

1 Scope

- 1.1 This specification is applicable to lead free and halogen free of ROHS directive for RAA series thick film chip resistors array.
- 1.2 This product is for automotive electronic application.
- 1.3 AEC-Q200 qualified , grade 1.

2 Explanation Of Part Numbers

(EX)

Type	Size	Number of Circuits	Terminal Type	Nominal Resistance		Resistance Tolerance	Packaging (Refer to IE-SP-055)
Thick Film Chip Resistors Array for automotive grade	02(0402) 03(0603)	2:2 circuits 4:4 circuits 8:8 circuits	D:Convex	5% (3-Digit)	EX.10Ω=100 4.7Ω=4R7 JUMPER=000	D=± 0.5% F=± 1% J=± 5%	TH : 2 mm Pitch Carrier Tape 10000 pcs H2 : 2 mm Pitch Carrier Tape 20000 pcs H3 : 2 mm Pitch Carrier Tape 30000 pcs H4 : 2 mm Pitch Carrier Tape 40000 pcs H5 : 2 mm Pitch Carrier Tape 50000 pcs TP : 4 mm Pitch Carrier Tape 5000 pcs P2 : 4 mm Pitch Carrier Tape 10000 pcs P3 : 4 mm Pitch Carrier Tape 15000 pcs P4 : 4 mm Pitch Carrier Tape 20000 pcs
				0.5% 1% (4-Digit)	EX. 10.2Ω=10R2 10KΩ=1002		

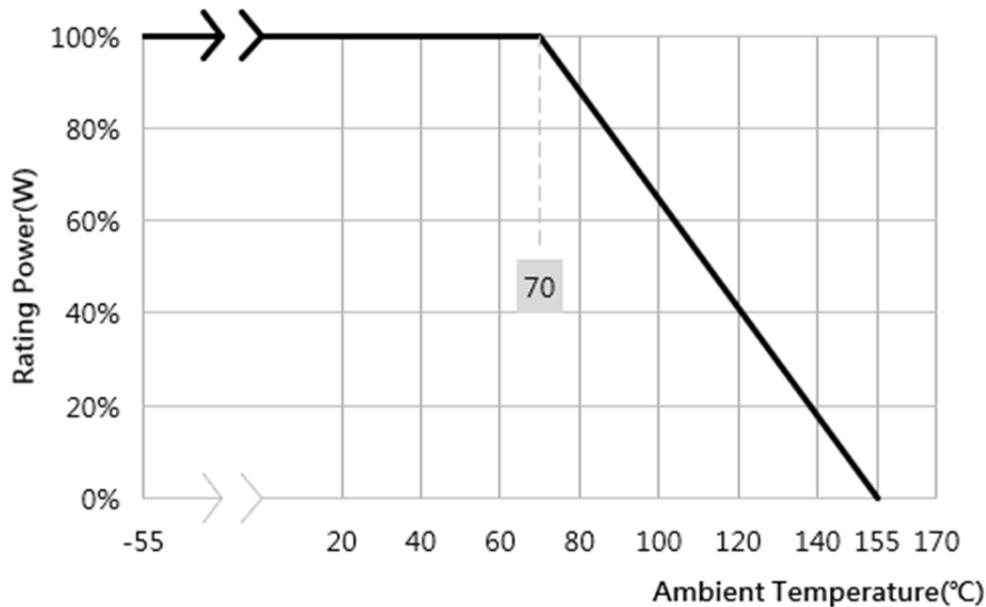
3 General Specifications

Type	Rated Power at 70°C	Max. Working Voltage	Max. Overload Voltage	T.C.R. (ppm/°C)	Resistance Range			Number of Terminals	Number of Resistors	JUMPER (0Ω)	JUMPER (0Ω)
					D(±0.5%) E-24 · E-96	F(±1%) E-24 · E-96	J(±5%) E-24			J (±5%)	J (±5%)
RAA02-2D (0402)	1/16 W	25V	50V	±300	-----	1Ω≤R<10Ω	1Ω≤R<10Ω	4	2	1A	50mΩ MAX.
				±200	-----	10Ω≤R≤10MΩ	10Ω≤R≤10MΩ				
RAA03-2D (0603)	1/16 W	50V	100V	±200	-----	10Ω≤R≤10MΩ	1Ω≤R≤10MΩ	4	2	1A	50mΩ MAX.
RAA02-4D (0402)	1/16 W	25V	50V	±300	-----	1Ω≤R<10Ω	1Ω≤R<10Ω	8	4	1A	50mΩ MAX.
				±200	-----	10Ω≤R≤10MΩ	10Ω≤R≤10MΩ				
RAA03-4D (0603)	1/16 W	50V	100V	±200	22Ω≤R≤470KΩ	1Ω≤R≤10MΩ	1Ω≤R≤10MΩ	8	4	1A	50mΩ MAX.
RAA02-8D (0402)	1/16 W	25V	50V	±250	-----	10Ω≤R≤10MΩ	1Ω≤R≤10MΩ	16	8	1A	50mΩ MAX.
Operating Temperature Range				- 55°C ~ +155°C							

