

## Automotive, Sulfur Resistant Lead (Pb)-Free Thick Film, Rectangular Chip Resistors



### FEATURES

- Superior resistance against H<sub>2</sub>S-atmosphere
- Stability  $\Delta R/R = 1\%$  for 1000 h at 70 °C
- Metal glaze on high quality ceramic
- Pure tin solder contacts on Ni barrier layer, provides compatibility with lead (Pb)-free and lead containing soldering processes
- AEC-Q200 qualified, rev. C compliant
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

| STANDARD ELECTRICAL SPECIFICATIONS  |                |                  |   |                                 |   |                  |                           |          |
|---|----------------|------------------|---|---------------------------------|---|------------------|---------------------------|----------|
| MODEL   | CASE SIZE INCH | CASE SIZE METRIC | POWER RATING $P_{70\text{ }^\circ\text{C}}$ W | LIMITING ELEMENT VOLTAGE MAX. V | TEMPERATURE COEFFICIENT ppm/K   | TOLERANCE %      | RESISTANCE RANGE $\Omega$ | SERIES   |
| RCA0402   | 0402           | RR1005           | 0.063   | 50                              | $\pm 50$  | $\pm 0.5, \pm 1$ | 100 to 1.0M               | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 0.5$        | 10 to 1.0M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 1$          | 10 to 10M                 | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 1$          | 1.0 to 9.76               | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 5$          | 1.0 to 10M                | E24      |
| Zero-Ohm-Resistor: $R_{\text{max.}} = 20 \text{ m}\Omega, I_{\text{max.}}$ at 70 °C = 1.5 A |                |                  |   |                                 |   |                  |                           |          |
| RCA0603   | 0603           | RR1608           | 0.10  | 75                              | $\pm 50$  | $\pm 0.5, \pm 1$ | 100 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 0.5$        | 10 to 10M                 | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 1$          | 1.0 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 5$          | 1.0 to 10M                | E24      |
|   |                |                  |   |                                 | Zero-Ohm-Resistor: $R_{\text{max.}} = 20 \text{ m}\Omega, I_{\text{max.}}$ at 70 °C = 2.0 A |                  |                           |          |
| RCA0805   | 0805           | RR2012           | 0.125   | 150                             | $\pm 50$  | $\pm 0.5, \pm 1$ | 100 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 0.5$        | 10 to 10M                 | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 1$          | 1.0 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 5$          | 1.0 to 10M                | E24      |
|   |                |                  |   |                                 | Zero-Ohm-Resistor: $R_{\text{max.}} = 20 \text{ m}\Omega, I_{\text{max.}}$ at 70 °C = 2.5 A |                  |                           |          |
| RCA1206   | 1206           | RR3216           | 0.25  | 200                             | $\pm 50$  | $\pm 0.5, \pm 1$ | 100 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 0.5$        | 10 to 10M                 | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 1$          | 1.0 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 5$          | 1.0 to 10M                | E24      |
|   |                |                  |   |                                 | Zero-Ohm-Resistor: $R_{\text{max.}} = 20 \text{ m}\Omega, I_{\text{max.}}$ at 70 °C = 3.5 A |                  |                           |          |
| RCA1210   | 1210           | RR3225           | 0.5   | 200                             | $\pm 50$  | $\pm 0.5, \pm 1$ | 100 to 1.0M               | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 0.5$        | 10 to 1.0M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 1$          | 1.0 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 5$          | 1.0 to 10M                | E24      |
|   |                |                  |   |                                 | Zero-Ohm-Resistor: $R_{\text{max.}} = 20 \text{ m}\Omega, I_{\text{max.}}$ at 70 °C = 5.0 A |                  |                           |          |
| RCA1218   | 1218           | RR3246           | 1.0   | 200                             | $\pm 50$  | $\pm 0.5, \pm 1$ | 100 to 2.2M               | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 0.5$        | 100 to 2.2M               | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 1$          | 1.0 to 2.2M               | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 5$          | 1.0 to 2.2M               | E24      |
|   |                |                  |   |                                 | Zero-Ohm-Resistor: $R_{\text{max.}} = 20 \text{ m}\Omega, I_{\text{max.}}$ at 70 °C = 7.0 A |                  |                           |          |
| RCA2010   | 2010           | RR5025           | 0.75  | 400                             | $\pm 50$  | $\pm 0.5, \pm 1$ | 100 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 0.5$        | 10 to 10M                 | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 1$          | 1.0 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 5$          | 1.0 to 10M                | E24      |
|   |                |                  |   |                                 | Zero-Ohm-Resistor: $R_{\text{max.}} = 20 \text{ m}\Omega, I_{\text{max.}}$ at 70 °C = 6.0 A |                  |                           |          |
| RCA2512   | 2512           | RR6332           | 1.0   | 500                             | $\pm 50$  | $\pm 0.5, \pm 1$ | 100 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 0.5$        | 10 to 10M                 | E24; E96 |
|   |                |                  |   |                                 | $\pm 100$   | $\pm 1$          | 1.0 to 10M                | E24; E96 |
|   |                |                  |   |                                 | $\pm 200$   | $\pm 5$          | 1.0 to 10M                | E24      |
|   |                |                  |   |                                 | Zero-Ohm-Resistor: $R_{\text{max.}} = 20 \text{ m}\Omega, I_{\text{max.}}$ at 70 °C = 7.0 A |                  |                           |          |

