

### 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.
- High rated power capability.
- 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: AQ0805B100RT5K25 - AQ0805  $\pm 0.1\%$  100 $\Omega$  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
<b>AQ</b>	<b>0805</b>	<b>D</b>	<b>49K9</b>	<b>T</b>	<b>5</b>	<b>K</b>	<b>25</b>
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%	1R <sup>1</sup> =1 $\Omega$ 4R7=4.7 $\Omega$ 4K7=4.7K $\Omega$ 100K <sup>2</sup> =100K $\Omega$ 3M <sup>3</sup> =3M $\Omega$	T=T/R <sup>5</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	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<sup>0</sup>,  $\Omega$ .

② K=Kilo, 10<sup>3</sup>, K $\Omega$ .

③ M=Mega, 10<sup>6</sup>, M $\Omega$ .

④ T/R=Taping in Reel package type.

⑤ P.C.: Personal and Customized.

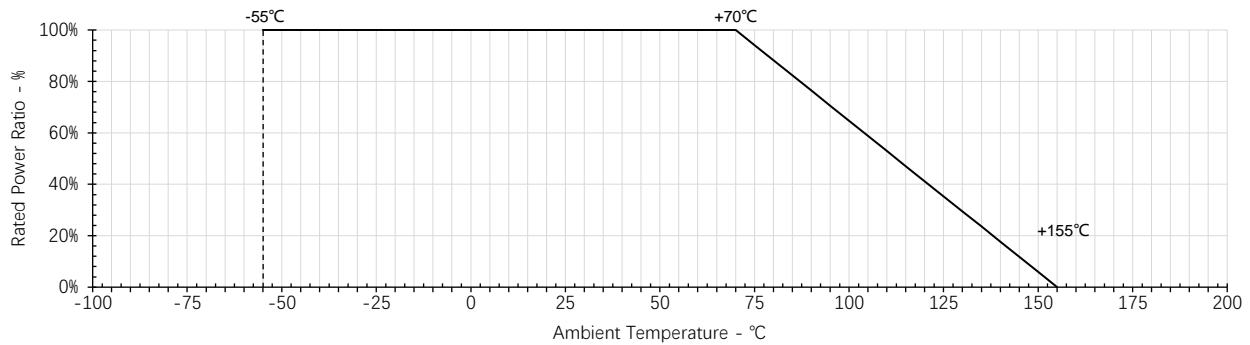
### CHARACTERISTICS

Type	Rated Power	MWV <sup>①</sup>	MOV <sup>②</sup>	TCR(PPM/ $^\circ\text{C}$ )	Resistance Range		
					$\pm 0.05\%$	$\pm 0.1\%, \pm 0.25\%$	$\pm 0.5\%, \pm 1\%$
AQ0402	1/10W	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 $\Omega$
AQ0603	1/5W	150V	300V	$\pm 5$	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 $\Omega$
AQ0805	1/4W	200V	400V	$\pm 5$	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 $\Omega$
AQ1206	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 $\Omega$
AQ1210	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 $\Omega$
AQ2010	3/4W	200V	400V	$\pm 5$	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 $\Omega$
AQ2512	1W	200V	400V	$\pm 5$	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.

### 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.

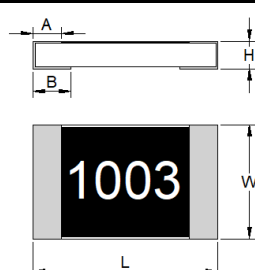
$$E = \sqrt{P \times R}$$

E=Rated voltage(V)

P=Rated power(W)

R=Nominal resistance(Ω)

### DIMENSIONS

Figure	Type	L	W	H	A	B	Unit: mm
	AQ0402	1.00±0.10	0.45±0.10	0.30±0.05	0.20±0.10	0.25±0.10	
	AQ0603	1.50±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.15	
	AQ0805	1.95±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.15	
	AQ1206	3.05±0.10	1.50±0.10	0.50±0.10	0.45±0.20	0.35±0.15	
	AQ1210	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20	
	AQ2010	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20	
	AQ2512	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20	

