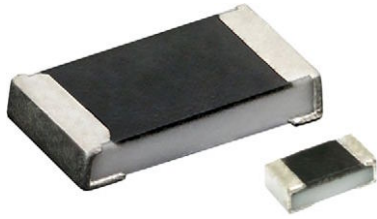


Anti-Surge, High Power Thick Film Chip Resistors



RoHS
COMPLIANT
HALOGEN
FREE

FEATURES

- Excellent surge pulse capability
- Superior ESD surge characteristics
- High power rating
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Automotive
- Industrial
- Telecommunications
- Medical

LINKS TO ADDITIONAL RESOURCES



The anti-surge thick film chip resistor series combines a significantly higher power rating and pulse load performance as compared to standard chip resistors.

| TECHNICAL SPECIFICATIONS | | | | |
|--------------------------------------------------------------------------------|----------------------------------------------------|------------|------------|------------|
| DESCRIPTION | RCS0402 e3 | RCS0603 e3 | RCS0805 e3 | RCS1206 e3 |
| Imperial size | 0402 | 0603 | 0805 | 1206 |
| Metric size code | RR1005M | RR1608M | RR2012M | RR3126M |
| Resistance range | 1 Ω to 10 M Ω ; jumper (0 Ω) | | | |
| Resistance tolerance | $\pm 5\%$; $\pm 1\%$; $\pm 0.5\%$ | | | |
| Temperature coefficient | ± 200 ppm/K; ± 100 ppm/K | | | |
| Rated dissipation, P_{70} ⁽¹⁾ | 0.2 W | 0.25 W | 0.5 W | 0.5 W |
| Operating voltage, U_{max} , AC _{RMS} /DC | 50 V | 75 V | 150 V | 200 V |
| Permissible film temperature, $\vartheta_{F max}$ ⁽¹⁾ | 155 °C | | | |
| Operating temperature range | -55 °C to +155 °C | | | |
| Max. resistance change at P_{70} for resistance range, $ \Delta R/R $ after: | | | | |
| 1000 h | $\leq 1.0\%$ | | | |
| 8000 h | $\leq 2.0\%$ | | | |
| Permissible voltage against ambient (insulation): | | | | |
| 1 min, U_{ins} | 75 V | 100 V | 200 V | 300 V |
| Failure rate: FIT _{observed} | $\leq 0.1 \times 10^{-9}/h$ | | | |

Note

⁽¹⁾ Please refer to APPLICATION INFORMATION below

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature is not exceeded.

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 lifetime.



| TEMPERATURE COEFFICIENT AND RESISTANCE RANGE | | | | |
|----------------------------------------------|-----------------------------------|-----------|--------------|----------|
| TYPE / SIZE | TCR | TOLERANCE | RESISTANCE | E-SERIES |
| RCS0402 e3 | ± 200 ppm/K | ± 5 % | 1 Ω to 10 MΩ | E24 |
| | ± 100 ppm/K | ± 1 % | 1 Ω to 10 MΩ | E24; E96 |
| | ± 100 ppm/K | ± 0.5 % | 1 Ω to 10 MΩ | E24; E96 |
| | Jumper, $I_{max.} = 3\text{ A}$ | ≤ 20 mΩ | 0 Ω | - |
| RCS0603 e3 | ± 200 ppm/K | ± 5 % | 1 Ω to 10 MΩ | E24 |
| | ± 100 ppm/K | ± 1 % | 1 Ω to 10 MΩ | E24; E96 |
| | ± 100 ppm/K | ± 0.5 % | 1 Ω to 10 MΩ | E24; E96 |
| | Jumper, $I_{max.} = 3.5\text{ A}$ | ≤ 20 mΩ | 0 Ω | - |
| RCS0805 e3 | ± 200 ppm/K | ± 5 % | 1 Ω to 10 MΩ | E24 |
| | ± 100 ppm/K | ± 1 % | 1 Ω to 10 MΩ | E24; E96 |
| | ± 100 ppm/K | ± 0.5 % | 1 Ω to 10 MΩ | E24; E96 |
| | Jumper, $I_{max.} = 4\text{ A}$ | ≤ 20 mΩ | 0 Ω | - |
| RCS1206 e3 | ± 200 ppm/K | ± 5 % | 1 Ω to 10 MΩ | E24 |
| | ± 100 ppm/K | ± 1 % | 1 Ω to 10 MΩ | E24; E96 |
| | ± 100 ppm/K | ± 0.5 % | 1 Ω to 10 MΩ | E24; E96 |
| | Jumper, $I_{max.} = 5\text{ A}$ | ≤ 20 mΩ | 0 Ω | - |

