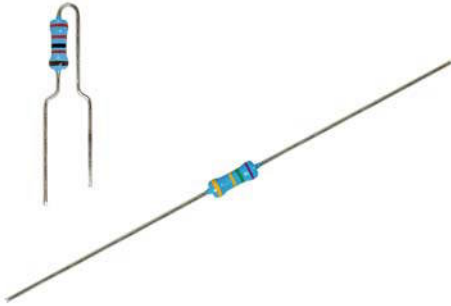


High Ohmic / High Voltage Metal Glaze Ledged Resistors



A metal glazed film is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned electrolytic copper wires are welded to the end-caps. The resistors are coated with a light blue lacquer which provides electrical, mechanical, and climatic protection.

FEATURES

- AEC-Q200 qualified
- High pulse loading capability (maximum 7 kV)
- Radial version available
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Lighting ballast
- High humidity environment
- White goods
- Power supplies

| TECHNICAL SPECIFICATIONS | |
|---|----------------------|
| DESCRIPTION | VR25 |
| Imperial size | 0207 |
| Resistance range ⁽¹⁾ | 100 kΩ to 22 MΩ |
| Resistance tolerance | ± 10 %; ± 5 %; ± 1 % |
| Temperature coefficient | ≤ ± 200 ppm/K |
| Rated dissipation, P_{70} | 0.25 W |
| Operating voltage, U_{max} . AC/DC | 1600 V |
| Operating temperature range | -55 °C to +155 °C |
| Peak permissible film temperature | 155 °C |
| Thermal resistance (R_{th}) | 140 K/W |
| Insulation voltage: 1 min.; U_{ins} | 700 V |
| Maximum noise (white noise) | 5 μV/V |
| Max. resistance change at rated dissipation for resistance range, $ \Delta R/R $ max., after 1000 h | 1.5 % |

Note

⁽¹⁾ Ohmic values (other than resistance range) are available on request.

| SAFETY REQUIREMENTS AND QUALIFICATIONS | |
|--|----------|
| DESCRIPTION | VR25 |
| Safety requirements / qualifications | AEC-Q200 |



| TEMPERATURE COEFFICIENT AND RESISTANCE RANGE | | | | |
|--|---------------|-----------|-----------------|----------|
| TYPE | TCR | TOLERANCE | RESISTANCE | E-SERIES |
| VR25 | ≤ ± 200 ppm/K | ± 1 % | 100 kΩ to 15 MΩ | E24; E96 |
| | | ± 5 % | 100 kΩ to 22 MΩ | E24; E96 |
| | | ± 10 % | 15 MΩ to 22 MΩ | E24 |

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: VR25000001003FA100

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V | R | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | F | A | 1 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | |
|-------------------------------|------------------------|---------------------|---|---|-----------------------------------|--------------------------|
| TYPE / SIZE VR25000 = VR25 | VARIANT 0 = neutral | TCR 0 = standard | RESISTANCE 3 digit value 1 digit multiplier MULTIPLIER 0 = *10 ⁰ 1 = *10 ¹ 2 = *10 ² 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵ 6 = *10 ⁶ | TOLERANCE (1) F = ± 1 % J = ± 5 % K = ± 10 % | PACKAGING A1 A5 R5 N4 | SPECIAL 00 = standard |
|-------------------------------|------------------------|---------------------|---|---|-----------------------------------|--------------------------|

PRODUCT DESCRIPTION: VR25 1 % A1 100K

| | | | |
|---------------------|---------------------------------------|-----------------------------------|-----------------------------|
| VR25 | 1 % | A1 | 100K |
| TYPE / SIZE VR25 | TOLERANCE ± 1 % ± 5 % ± 10 % | PACKAGING A1 A5 R5 N4 | RESISTANCE 100K = 100 kΩ |

Note

(1) See table "Temperature Coefficient and Resistance Range" for selecting correct ohmic value - tolerance combination.

| PACKAGING | | | | | | |
|-----------|------|----------|--|-------|---------|-------------------------|
| TYPE | CODE | QUANTITY | PACKAGING STYLE | WIDTH | PITCH | DIMENSIONS |
| VR25 | A1 | 1000 | Taped according to IEC 60286-1 fan-folded in a box | 53 mm | 5 mm | 75 mm x 31 mm x 260 mm |
| | A5 | 5000 | | 53 mm | 5 mm | 76 mm x 105 mm x 265 mm |
| | N4 | 4000 | Taped according to IEC 60286-2 fan-folded in a box | - | 12.7 mm | 48 mm x 253 mm x 330 mm |
| | R5 | 5000 | Taped according to IEC 60286-1 on a reel | 53 mm | 5 mm | 93 mm x 300 mm x 298 mm |



DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade ceramic body and conditioned to achieve the desired temperature coefficient. Plated steel termination caps are firmly pressed on the metalized rods. Mostly, a special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramics. Connecting wires of electrolytic copper plated with 100 % pure tin are welded to the termination caps. The resistor elements are covered by a light blue protective coating designed for electrical, mechanical, and climatic protection. Four or five color code rings designate the resistance value and tolerance in accordance with **IEC 60062**.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **IEC 60286-1** or for the radial versions in accordance to **IEC 60286-2**.

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 ⁽¹⁾
- The Global Automotive Declarable Substance List (GADSL) ⁽²⁾
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) ⁽³⁾ 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.

Notes

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

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping.

The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth, in compliance with IEC 60068-2-82, has been proven under extensive testing.

The encapsulant is resistant to cleaning solvent specified in IEC 60115-1. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

APPROVALS

These resistors meet the requirements of AEC-Q200.

RELATED PRODUCTS

For a correlated range of Metal Film Resistors see the datasheet:

“High Ohmic / High Voltage Metal Film Leaded Resistors”, www.vishay.com/doc?30260

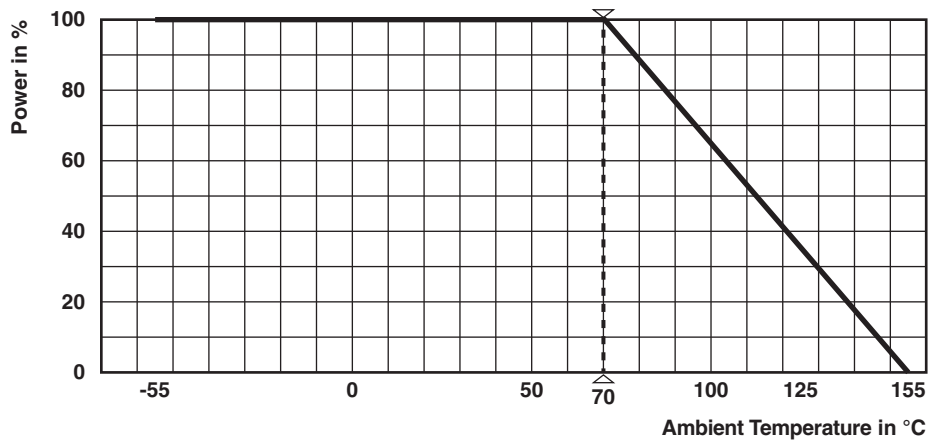
For product that offers high power dissipation and metal oxide film technology see the datasheet:

“High Power Metal Oxide Leaded Resistors”, www.vishay.com/doc?20128

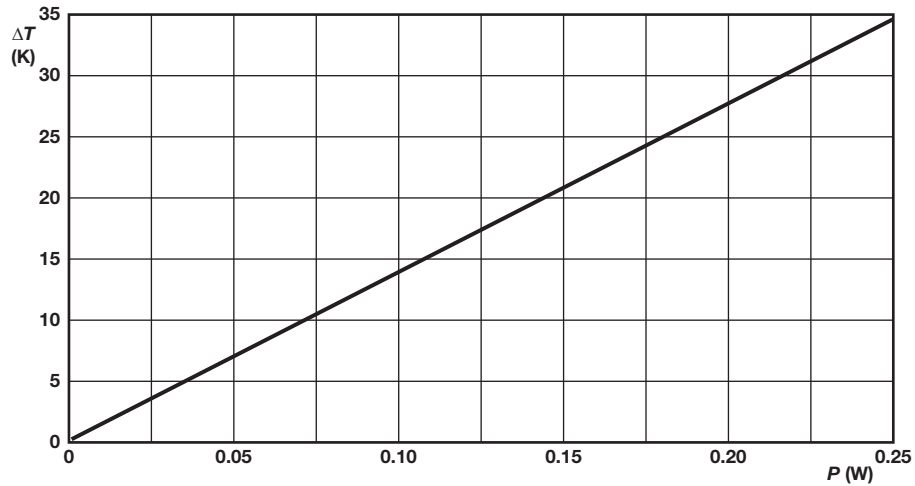


FUNCTIONAL PERFORMANCE

Derating

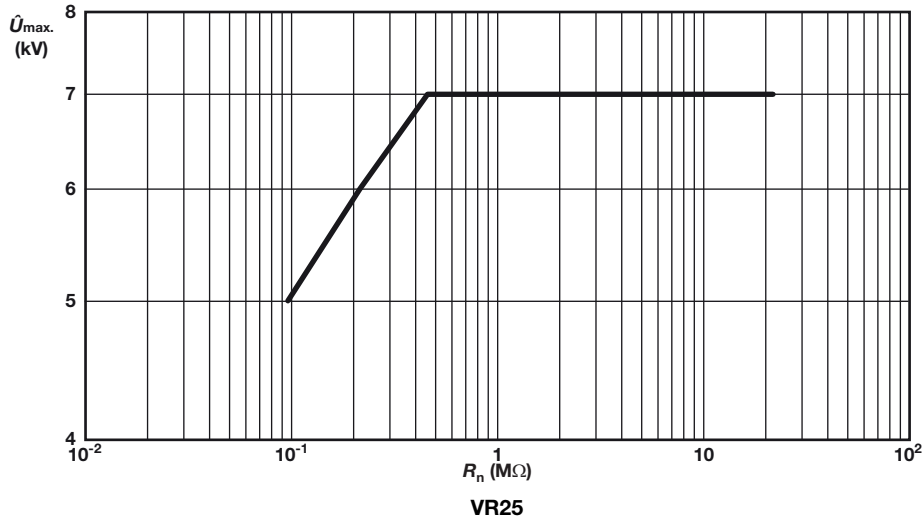


Hot-Spot Temperature Rise (ΔT) as a Function of Dissipated Power

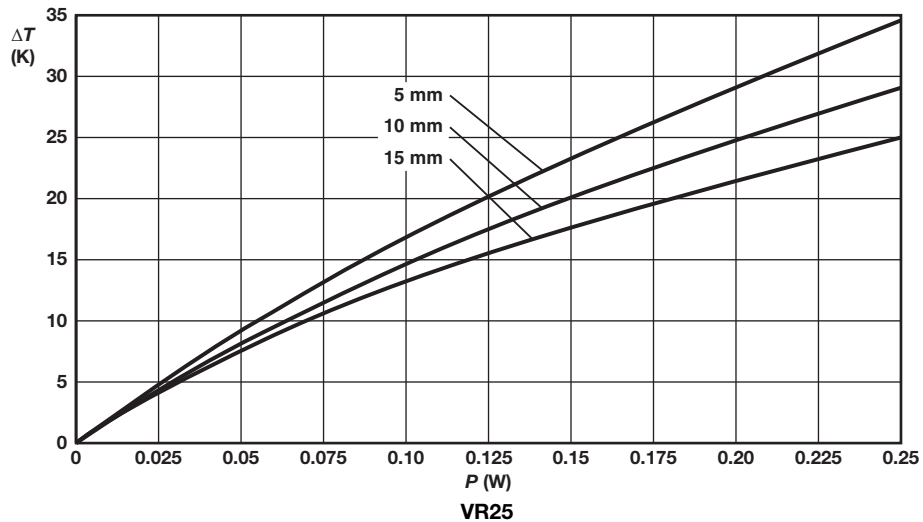


VR25

Maximum allowed peak pulse voltage in accordance with IEC 60065, 14.2;
 50 discharges from a 1nF capacitor charged to \hat{U}_{max} ; 12 discharges/min (drift $\Delta R/R \leq 2\%$)



Temperature Rise (ΔT) at the Lead End (Soldering Point) as a Function of Dissipated Power at Various Lead Lengths after Mounting



TESTS PROCEDURES AND REQUIREMENTS

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

- IEC 60115-1, generic specification (includes tests)

The test and requirements table contains only the most important tests. For the full test schedule refer to the documents listed above.

The tests are carried out with reference to IEC 60115-1, in accordance with IEC 60068-2-xx test method and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3.

A climatic category 55 / 155 / 56 is applied, defined by the lower category temperature (LCT = -55 °C), the upper category temperature (UCT = 155 °C), and the duration of exposure in the damp heat, steady state test (56 days).