3.1 Power Derating Curve :

Operating Temperature Range : - 55 ~ 155 °C

For resistors operated in ambient temperatures above 70°C, power rating shall be derated in accordance with figure below.



3.2 Voltage Rating :

The resistor shall have a DC continuous working voltage or a rms. AC continuous working voltage at commercial-line frequency and wave form corresponding to the power rating, as determined from the following:

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

E=額定電壓(V)

R=公稱阻值(Ω)

P=額定功率(W)

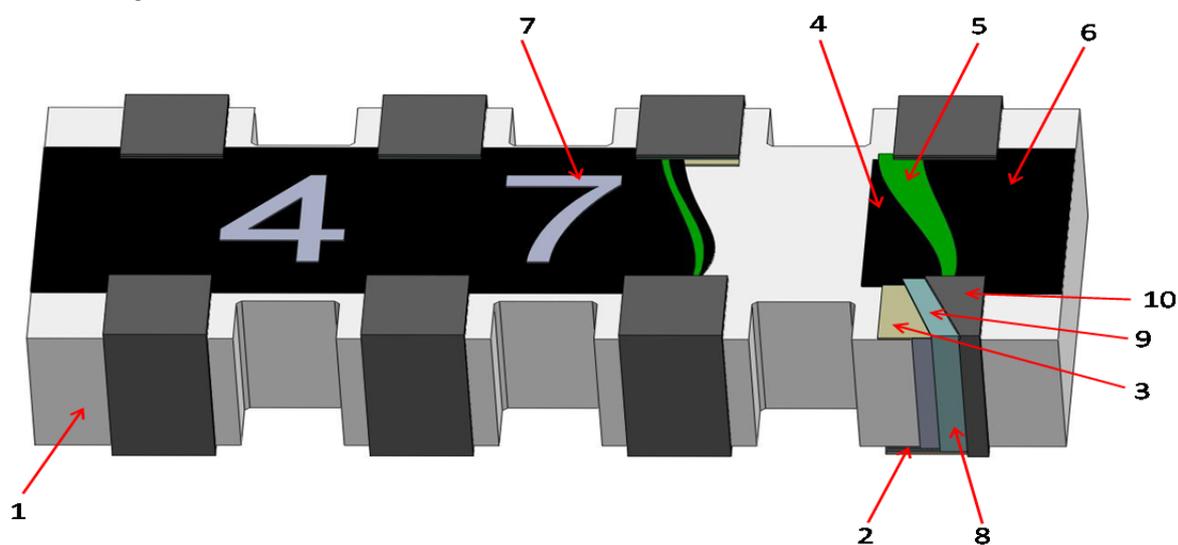
4 Dimensions(mm)

<p style="text-align: center;">RAA03-2D</p>	<p style="text-align: center;">Circuits</p> <p style="text-align: center;">$R1=R2$</p>
<p style="text-align: center;">RAA02-4D / RAA03-4D</p>	<p style="text-align: center;">Circuits</p> <p style="text-align: center;">$R1=R2=R3=R4$</p>
<p style="text-align: center;">RAA02-8D</p>	<p style="text-align: center;">Circuits</p> <p style="text-align: center;">$R1=R2=R3=R4=R5=R6=R7=R8$</p>
<p style="text-align: center;">RAA02-2D</p>	<p style="text-align: center;">Circuits</p> <p style="text-align: center;">$R1=R2$</p>