Note

- The temperature coefficient of resistance (TCR) is not specified for 0 Ω jumpers

| PACKAGING | | | | | | |
|-------------|----------|-----------------|----------------------------------------------|-----------------|-------|----------------------|
| TYPE / SIZE | CODE | QUANTITY | PACKAGING STYLE | WIDTH | PITCH | PACKAGING DIMENSIONS |
| RCS0402 e3 | ED = ET7 | 10 000 | Paper tape according to IEC 60286-3, Type 1a | 8 mm | 2 mm | Ø 180 mm/7" |
| | EE = EF4 | 50 000 | | | | Ø 330 mm/13" |
| RCS0603 e3 | EI = ET2 | 5000 | | | 2 mm | Ø 180 mm/7" |
| | ED = ET3 | 10 000 | | | | Ø 180 mm/7" |
| | EL = ET4 | 20 000 | | | | Ø 285 mm/11.25" |
| | EE = ET8 | 50 000 | | | | Ø 330 mm/13" |
| | EA = ET1 | 5000 | | | | 4 mm |
| EB = ET5 | 10 000 | Ø 285 mm/11.25" | | | | |
| EC = ET6 | 20 000 | Ø 330 mm/13" | | | | |
| RCS0805 e3 | EA = ET1 | 5000 | | | 4 mm | Ø 180 mm/7" |
| | EB = ET5 | 10 000 | Ø 285 mm/11.25" | | | |
| | EC = ET6 | 20 000 | Ø 330 mm/13" | | | |
| RCS1206 e3 | EA = ET1 | 5000 | 4 mm | Ø 180 mm/7" | | |
| | EB = ET5 | 10 000 | | Ø 285 mm/11.25" | | |
| | EC = ET6 | 20 000 | | Ø 330 mm/13" | | |



PART NUMBER AND PRODUCT DESCRIPTION

Part Number: RCS0805100RFKEC
Part Number: RCS08050000Z0EC

R C S 0 8 0 5 1 0 0 R F K E C

| | | | | |
|---------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------|
| TYPE / SIZE RCS0402 RCS0603 RCS0805 RCS1206 | RESISTANCE R = decimal K = thousand M = million 0000 = jumper | TOLERANCE D = ± 0.5 % F = ± 1.0 % J = ± 5.0 % Z = jumper | TCR K = ± 100 ppm/K N = ± 200 ppm/K 0 = jumper | PACKAGING EA, EB, EC, ED, EE, EI, EL |
|---------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------|

Product Description: RCS0805 100 100R 1 % ET6 e3
Product Description: RCS0805 0R0 ET6 e3

| | | | | | |
|---------------------------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------|
| RCS0805 | 100 | 100R | 1 % | ET6 | e3 |
| TYPE / SIZE RCS0402 RCS0603 RCS0805 RCS1206 | TCR ± 100 ppm/K ± 200 ppm/K | RESISTANCE 10R = 10 Ω 100R = 100 Ω 10K = 10 kΩ 1M0 = 1 MΩ 0R0 = jumper | TOLERANCE ± 0.5 % ± 1.0 % ± 5.0 % | PACKAGING ET1, ET2, ET3, ET4, ET5, ET6, ET7, ET8, EF4 | LEAD (Pb)-FREE e3 = pure tin termination finish |



DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A cermet film layer and a glass-over are deposited on a high grade (Al₂O₃) ceramic substrate with its prepared inner contacts on both sides. A special laser is used to achieve the target value and the desired power dissipation performance by smoothly fine trimming the resistive layer without damaging the ceramics. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure matte tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure on 100 % of the individual chip resistors. Only accepted products are laid directly into the tape in accordance with **IEC 60286-3 Type 1a** ⁽¹⁾.

