



**THE DATASHEET OF  
CRCW2010100RJNTF**



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



### FEATURES

- Stability  $\Delta R/R = 1\%$  for 1000 h at 70 °C
- Lead (Pb)-bearing termination plating on Ni barrier layer
- Metal glaze on high quality ceramic
- Halogen-free according to IEC 61249-2-21 definition
- AEC-Q200 qualified, rev. C compliant

**HALOGEN  
FREE**

### STANDARD ELECTRICAL SPECIFICATIONS

| MODEL        | SIZE |          | RATED DISSIPATION<br>$P_{70}$<br>W  | LIMITING ELEMENT<br>VOLTAGE<br>$U_{max. AC/DC}$ | TEMPERATURE<br>COEFFICIENT<br>ppm/K | TOLERANCE<br>%     | RESISTANCE<br>RANGE<br>$\Omega$ | SERIES          |
|--------------|------|----------|---|---|-------------------------------------|--------------------|---------------------------------|-----------------|
|              | INCH | METRIC   |   |   |                                     |                    |                                 |                 |
| D10/CRCW0402 | 0402 | RR 1005M | 0.063   | 50  | $\pm 100$<br>$\pm 200$              | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                      | E24; E96<br>E24 |
|              |      |          | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega$ , $I_{max.} = 1.5\text{ A}$ |   |                                     |                    |                                 |                 |
| D11/CRCW0603 | 0603 | RR 1608M | 0.10  | 75  | $\pm 100$<br>$\pm 200$              | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                      | E24; E96<br>E24 |
|              |      |          | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega$ , $I_{max.} = 2.0\text{ A}$ |   |                                     |                    |                                 |                 |
| D12/CRCW0805 | 0805 | RR 2012M | 0.125   | 150   | $\pm 100$<br>$\pm 200$              | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                      | E24; E96<br>E24 |
|              |      |          | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega$ , $I_{max.} = 2.5\text{ A}$ |   |                                     |                    |                                 |                 |
| D25/CRCW1206 | 1206 | RR 3216M | 0.25  | 200   | $\pm 100$<br>$\pm 200$              | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                      | E24; E96<br>E24 |
|              |      |          | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega$ , $I_{max.} = 3.5\text{ A}$ |   |                                     |                    |                                 |                 |
| CRCW1210     | 1210 | RR 3225M | 0.50  | 200   | $\pm 100$<br>$\pm 200$              | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                      | E24; E96<br>E24 |
|              |      |          | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega$ , $I_{max.} = 5.0\text{ A}$ |   |                                     |                    |                                 |                 |
| CRCW1218     | 1218 | RR 3246M | 1.0   | 200   | $\pm 100$<br>$\pm 200$              | $\pm 1$<br>$\pm 5$ | 1R0 to 2M2                      | E24; E96<br>E24 |
|              |      |          | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega$ , $I_{max.} = 7.0\text{ A}$ |   |                                     |                    |                                 |                 |
| CRCW2010     | 2010 | RR 5025M | 0.75  | 400   | $\pm 100$<br>$\pm 200$              | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                      | E24; E96<br>E24 |
|              |      |          | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega$ , $I_{max.} = 6.0\text{ A}$ |   |                                     |                    |                                 |                 |
| CRCW2512     | 2512 | RR 6332M | 1.0   | 500   | $\pm 100$<br>$\pm 200$              | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                      | E24; E96<br>E24 |
|              |      |          | Zero-Ohm-Resistor: $R_{max.} = 20\text{ m}\Omega$ , $I_{max.} = 7.0\text{ A}$ |   |                                     |                    |                                 |                 |

### 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 datasheet "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            | D10/<br>CRCW0402         | D11/<br>CRCW0603 | D12/<br>CRCW0805 | D25/<br>CRCW1206 | CRCW1210 | CRCW1218 | CRCW2010 | CRCW2512 |
| Rated dissipation at 70 °C <sup>(1)</sup>  | W               | 0.063                    | 0.1              | 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 <sup>9</sup>        |                  |                  |                  |          |          |          |          |
| Category temperature range                 | °C              | - 55 to + 155            |                  |                  |                  |          |          |          |          |
| Failure rate                               | h <sup>-1</sup> | < 0.1 x 10 <sup>-9</sup> |                  |                  |                  |          |          |          |          |
| Weight                                     | 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 °C is not exceeded.

