

## FEATURE

- AEC-Q200 qualified.
- High accuracy up to  $\pm 0.05\%$ .
- Narrow TCR to  $\pm 5\text{PPM}/^\circ\text{C}$ .
- Total lead-free without RoHS exemptions (7C-1).
- High reliability and stability.
- Meet application requirements for high temperature and high humidity with  $85^\circ\text{C}$  and  $85\%\text{RH}$ .
- 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  $\pm 0.5\%$  49.9K $\Omega$  T/R-5000 1/4W 25PPM/ $^\circ\text{C}$

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= $\pm 0.05\%$ B= $\pm 0.1\%$ C= $\pm 0.25\%$ D= $\pm 0.5\%$ F= $\pm 1\%$	1R <sup>1</sup> =1 $\Omega$ 4R7=4.7 $\Omega$ 4K7=4.7K $\Omega$ 100K <sup>2</sup> =100K $\Omega$ 1M2 <sup>3</sup> =1.2M $\Omega$	T=T/R <sup>4</sup>	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 1=1W	05=5PPM/ $^\circ\text{C}$ 10=10PPM/ $^\circ\text{C}$ 25=25PPM/ $^\circ\text{C}$ 50=50PPM/ $^\circ\text{C}$ 00=Refer to table as below.

Note: ① R=Radix,  $10^0$ ,  $\Omega$ .

④ T/R=Taping in Reel package type.

② K=Kilo,  $10^3$ , K $\Omega$ .

⑤ P.C.: Personal and Customized.

③ M=Mega,  $10^6$ , M $\Omega$ .