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapor phase as shown in **IEC 61760-1**. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings potting compounds and their processes, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

The resistors are RoHS-compliant, the pure matte tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years. The immunity of the plating against tin whisker growth has been proven under extensive testing.

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein ⁽²⁾
- The Global Automotive Declarable Substance List (GADSL) ⁽³⁾
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) ⁽⁴⁾ for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see www.vishay.com/how/leadfree.

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at www.vishay.com/doc?49037.

APPROVALS

The resistors are qualified according to AEC-Q200.

Where applicable, the resistors are tested in accordance with **EN 140401-802** which refers to **EN 60115-1**, **EN 60115-8** and the variety of environmental test procedures of the **IEC 60068** ⁽¹⁾ series.

RELATED PRODUCTS

For more information about products with superior surge and pulse performance please refer to D/CRCW-IF e3, Pulse Proof Thick Film Chip Resistors datasheet (www.vishay.com/doc?20024).

The CRCW-HP e3 product series is designed for those applications where both enhanced power rating and superior pulse loading performance is required.

For ordering CRCW-HP e3 please refer to latest edition of datasheet (www.vishay.com/doc?20043).

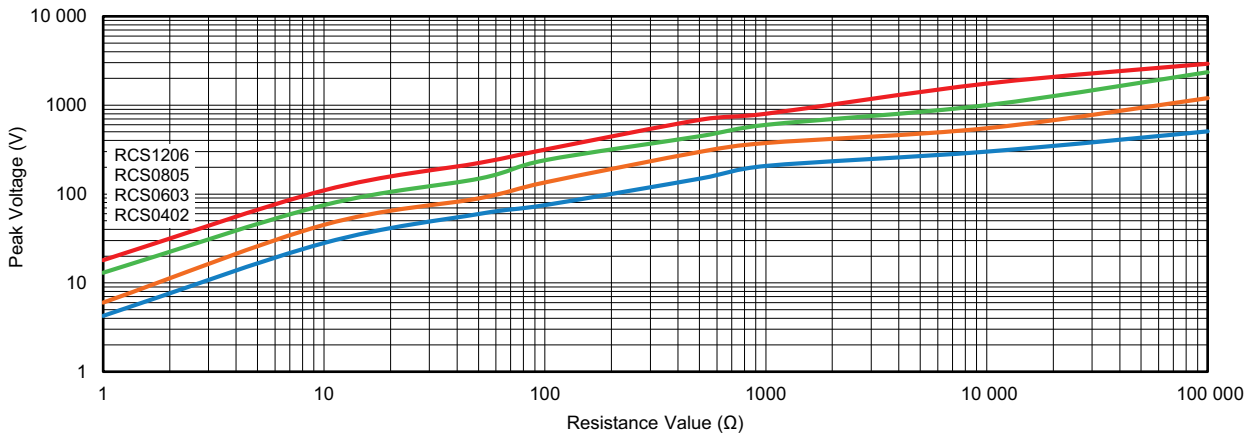
For thick film resistors with standard requirements for power rating, please refer to D/CRCW e3, Standard Thick Film Chip Resistors datasheet (www.vishay.com/doc?20035)

Notes

- (1) The quoted IEC standards are also released as EN standards with the same number and identical contents
- (2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at <http://std.iec.ch/iec62474>.
- (3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org
- (4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at <http://echa.europa.eu/candidate-list-table>