### PART NUMBER AND PRODUCT DESCRIPTION

**Part Number: CRCW0805562RFKTA <sup>(2)</sup>**

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|
| C | R | C | W | 0 | 8 | 0 | 5 | 5 | 6 | 2 | R | F | K | T | A |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|

| MODEL  | VALUE   | TOLERANCE                            | TCR   | PACKAGING  | SPECIAL        |
|--|---|--------------------------------------|---|--|----------------|
| 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 %<br>J = ± 5 %<br>Z = Jumper | K = ± 100 ppm/K<br>N = ± 200 ppm/K<br>S = Jumper or special | TA<br>TB<br>TC<br>TD<br>TE<br>TF<br>TG<br>TH<br>TK | Up to 2 digits |

**Product Description: CRCW0805 100 562R 1 % RT1**

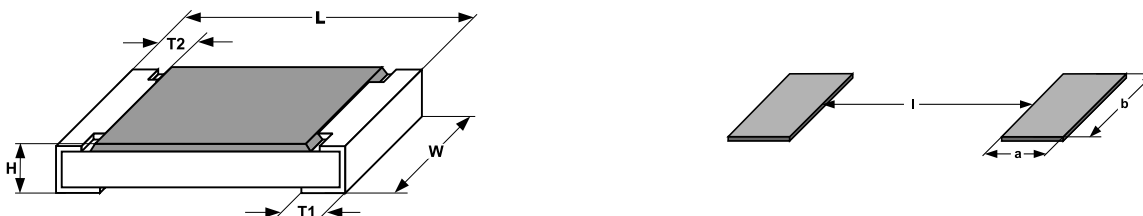
| CRCW0805   | 100                        | 562R   | 1 %            | RT1   |
|--|----------------------------|--|----------------|---|
| MODEL  | TCR                        | RESISTANCE VALUE   | TOLERANCE      | PACKAGING   |
| CRCW0402<br>CRCW0603<br>CRCW0805<br>CRCW1206<br>CRCW1210<br>CRCW1218<br>CRCW2010<br>CRCW2512 | ± 100 ppm/K<br>± 200 ppm/K | 10R = 10 $\Omega$<br>562R = 562 $\Omega$<br>10K = 10.0 k $\Omega$<br>1M = 1 M $\Omega$<br>0R0 = Jumper | ± 1 %<br>± 5 % | RT1<br>RT5<br>RT6<br>RT7<br>RF4<br>R02<br>R67<br>R82<br>RT9 |

**Note**

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

| PACKAGING    |               |  |             |               |   |             |               |
|--------------|---------------|--|-------------|---------------|---|-------------|---------------|
| MODEL        | UNIT          | PAPER TAPE<br>ACC. IEC 60286-3, TYPE I |             |               | BLISTER TAPE<br>ACC. IEC 60286-3, TYPE II |             |               |
|              |               | QUANTITY                               | PART NUMBER | PRODUCT DESC. | QUANTITY                                  | PART NUMBER | PRODUCT DESC. |
| D10/CRCW0402 | 180 mm/7"     | 10 000                                 | TD          | RT7           |   |             |               |
|              | 330 mm/13"    | 50 000                                 | TE          | RF4           |   |             |               |
| D11/CRCW0603 | 180 mm/7"     | 5000                                   | TA          | RT1           |   |             |               |
|              | 285 mm/11.25" | 10 000                                 | TB          | RT5           |   |             |               |
|              | 330 mm/13"    | 20 000                                 | TC          | RT6           |   |             |               |
| D12/CRCW0805 | 180 mm/7"     | 5000                                   | TA          | RT1           |   |             |               |
|              | 285 mm/11.25" | 10 000                                 | TB          | RT5           |   |             |               |
|              | 330 mm/13"    | 20 000                                 | TC          | RT6           |   |             |               |
| D25/CRCW1206 | 180 mm/7"     | 5000                                   | TA          | RT1           |   |             |               |
|              | 285 mm/11.25" | 10 000                                 | TB          | RT5           |   |             |               |
|              | 330 mm/13"    | 20 000                                 | TC          | RT6           |   |             |               |
| CRCW1210     | 180 mm/7"     | 5000                                   | TA          | RT1           |   |             |               |
|              | 285 mm/11.25" | 10 000                                 | TB          | RT5           |   |             |               |
|              | 330 mm/13"    | 20 000                                 | TC          | RT6           |   |             |               |
| CRCW1218     | 180 mm/7"     |  |             |               | 4000                                      | TK          | RT9           |
| CRCW2010     | 180 mm/7"     |  |             |               | 4000                                      | TF          | R02           |
| CRCW2512     | 180 mm/7"     |  |             |               | 2000                                      | TG          | R67           |
|              |               |  |             |               | 4000                                      | TH          | R82           |

