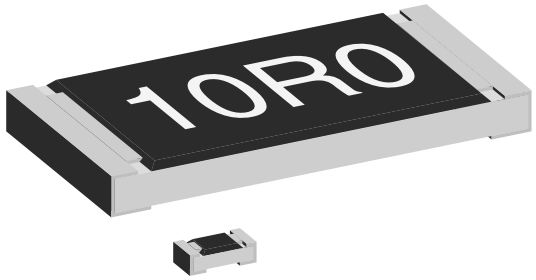
# Lead (Pb)-Free Thick Film, Rectangular Chip Resistors




## FEATURES

- Stability $\Delta R/R$ = 1 % for 1000 h at 70 ° C
- Pure tin solder contacts on Ni barrier layer provides compatibility with lead (Pb)-free and lead containing soldering processes
- Metal glaze on high quality ceramic
- Compliant to RoHS Directive 2002/95/EC
- Halogen-free according to IEC 61249-2-21 definition
- AEC-Q200 qualified, rev. C compliant

RoHS COMPLIANT
HALOGEN FREE

## STANDARD ELECTRICAL SPECIFICATIONS

| MODEL | SIZE | | RATED DISIPATION $P_{70\,°C}$ W | LIMITING ELEMENT VOLTAGE $U_{max.}$ AC/DC | TEMPERATURE COEFFICIENT ppm/K | TOLERANCE % | RESISTANCE RANGE Ω | SERIES |
|---|---|---|---|---|---|---|---|---|
| | INCH | METRIC | | | | | | |
| CRCW0201 | 0201 | RR 0603M | 0.05 | 30 | ± 100<br>± 200 | ± 1<br>± 1<br>± 5 | 47R to 1M0<br>10R to 1M0 | E24; E96<br>E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 50 mΩ, $I_{max.}$ at 70 °C = 1.0 A | | | | | |
| D10/CRCW0402 | 0402 | RR 1005M | 0.063 | 50 | ± 100<br>± 200 | ± 1<br>± 5 | 1R0 to 10M | E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 20 mΩ, $I_{max.}$ at 70 °C = 1.5 A | | | | | |
| D11/CRCW0603 | 0603 | RR 1608M | 0.10 | 75 | ± 100<br>± 200 | ± 1<br>± 5 | 1R0 to 10M | E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 20 mΩ, $I_{max.}$ at 70 °C = 2.0 A | | | | | |
| D12/CRCW0805 | 0805 | RR 2012M | 0.125 | 150 | ± 100<br>± 200 | ± 1<br>± 5 | 1R0 to 10M | E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 20 mΩ, $I_{max.}$ at 70 °C = 2.5 A | | | | | |
| D25/CRCW1206 | 1206 | RR 3216M | 0.25 | 200 | ± 100<br>± 200 | ± 1<br>± 5 | 1R0 to 10M | E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 20 mΩ, $I_{max.}$ at 70 °C = 3.5 A | | | | | |
| CRCW1210 | 1210 | RR 3225M | 0.5 | 200 | ± 100<br>± 200 | ± 1<br>± 5 | 1R0 to 10M | E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 20 mΩ, $I_{max.}$ at 70 °C = 5.0 A | | | | | |
| CRCW1218 | 1218 | RR 3246M | 1.0 | 200 | ± 100<br>± 200 | ± 1<br>± 5 | 1R0 to 2M2 | E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 20 mΩ, $I_{max.}$ at 70 °C = 7.0 A | | | | | |
| CRCW2010 | 2010 | RR 5025M | 0.75 | 400 | ± 100<br>± 200 | ± 1<br>± 5 | 1R0 to 10M | E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 20 mΩ, $I_{max.}$ at 70 °C = 6.0 A | | | | | |
| CRCW2512 | 2512 | RR 6332M | 1.0 | 500 | ± 100<br>± 200 | ± 1<br>± 5 | 1R0 to 10M | E24; E96<br>E24 |
| | | | Zero-Ohm-Resistor: $R_{max.}$ = 20 mΩ, $I_{max.}$ 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 lifetime.
- Marking: See data sheet “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 | CRCW0201 | D10/ CRCW0402 | D11/ CRCW0603 | D12/ CRCW0805 | D25/ CRCW1206 | CRCW1210 | CRCW1218 | CRCW2010 | CRCW2512 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rated dissipation $P_{70}$ (1) | W | 0.05 | 0.063 | 0.1 | 0.125 | 0.25 | 0.5 | 1.0 | 0.75 | 1.0 |
| Limiting element voltage $U_{max.}$ AC/DC | V | 30 | 50 | 75 | 150 | 200 | 200 | 200 | 400 | 500 |
| Insulation voltage $U_{ins}$ (1 min) | V | 50 | > 75 | > 100 | > 200 | > 300 | > 300 | > 300 | > 300 | > 300 |
| Insulation resistance | Ω | > $10^9$ | | | | | | | | |
| Category temperature range | °C | - 55 to + 155 | | | | | | | | |
| Failure rate | $h^{-1}$ | 1 x $10^{-9}$ | < 0.1 x $10^{-9}$ | | | | | | | |
| Weight | mg | 0.17 | 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 °C is not exceeded.