## CHARACTERISTICS

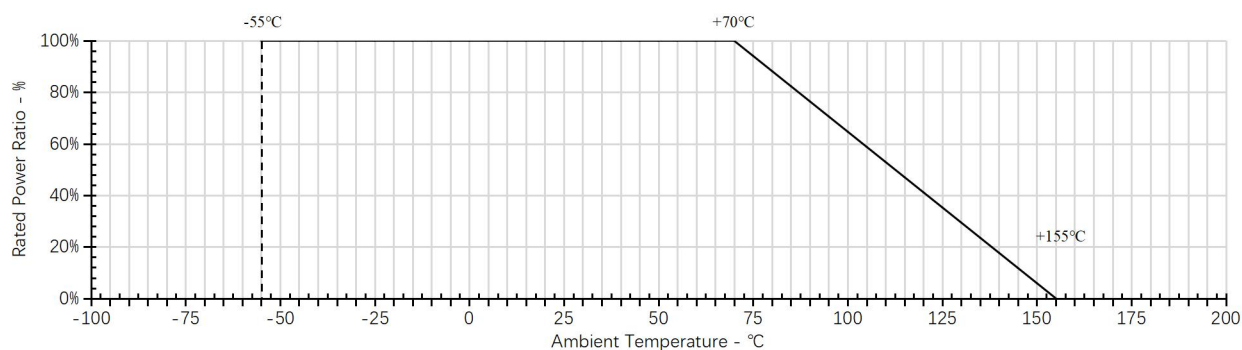
Type	Rated Power	MWV <sup>①</sup>	MOV <sup>②</sup>	TCR(PPM/ $^\circ\text{C}$ )	Resistance Range		
					$\pm 0.05\%$	$\pm 0.1\%$ , $\pm 0.25\%$	$\pm 0.5\%$ , $\pm 1\%$
AT0402	1/16W 1/10W 1/8W	50V	100V	$\pm 5$	100 $\Omega$ -2K $\Omega$	100 $\Omega$ -2K $\Omega$	100 $\Omega$ -2K $\Omega$
				$\pm 10$	10 $\Omega$ -12K $\Omega$	10 $\Omega$ -12K $\Omega$	10 $\Omega$ -12K $\Omega$
				$\pm 25$ , $\pm 50$	10 $\Omega$ -330K $\Omega$	10 $\Omega$ -330K $\Omega$	10 $\Omega$ -330K $\Omega$
AT0603	1/10W 1/5W	75V	150V	$\pm 5$	100 $\Omega$ -4K $\Omega$	100 $\Omega$ -4K $\Omega$	100 $\Omega$ -4K $\Omega$
				$\pm 10$	10 $\Omega$ -50K $\Omega$	10 $\Omega$ -50K $\Omega$	10 $\Omega$ -50K $\Omega$
				$\pm 25$ , $\pm 50$	10 $\Omega$ -1M $\Omega$	1 $\Omega$ -1M $\Omega$	1 $\Omega$ -1M $\Omega$
AT0805	1/8W 1/4W	150V	300V	$\pm 5$	100 $\Omega$ -15K $\Omega$	100 $\Omega$ -15K $\Omega$	100 $\Omega$ -15K $\Omega$
				$\pm 10$	10 $\Omega$ -100K $\Omega$	10 $\Omega$ -100K $\Omega$	10 $\Omega$ -100K $\Omega$
				$\pm 25$ , $\pm 50$	4.7 $\Omega$ -511K $\Omega$	1 $\Omega$ -2M $\Omega$	1 $\Omega$ -2M $\Omega$
AT1206	1/4W 1/2W	200V	400V	$\pm 5$	100 $\Omega$ -15K $\Omega$	100 $\Omega$ -15K $\Omega$	100 $\Omega$ -15K $\Omega$
				$\pm 10$	10 $\Omega$ -200K $\Omega$	10 $\Omega$ -200K $\Omega$	10 $\Omega$ -200K $\Omega$
				$\pm 25$ , $\pm 50$	4.7 $\Omega$ -1M $\Omega$	1 $\Omega$ -3M $\Omega$	1 $\Omega$ -3M $\Omega$
AT1210	1/3W 1/2W	200V	500V	$\pm 5$	100 $\Omega$ -15K $\Omega$	100 $\Omega$ -15K $\Omega$	100 $\Omega$ -15K $\Omega$
				$\pm 10$	10 $\Omega$ -200K $\Omega$	10 $\Omega$ -200K $\Omega$	10 $\Omega$ -200K $\Omega$
				$\pm 25$ , $\pm 50$	4.7 $\Omega$ -1M $\Omega$	1 $\Omega$ -3M $\Omega$	1 $\Omega$ -3M $\Omega$
AT2010	1/2W 3/4W	200V	500V	$\pm 5$	100 $\Omega$ -25K $\Omega$	100 $\Omega$ -25K $\Omega$	100 $\Omega$ -25K $\Omega$
				$\pm 10$	10 $\Omega$ -200K $\Omega$	10 $\Omega$ -200K $\Omega$	10 $\Omega$ -200K $\Omega$
				$\pm 25$ , $\pm 50$	4.7 $\Omega$ -3M $\Omega$	1 $\Omega$ -3M $\Omega$	1 $\Omega$ -3M $\Omega$
AT2512	3/4W 1W	200V	500V	$\pm 5$	100 $\Omega$ -25K $\Omega$	100 $\Omega$ -25K $\Omega$	100 $\Omega$ -25K $\Omega$
				$\pm 10$	10 $\Omega$ -200K $\Omega$	10 $\Omega$ -200K $\Omega$	10 $\Omega$ -200K $\Omega$
				$\pm 25$ , $\pm 50$	4.7 $\Omega$ -3M $\Omega$	1 $\Omega$ -3M $\Omega$	1 $\Omega$ -3M $\Omega$

Note: ① MWV=Max. Working Voltage;

② MOV=Max. Overload Voltage.

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## POWER DERATING CURVE



Note: Working Temperature within -55°C ~ +155°C.

## 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.

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

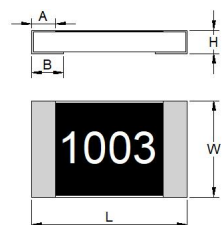
E=Rated voltage(V)

P=Rated power(W)

R=Nominal resistance(Ω)

