

## Standard Thick Film Chip Resistors



### FEATURES

- Stability  $\Delta R/R = 1\%$  for 1000 h at 70 °C
- 2 mm pitch packaging option for 0603 size
- 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
- AEC-Q200 qualified
- 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        | SIZE |          | RATED DISSIPATION<br>$P_{70^\circ\text{C}}$<br>W | LIMITING ELEMENT VOLTAGE<br>$U_{\text{max. AC/DC}}$ | TEMPERATURE COEFFICIENT<br>ppm/K | TOLERANCE<br>%     | RESISTANCE 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 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| 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 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| 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 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| 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 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| CRCW1210     | 1210 | RR 3225M | 0.5                                              | 200                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| CRCW1218     | 1218 | RR 3246M | 1.0                                              | 200                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 2M2                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| CRCW2010     | 2010 | RR 5025M | 0.75                                             | 400                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| CRCW2512     | 2512 | RR 6332M | 1.0                                              | 500                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |

#### 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     | D10/<br>CRCW0402       | D11/<br>CRCW0603 | D12/<br>CRCW0805 | D25/<br>CRCW1206 | CRCW1210 | CRCW1218 | CRCW2010 | CRCW2512 |
|----------------------------------------------|----------|------------------------|------------------|------------------|------------------|----------|----------|----------|----------|
| Rated dissipation $P_{70}$ <sup>(1)</sup>    | W        | 0.063                  | 0.1              | 0.125            | 0.25             | 0.5      | 1.0      | 0.75     | 1.0      |
| Limiting element voltage<br>$U_{max. AC/DC}$ | V        | 50                     | 75               | 150              | 200              | 200      | 200      | 400      | 500      |
| Insulation voltage<br>$U_{ins}$ (1 min)      | V        | > 75                   | > 100            | > 200            | > 300            | > 300    | > 300    | > 300    | > 300    |
| Insulation resistance                        | $\Omega$ | > $10^9$               |                  |                  |                  |          |          |          |          |
| Category temperature range                   | °C       | - 55 to + 155          |                  |                  |                  |          |          |          |          |
| Failure rate                                 | $h^{-1}$ | < $0.1 \times 10^{-9}$ |                  |                  |                  |          |          |          |          |
| 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: CRCW0603562RFKEC

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

| 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 = $\pm 1.0\%$<br>J = $\pm 5.0\%$<br>Z = Jumper | K = $\pm 100$ ppm/K<br>N = $\pm 200$ ppm/K<br>0 = Jumper | EA, EB,<br>EC, ED,<br>EE, EF,<br>EG, EH,<br>EI, EL,<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                      |
| D10/CRCW0402<br>D11/CRCW0603<br>D12/CRCW0805<br>D25/CRCW1206<br>CRCW1210<br>CRCW1218<br>CRCW2010<br>CRCW2512 | $\pm 200$ ppm/K<br>$\pm 100$ ppm/K | 10R = 10 $\Omega$<br>562R = 562 $\Omega$<br>10K = 10 k $\Omega$<br>1M0 = 1 M $\Omega$<br>0R0 = Jumper | $\pm 5\%$<br>$\pm 1\%$ | ET1, ET2,<br>ET3, ET4,<br>ET5, ET6,<br>ET7, ET8,<br>ET9, EF4,<br>E02, E67,<br>E82 | e3 = Pure tin<br>termination finish |

| PACKAGING |          |          |                                                |       |       |               |
|-----------|----------|----------|------------------------------------------------|-------|-------|---------------|
| MODEL     | CODE     | QUANTITY | CARRIER TAPE                                   | WIDTH | PITCH | REEL DIAMETER |
| CRCW0402  | ED = ET7 | 10 000   | Paper tape acc.<br>to IEC 60068-3<br>Type I    | 8 mm  | 2 mm  | 180 mm/7"     |
|           | EE = EF4 | 50 000   |                                                |       |       | 330 mm/13"    |
| CRCW0603  | EI = ET2 | 5000     |                                                | 8 mm  | 2 mm  | 180 mm/7"     |
|           | ED = ET3 | 10 000   |                                                |       |       | 180 mm/7"     |
|           | EL = ET4 | 20 000   |                                                | 8 mm  | 4 mm  | 285 mm/11.25" |
|           | EE = ET8 | 50 000   |                                                |       |       | 330 mm/13"    |
|           | EA = ET1 | 5000     |                                                |       |       | 180 mm/7"     |
|           | EB = ET5 | 10 000   |                                                |       |       | 285 mm/11.25" |
|           | EC = ET6 | 20 000   |                                                |       |       | 330 mm/13"    |
| CRCW0805  | EA = ET1 | 5000     |                                                | 8 mm  | 4 mm  | 180 mm/7"     |
|           | EB = ET5 | 10 000   |                                                |       |       | 285 mm/11.25" |
|           | EC = ET6 | 20 000   |                                                |       |       | 330 mm/13"    |
| CRCW1206  | EA = ET1 | 5000     |                                                | 8 mm  | 4 mm  | 180 mm/7"     |
|           | EB = ET5 | 10 000   |                                                |       |       | 285 mm/11.25" |
|           | EC = ET6 | 20 000   |                                                |       |       | 330 mm/13"    |
| CRCW1210  | EA = ET1 | 5000     |                                                | 8 mm  | 4 mm  | 180 mm/7"     |
|           | EB = ET5 | 10 000   |                                                |       |       | 285 mm/11.25" |
|           | EC = ET6 | 20 000   |                                                |       |       | 330 mm/13"    |
| CRCW1218  | EK = ET9 | 4000     | Blister tape acc.<br>to IEC 60068-3<br>Type II | 12 mm | 4 mm  | 180 mm/7"     |
| CRCW2010  | EF = E02 | 4000     |                                                | 12 mm | 4 mm  | 180 mm/7"     |
| CRCW2512  | EG = E67 | 2000     |                                                | 12 mm | 8 mm  | 180 mm/7"     |
|           | EH = E82 | 4000     |                                                |       | 4 mm  |               |

