-Q200-002**	△R/R=±0.5%
Solderability	Pretreatment: Dry heat +155℃ for 4 hours, or with equivalent test method, PCT aging for 4 hours. Then take the specimens out to stabilize at room temperature for 2 hours. Test method: 1. Put the specimens in a tin furnace at 245±3℃ for 3 seconds, then take them out and check the soldering appearance by microscope. 2. Reflow soldering test with peak temperature 235℃ for 40± 5 seconds. **Reference: AEC-Q200 Test 18, J-STD-002, IEC 60115-1 11.1.4.3**	1. Solder coverage must be 95% minimum. 2. Without welding rejection. And soldering is higher than 1/2 of side termination height.
Electrical Characterization	TCR(ppm/℃)=$\frac{(R_2-R_1)}{R_1\times(T_2-T_1)}\times10^6$ R_1: Resistance value at room temperature (Ω) R_2: Resistance value at test temperature -55℃ or +125℃ T_1: Temperature at room temperature (℃) T_2: Temperature at -55℃ or +125℃ **Reference: AEC-Q200 Test 19, IEC 60115-1 6.2**	Details in table CHARACTERISTICS
Board Flex	Put PCBA mounted with the specimens in test machine, press down the PCBA to standard depth with testing block and stabilize for 60 seconds, then measure the resistance value change rate. Size: 0402, 0603, 0805 / 1206, 1210 / 2010, 2512 Depth: 5mm / 3mm / 2mm **Reference: AEC-Q200 TEST 21, AEC-Q200-005**	△R/R=±0.1%
Terminal Strength	Apply 1.8Kgf external force on the side of specimen, then check the soldering joint strength. Size: 0402 / 0603 and above Force: 1 Kgf. / 1.8 Kgf. **Reference: AEC Q200-005**	No mechanical damage or peel-off of side end
Short Time Overload	Load 2.5 times of rated voltage or maximum overload voltage whichever is less for 5 seconds. Then measure the resistance value change rate. **Reference: IEC 60115-1 8.1.4.2**	△R/R=±0.1%
Mechanical shock	Put the specimens in test machine, shocks with half sine wave which acceleration set up as 100g's and each three times in X, Y and Z directions with pulse duration as 6 ms. **Reference: AEC-Q200 Test 13, MIL-STD -202 Method 213**	△R/R=±0.1%
Vibration	Put the specimens in test machine, vibrates with 10 to 20Hz frequency which acceleration set up as 5g's, and each 12 times in X, Y and Z directions as a cycle which duration as 20 minutes, totally 36 cycles. **Reference: AEC-Q200 Test 14, MIL-STD -202 Method 204**	△R/R=±0.1%
Flammability	Put the specimens in test environment, and burn them for 10 seconds and the flame extinguished within 60 seconds. **Reference: AEC-Q200 Test 20, UL-94**	V-0 Specimens haven't burn, and the bottom cotton without flame.

Item	Test Method	Acceptable Criterion
Flame retardancy	Put the specimens mounted on PCB and subjected to voltage from 9.0 to 32.0 VDC (current clamped up to 500A) in 1.0 VDC increments. Each voltage level shall be applied for one hour minimum, or until the specimens is either electrically open of a failure occurs. **Reference: AEC-Q200 Test 24, AEC-Q200-001**	1. A flame duration less than 3.0 seconds. 2. Without explosion 3. A temperature above 350℃ sustained for less than 10 seconds
Sulfide test 1	Sulfur vapor test, 90℃, dry sulfur powder, unpowered, 750 hours or 1000 hours. **Reference: ASTM-809-95, EIA-977**	△R/R=±1.0%
Sulfide test 2	Cutting oil with sulfur powder with a specific gravity of 96.5:3.5,105℃, 500 hours. **Customer requirements**	△R/R=±2%

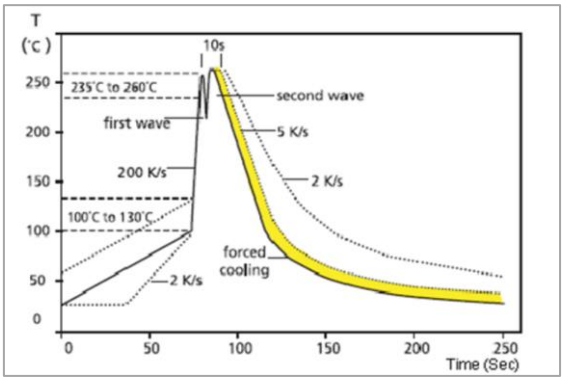
SOLDERING

Lead Free IR Reflow Soldering Profile



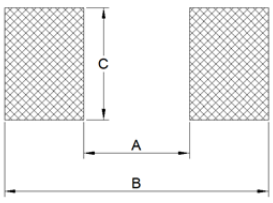
- Top temperature should be under 260^{+5}_{-0}℃ for 10 sec.
- Reference: J-STD-020D

Lead Free Double-Wave Soldering Profile



- Suitable for 0603 above size products
- 350±10℃ for 3 sec. by soldering iron.

SOLDERING PAD



Unit: mm

Type	A	B	C
AT0402	0.5	1.5	0.6
AT0603	0.8	2.1	0.9
AT0805	1.2	3.0	1.3
AT1206	2.2	4.2	1.6
AT1210	2.2	4.2	2.8
AT2010	3.5	6.1	2.8
AT2512	3.8	8.0	3.5

WORKING ENVIRONMENT

If user intends to use products in special environments or states (including but not limited to the following), it is necessary to approve special characteristics and reliability for the following or other application environments.

A. High temperature.
B. Near the sea, or corrosive gas, such as Cl_2, H_2S, NH_3, SO_2 and NO_2, etc.
C. Unverified liquids, such as water, oil, chemical or organic solvent.
D. Unverified resin or paint to cover products.
E. Products should be washed with water soluble cleaner even if non cleaning flux.

STORAGE / CARRY CONDITIONS

A. Temperature: 25±5℃
B. Humidity: 60±15%RH
C. Storage life: 2 years. FIFO
D. Please hold box correct orientation when storing and carrying. It is strictly prohibited to fall or squeeze the box, otherwise the product electrode or body may be damaged.

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VERSION HISTORY

Version	Date	Change Item(s)	Description
A	2022/04/25	-	First version
B	2022/11/24	Reliability	Update test items, test method and acceptable criterion.