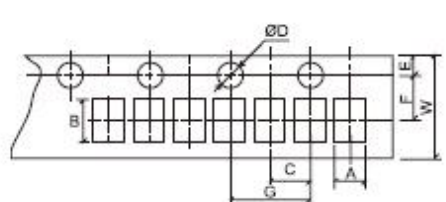
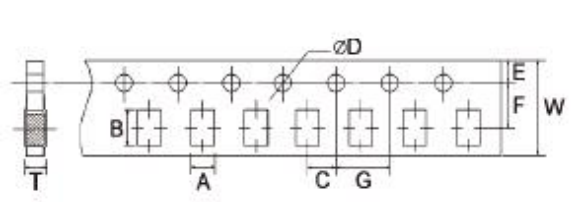
## DIMENSION

unit: mm

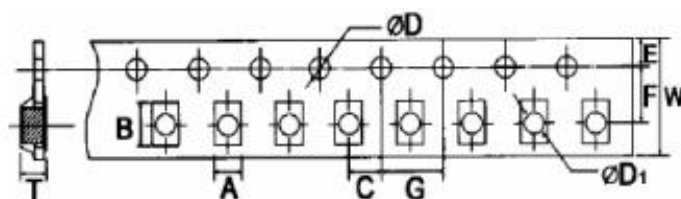
Figure	Type	L	W	H	A	B
	AT0402	1.00±0.10	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10
	AT0603	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20
	AT0805	2.00±0.15	1.25±0.15	0.55±0.10	0.30±0.20	0.40±0.20
	AT1206	3.10±0.15	1.55±0.15	0.55±0.10	0.40±0.20	0.45±0.20
	AT1210	3.10±0.10	2.60±0.20	0.55±0.10	0.40±0.20	0.45±0.20
	AT2010	5.00±0.10	2.50±0.20	0.55±0.10	0.50±0.25	0.50±0.20
	AT2512	6.35±0.10	3.20±0.20	0.55±0.10	0.50±0.25	0.50±0.20

## PACKING

• Taping unit: mm

Carrier Taping A	Carrier Taping B
	

### Embossed Taping

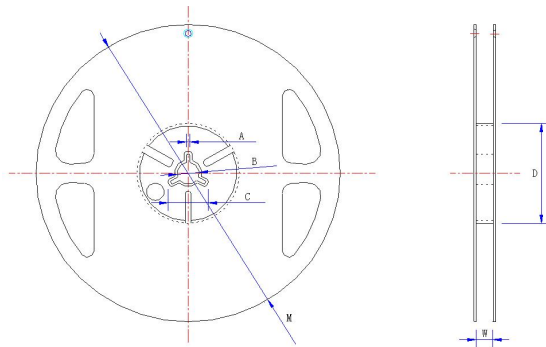


### Taping Dimensions

Type or Size		A±0.2	B±0.2	C±0.05	ØD <sub>-0</sub> <sup>+0.1</sup>	E±0.1	F±0.05	G±0.1	W±0.2	T±0.1
Carrier Taping A	0402	0.67±0.1	1.17±0.1	2.0	1.5	1.75	3.5	4.0	8.0	0.47
	0603	1.10	1.90	2.0	1.5	1.75	3.5	4.0	8.0	0.67
Carrier Taping B	0805	1.65	2.40	2.0	1.5	1.75	3.5	4.0	8.0	0.81
	1206	1.90	3.45	2.0	1.5	1.75	3.5	4.0	8.0	0.81
	1210	2.85	3.50	2.0	1.5	1.75	3.5	4.0	8.0	0.81

Type or Size	A±0.2	B±0.2	C±0.05	$\phi D_{-0}^{+0.1}$	$\phi D_{-0}^{+0.25}$	E±0.1	F±0.05	G±0.1	W±0.2	T±0.1
Embossed Taping	2010	2.90	5.60	2.00	1.50	1.75	5.50	4.00	12.00	1.00
	1812	3.50	4.80	2.00	1.50	1.75	5.50	4.00	12.00	1.00
	2512	3.50	6.70	2.00	1.50	1.75	5.50	4.00	12.00	1.00

### Reel



Type	SPQ PCS/RI.	A±0.5	B±0.5	C±0.5	D±1	M±2	W±1
0402	10,000	2.0	13.0	21.0	60.0	178.0	10.0
0603	5,000	2.0	13.0	21.0	60.0	178.0	10.0
0805	5,000	2.0	13.0	21.0	60.0	178.0	10.0
1206	5,000	2.0	13.0	21.0	60.0	178.0	10.0
1210	5,000	2.0	13.0	21.0	60.0	178.0	10.0
1812	4,000	2.0	13.0	21.0	60.0	178.0	13.8
2010	4,000	2.0	13.0	21.0	60.0	178.0	13.8
2512	4,000	2.0	13.0	21.0	60.0	178.0	13.8