Unit : mm

DIM TYPE	L	W	H	L1	L2	P	Q
RAA02-2D (0402)	1.00±0.10	1.00±0.10	0.30±0.05	0.15±0.10	0.25±0.10	(0.67)	0.33±0.10
RAA03-2D (0603)	1.60±0.15	1.60±0.15	0.45±0.10	0.30±0.15	0.30±0.15	(0.80)	0.60±0.10
RAA02-4D (0402)	2.00±0.10	1.00±0.10	0.40±0.10	0.20±0.10	0.25±0.10	(0.50)	0.30±0.10
RAA03-4D (0603)	3.20±0.20	1.60±0.15	0.50±0.10	0.30±0.15	0.30±0.15	(0.80)	0.50±0.10
RAA02-8D (0402)	4.00±0.20	1.60±0.10	0.40±0.10	0.30±0.15	0.30±0.10	(0.50)	0.25±0.10

5 Structure Graph



1	Ceramic substrate	6	2nd Protective coating
2	Bottom inner electrode	7	Marking
3	Top inner electrode	8	Terminal inner electrode
4	Resistive layer	9	Ni plating
5	1st Protective coating	10	Sn plating

6 Reliability Test

Item	Conditions	Specifications	
		Resistors	Jumper
High Temperature Exposure (Storage)	Put the specimens in the chamber with temperature of $155\pm 3^{\circ}\text{C}$ for 1000 hours. Then take them out to stabilize in room temperature for 24 ± 4 hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	0.5%、1% : $\Delta R = \pm 1.0\%$ 5% : $\Delta R = \pm 2.0\%$	Refer to item 3. general specifications
Temperature Cycling	$-55\sim +155^{\circ}\text{C}$, soak time 30min · Transition Time :1minute, 1000 cycles . JESD22 Method JA-104	$\Delta R = \pm 2.0\%$	Refer to item 3. general specifications
Short Time Overload	Applied 2.5 times rated voltage for 5 seconds and release the load for about 30 minutes, then measure its resistance variance rate. (Rated voltage refer to item 3. general specifications) Refer to JIS-C5201-1 4.13	0.5%、1% : $\Delta R = \pm 1.0\%$ 5% : $\Delta R = \pm 2.0\%$	Refer to item 3. general specifications
Biased Humidity	Solder the specimens on the test PCB and put them into the constant temperature humidity chamber with $85\pm 2^{\circ}\text{C}$ and $85\pm 5\% \text{RH}$. Then apply the test voltage that calculates based on the 10% of rated power for 1000hrs. Then take them out to stabilize in room temperature for 24 ± 4 hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	0.5%、1% : $\Delta R = \pm 2.0\%$ 5% : $\Delta R = \pm 3.0\%$	Refer to item 3. general specifications
Operational Life	Put the tested resistor in chamber under temperature $70\pm 2^{\circ}\text{C}$ and load the rated voltage for 90 minutes on, 30 minutes off, total 1000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate MIL-STD-202 Method 108	0.5%、1% : $\Delta R = \pm 2.0\%$ 5% : $\Delta R = \pm 3.0\%$	Refer to item 3. general specifications
Resistance to Soldering Heat	The specimens are fully immersed into the Pb-free solder pot, then take them out to stabilize for 1 hour or more and measure of its resistance variance rate. Temp of solder pot : $260\pm 5^{\circ}\text{C}$ Soldering duration : 10 ± 1 sec. Experiment evidence AEC-Q200	$\Delta R = \pm 1.0\%$	Refer to item 3. general specifications

Item	Conditions	Specifications	
		Resistors	Jumper
ESD	Put the specimens on the test fixture and two (2) discharges (2KV DC) shall be applied to each PUT, one (1) with a positive polarity and one (1) with a negative polarity. Afterwards, the specimens stabilize for 30min or more and measure of its resistance variance rate. The test is performed with direct contact and regular discharge mode. The resistor and capacitor used on the spearhead is 2000Ω and 150pF respectively. Experiment evidence AEC-Q200	ΔR= ±3.0%	Refer to item 3. general specifications
Solderability	Test method: Test item 1 (solder pot test): Method B Precondition: The specimens are subjected to 155°C dry bake for 4hrs±15min. The specimens are immersed into the flux first, then fully immersed into the solder pot, at a temperature of 235± 5°C for 5+0/-0.5 sec. Then rinse with water and observe the soldering coverage under the microscope. Test item 2 (Leaching test): Method D The specimens are immersed into the flux first, then fully immersed into the solder pot, at a temperature of 260±5°C for 30+0/-0.5 sec. Then rinse with water and observe the soldering coverage under the microscope. Experiment evidence AEC-Q200	<ol style="list-style-type: none"> 1. Soldering coverage over 95% 2. At the edge of terminal, the object underneath (e.g. white ceramic) shall not expose. 	
Electrical Characterization	$TCR \left(ppm / ^\circ C \right) = \frac{R2-R1}{R1(T2-T1)} \times 10^6$ R1: Resistance at room temperature (Ω) R2: Resistance at -55°C or +125°C(Ω) T1: Room temperature (°C) T2: Temperature -55°C or +125°C Experiment evidence: AEC-Q200	Refer to item 3. general specifications	NA

