

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


FEATURES

- Superior resistance against H₂S-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



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 Ω | SERIES |
| RCA0402 | 0402 | RR1005 | 0.063 | 50 | ± 50 | $\pm 0.5, \pm 1$ | 100 to 1.0M | E24; E96 |
| | | | | | ± 100 | ± 0.5 | 10 to 1.0M | E24; E96 |
| | | | | | ± 100 | ± 1 | 10 to 10M | E24; E96 |
| | | | | | ± 200 | ± 1 | 1.0 to 9.76 | E24; E96 |
| | | | | | ± 200 | ± 5 | 1.0 to 10M | E24 |
| Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega, I_{max.}$ at 70 °C = 1.5 A | | | | | | | | |
| RCA0603 | 0603 | RR1608 | 0.10 | 75 | ± 50 | $\pm 0.5, \pm 1$ | 100 to 10M | E24; E96 |
| | | | | | ± 100 | ± 0.5 | 10 to 10M | E24; E96 |
| | | | | | ± 100 | ± 1 | 1.0 to 10M | E24; E96 |
| | | | | | ± 200 | ± 5 | 1.0 to 10M | E24 |
| | | | | | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega, I_{max.}$ at 70 °C = 2.0 A | | | |
| RCA0805 | 0805 | RR2012 | 0.125 | 150 | ± 50 | $\pm 0.5, \pm 1$ | 100 to 10M | E24; E96 |
| | | | | | ± 100 | ± 0.5 | 10 to 10M | E24; E96 |
| | | | | | ± 100 | ± 1 | 1.0 to 10M | E24; E96 |
| | | | | | ± 200 | ± 5 | 1.0 to 10M | E24 |
| | | | | | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega, I_{max.}$ at 70 °C = 2.5 A | | | |
| RCA1206 | 1206 | RR3216 | 0.25 | 200 | ± 50 | $\pm 0.5, \pm 1$ | 100 to 10M | E24; E96 |
| | | | | | ± 100 | ± 0.5 | 10 to 10M | E24; E96 |
| | | | | | ± 100 | ± 1 | 1.0 to 10M | E24; E96 |
| | | | | | ± 200 | ± 5 | 1.0 to 10M | E24 |
| | | | | | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega, I_{max.}$ at 70 °C = 3.5 A | | | |
| RCA1210 | 1210 | RR3225 | 0.5 | 200 | ± 50 | $\pm 0.5, \pm 1$ | 100 to 1.0M | E24; E96 |
| | | | | | ± 100 | ± 0.5 | 10 to 1.0M | E24; E96 |
| | | | | | ± 100 | ± 1 | 1.0 to 10M | E24; E96 |
| | | | | | ± 200 | ± 5 | 1.0 to 10M | E24 |
| | | | | | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega, I_{max.}$ at 70 °C = 5.0 A | | | |
| RCA1218 | 1218 | RR3246 | 1.0 | 200 | ± 50 | $\pm 0.5, \pm 1$ | 100 to 2.2M | E24; E96 |
| | | | | | ± 100 | ± 0.5 | 100 to 2.2M | E24; E96 |
| | | | | | ± 100 | ± 1 | 1.0 to 2.2M | E24; E96 |
| | | | | | ± 200 | ± 5 | 1.0 to 2.2M | E24 |
| | | | | | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega, I_{max.}$ at 70 °C = 7.0 A | | | |
| RCA2010 | 2010 | RR5025 | 0.75 | 400 | ± 50 | $\pm 0.5, \pm 1$ | 100 to 10M | E24; E96 |
| | | | | | ± 100 | ± 0.5 | 10 to 10M | E24; E96 |
| | | | | | ± 100 | ± 1 | 1.0 to 10M | E24; E96 |
| | | | | | ± 200 | ± 5 | 1.0 to 10M | E24 |
| | | | | | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega, I_{max.}$ at 70 °C = 6.0 A | | | |
| RCA2512 | 2512 | RR6332 | 1.0 | 500 | ± 50 | $\pm 0.5, \pm 1$ | 100 to 10M | E24; E96 |
| | | | | | ± 100 | ± 0.5 | 10 to 10M | E24; E96 |
| | | | | | ± 100 | ± 1 | 1.0 to 10M | E24; E96 |
| | | | | | ± 200 | ± 5 | 1.0 to 10M | E24 |
| | | | | | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega, I_{max.}$ 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} ⁽¹⁾ | 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 | Ω | > 10^9 | | | | | | | |
| Category temperature range | $^{\circ}C$ | - 55 to + 155 | | | | | | | |
| Failure rate | h^{-1} | < 0.1×10^{-9} | | | | | | | |
| Mass | mg | 0.65 | 2 | 5.5 | 10 | 16 | 29.5 | 25.5 | 40.5 |

Note

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

Notes

- ⁽²⁾ Preferred way for ordering products is by use of the PART NUMBER
- ⁽³⁾ 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 ^{+0.10} / _{-0.05} | 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 ^{+0.20} / _{-0.10} | 1.25 ± 0.15 | 0.45 ± 0.05 | 0.3 ^{+0.20} / _{-0.10} | 0.3 ± 0.2 | 0.7 | 1.3 | 1.2 | 0.9 | 1.3 | 1.3 |
| 1206 | 3216 | 3.2 ^{+0.10} / _{-0.20} | 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 ^{+0.10} / _{-0.20} | 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 85 % ± 4 % RH | 90 °C ± 2 °C 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 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE (ΔR) | |
| | | | | SIZE 0402 | SIZE 0603 TO 2512 |
| | | | | STABILITY CLASS 2 OR BETTER | |
| | | | Stability for product types: | 1 Ω to 10 M Ω | |
| | | | RCA e3 | 0.5 %, ± 1 %, ± 5 % | |
| 4.5 | - | Resistance | - | 0.5 %, ± 1 %, ± 5 % | |
| 4.8.4.2 | - | Temperature coefficient | (20/- 55/20) °C and (20/125/20) °C | ± 50 ppm/K, ± 100 ppm/K, ± 200 ppm/K | |
| 4.13 | - | Short time overload | $U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; duration: According to style | $\pm (0.25 \% R + 0.05 \Omega)$ | |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min. at - 55 °C; 30 min. at 125 °C 5 cycles 1000 cycles | $\pm (0.25 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$ | |
| 4.25.1 | - | Endurance at 70 °C | $U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1.5 h on; 0.5 h off; 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 (260 \pm 5) °C (10 \pm 1) s | $\pm (0.25 \% R + 0.05 \Omega)$ | |
| 4.24 | 78 (Cab) | Damp heat, steady state | (40 \pm 2) °C; (93 \pm 3) % RH; 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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