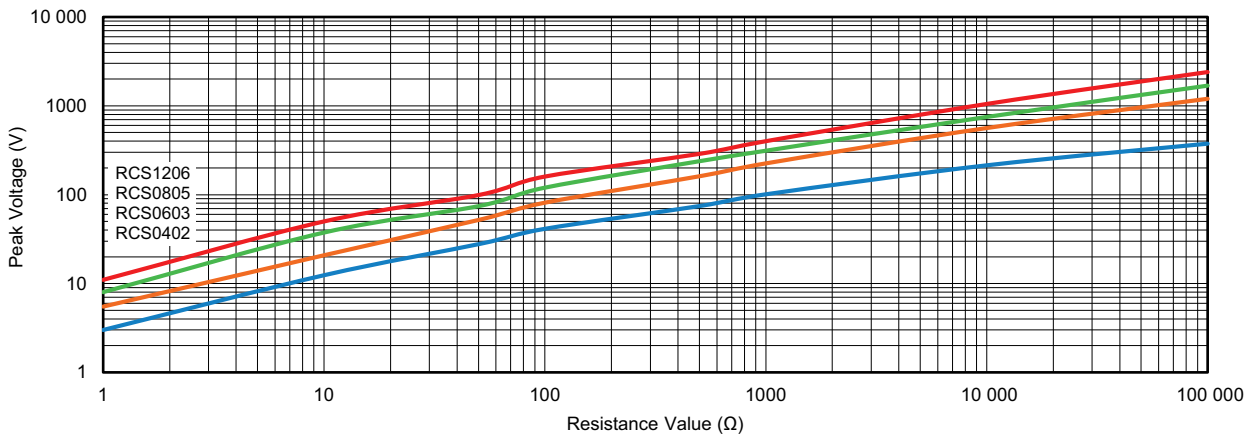
FUNCTIONAL PERFORMANCE

Single Pulse High Power Overload 1.2 μ s / 50 μ s Pulse



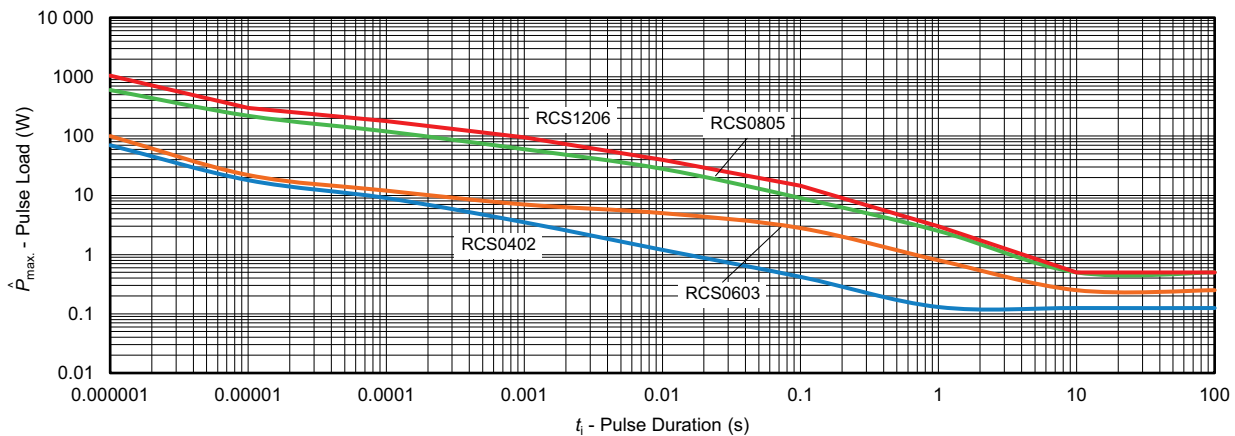
Pulse load rating in accordance with EN 60115-1, 4.27; 1.2 μ s / 50 μ s;
5 pulses at 12 s intervals; for permissible resistance change 1 %