## 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



**Derating**


| TEST PROCEDURES AND REQUIREMENTS |                                  |                                 |                                                                                                               |                                                                                        |                                                                |
|----------------------------------|----------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------|
| EN<br>60115-1<br>CLAUSE          | IEC<br>60068-2<br>TEST<br>METHOD | TEST                            | PROCEDURE                                                                                                     | REQUIREMENTS<br>PERMISSIBLE CHANGE ( $\Delta R$ )                                      |                                                                |
|                                  |                                  |                                 |                                                                                                               | SIZE 0402 to 2512                                                                      |                                                                |
|                                  |                                  |                                 |                                                                                                               | STABILITY<br>CLASS 1<br>OR BETTER                                                      | STABILITY<br>CLASS 2<br>OR BETTER                              |
|                                  |                                  |                                 | Stability for product types:                                                                                  | 1 $\Omega$ to 10 M $\Omega$                                                            |                                                                |
|                                  |                                  |                                 | D/CRCW e3                                                                                                     |                                                                                        |                                                                |
| 4.5                              | -                                | Resistance                      | -                                                                                                             | $\pm 1 \%$                                                                             | $\pm 5 \%$                                                     |
| 4.7                              | -                                | Voltage proof                   | $U = 1.4 \times U_{ins}$ ; 60 s                                                                               | No flashover or breakdown                                                              |                                                                |
| 4.13                             | -                                | Short time overload             | $U = 2.5 \times \sqrt{P_{70} \times R}$<br>$\leq 2 \times U_{max.}$ ;<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;<br>Sn60Pb40<br>non activated flux;<br>(235 $\pm$ 5) $^{\circ}$ C<br>(2 $\pm$ 0.2) s       | Good tinning ( $\geq 95 \%$ covered)<br>no visible damage                              |                                                                |
|                                  |                                  |                                 | Solder bath method;<br>Sn96.5Ag3Cu0.5<br>non-activated flux;<br>(245 $\pm$ 5) $^{\circ}$ C<br>(3 $\pm$ 0.3) s | Good tinning ( $\geq 95 \%$ covered)<br>no visible damage                              |                                                                |
| 4.8.4.2                          | -                                | Temperature<br>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<br>(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;<br>3 times                                                                                        | No visible damage, no open circuit in bent position<br>$\pm (0.25 \% R + 0.05 \Omega)$ |                                                                |
| 4.19                             | 14 (Na)                          | Rapid change of<br>temperature  | 30 min. at - 55 $^{\circ}$ C;<br>30 min. at 125 $^{\circ}$ C<br><br>5 cycles<br><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:              | -                                                                                                             | $\pm (1 \% R + 0.05 \Omega)$                                                           | $\pm (2 \% R + 0.1 \Omega)$                                    |
| 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                                                                                        |                                                                                        |                                                                |
| 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<br>at 70 $^{\circ}$ C | $U = \sqrt{P_{70} \times R} \leq U_{max.}$ ;<br>1.5 h on; 0.5 h off;                                          |                                                                                        |                                                                |
|                                  |                                  |                                 | 70 $^{\circ}$ C; 1000 h                                                                                       | $\pm (1 \% R + 0.05 \Omega)$                                                           | $\pm (2 \% R + 0.1 \Omega)$                                    |
|                                  |                                  |                                 | 70 $^{\circ}$ C; 8000 h                                                                                       | $\pm (2 \% R + 0.1 \Omega)$                                                            | $\pm (4 \% R + 0.1 \Omega)$                                    |

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

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**