**DIMENSIONS**



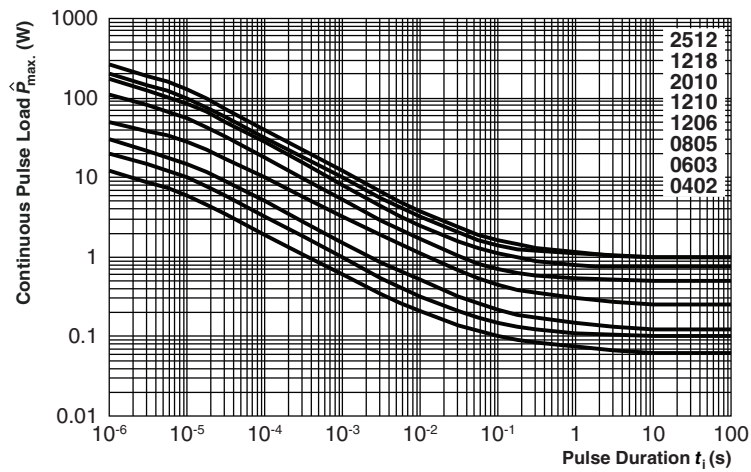
| SIZE |        | DIMENSIONS in millimeters                |             |             |   |           | SOLDER PAD DIMENSIONS in millimeters |     |     |                |     |     |
|------|--------|--|-------------|-------------|---|-----------|--------------------------------------|-----|-----|----------------|-----|-----|
|      |        |  |             |             |   |           | REFLOW SOLDERING                     |     |     | WAVE SOLDERING |     |     |
| INCH | METRIC | L  | W           | H           | T1                                      | T2        | a                                    | b   | l   | a              | b   | l   |
| 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**

