

# AL Series

## Automotive Low Resistance Thick Film Chip Resistors

Version. B



### FEATURE

- AEC-Q200 Qualified
- Superior Anti-Sulfur performance
- Standard SMT structure for highly efficient process
- High stability and reliability
- Low resistance value down to 10mΩ
- Superior TCR performance narrow to  $\pm 100$  PPM/°C
- RoHS complaint
- Applications:
  - Multimedia entertainment, Vehicle navigation, Audio control unit
  - Electric door and window, electric seat control unit
  - Reversing image radar
  - Automotive lighting and control unit
  - Consumer electronics, etc.

### MANUFACTURER PART NO.

For example: AL0805J0R47T5G00-AL0805  $\pm 5\%$  0.47Ω T/R-5000

Series	Size	Tol.	Value	PKG	SPQ	Feature	TCR
2 codes	4 codes	1 code	2~5 codes	1 code	1 code	1 code	2 codes
AL	0805	J	0R47	T	5	G	00
Automotive Low Resistance Thick Film Chip Resistors	0402 0603 0805 1206 1210 2010 2512	F= $\pm 1\%$ J= $\pm 5\%$	0R01 <sup>①</sup> =0.01Ω 0R1=0.1Ω 0R47=0.47Ω	T=T/R <sup>②</sup>	4=4K 5=5K A=10K	G=Std. S=P.C. <sup>③</sup>	00=Refer to table as below.

Note: ① R=Radix, 10<sup>0</sup>, Ω

② T/R=Taping in Reel package type

③ P.C.=Personal and Customized.

### CHARACTERISTICS

Type	Power Rating	Max. Current Rated	Max. Current Overload	Tolerance	TCR	Resistance Range
AL0402	1/8W	1.58A	3.95A	$\pm 1\%$ , $\pm 5\%$	$\pm 700$ PPM/°C	50mΩ $\leq$ R < 100mΩ
					$\pm 200$ PPM/°C	100mΩ $\leq$ R $\leq$ 1000mΩ
AL0603	1/5W	4.47A	11.18A	$\pm 1\%$ , $\pm 5\%$	$\pm 1500$ PPM/°C	10mΩ $\leq$ R < 15mΩ
					$\pm 1000$ PPM/°C	15mΩ $\leq$ R < 20mΩ
					$\pm 800$ PPM/°C	20mΩ $\leq$ R < 30mΩ
					$\pm 600$ PPM/°C	30mΩ $\leq$ R < 33mΩ
					$\pm 400$ PPM/°C	33mΩ $\leq$ R $\leq$ 50mΩ
					$\pm 300$ PPM/°C	50mΩ < R $\leq$ 100mΩ
AL0805	1/4W	5.00A	12.50A	$\pm 1\%$ , $\pm 5\%$	$\pm 800$ PPM/°C	10mΩ $\leq$ R $\leq$ 15mΩ
					$\pm 600$ PPM/°C	15mΩ < R $\leq$ 25mΩ
					$\pm 400$ PPM/°C	25mΩ < R $\leq$ 50mΩ
					$\pm 200$ PPM/°C	50mΩ < R $\leq$ 200mΩ
AL1206	1/3W	5.77A	14.43A	$\pm 1\%$ , $\pm 5\%$	$\pm 100$ PPM/°C	200mΩ < R $\leq$ 1000mΩ
					$\pm 700$ PPM/°C	10mΩ $\leq$ R < 15mΩ
					$\pm 400$ PPM/°C	15mΩ $\leq$ R $\leq$ 30mΩ
					$\pm 300$ PPM/°C	30mΩ < R $\leq$ 50mΩ
					$\pm 200$ PPM/°C	50mΩ < R $\leq$ 100mΩ
					$\pm 150$ PPM/°C	100mΩ < R $\leq$ 1000mΩ