### Notes

- These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional time.
- Marking: See document "Surface Mount Resistor Marking" (document number 20020).
- Power rating depends on the max. temperature at the solder point, the component placement density and the substrate material.



| TECHNICAL SPECIFICATIONS                   |             |                        |         |         |         |         |         |         |         |
|--|-------------|------------------------|---------|---------|---------|---------|---------|---------|---------|
| PARAMETER                                  | UNIT        | RCA0402                | RCA0603 | RCA0805 | RCA1206 | RCA1210 | RCA1218 | RCA2010 | RCA2512 |
| Rated dissipation $P_{70}$ <sup>(1)</sup>  | W           | 0.063                  | 0.10    | 0.125   | 0.25    | 0.5     | 1.0     | 0.75    | 1.0     |
| Limiting element voltage $U_{max}$ . AC/DC | V           | 50                     | 75      | 150     | 200     | 200     | 200     | 400     | 500     |
| Insulation voltage $U_{ins.}$ (1 min)      | V           | > 75                   | > 100   | > 200   | > 300   | > 300   | > 300   | > 300   | > 300   |
| Insulation resistance                      | $\Omega$    | > $10^9$               |         |         |         |         |         |         |         |
| Category temperature range                 | $^{\circ}C$ | - 55 to + 155          |         |         |         |         |         |         |         |
| Failure rate                               | $h^{-1}$    | < $0.1 \times 10^{-9}$ |         |         |         |         |         |         |         |
| Mass                                       | mg          | 0.65                   | 2       | 5.5     | 10      | 16      | 29.5    | 25.5    | 40.5    |

**Note**

<sup>(1)</sup> The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heat flow support of the printed-circuit board (thermal resistance). The rated dissipation applies only if the permitted film temperature of 155  $^{\circ}C$  is not exceeded.