Single Pulse High Power Overload 10 μ s / 700 μ s Pulse



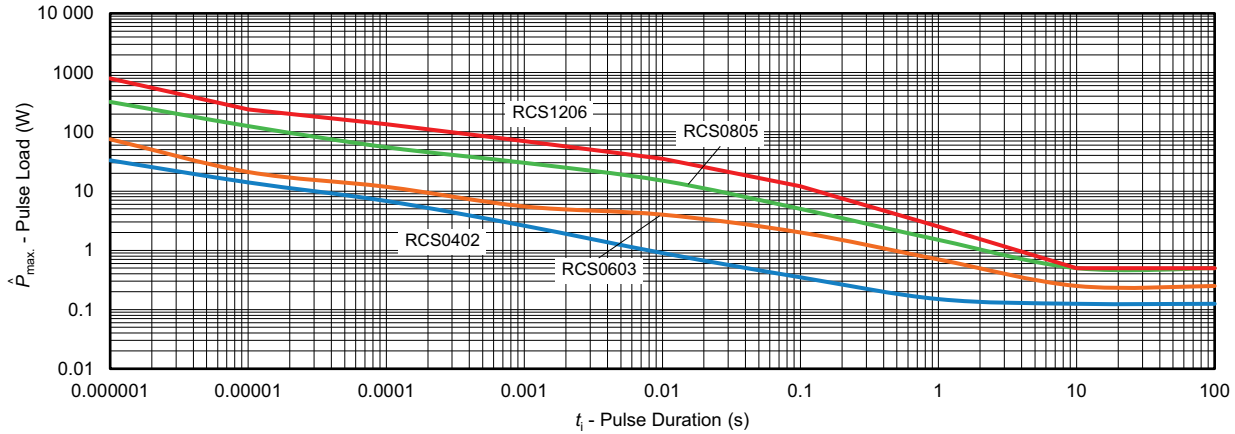
Pulse load rating in accordance with EN 60115-1, 4.27; 10 μ s / 700 μ s;
10 pulses at 1 min intervals; for permissible resistance change 1 %

Single Pulse



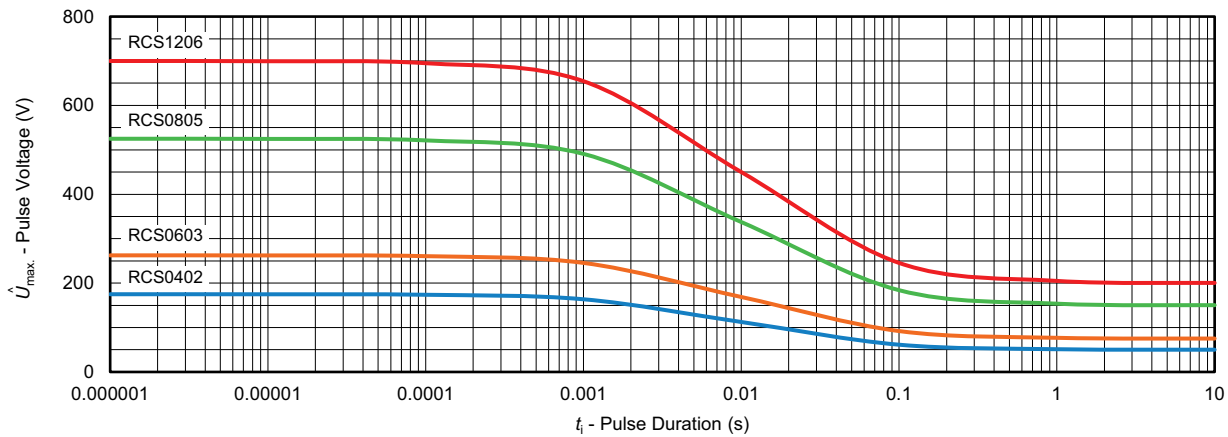
Maximum pulse load, single pulse; applicable if $\bar{P} \rightarrow 0$ and $n < 1000$ and $\hat{U} = \hat{U}_{max}$;
for permissible resistance change equivalent to 8000 h operation