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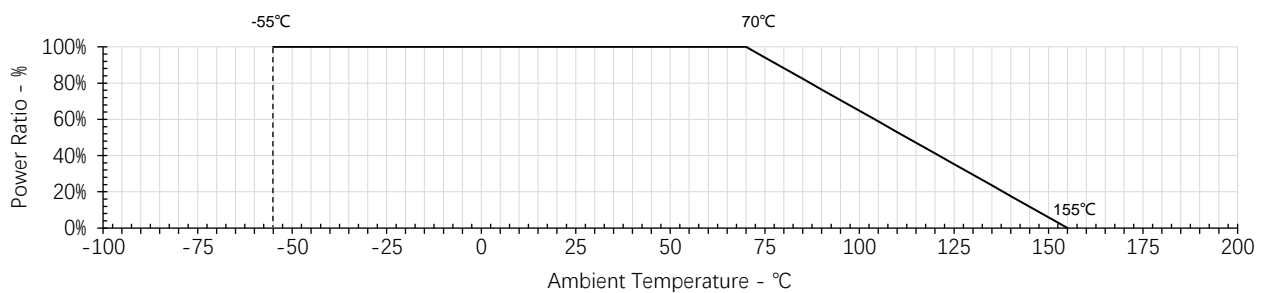
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Type	Power Rating	Max. Current Rated	Max. Current Overload	Tolerance	TCR PPM/°C	Resistance Range
AL1210	1/2W	7.07A	17.67A	±1%, ±5%	±500 PPM/°C	10mΩ ≤ R < 15mΩ
					±400 PPM/°C	15mΩ ≤ R < 20mΩ
					±300 PPM/°C	20mΩ ≤ R ≤ 50mΩ
					±100 PPM/°C	50mΩ < R ≤ 1000mΩ
AL2010	3/4W	8.66A	21.65A	±1%, ±5%	±600 PPM/°C	10mΩ ≤ R < 15mΩ
					±500 PPM/°C	15mΩ ≤ R < 20mΩ
					±300 PPM/°C	20mΩ ≤ R ≤ 30mΩ
					±200 PPM/°C	30mΩ < R ≤ 50mΩ
					±150 PPM/°C	50mΩ < R ≤ 100mΩ
AL2512	1W	10.00A	25.00A	±1%, ±5%	±600 PPM/°C	10mΩ ≤ R < 15mΩ
					±400 PPM/°C	15mΩ ≤ R < 20mΩ
					±300 PPM/°C	20mΩ ≤ R ≤ 30mΩ
					±200 PPM/°C	30mΩ < R ≤ 50mΩ
					±150 PPM/°C	50mΩ < R ≤ 100mΩ
					±100 PPM/°C	100mΩ < R ≤ 1000mΩ

### POWER DERATING CURVE



Note: Operating Temperature Range: -55°C ~ +155°C

### RATED CURRENT

The resistor shall have a Rated Current which would be DC or AC corresponding to the Rated Power, and it can be calculated by formula as below.

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

Formula:

$$I = \sqrt{P/R}$$

I=Rated current (A)

P=Rated power (W)

R=Nominal resistance (Ω)

### DIMENSIONS

Figure	Type	L	W	H	A	B
	AL0402	1.00±0.10	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10
	AL0603	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20
	AL0805	2.00±0.15	1.25±0.15	0.55±0.10	0.40±0.20	0.40±0.20
	AL1206	3.10±0.15	1.55±0.15	0.55±0.10	0.45±0.20	0.45±0.20
	AL1210	3.10±0.10	2.60±0.20	0.55±0.10	0.50±0.25	0.50±0.20
	AL2010	5.00±0.10	2.50±0.20	0.55±0.10	0.60±0.25	0.50±0.20
	AL2512	6.35±0.10	3.20±0.20	0.55±0.10	0.60±0.25	0.80±0.30