## PART NUMBER AND PRODUCT DESCRIPTION

**Part Number: CRCW0603562RFKEC (2)**

| C | R | C | W | 0 | 6 | 0 | 3 | 5 | 6 | 2 | R | F | K | E | C | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| MODEL | VALUE | TOLERANCE | TCR | PACKAGING | SPECIAL |
|---|---|---|---|---|---|
| **CRCW0201**<br>**CRCW0402**<br>**CRCW0603**<br>**CRCW0805**<br>**CRCW1206**<br>**CRCW1210**<br>**CRCW1218**<br>**CRCW2010**<br>**CRCW2512** | **R** = Decimal<br>**K** = Thousand<br>**M** = Million<br>**0000** = Jumper | **F** = ± 1.0 %<br>**J** = ± 5.0 %<br>**Z** = Jumper | **K** = ± 100 ppm/K<br>**N** = ± 200 ppm/K<br>**0** = Jumper<br>**S** = Special | **EA, EB,**<br>**EC, ED,**<br>**EE, EF,**<br>**EG, EH,**<br>**EK** | Up to 2 digits |
|---|---|---|---|---|---|

**Product Description: D11/CRCW0603 100 562R 1 % ET6 e3**

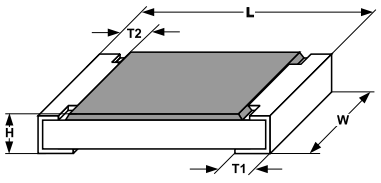
| D11/CRCW0603 | 100 | 562R | 1 % | ET6 | e3 |
|---|---|---|---|---|---|
| MODEL | TCR | RESISTANCE VALUE | TOLERANCE | PACKAGING | LEAD (Pb)-FREE |
| **CRCW0201**<br>**D10/CRCW0402**<br>**D11/CRCW0603**<br>**D12/CRCW0805**<br>**D25/CRCW1206**<br>**CRCW1210**<br>**CRCW1218**<br>**CRCW2010**<br>**CRCW2512** | ± **200** ppm/K<br>± **100** ppm/K | **10R** = 10 Ω<br>**562R** = 562 Ω<br>**10K** = 10 kΩ<br>**1M** = 1 MΩ<br>**0R0** = Jumper | ± **5 %**<br>± **1 %** | **ET1, ET5,**<br>**ET6, ET7,**<br>**EF4, E02,**<br>**E67, E82,**<br>**ET9** | **e3** = Pure tin termination finish |

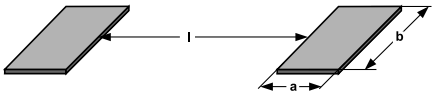
**Note**

(2) Preferred way for ordering products is by use of the PART NUMBER.