Continuous Pulse



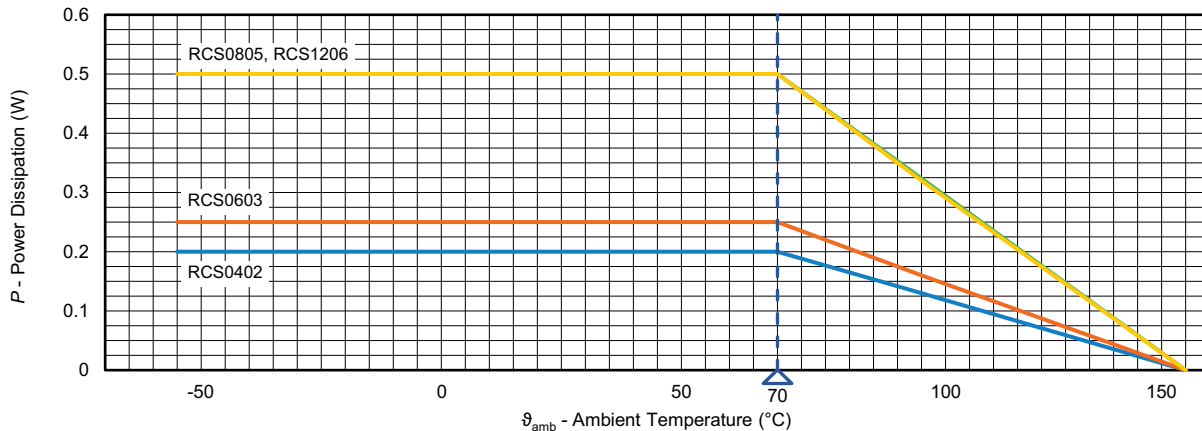
Maximum pulse load, continuous pulses; applicable if $\bar{P} \leq P(\vartheta_{amb})$ and $\hat{U} = \hat{U}_{max}$; for permissible resistance change equivalent to 8000 h operation

Pulse Voltage



Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} = \hat{P}_{max}$; for permissible resistance change equivalent to 8000 h operation

Derating





TESTS AND REQUIREMENTS

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

EN 60115-1, generic specification

EN 60115-8 (successor of EN 140400), sectional specification

EN 140401-802, detail specification

IEC 60068-2-xx, test methods

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-802. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included.

The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days).

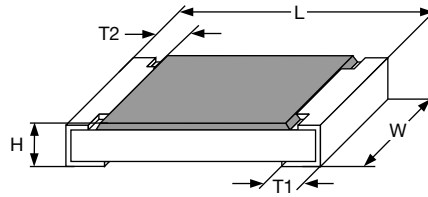
The components are mounted for testing on boards in accordance with EN 60115-8, 2.4.2 unless otherwise specified.