## RELIABILITY

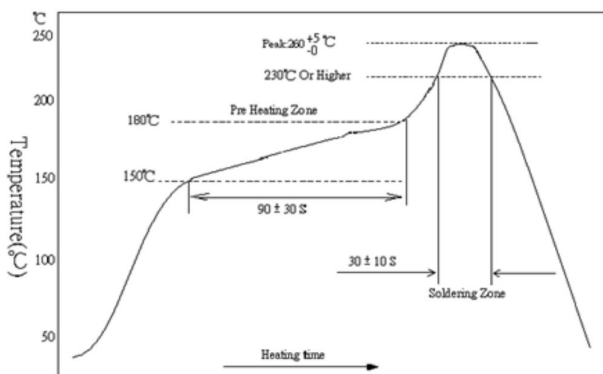
Item	Test Method	Acceptable Criterion
High Temperature Exposure	+155°C, 1000hrs., unpowered, measure the resistance change rate after test. Reference: AEC-Q200 Test 3, MIL-STD-202 Method 108	$\Delta R/R = \pm(0.2\% + 0.05\Omega)$
Temperature Cycling	-55~+155°C, soak time 30min, Transition Time :1minute, 1000 cycles Reference: AEC-Q200 Test 4, JESD22 Method JA-104	$\Delta R/R = \pm(0.2\% + 0.05\Omega)$
Humidity Bias	85°C, 85%, 10% rated power, 1000H, after the test and stand 24H to measure the change rate of resistance value for components with specified operating voltages higher or equal to 500V, 10% of operating voltage. Reference: AEC-Q200 TEST 7, MIL-STD-202 Method 103	$\Delta R/R = \pm(0.2\% + 0.05\Omega)$
High Temperature Operating Life	maximum specified operating temperature at 100% rated power without derating, 1000H, 90 min ON, 30 min OFF Reference: AEC-Q200 Test 8, MIL-STD -202 Method 108	$\Delta R/R = \pm(0.2\% + 0.05\Omega)$