| PACKAGING | | | | | | | |
|---|---|---|---|---|---|---|---|
| MODEL | UNIT | PAPER TAPE ON REEL ACC. TO IEC 60286-3, TYPE I | | | BLISTER TAPE ON REEL ACC. TO IEC 60286-3, TYPE II | | |
| | | QUANTITY | PART NUMBER | PRODUCT DESC. | QUANTITY | PART NUMBER | PRODUCT DESC. |
| CRCW0201 | 180 mm/7" | 10 000 | ED | ET7 | | | |
| | 330 mm/13" | 50 000 | EE | EF4 | | | |
| D10/CRCW0402 | 180 mm/7" | 10 000 | ED | ET7 | | | |
| | 330 mm/13" | 50 000 | EE | EF4 | | | |
| D11/CRCW0603 | 180 mm/7" | 5000 | EA | ET1 | | | |
| | 285 mm/11.25" | 10 000 | EB | ET5 | | | |
| | 330 mm/13" | 20 000 | EC | ET6 | | | |
| D12/CRCW0805 | 180 mm/7" | 5000 | EA | ET1 | | | |
| | 285 mm/11.25" | 10 000 | EB | ET5 | | | |
| | 330 mm/13" | 20 000 | EC | ET6 | | | |
| D25/CRCW1206 | 180 mm/7" | 5000 | EA | ET1 | | | |
| | 285 mm/11.25" | 10 000 | EB | ET5 | | | |
| | 330 mm/13" | 20 000 | EC | ET6 | | | |
| CRCW1210 | 180 mm/7" | 5000 | EA | ET1 | | | |
| | 285 mm/11.25" | 10 000 | EB | ET5 | | | |
| | 330 mm/13" | 20 000 | EC | ET6 | | | |
| CRCW1218 | 180 mm/7" | | | | 4000 | EK | ET9 |
| CRCW2010 | 180 mm/7" | | | | 4000 | EF | E02 |
| CRCW2512 | 180 mm/7" | | | | 2000 | EG | E67 |
| | | | | | 4000 | EH | E82 |

## DIMENSIONS

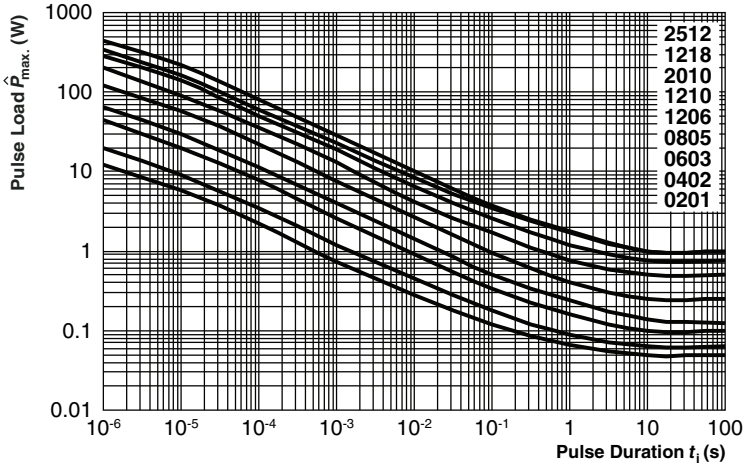



| SIZE | | DIMENSIONS in millimeters | | | | | SOLDER PAD DIMENSIONS in millimeters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | REFLOW SOLDERING | | | WAVE SOLDERING | | |
| INCH | METRIC | L | W | H | T1 | T2 | a | b | l | a | b | l |
| 0201 | 0525 | 0.6 ± 0.05 | 0.3 ± 0.05 | 0.23 ± 0.05 | 0.15 ± 0.05 | 0.15 $^{+0.05}_{-0.10}$ | 0.28 | 0.43 | 0.23 | | | |
| 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 |