Unit: mm

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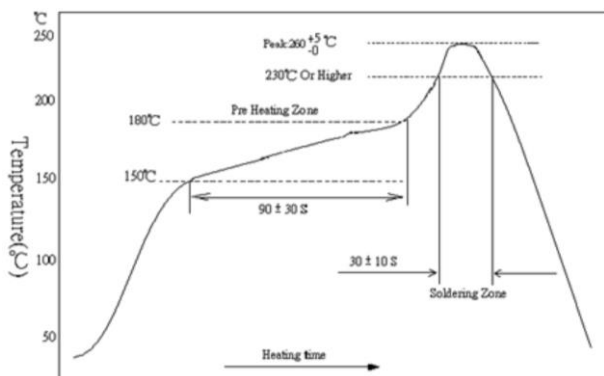
### RELIABILITY

Item	Test Method	Acceptable Criterion								
High Temperature Exposure	+155°C, 1000hrs., unpowered, measure the resistance change rate after test. <b>Reference: AEC-Q200 Test 3, MIL-STD-202 Method 108</b>	1% Series: $\Delta R/R = \pm 1.0\%$ 5% Series: $\Delta R/R = \pm 2.0\%$								
Temperature Cycling	-55~+125°C, slope 10~20°C/min, dwell time 15min, 1000 cycles <b>Reference: AEC-Q200 Test 4, JESD22 Method JA-104</b>	$\Delta R/R = \pm 2.0\%$								
Biased Humidity	85°C, 85%RH, load 10% rated power, 1000hrs., take it out and stabilized 24 hrs. then measure the change rate of resistance value <b>Reference: AEC-Q200 TEST 7, MIL-STD-202 Method 103</b>	1% Series: $\Delta R/R = \pm 2.0\%$ 5% Series: $\Delta R/R = \pm 3.0\%$								
Operational Life	125°C, rated voltage (calculated according to derating curve), 1000 hrs., with cycle 90 min ON, 30 min OFF <b>Reference: AEC-Q200 Test 8, MIL-STD -202 Method 108</b>	1% Series: $\Delta R/R = \pm 2.0\%$ 5% Series: $\Delta R/R = \pm 3.0\%$								
Resistance to Solvent	Immerse in isopropanol solvent at room temperature (23±5°C) for 5min, wipe 10 times with a hard toothbrush, repeat 3 times, take them out to stabilize. <b>Reference: AEC-Q200 Test 12, MIL-STD-202 Method 215</b>	No visible damage								
Resistance to Soldering Heat	Soak in a tin furnace at 260±5°C for 10±1 seconds, take out and stand for more than 60 minutes, then measure the change rate of resistance value. <b>Reference: AEC-Q200 TEST 15, MIL-STD-202 Method 210</b>	$\Delta R/R = \pm 1.0\%$								
ESD	Human body mode, two discharges, positive and negative polarity once each <table border="1" style="margin-left: 20px;"> <tr> <td>Size</td> <td>0402, 0603</td> <td>0805 and above</td> </tr> <tr> <td>Test Voltage</td> <td>1000V</td> <td>2000V</td> </tr> </table> <b>Reference: AEC-Q200 Test 17, AEC-Q200-002</b>	Size	0402, 0603	0805 and above	Test Voltage	1000V	2000V	$\Delta R/R = \pm 2.0\%$		
Size	0402, 0603	0805 and above								
Test Voltage	1000V	2000V								
Solderability	Pretreatment: dry heat 155°C, 4 hrs. or PCT aging for 4 hrs. (equivalent), after take out, stand at room temperature for 2 hrs. Test method: 1. Dip the resistance in a tin furnace at +245±3°C for 3 seconds, then take it out and observe the solder area under a microscope; 2. Reflow soldering test, Peak Temperature: +235°C, T=40± 5 seconds. <b>Reference: AEC-Q200 Test 18, J-STD-002 &amp; IEC 60115-1 11.1.4.3</b>	Soldering coverage over 95% At the edge of terminal, the object underneath (e.g., white ceramic) shall not expose.								
Electrical Characterization	$TCR(PPM/^\circ C) = \frac{(R_2 - R_1)}{R_1 \times (T_2 - T_1)} \times 10^6$ $R_1$ : Resistance value tested at room temperature ( $\Omega$ ) $R_2$ : Resistance value tested at -55°C or +125°C $T_1$ : Temperature at room temperature ( $^\circ C$ ) $T_2$ : Temperature at -55°C or +125°C <b>Reference: AEC-Q200 Test 19, IEC 60115-1 6.2</b>	Details in table CHARACTERISTIC								
Board Flex	The SMD resistance was welded to the test board and bent with the standard pressure block. After standing for 60 sec. under the corresponding deformation condition, the change rate of resistance value of the part was tested. <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	$\Delta R/R = \pm 1.0\%$
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 <b>Reference: AEC Q200-005</b>	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. <b>Reference: IEC 60115-1 8.1.4.2</b>	1% Series: $\Delta R/R = \pm 1.0\%$ 5% Series: $\Delta R/R = \pm 2.0\%$								
Mechanical shock	Half sine wave, acceleration 100g's, each three times in X, Y and Z directions, pulse width 6ms. <b>Reference: AEC-Q200 Test 13, MIL-STD -202 Method 213</b>	$\Delta R/R = \pm 1.0\%$								
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. <b>Reference: AEC-Q200 Test 14, MIL-STD -202 Method 204</b>	$\Delta R/R = \pm 1.0\%$								
Flammability	V-0 <b>Reference: AEC-Q200 Test 20, UL-94</b>	Without flash, and igniting the cotton below.								
Flame retardancy	9 V <sub>dc</sub> to 32 V <sub>dc</sub> (clamp current 500A) in each increment 1 V <sub>dc</sub> for 1 hr. <b>Reference: AEC-Q200 Test 24, AEC-Q200-001</b>	1. Nonflammable 2. Do not explode 3. The temperature cannot be higher than 350°C for 10 seconds								
FOS	Put the test sample resistor in sulfur vapor, at a temperature of 105±2°C for 750hrs <b>Reference: ASTM-B-809-95&amp;EIA977</b>	$\Delta R/R = \pm 4.0\%$								