| PART NUMBER AND PRODUCT DESCRIPTION  |   |   |   |                                       |   |  |  |   |  |                                  |   |   |   |   |
|--|---|---|---|---------------------------------------|---|--|--|---|--|----------------------------------|---|---|---|---|
| Part Number: RCA080510K0FKEA <sup>(2)</sup>  |   |   |   |                                       |   |  |  |   |  |                                  |   |   |   |   |
| R  | C | A   | 0 | 8                                     | 0   | 5  | 1  | 0   | K  | 0                                | F | K | E | A |
| MODEL  |   | VALUE   |   |                                       | TOLERANCE   |  | TCR  |   | PACKAGING <sup>(3)</sup>                           |                                  |   |   |   |   |
| RCA0402<br>RCA0603<br>RCA0805<br>RCA1206<br>RCA1210<br>RCA1218<br>RCA2010<br>RCA2512 |   | R = Decimal<br>K = Thousand<br>M = Million<br>0000 = 0 $\Omega$ Jumper        |   |                                       | D = $\pm 0.5\%$<br>F = $\pm 1\%$<br>J = $\pm 5\%$<br>Z = Jumper |  | H = $\pm 50$ ppm/K<br>K = $\pm 100$ ppm/K<br>N = $\pm 200$ ppm/K<br>S = Jumper |   | EA<br>EB<br>EC<br>ED<br>EE<br>EF<br>EG<br>EH<br>EK |                                  |   |   |   |   |
| Product Description: RCA0805 10K 1% 100 ET1 e3                                       |   |   |   |                                       |   |  |  |   |  |                                  |   |   |   |   |
| RCA0805  |   | 10K   |   | 1%                                    |   | 100  |  | ET1   |  | e3                               |   |   |   |   |
| MODEL  |   | RESISTANCE VALUE  |   | TOLERANCE                             |   | TCR  |  | PACKAGING <sup>(3)</sup>                            |  | LEAD (Pb)-FREE                   |   |   |   |   |
| RCA0402<br>RCA0603<br>RCA0805<br>RCA1206<br>RCA1210<br>RCA1218<br>RCA2010<br>RCA2512 |   | 10R = 10 $\Omega$<br>10K = 10 k $\Omega$<br>1M = 1 M $\Omega$<br>0R0 = Jumper |   | $\pm 0.5\%$<br>$\pm 1\%$<br>$\pm 5\%$ |   | $\pm 50$ ppm/K<br>$\pm 100$ ppm/K<br>$\pm 200$ ppm/K |  | ET1, ET5<br>ET6, ET7<br>EF4, E02<br>E67, E82<br>ET9 |  | e3 = Pure tin termination finish |   |   |   |   |

**Notes**

- <sup>(2)</sup> Preferred way for ordering products is by use of the PART NUMBER
- <sup>(3)</sup> Please refer to table PACKAGING, see next page

| PACKAGING |            |               |       |              |                |         |               |         |
|-----------|------------|---------------|-------|--------------|----------------|---------|---------------|---------|
| MODEL     | REEL       |               |       |              |                |         |               |         |
|           | TAPE WIDTH | DIAMETER      | PITCH | PIECES/ REEL | PACKAGING CODE |         |               |         |
|           |            |               |       |              | PART NUMBER    |         | PRODUCT DESC. |         |
|           |            |               |       |              | PAPER          | BLISTER | PAPER         | BLISTER |
| RCA0402   | 8 mm       | 180 mm/7"     | 2 mm  | 10 000       | ED             |         | ET7           |         |
|           |            | 285 mm/11.25" | 2 mm  | 20 000       | EC             |         | ET6           |         |
|           |            | 330 mm/13"    | 2 mm  | 50 000       | EE             |         | EF4           |         |
| RCA0603   | 8 mm       | 180 mm/7"     | 4 mm  | 5000         | EA             |         | ET1           |         |
|           |            | 285 mm/11.25" | 4 mm  | 10 000       | EB             |         | ET5           |         |
|           |            | 330 mm/13"    | 4 mm  | 20 000       | EC             |         | ET6           |         |
| RCA0805   | 8 mm       | 180 mm/7"     | 4 mm  | 5000         | EA             |         | ET1           |         |
|           |            | 285 mm/11.25" | 4 mm  | 10 000       | EB             |         | ET5           |         |
|           |            | 330 mm/13"    | 4 mm  | 20 000       | EC             |         | ET6           |         |
| RCA1206   | 8 mm       | 180 mm/7"     | 4 mm  | 5000         | EA             |         | ET1           |         |
|           |            | 285 mm/11.25" | 4 mm  | 10 000       | EB             |         | ET5           |         |
|           |            | 330 mm/13"    | 4 mm  | 20 000       | EC             |         | ET6           |         |
| RCA1210   | 8 mm       | 180 mm/7"     | 4 mm  | 5000         | EA             |         | ET1           |         |
|           |            | 285 mm/11.25" | 4 mm  | 10 000       | EB             |         | ET5           |         |
|           |            | 330 mm/13"    | 4 mm  | 20 000       | EC             |         | ET6           |         |
| RCA1218   | 12 mm      | 180 mm/7"     | 4 mm  | 4000         |                | EK      |               | ET9     |
| RCA2010   | 12 mm      | 180 mm/7"     | 4 mm  | 4000         |                | EF      |               | E02     |
| RCA2512   | 12 mm      | 180 mm/7"     | 8 mm  | 2000         |                | EG      |               | E67     |
|           |            |               | 4 mm  | 4000         |                | EH      |               | E82     |