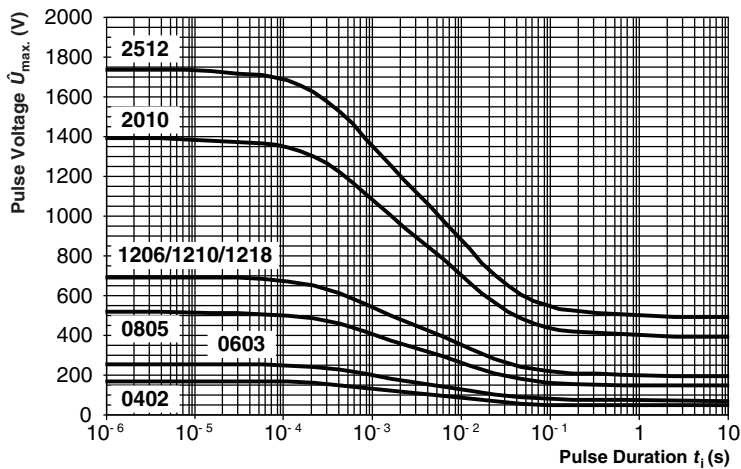
**Single Pulse**



**Continuous Pulse**



**Pulse Voltage**





**Derating**



**Non-Linearity**



**Current Noise**



| <b>TEST PROCEDURES AND REQUIREMENTS</b> |                                  |   |  |  |  |
|---|----------------------------------|---|--|--|--|
| EN<br>60115-1<br>CLAUSE                 | IEC<br>60082-2<br>TEST<br>METHOD | TEST  | PROCEDURE  | REQUIREMENTS PERMISSIBLE<br>CHANGE ( $\Delta R$ )  |  |
|   |                                  |   |  | STABILITY CLASS 1<br>OR BETTER   | STABILITY CLASS 2<br>OR BETTER                               |
|   |                                  |   |  | Stability for product types:   | 1 $\Omega$ to 10 M $\Omega$                                  |
|   |                                  |   | <b>D/CRCW</b>  |  |  |
| 4.5                                     | -                                | Resistance                                    | -  | $\pm 1\%$  | $\pm 5\%$  |
| 4.7                                     | -                                | Voltage proof                                 | $U = 1.4 \cdot U_{ins}$ ; 60 s   | No flashover or breakdown  |  |
| 4.13                                    | -                                | Short time overload                           | $U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$ ;<br>duration: Acc. to style                                | $\pm (0.25\% R + 0.05 \Omega)$   | $\pm (0.5\% R + 0.05 \Omega)$                                |
| 4.17.2                                  | 58 (Td)                          | Solderability                                 | Solder bath method; Sn60Pb40;<br>non-activated flux;<br>(235 $\pm$ 5) $^{\circ}$ C, (2 $\pm$ 0.2) s                        | Good tinning ( $\geq 95\%$<br>covered);<br>no visible damage                             |  |
| 4.8.4.2                                 | -                                | Temperature coefficient                       | (20/- 55/20) $^{\circ}$ C and<br>(20/125/20) $^{\circ}$ C  | $\pm 100$ ppm/K  | $\pm 200$ ppm/K  |
| 4.32                                    | 21 (Uu <sub>3</sub> )            | Shear (adhesion)                              | RR 1608 and smaller: 9 N<br>RR 2012 and larger: 45 N   | No visible damage  |  |
| 4.33                                    | 21 (Uu <sub>1</sub> )            | Substrate bending                             | Depth 2 mm; 3 times  | No visible damage,<br>no open circuit in bent position<br>$\pm (0.25\% R + 0.05 \Omega)$ |  |
| 4.19                                    | 14 (Na)                          | Rapid change of temperature                   | 30 min. at - 55 $^{\circ}$ C;<br>30 min. at 125 $^{\circ}$ C<br>5 cycles<br>1000 cycles                                    | $\pm (0.25\% R + 0.05 \Omega)$<br>$\pm (1\% R + 0.05 \Omega)$                            | $\pm (0.5\% R + 0.05 \Omega)$<br>$\pm (1\% R + 0.05 \Omega)$ |
| 4.23                                    | -                                | Climatic sequence:                            | -  |  |  |
| 4.23.2                                  | 2 (Ba)                           | Dry heat                                      | 125 $^{\circ}$ C; 16 h   |  |  |
| 4.23.3                                  | 30 (Db)                          | Damp heat, cyclic                             | 55 $^{\circ}$ C; $\geq 90\%$ RH;<br>24 h; 1 cycle  |  |  |
| 4.23.4                                  | 1 (Aa)                           | Cold  | - 55 $^{\circ}$ C; 2 h   | $\pm (1\% R + 0.05 \Omega)$  | $\pm (2\% R + 0.1 \Omega)$                                   |
| 4.23.5                                  | 13 (M)                           | Low air pressure                              | 1 kPa; (25 $\pm$ 10) $^{\circ}$ C; 1 h   |  |  |
| 4.23.6                                  | 30 (Db)                          | Damp heat, cyclic                             | 55 $^{\circ}$ C; $\geq 90\%$ RH;<br>24 h; 5 cycles   |  |  |
| 4.23.7                                  | -                                | DC load                                       | $U = \sqrt{P_{70} \times R}$   |  |  |
| 4.25.1                                  | -                                | Endurance at 70 $^{\circ}$ C                  | $U = \sqrt{(P_{70} \times R)} \leq U_{max.}$<br>1.5 h on; 0.5 h off;<br>70 $^{\circ}$ C; 1000 h<br>70 $^{\circ}$ C; 8000 h | $\pm (1\% R + 0.05 \Omega)$<br>$\pm (2\% R + 0.1 \Omega)$                                | $\pm (2\% R + 0.1 \Omega)$<br>$\pm (4\% R + 0.1 \Omega)$     |
| 4.18.2                                  | 58 (Td)                          | Resistance to soldering heat                  | Solder bath method<br>(260 $\pm$ 5) $^{\circ}$ C; (10 $\pm$ 1) s   | $\pm (0.25\% R + 0.05 \Omega)$   | $\pm (0.5\% R + 0.05 \Omega)$                                |
| 4.35                                    | -                                | Flamability, needle flame test                | IEC 60695-11-5;<br>10 s  | No burning after 30 s  |  |
| 4.24                                    | 78 (Cab)                         | Damp heat, steady state                       | (40 $\pm$ 2) $^{\circ}$ C;<br>(93 $\pm$ 3) % RH; 56 days   | $\pm (1\% R + 0.05 \Omega)$  |  |
| 4.25.3                                  | -                                | Endurance at upper<br>category temperature    | 155 $^{\circ}$ C; 1000 h   | $\pm (1\% R + 0.05 \Omega)$  | $\pm (2\% R + 0.1 \Omega)$                                   |
| 4.40                                    | -                                | Electrostatic discharge<br>(human body model) | IEC 61340-3-1;<br>3 pos. + 3 neg. discharges;<br>ESD test voltage acc. to size   | $\pm (1\% R + 0.05 \Omega)$  |  |
| 4.29                                    | 45 (XA)                          | Component solvent resistance                  | Isopropyl alcohol;<br>50 $^{\circ}$ C; method 2  | No visible damage  |  |
| 4.30                                    | 45 (XA)                          | Solvent resistance of marking                 | Isopropyl alcohol;<br>50 $^{\circ}$ C; method 1, toothbrush  | Marking legible,<br>no visible damage  |  |