Item	Conditions		Specifications	
			Resistors	Jumper
Board Flex (Bending Test)	Solder the specimens on the test PCB and put the PCBA onto the Bending Tester. Add force at the central part of PCB, and the duration of the applied forces shall be 60 (+ 5) Sec. Measure of its resistance variance rate in load. Bending depth (D)=5mm Experiment evidence: AEC-Q200		$\Delta R = \pm 1.0\%$	Refer to item 3. general specifications
			No mechanical damage, peeling off of side end or chip crack.	
Sulfuration Test	Class : A	Put the tested resistor in sulfur vapor, at a temperature of $60 \pm 2^\circ\text{C}$ for 1000hrs Refer to ASTM-B-809-95&EIA977	$\Delta R = \pm 4.0\%$	Refer to item 3. general specifications

7 Plating Thickness

7.1 Ni : $\geq 2\mu\text{m}$

7.2 Sn(Tin) : $\geq 3\mu\text{m}$

7.3 Sn(Tin) : Matte Sn

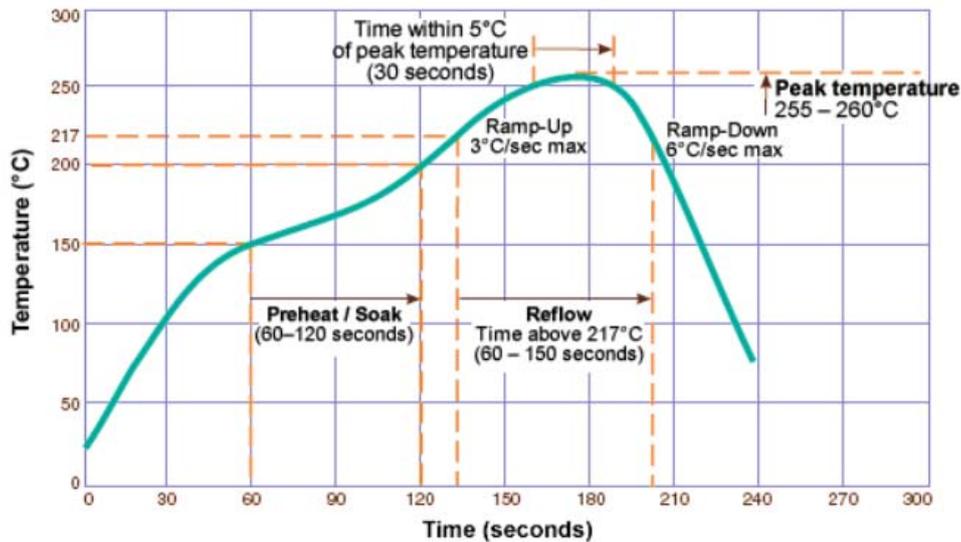
8 Rule of package empty quantity

Each reel that empty quantities don't exceed 0.1% of whole quantities and continuous 2pcs (included) are allowed.

9 Technical application notes: (This is for recommendation, please customer perform adjustment according to actual application)

9.1 Recommend Soldering Method:

(a) Lead Free IR-Reflow Soldering Profile (MEET J-STD-020)



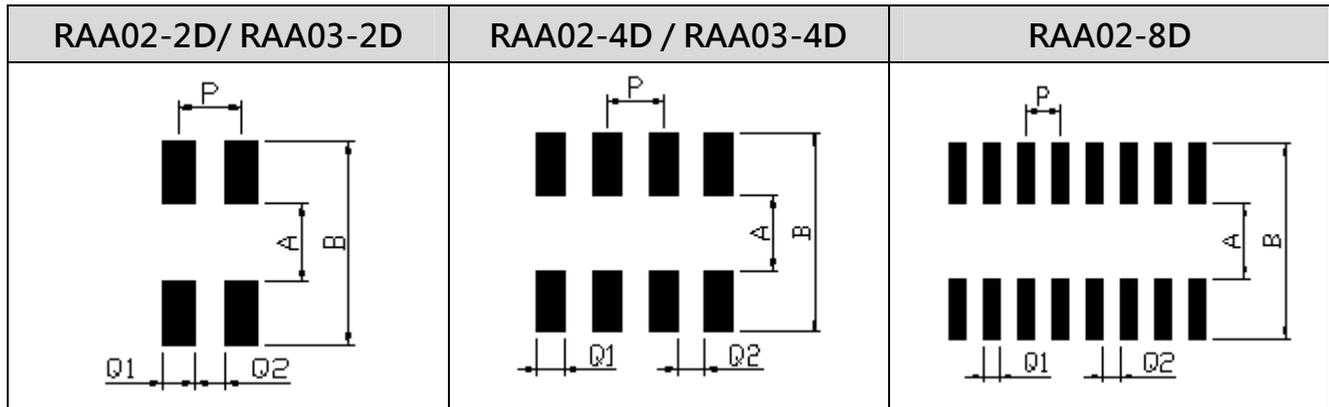
Remark : The peak temperature of soldering heat is $260 +5/-0$ °C for 10 Seconds.