| DIMENSIONS in millimeters |        |  |             |             |                                       |           |                       |     |     |                |     |     |
|---------------------------|--------|--|-------------|-------------|---------------------------------------|-----------|-----------------------|-----|-----|----------------|-----|-----|
|                           |        |  |             |             |                                       |           |                       |     |     |                |     |     |
| SIZE                      |        | DIMENSIONS                             |             |             |                                       |           | SOLDER PAD DIMENSIONS |     |     |                |     |     |
| INCH                      | METRIC | L                                      | W           | H           | T1                                    | T2        | REFLOW SOLDERING      |     |     | WAVE SOLDERING |     |     |
|                           |        |  |             |             |                                       |           | a                     | b   | l   | a              | b   | l   |
| 0402                      | 1005   | 1.0 ± 0.05                             | 0.5 ± 0.05  | 0.35 ± 0.05 | 0.25 ± 0.05                           | 0.2 ± 0.1 | 0.4                   | 0.6 | 0.5 |                |     |     |
| 0603                      | 1608   | 1.55 <sup>+0.10</sup> <sub>-0.05</sub> | 0.85 ± 0.1  | 0.45 ± 0.05 | 0.3 ± 0.2                             | 0.3 ± 0.2 | 0.5                   | 0.9 | 1.0 | 0.9            | 0.9 | 1.0 |
| 0805                      | 2012   | 2.0 <sup>+0.20</sup> <sub>-0.10</sub>  | 1.25 ± 0.15 | 0.45 ± 0.05 | 0.3 <sup>+0.20</sup> <sub>-0.10</sub> | 0.3 ± 0.2 | 0.7                   | 1.3 | 1.2 | 0.9            | 1.3 | 1.3 |
| 1206                      | 3216   | 3.2 <sup>+0.10</sup> <sub>-0.20</sub>  | 1.6 ± 0.15  | 0.55 ± 0.05 | 0.45 ± 0.2                            | 0.4 ± 0.2 | 0.9                   | 1.7 | 2.0 | 1.1            | 1.7 | 2.3 |
| 1210                      | 3225   | 3.2 ± 0.2                              | 2.5 ± 0.2   | 0.55 ± 0.05 | 0.45 ± 0.2                            | 0.4 ± 0.2 | 0.9                   | 2.5 | 2.0 | 1.1            | 2.5 | 2.2 |
| 1218                      | 3246   | 3.2 <sup>+0.10</sup> <sub>-0.20</sub>  | 4.6 ± 0.15  | 0.55 ± 0.05 | 0.45 ± 0.2                            | 0.4 ± 0.2 | 1.05                  | 4.9 | 1.9 | 1.25           | 4.8 | 1.9 |
| 2010                      | 5025   | 5.0 ± 0.15                             | 2.5 ± 0.15  | 0.6 ± 0.1   | 0.6 ± 0.2                             | 0.6 ± 0.2 | 1.0                   | 2.5 | 3.9 | 1.2            | 2.5 | 3.9 |
| 2512                      | 6332   | 6.3 ± 0.2                              | 3.15 ± 0.15 | 0.6 ± 0.1   | 0.6 ± 0.2                             | 0.6 ± 0.2 | 1.0                   | 3.2 | 5.2 | 1.2            | 3.2 | 5.2 |