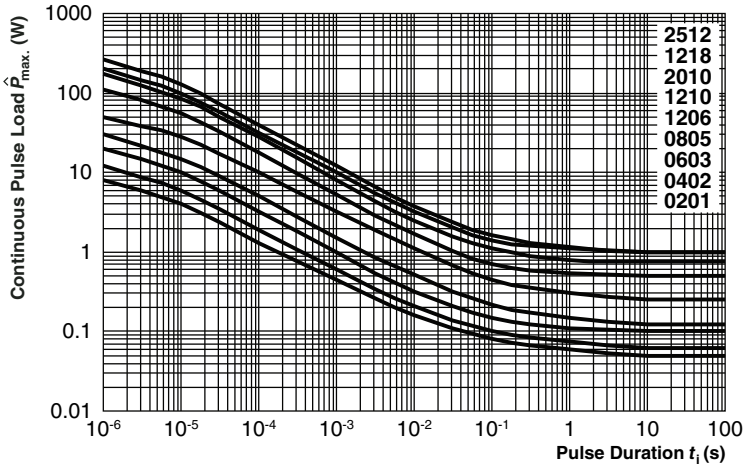
## FUNCTIONAL PERFORMANCE

### Single Pulse



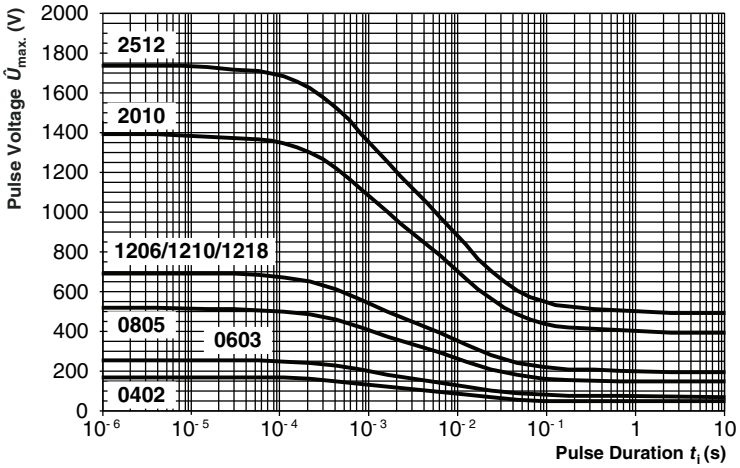

Maximum pulse load, single pulse; applicable if $\bar{P} \rightarrow 0$ and $n < 1000$ and $\hat{U} \leq \hat{U}_{max.}$; for permissible resistance change equivalent to 8000 h operation

### Continuous Pulse



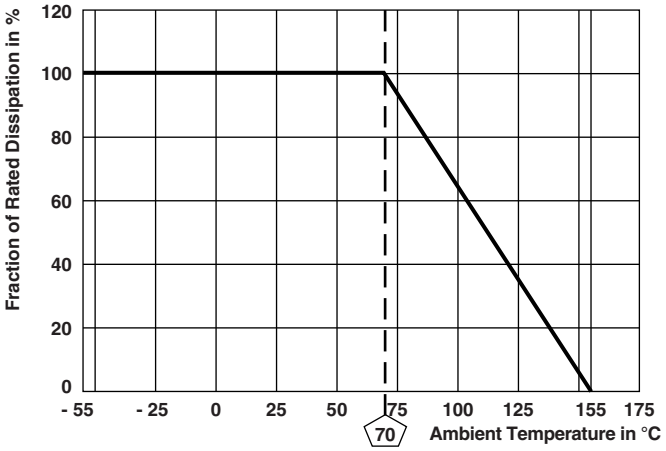

Maximum pulse load, continuous pulses; applicable if $\bar{P} \leq P\ (\vartheta_{amb})$ and $\hat{U} \leq \hat{U}_{max.}$; for permissible resistance change equivalent to 8000 h operation

### Pulse Voltage

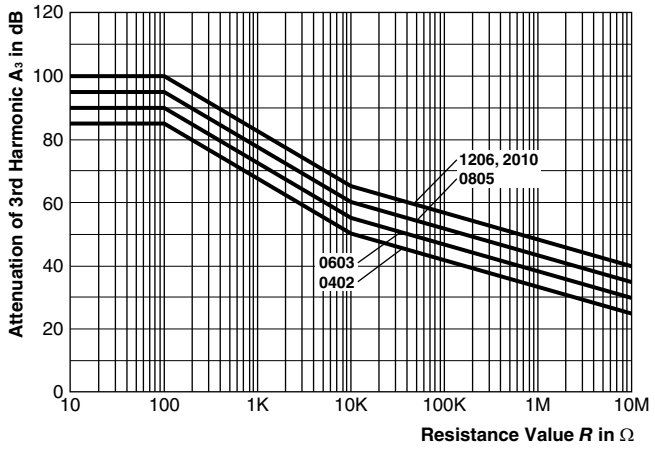



Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} \leq \hat{P}_{max.}$; for permissible resistance change equivalent to 8000 h operation