### RELIABILITY

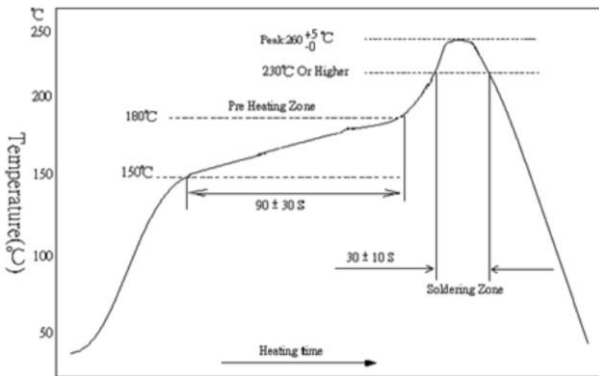
Item	Test Method	Acceptable Criterion
High Temperature Exposure	Put the specimens unpowered in test environment at +155°C for 1,000 hours, then take them out to measure the resistance value change rate. <b>Reference: AEC-Q200 Test 3, MIL-STD-202 Method 108</b>	ΔR/R=±0.2%
Temperature Cycling	Put the specimens in test environment, rise temperature from -55°C to +125°C with speed 10~20 °C 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. <b>Reference: AEC-Q200 Test 4, JESD22 Method JA-104</b>	ΔR/R=±0.2%
Biased Humidity	Put the specimens applied 10% of rated power in test environment at 85°C and 85%RH for 1000 hours. then take them out to stabilize for 24 hours and measure resistance value change rate. <b>Reference: AEC-Q200 TEST 7, MIL-STD-202 Method 103</b>	ΔR/R=±0.2%
Resistance to Solvent	Put the specimens in isopropanol solvent at room temperature 23±5°C 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. <b>Reference: AEC-Q200 Test 12, MIL-STD-202 Method 215</b>	No visible damage

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Item	Test Method	Acceptable Criterion								
Operational Life	Condition D Steady State $T_A = +125^{\circ}\text{C}$ . 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 $24 \pm 4$ hours and measure the resistance value change rate. <b>Reference: AEC-Q200 Test 8, MIL-STD -202 Method 108</b>	$\Delta R/R = \pm 0.2\%$								
Resistance to Soldering Heat	Put the specimens in tin furnace at $260 \pm 5^{\circ}\text{C}$ for $10 \pm 1_0$ seconds. Then take them out to stabilize for 1 hour, and measure the resistance value change rate. <b>Reference: AEC-Q200 TEST 15, MIL-STD-202 Method 210</b>	$\Delta R/R = \pm 0.1\%$								
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. <table border="1" style="margin-left: 20px;"> <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> <b>Reference: AEC-Q200 Test 17, AEC-Q200-002</b>	Size	0402, 0603	0805 and above	Voltage	1,000V	2,000V	$\Delta R/R = \pm 0.5\%$		
Size	0402, 0603	0805 and above								
Voltage	1,000V	2,000V								
Solderability	Pretreatment: Dry heat $+155^{\circ}\text{C}$ 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 $245 \pm 3^{\circ}\text{C}$ for 3 seconds, then take them out and check the soldering appearance by microscope. 2. Reflow soldering test with peak temperature $235^{\circ}\text{C}$ for $40 \pm 5$ seconds. <b>Reference: AEC-Q200 Test 18, J-STD-002, IEC 60115-1 11.1.4.3</b>	<ol style="list-style-type: none"> <li>Solder coverage must be 95% minimum.</li> <li>Without welding rejection. And soldering is higher than 1/2 of side termination height.</li> </ol>								
Electrical Characterization	$\text{TCR}(\text{ppm}/^{\circ}\text{C}) = -\frac{(R_2 - R_1)}{R_1 \times (T_2 - T_1)} \times 10^6$ $R_1$ : Resistance value at room temperature ( $\Omega$ ) $R_2$ : Resistance value at test temperature $-55^{\circ}\text{C}$ or $+125^{\circ}\text{C}$ $T_1$ : Temperature at room temperature ( $^{\circ}\text{C}$ ) $T_2$ : Temperature at $-55^{\circ}\text{C}$ or $+125^{\circ}\text{C}$ <b>Reference: AEC-Q200 Test 19, IEC 60115-1 6.2</b>	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. <table border="1" style="margin-left: 20px;"> <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> <b>Reference: AEC-Q200 TEST 21, AEC-Q200-005</b>	Size	0402, 0603, 0805	1206, 1210	2010, 2512	Depth	5mm	3mm	2mm	$\Delta R/R = \pm 0.1\%$
Size	0402, 0603, 0805	1206, 1210	2010, 2512							
Depth	5mm	3mm	2mm							
Terminal Strength	Apply 1.8Kgf external force on the side of specimen, then check the soldering joint strength. <table border="1" style="margin-left: 20px;"> <tr> <td>Size</td> <td>0402</td> <td>0603 and above</td> </tr> <tr> <td>Force</td> <td>1 Kgf.</td> <td>1.8 Kgf.</td> </tr> </table> <b>Reference: AEC Q200-005</b>	Size	0402	0603 and above	Force	1 Kgf.	1.8 Kgf.	No mechanical damage or peel-off of side end		
Size	0402	0603 and above								
Force	1 Kgf.	1.8 Kgf.								
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. <b>Reference: IEC 60115-1 8.1.4.2</b>	$\Delta R/R = \pm 0.1\%$								
Mechanical shock	Put the specimens in test machine, shocks with half sine wave which acceleration set up as $100\text{g}'\text{s}$ and each three times in X, Y and Z directions with pulse duration as 6 ms. <b>Reference: AEC-Q200 Test 13, MIL-STD -202 Method 213</b>	$\Delta R/R = \pm 0.1\%$								
Vibration	Put the specimens in test machine, vibrates with 10 to 20Hz frequency which acceleration set up as $5\text{g}'\text{s}$ , and each 12 times in X, Y and Z directions as a cycle which duration as 20 minutes, totally 36 cycles. <b>Reference: AEC-Q200 Test 14, MIL-STD -202 Method 204</b>	$\Delta R/R = \pm 0.1\%$								
Flammability	Put the specimens in test environment, and burn them for 10 seconds and the flame extinguished within 60 seconds. <b>Reference: AEC-Q200 Test 20, UL-94</b>	V-0 Specimens haven't burn, and the bottom cotton without flame.								
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 or a failure occurs. <b>Reference: AEC-Q200 Test 24, AEC-Q200-001</b>	<ol style="list-style-type: none"> <li>A flame duration less than 3.0 seconds.</li> <li>Without explosion</li> </ol> A temperature above $350^{\circ}\text{C}$ sustained for less than 10 seconds								