| TEST PROCEDURES AND REQUIREMENTS |                                  |  |  |   |                                |
|----------------------------------|----------------------------------|--|--|---|--------------------------------|
| EN<br>60115-1<br>CLAUSE          | IEC<br>60082-2<br>TEST<br>METHOD | TEST   | PROCEDURE  | REQUIREMENTS PERMISSIBLE<br>CHANGE ( $\Delta R$ ) |                                |
|                                  |                                  |  |  | STABILITY CLASS 1<br>OR BETTER                    | STABILITY CLASS 2<br>OR BETTER |
|                                  |                                  |  |  | Stability for product types:                      |                                |
|                                  |                                  |  | <b>D/CRCW</b>  | 1 $\Omega$ to 10 M $\Omega$                       | 1 $\Omega$ to 10 M $\Omega$    |
| 4.22                             | 6 (Fc)                           | Vibration, endurance by sweeping                           | f = 10 Hz to 2000 Hz;<br>x, y, z $\leq$ 1.5 mm;<br>A $\leq$ 200 m/s <sup>2</sup> ;<br>10 sweeps per axis | $\pm (0.25 \% R + 0.05 \Omega)$                   | $\pm (0.5 \% R + 0.05 \Omega)$ |
| 4.37                             | -                                | Periodic electric overload                                 | $U = \sqrt{15 \times P_{70} \times R} \leq 2 \times U_{max.}$ ;<br>0.1 s on; 2.5 s off;<br>1000 cycles   | $\pm (1 \% R + 0.05 \Omega)$                      |                                |
| 4.27                             | -                                | Single pulse high voltage overload, 10 $\mu$ s/700 $\mu$ s | $\dot{U} = 10 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$ ;<br>10 pulses                       | $\pm (1 \% R + 0.05 \Omega)$                      |                                |

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
- IEC 60068-2, environmental test procedures

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



## **Disclaimer**

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

 [View CRCW2010100RJNTF on WIN SOURCE](#)

 [Vishay Information](#)

## Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management