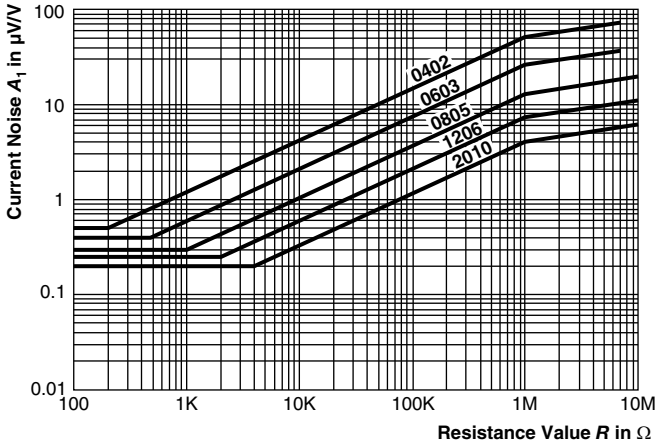
## Derating




## Non-Linearity




## Current Noise



## TEST PROCEDURES AND REQUIREMENTS

| EN 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R$) | | |
|---|---|---|---|---|---|---|
| | | | | SIZE 0402 to 2512 | | SIZE 0201 |
| | | | | STABILITY CLASS 1 OR BETTER | STABILITY CLASS 2 OR BETTER | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$) |
| | | | Stability for product types: | | | |
| | | | **D/CRCW e3** | 1 Ω to 10 MΩ | 1 Ω to 10 MΩ | 10 Ω to 1 MΩ |
| 4.5 | - | Resistance | - | ± 1 % | ± 5 % | ± 1 %; ± 5 % |
| 4.7 | - | Voltage proof | $U = 1.4 \times U_{ins}$; 60 s | No flashover or breakdown | | |
| 4.13 | - | Short time overload | $U = 2.5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{max.}$; duration: Acc. to style | ± (0.25 % $R$ + 0.05 Ω) | ± (0.5 % $R$ + 0.05 Ω) | ± (1 % $R$ + 0.05 Ω) |
| 4.17.2 | 58 (Td) | Solderability | Solder bath method; Sn60Pb40 non activated flux; (235 ± 5) °C (2 ± 0.2) s | Good tinning (≥ 95 % covered) no visible damage | | |
| | | | Solder bath method; Sn96.5Ag3Cu0.5 non-activated flux; (245 ± 5) °C (3 ± 0.3) s | Good tinning (≥ 95 % covered) no visible damage | | |
| 4.8.4.2 | - | Temperature coefficient | (20/- 55/20) °C and (20/125/20) °C | ± 100 ppm/K | ± 200 ppm/K | ± 100 ppm/K, ± 200 ppm/K |
| 4.32 | 21 ($Uu_3$) | Shear (adhesion) | RR 1608 and smaller: 9 N RR 2012 and larger: 45 N | No visible damage | | |
| 4.33 | 21 ($Uu_1$) | Substrate bending | Depth 2 mm; 3 times | No visible damage, no open circuit in bent position ± (0.25 % $R$ + 0.05 Ω) | | ± (0.5 % $R$ + 0.05 Ω) |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min. at - 55 °C; 30 min. at 125 °C | | | |
| | | | 5 cycles | ± (0.25 % $R$ + 0.05 Ω) | ± (0.5 % $R$ + 0.05 Ω) | ± (0.5 % $R$ + 0.05 Ω) |
| | | | 1000 cycles | ± (1 % $R$ + 0.05 Ω) | ± (1 % $R$ + 0.05 Ω) | ± (1 % $R$ + 0.05 Ω) |
| 4.23 | - | Climatic sequence: | - | | | |
| 4.23.2 | 2 (Ba) | Dry heat | 125 °C; 16 h | | | |
| 4.23.3 | 30 (Db) | Damp heat, cyclic | 55 °C; ≥ 90 % RH; 24 h; 1 cycle | | | |
| 4.23.4 | 1 (Aa) | Cold | - 55 °C; 2 h | ± (1 % $R$ + 0.05 Ω) | ± (2 % $R$ + 0.1 Ω) | ± (2 % $R$ + 0.1 Ω) |
| 4.23.5 | 13 (M) | Low air pressure | 1 kPa; (25 ± 10) °C; 1 h | | | |
| 4.23.6 | 30 (Db) | Damp heat, cyclic | 55 °C; ≥ 90 % RH; 24 h; 5 cycles | | | |
| 4.23.7 | - | DC load | $U = \sqrt{P_{70} \times R}$ | | | |
| 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 | ± (1 % $R$ + 0.05 Ω) | ± (2 % $R$ + 0.1 Ω) | ± (2 % $R$ + 0.1 Ω) |
| | | | 70 °C; 8000 h | ± (2 % $R$ + 0.1 Ω) | ± (4 % $R$ + 0.1 Ω) | ± (4 % $R$ + 0.1 Ω) |