FUNCTIONAL PERFORMANCE

| PERFORMANCE IN SULFUR-CONTAINING AMBIANCE  |   |   |
|--|---|---|
| TEST NAME                                  | HUMID SULFUR VAPOR TEST   | HUMID SULFUR VAPOR TEST (Accelerated)   |
| Reference specification                    | ASTM B809-95  | ASTM B809-95 accelerated conditions   |
| Test conditions (temperature, humidity)    | 60 °C ± 2 °C<br>85 % ± 4 % RH   | 90 °C ± 2 °C<br>74 % ± 7 % RH   |
| Aggressive agent                           | Sulfur (saturated vapor)  | Sulfur (saturated vapor)  |
| Failure criteria in VI under magnification | No silver sulfide growth at the interface between termination and protective overcoat. No signs of mechanical damage. | No silver sulfide growth at the interface between termination and protective overcoat. No signs of mechanical damage. |
| Failure criteria in electrical test        | ≤ (± 1 % R + 0.05 Ω)  | ≤ (± 1 % R + 0.05 Ω)  |
| Time before failure                        | 8000 h  | 1000 h  |





| TEST PROCEDURES AND REQUIREMENTS |                            |   |  |   |                                |
|----------------------------------|----------------------------|---|--|---|--------------------------------|
| EN 60115-1<br>CLAUSE             | IEC 60068-2<br>TEST METHOD | TEST                                    | PROCEDURE  | REQUIREMENTS<br>PERMISSIBLE CHANGE ( $\Delta R$ )               |                                |
|                                  |                            |   |  | SIZE 0402   | SIZE 0603 TO 2512              |
|                                  |                            |   |  | STABILITY CLASS 2 OR BETTER                                     |                                |
|                                  |                            |   | Stability for product types:   | 1 $\Omega$ to 10 M $\Omega$                                     |                                |
|                                  |                            |   | RCA e3   | 0.5 %, $\pm 1$ %, $\pm 5$ %                                     |                                |
| 4.5                              | -                          | Resistance                              | -  | 0.5 %, $\pm 1$ %, $\pm 5$ %                                     |                                |
| 4.8.4.2                          | -                          | Temperature coefficient                 | (20/- 55/20) °C and (20/125/20) °C   | $\pm 50$ ppm/K, $\pm 100$ ppm/K, $\pm 200$ ppm/K                |                                |
| 4.13                             | -                          | Short time overload                     | $U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$ ;<br>duration: According to style | $\pm (0.25 \% R + 0.05 \Omega)$                                 |                                |
| 4.19                             | 14 (Na)                    | Rapid change of temperature             | 30 min. at - 55 °C;<br>30 min. at 125 °C<br>5 cycles<br>1000 cycles                              | $\pm (0.25 \% R + 0.05 \Omega)$<br>$\pm (1 \% R + 0.05 \Omega)$ |                                |
| 4.25.1                           | -                          | Endurance at 70 °C                      | $U = \sqrt{P_{70} \times R} \leq U_{max.}$ ;<br>1.5 h on; 0.5 h off;<br>70 °C, 1000 h            | $\pm (1 \% R + 0.05 \Omega)$                                    | $\pm (0.5 \% R + 0.05 \Omega)$ |
| 4.18.2                           | 58 (Td)                    | Resistance to soldering heat            | Solder bath method<br>(260 $\pm$ 5) °C<br>(10 $\pm$ 1) s   | $\pm (0.25 \% R + 0.05 \Omega)$                                 |                                |
| 4.24                             | 78 (Cab)                   | Damp heat, steady state                 | (40 $\pm$ 2) °C;<br>(93 $\pm$ 3) % RH;<br>56 days  | $\pm (1 \% R + 0.05 \Omega)$                                    | $\pm (0.5 \% R + 0.05 \Omega)$ |
| 4.25.3                           | -                          | Endurance at upper category temperature | 155 °C, 1000 h   | $\pm (0.5 \% R + 0.05 \Omega)$                                  |                                |

All tests are carried out in accordance with the following specifications:

- EN 60115-1, generic specification
- EN 140400, sectional specification
- EN 140401-802, detail specification
- AEC-Q200, automotive specification
- IEC 60068-2, environmental test procedures
- ASTM B 809-95, standard test method for porosity in metallic coatings by humid sulfur.

Packaging of components is done in paper or blister tapes according to IEC 60286-3.



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