(b) Soldering Iron: temperature $350^{\circ}\text{C} \pm 10^{\circ}\text{C}$, dwell time shall be less than 3 sec.

9.2 Recommend Land Pattern Design (For Reflow Soldering) :

When a component is soldered, the resistance after soldering changes slightly depending on the size of the soldering area and the amount of soldering. When designing a circuit, it is necessary to consider the effect of a decrease or increase in its resistance.

Unit : mm



TYPE \ DIM	A	B	P	Q1	Q2
RAA02-2D	0.50	2.00	0.67	0.33	0.34
RAA03-2D	1.00	2.60	0.80	0.40	0.40
RAA02-4D	0.50	2.00	0.50	0.28	0.22
RAA03-4D	1.00	2.60	0.80	0.40	0.40
RAA02-8D	1.00	2.60	0.50	0.25	0.25

9.3 Automobile Electronic Application:

This specification is for automobile electronic use. RALEC will take no responsibility if any damage, cost or loss occurs when the product has been used in any special circumstances.

- (a) Information 、 entertainment 、 navigation 、 audio control units.
- (b) Comfortable door, window, seat control unit.
- (c) Internal lighting control unit.

9.4 Environment Precautions:

If consumer intends to use our company product in special environment or condition (including but not limited to those mentioned below), then will need to make individual recognition of product features and reliability accordingly.

- (a) Used in high temperature and humidity environment
- (b) Exposed to sea breeze or other corrosive gas, such as Cl₂ 、 H₂S 、 NH₃ 、 SO₂ and NO₂.
- (c) Used in non-verified liquids including water, oil, chemical and organic solvents.
- (d) Using non-verified resin or other coating material to seal or coat our Company product.
- (e) After soldering, it is necessary to use water-soluble detergents to clean residual solder fluxes, even though no-clean fluxes are recommended.

9.5 Momentary Overload Precautions:

The product might be out of function when momentary overloaded. Please make sure to avoid momentary overloading while using and preserving.

9.6 Operation and Processing Precautions:

- (a) Avoid damage to the edge of resistor and protective layer caused by mechanical stress.
- (b) Handle with care when printing circuit board (PCB) is divided or fixed on support body, because bending of printing circuit board (PCB) mounting will make mechanical stress for resistors.
- (c) Make sure the power rating is under the limit when using the resistor. When power rating is over the limit, the resistor will be overloaded. There might be machinery damage due to the climbing temperature
- (d) If the resistor will be exposed under massive impact load (shock wave) in a short period of time, the working environment must be set up well before use.
- (e) Please make evaluation and confirmation when the product is well used in your company and have a through consideration of its fail-safe design to ensure the system safety.

10 Storage and transportation requirement

- 10.1 The temperature condition must be controlled at $25\pm 5^{\circ}\text{C}$, the R.H. must be controlled at $60\pm 15\%$. The stock can maintain quality level in two years.
- 10.2 Please avoid the mentioned harsh environment below when storing to ensure product performance and its' weldability. Places exposed to sea breeze or other corrosive gas, such as Cl_2 、 H_2S 、 NH_3 、 SO_2 and NO_2 .
- 10.3 When the product is moved and stored, please ensure the correct orientation of the box. Do not drop or squeeze the box. Otherwise, the electrode or the body of the product may be damaged.

11 The carton packaged for electronic-information products is made by the symbol as follows: (For China)

	
<p>Marking for control of pollution cause by electronic-information products</p>	<p>Marking for package recovery</p>

12 Attachments

12.1 Document Revise Record Paper(QA-QR-027)

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