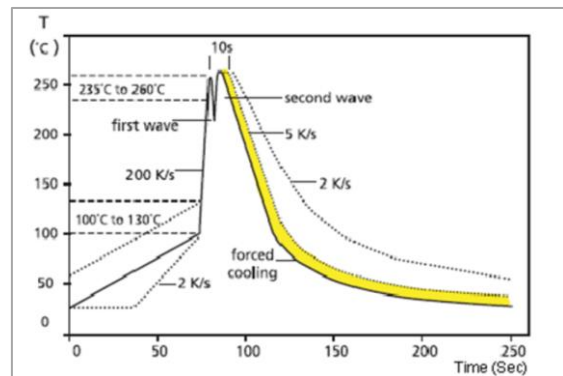
### SOLDERING

Lead Free IR Reflow Soldering Profile



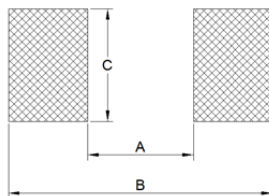
- Top temperature should be under  $260 \pm 5^{\circ}\text{C}$  for 10 sec.
- Reference: J-STD-020D

Lead Free Double-Wave Soldering Profile



- Suitable for 0603 above size products
- $350 \pm 10^{\circ}\text{C}$  for 3 sec. by soldering iron.

### SOLDERING PAD



Unit: mm

Type	A	B	C
AQ0402	0.5	1.5	0.6
AQ0603	0.8	2.1	0.9
AQ0805	1.2	3.0	1.3
AQ1206	2.2	4.2	1.6
AQ1210	2.2	4.2	2.8
AQ2010	3.5	6.1	2.8
AQ2512	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:  $25 \pm 5^{\circ}\text{C}$
- Humidity:  $60 \pm 15\% \text{RH}$
- 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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