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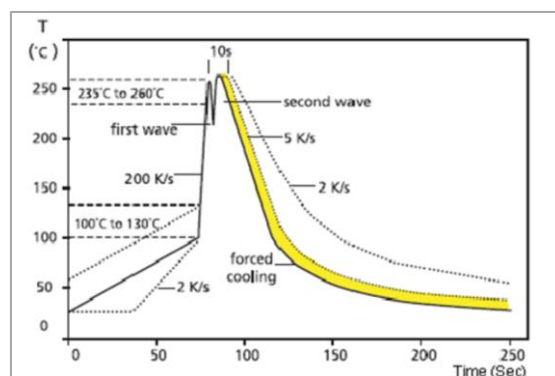
### SOLDERING

Lead Free IR Reflow Soldering Profile



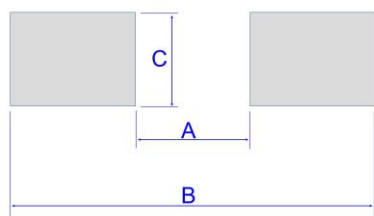
- Top temperature should be under 260 +5/-0 °C ,10Sec.
- Reference: J-STD-020D

Lead Free Double-Wave Soldering Profile



- Suitable for 0603 above size products
- 350±10°C within 3 Sec. for soldering iron.

### SOLDERING PAD



Unit: mm

Type	A	B	C
AL0402	0.5	1.5	0.6
AL0603	0.8	2.1	0.9
AL0805	1.2	3.0	1.3
AL1206	2.2	4.2	1.6
AL1210	2.2	4.2	2.8
AL2010	3.5	6.1	2.8
AL2512	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 Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub> and NO<sub>2</sub>, 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 CONDITION

- Temperature: 20±15°C
- Humidity: 60±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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