| TEST PROCEDURES AND REQUIREMENTS | | | | | |
|----------------------------------|-----------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------------------------|
| EN 60115-1 CLAUSE | IEC 60068-2 (1) TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE (ΔR) | |
| | | | | STABILITY CLASS 1 OR BETTER | STABILITY CLASS 2 OR BETTER |
| | | | | 1 Ω to 10 M Ω | |
| | | | Stability for product types: | | |
| | | | RCS e3 | | |
| 4.5 | - | Resistance | - | $\pm 0.5 \% ; \pm 1 \%$ | $\pm 5 \%$ |
| 4.8 | - | Temperature coefficient | At (20 / -55 / 20) °C and (20 / 155 / 20) °C | $\pm 100 \text{ ppm/K}$ | $\pm 200 \text{ ppm/K}$ |
| 4.25.1 | - | Endurance at 70 °C | $U = \sqrt{P_{70}} \times R$ or $U = U_{\text{max}}$, whichever is the less severe; 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h | $\pm (1 \% R + 0.05 \Omega)$ $\pm (2 \% R + 0.1 \Omega)$ | $\pm (2 \% R + 0.1 \Omega)$ $\pm (4 \% R + 0.1 \Omega)$ |
| 4.25.3 | - | Endurance at upper category temperature | 155 °C; 1000 h | $\pm (1 \% R + 0.05 \Omega)$ | $\pm (2 \% R + 0.1 \Omega)$ |
| 4.24 | 78 (Cab) | Damp heat, steady state | (40 \pm 2) °C; 56 days; (93 \pm 3) % RH | $\pm (1 \% R + 0.05 \Omega)$ | |
| 4.37 | 67 (Cy) | Damp heat, steady state, accelerated | (85 \pm 2) °C; (85 \pm 5) % RH $U = \sqrt{0.1} \times P_{85} \times R \leq 100 \text{ V}$; 1000 h | $\pm (1 \% R + 0.05 \Omega)$ | $\pm (2 \% R + 0.1 \Omega)$ |
| 4.23 | - | Climatic sequence: | | | |
| 4.23.2 | 2 (Bb) | Dry heat | 125 °C; 16 h | | |
| 4.23.3 | 30 (Db) | Damp | 55 °C; 24 h; $\geq 90 \% \text{ RH}$; 1 cycle | | |
| 4.23.4 | 1 (Ab) | Cold | -55 °C; 2 h | | |
| 4.23.5 | 13 (M) | Low air pressure | 8.5 kPa; 2 h; (25 \pm 10) °C | | |
| 4.23.6 | 30 (Db) | Damp heat, cyclic | 55 °C; 24 h; $\geq 90 \% \text{ RH}$; 5 cycles | $\pm (1 \% R + 0.05 \Omega)$ | $\pm (2 \% R + 0.1 \Omega)$ |
| 4.23.7 | - | DC load | $U = \sqrt{P_{70}} \times R \leq U_{\text{max}}$; 1 min | | |
| - | 1 (Aa) | Cold | -55 °C; 2 h | $\pm (0.25 \% R + 0.05 \Omega)$ | $\pm (0.5 \% R + 0.05 \Omega)$ |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min. at -55 °C and 30 min. at 125 °C 1000 cycles | $\pm (1 \% R + 0.05 \Omega)$ no visible damage | |
| 4.13 | - | Short time overload | $U = 2.5 \times \sqrt{P_{70}} \times R \leq 2 \times U_{\text{max}}$; whichever is the less severe; 5 s | $\pm (2 \% R + 0.05 \Omega)$ | |
| 4.27 | - | Single pulse high voltage overload | Severity no. 4: $U = 10 \times \sqrt{P_{70}} \times R$ or $U = 2 \times U_{\text{max}}$; whichever is the less severe; 10 pulses 10 μs / 700 μs | $\pm (1 \% R + 0.05 \Omega)$ no visible damage | |