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Item	Test Method	Acceptable Criterion								
Resistance to Solvent	Immerse in isopropanol solvent at room temperature (23±5℃) for 5min, wipe 10 times with a hard toothbrush, repeat 3 times, take out and blow dry for examination Reference: AEC-Q200 Test 12, MIL-STD-202 Method 215	No visible damage								
Resistance to Soldering Heat	Reflow test, time above 217 °C is 60s-150s, time above 250 ± 5℃ is 30±5s Reference: AEC-Q200 TEST 15, MIL-STD-202 Method 210	Δ R/R=±(0.1%+0.05Ω)								
ESD	Human body mode, two discharges, positive and negative polarity once each <table><tr><td>Size</td><td>0402, 0603</td><td>0805 and above</td></tr><tr><td>Voltage</td><td>1,000V</td><td>2,000V</td></tr></table> Reference: AEC-Q200 Test 17, AEC-Q200-002	Size	0402, 0603	0805 and above	Voltage	1,000V	2,000V	Δ R/R=±(0.5%+0.05Ω)		
Size	0402, 0603	0805 and above								
Voltage	1,000V	2,000V								
Solderability	Pretreatment: dry heat 155℃, 4H, after take out, stand at room temperature for 2 hours. Test method B1: Dip the resistance in a tin furnace at 245±5℃ for 5 seconds, then take it out and observe the solder area under a microscope; Test method D: 260±5℃, T=30+5/-0s. Reference: AEC-Q200 Test 18, J-STD-002 & IEC 60115-1 11.1.4.3	Soldering coverage over 95% At the edge of terminal, the object underneath (e.g., white ceramic) shall not expose.								
Electrical Characterization	$TCR(ppm/^{\circ}C)=\frac{(R_2-R_1)}{R_1\times(T_2-T_1)}\times10^6$ $R_1$ : 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	The SMD resistance was welded to the test board and bent with the standard pressure block. After standing for 60s under the corresponding deformation condition, the change rate of resistance value of the part was tested. <table><tr><td>Size</td><td>0402, 0603, 0805</td><td>1206, 1210</td><td>2010, 2512</td></tr><tr><td>Depth</td><td>5mm</td><td>3mm</td><td>2mm</td></tr></table> Reference: AEC-Q200 TEST 21, AEC-Q200-005	Size	0402, 0603, 0805	1206, 1210	2010, 2512	Depth	5mm	3mm	2mm	Δ R/R=±(0.1%+0.05Ω)
Size	0402, 0603, 0805	1206, 1210	2010, 2512							
Depth	5mm	3mm	2mm							
Terminal Strength	Apply 1.8Kgf. external force (0402,1 Kgf.) on the side of the part to test the solder joint adhesion of the part. Reference: AEC Q200-005	No mechanical damage or peel-off of side end								
Short Time Overload	Apply 2.5 times rated voltage or maximum overload voltage (whichever is the smallest) for 5 seconds. Reference: IEC 60115-1 8.1.4.2	Δ R/R=±(0.1%+0.05Ω)								
Mechanical shock	Half sine wave, acceleration 100g's, each three times in X, Y and Z directions, pulse width 6ms. Reference: AEC-Q200 Test 13, MIL-STD -202 Method 213	Δ R/R=±(0.1%+0.05Ω)								
Vibration	Frequency: 10Hz~2000Hz, acceleration: 5g's, X, Y, Z three directions, 12 cycles in each direction, a total of 36 cycles, a single cycle test for 20min. Reference: AEC-Q200 Test 14, MIL-STD -202 Method 204	Δ R/R=±(0.1%+0.05Ω)								
Flammability	Protective layer flammability report or component needle flame test report Reference: AEC-Q200 Test 20, UL-94, IEC 60695-11-5	Do not burn and cotton below do not ignite								
Flame retardancy	9V <sub>DC</sub> to 32V <sub>DC</sub> (clamp current 500A) in each increment 1V <sub>DC</sub> for 1 hr. Reference: AEC-Q200 Test 24, AEC-Q200-001	1. Nonflammable 2. Do not explode 3. The temperature cannot be higher than 350℃ for 10 seconds								
Sulfide test 1	Put the test sample resistor in sulfur vapor, at a temperature of 105±2℃ for 750hrs Reference: ASTM-B-809-95&EIA977	Δ R/R=±(1%+0.05Ω)								
Sulfide test 2	Cutting oil with sulfur powder with a specific gravity of 96.5:3.5, 105℃, 500 hrs. Customer requirements	Δ R/R=±(2%+0.05Ω)								

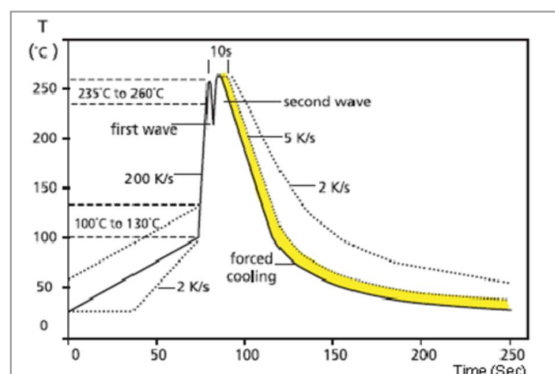
## SOLDERING

Lead Free IR Reflow Soldering Profile



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

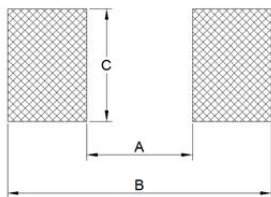
Lead Free Double-Wave Soldering Profile



- Suitable for 0603 above size products
- $350 \pm 10$ °C for 3 sec. by soldering iron.

## SOLDERING PAD

unit: mm

Figure	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.

- High temperature.
- Near the sea, or corrosive gas, such as  $\text{Cl}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ ,  $\text{SO}_2$  and  $\text{NO}_2$ , etc.
- Unverified liquids, such as water, oil, chemical or organic solvent.
- Unverified resin or paint to cover products.
- Products should be washed with water soluble cleaner even if non cleaning flux.

## STORAGE / CARRY CONDITIONS

- Temperature:  $25 \pm 5$ °C
- Humidity:  $60 \pm 15\%$  RH
- Storage life: 2 years. FIFO
- 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. F

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