## TEST PROCEDURES AND REQUIREMENTS

| EN 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R$) | | |
|---|---|---|---|---|---|---|
| | | | | SIZE 0402 to 2512 | | SIZE 0201 |
| | | | | STABILITY CLASS 1 OR BETTER | STABILITY CLASS 2 OR BETTER | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$) |
| | | | Stability for product types: | | | |
| | | | **D/CRCW e3** | 1 Ω to 10 MΩ | 1 Ω to 10 MΩ | 10 Ω to 1 MΩ |
| 4.18.2 | 58 (Td) | Resistance to soldering heat | Solder bath method (260 ± 5) °C; (10 ± 1) s | ± (0.25 % $R$ + 0.05 Ω) | ± (0.5 % $R$ + 0.05 Ω) | ± (1 % $R$ + 0.05 Ω) |
| 4.35 | - | Flamability, needle flame test | IEC 60695-11-5; 10 s | No burning after 30 s | | |
| 4.24 | 78 (Cab) | Damp heat, steady state | (40 ± 2) °C; (93 ± 3) % RH; 56 days | ± (1 % $R$ + 0.05 Ω) | | ± (2 % $R$ + 0.1 Ω) |
| 4.25.3 | - | Endurance at upper category temperature | 155 °C, 1000 h | ± (1 % $R$ + 0.05 Ω) | ± (2 % $R$ + 0.1 Ω) | ± (2 % $R$ + 0.1 Ω) |
| 4.40 | - | Electrostatic discharge (human body model) | IEC 61340-3-1; 3 pos. + 3 neg. discharges; ESD voltage acc. to size | ± (1 % $R$ + 0.05 Ω) | | |
| 4.29 | 45 (XA) | Component solvent resistance | Isopropyl alcohol; 50 °C; method 2 | No visible damage | | |
| 4.30 | 45 (XA) | Solvent resistance of marking | Isopropyl alcohol; 50 °C; method 1, toothbrush | Marking legible, no visible damage | | |
| 4.22 | 6 (Fc) | Vibration, endurance by sweeping | f = 10 Hz to 2000 Hz; x, y, z ≤ 1.5 mm; A ≤ 200 m/s$^2$; 10 sweeps per axis | ± (0.25 % $R$ + 0.05 Ω) | ± (0.5 % $R$ + 0.05 Ω) | ± (0.5 % $R$ + 0.05 Ω) |
| 4.37 | - | Periodic electric overload | $U = \sqrt{15 \times P_{70} \times R}$ ≤ 2 x $U_{max.}$; 0.1 s on; 2.5 s off; 1000 cycles | ± (1 % $R$ + 0.05 Ω) | | |
| 4.27 | - | Single pulse high voltage overload, 10 µs/700 µs | $\hat{U} = 10 \times \sqrt{P_{70} \times R}$ ≤ 2 x $U_{max.}$; 10 pulses | ± (1 % $R$ + 0.05 Ω) | | |

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
- IEC 60068-2, environmental test procedures

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

# Disclaimer

All product specifications and data are subject to change without notice.

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