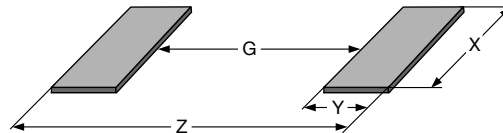
| TEST PROCEDURES AND REQUIREMENTS | | | | | |
|----------------------------------|-------------------------------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------|
| EN 60115-1 CLAUSE | IEC 60068-2 ⁽¹⁾ TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE (ΔR) | |
| | | | | STABILITY CLASS 1 OR BETTER | STABILITY CLASS 2 OR BETTER |
| | | | Stability for product types: | | |
| | | | RCS e3 | | |
| 4.39 | - | Periodic electric overload | $U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles | $\pm (1 \% R + 0.05 \Omega)$ no visible damage | |
| 4.38 | - | Electrostatic discharge (human body model) | IEC 61340-3-1 ⁽¹⁾ ; 3 positive + 3 negative discharges; ESD voltage according to the size | $\pm (1 \% R + 0.05 \Omega)$ | |
| 4.22 | 6 (Fc) | Vibration | Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s ² ; 7.5 h | $\pm (0.25 \% R + 0.05 \Omega)$ no visible damage | $\pm (0.5 \% R + 0.05 \Omega)$ no visible damage |
| 4.17 | 58 (Td) | Solderability | Solder bath method, SnPb40; non-activated flux (235 \pm 5) °C; (2 \pm 0.2) s Solder bath method, Sn96.5Ag3Cu0.5; non-activated flux (245 \pm 5) °C; (3 \pm 0.3) s | Good tinning (≥ 95 % covered); no visible damage | |
| 4.18 | 58 (Td) | Resistance to soldering heat | Soldering bath method; (260 \pm 5) °C; (10 \pm 1) s | $\pm (0.25 \% R + 0.05 \Omega)$ | $\pm (0.5 \% R + 0.05 \Omega)$ |
| 4.29 | 45 (XA) | Component solvent resistance | Isopropyl alcohol +50 °C; method 2 | No visible damage | |
| 4.32 | 21 (Ue ₃) | Shear (adhesion) | RCS0402 e3: 9 N RCS0603 e3 to RCS1206 e3: 17.7 N | No visible damage | |
| 4.33 | 21 (Ue ₁) | Substrate bending | Depth 2 mm; 3 times | $\pm (0.25 \% R + 0.05 \Omega)$ no visible damage, no open circuit in bent position | |
| 4.7 | - | Voltage proof | $U = 1.4 \times U_{ins}$; 60 s | No flashover or breakdown | |
| 4.35 | - | Flammability, needle flame test | IEC 60695-11-5 ⁽¹⁾ ; 10 s | No burning after 30 s | |

Note

⁽¹⁾ The quoted IEC standards are also released as EN standards with the same number and identical contents

DIMENSIONS


| DIMENSIONS AND MASS | | | | | | |
|---------------------|----------------------|-------------|-------------|---------------------|------------|-----------|
| TYPE / SIZE | L (mm) | W (mm) | H (mm) | T1 (mm) | T2 (mm) | MASS (mg) |
| RCS0402 e3 | 1.0 ± 0.05 | 0.5 ± 0.05 | 0.35 ± 0.05 | 0.25 ± 0.10 | 0.2 ± 0.10 | 0.65 |
| RCS0603 e3 | 1.55 + 0.10 / - 0.05 | 0.85 ± 0.10 | 0.45 ± 0.05 | 0.3 ± 0.20 | 0.3 ± 0.20 | 2 |
| RCS0805 e3 | 2.0 + 0.20 / - 0.10 | 1.25 ± 0.15 | 0.45 ± 0.05 | 0.3 + 0.20 / - 0.10 | 0.3 ± 0.20 | 5.5 |
| RCS1206 e3 | 3.2 + 0.10 / - 0.20 | 1.6 ± 0.15 | 0.55 ± 0.10 | 0.45 ± 0.20 | 0.4 ± 0.20 | 10 |

SOLDER PAD DIMENSIONS


| RECOMMENDED SOLDER PAD DIMENSIONS | | | | | | | | |
|-----------------------------------|----------------|--------|--------|--------|------------------|--------|--------|--------|
| TYPE / SIZE | WAVE SOLDERING | | | | REFLOW SOLDERING | | | |
| | G (mm) | Y (mm) | X (mm) | Z (mm) | G (mm) | Y (mm) | X (mm) | Z (mm) |
| RCS0402 e3 | - | - | - | - | 0.45 | 0.6 | 0.6 | 1.65 |
| RCS0603 e3 | 0.65 | 1.10 | 1.25 | 2.85 | 0.75 | 0.75 | 1.00 | 2.25 |
| RCS0805 e3 | 0.90 | 1.30 | 1.60 | 3.50 | 1.00 | 0.95 | 1.45 | 2.90 |
| RCS1206 e3 | 1.40 | 1.40 | 1.95 | 4.20 | 1.50 | 1.05 | 1.80 | 3.60 |

Notes

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g in standards IEC 61188-5-x ⁽¹⁾ or in publication IPC-7351
- ⁽¹⁾ The quoted IEC standards are also released as EN standards with the same number and identical contents



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