Unless otherwise specified the following values apply:

- Temperature: 15 °C to 35 °C
- Relative humidity: 45 % to 75 %
- Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

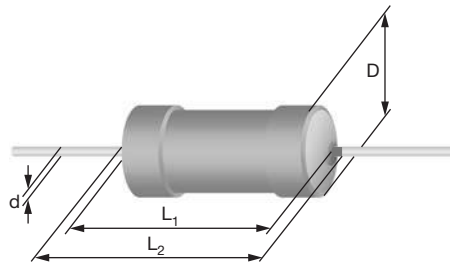
For performing some of the tests, the components are mounted on a test board in accordance with IEC 60115-1, 4.31.

In test procedures and requirements table, only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2-xx test methods. A short description of the test procedure is also given.

| TESTS PROCEDURES AND REQUIREMENTS | | | | |
|-----------------------------------|--------------------------------|------------------------------|--|---|
| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R_{max.}$) |
| 4.6.1.1 | | Insulation resistance | $U_{max. DC} = 500 V$ during 1 min; V-block method | R_{ins} min.: 10 000 M Ω |
| 4.7 | | Voltage proof | $U_{RMS} = U_{ins}$; 60 s | No breakdown or flashover |
| 4.8 | | Temperature coefficient | At (20 / -55 / 20) °C and (20 / 155 / 20) °C | $\leq \pm 200$ ppm/K |
| 4.12 | | Noise | IEC 60195 | Max. 5 $\mu V/V$ |
| 4.13 | | Short time overload | Room temperature; $2.5 \times \sqrt{P_{70} \times R}$; (voltage not more than 2 x limiting voltage); 10 cycles; 5 s ON and 45 s OFF | ΔR max.: $\pm 2 \% R$ |
| 4.16 | 21 (Ua1) 21 (Ub) 21 (Uc) | Robustness of terminations | Tensile, bending, and torsion | No damage ΔR max.: $\pm 0.5 \% R$ |
| 4.17 | 20 (Ta) | Solderability | +235 °C; 2 s; solder bath method; SnPb40 +245 °C; 3 s; solder bath method; SnAg3Cu0.5 (before aging) | Good tinning ($\geq 95 \%$ covered); no damage |
| | | | +235 °C; 2 s; solder bath method; SnPb40 +245 °C; 3 s; solder bath method; SnAg3Cu0.5 (after aging) | Good tinning ($\geq 95 \%$ covered); no damage |
| 4.18 | 20 (Tb) | Resistance to soldering heat | Unmounted components (260 \pm 5) °C; (10 \pm 1) s | ΔR max.: $\pm 0.5 \% R$ |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min at -55 °C and 30 min at +155 °C; 5 cycles | ΔR max.: $\pm 0.5 \% R$ |
| 4.20 | 29 (Eb) | Bump | 3 x 1500 bumps in 3 directions; 40 g | No damage ΔR max.: $\pm 0.5 \% R$ |
| 4.22 | 6 (Fc) | Vibration | 10 sweep cycles per direction; 10 Hz to 2000 Hz; 1.5 mm or 200 m/s ² | No damage ΔR max.: $\pm 0.5 \% R$ |
| 4.23 | | Climatic sequence: | | |
| 4.23.2 | 2 (Bb) | Dry heat | 16 h; 155 °C | R_{ins} min.: 1 G Ω ΔR max.: $\pm 1.5 \% R$ |
| 4.23.3 | 30 (Db) | Damp heat cyclic | 24 h; 25 °C to 55 °C; 90 % to 100 % RH | |
| 4.23.4 | 1 (Ab) | Cold | 2 h; -55 °C | |
| 4.23.5 | 13 (M) | Low air pressure | 2 h; 8.5 kPa; 15 °C to 35 °C | |
| 4.23.6 | 30 (Db) | Damp heat remaining cyclic | 5 days; 55 °C; 95 % to 100 % RH; 5 cycles | |
| 4.23.7 | | DC load | Apply rated power for 1 min | |

| TESTS PROCEDURES AND REQUIREMENTS | | | | |
|-----------------------------------|-------------------------|--|--|---|
| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R_{max.}$) |
| 4.24 | 78 (Cab) | Damp heat (steady state) | 56 days; 40 °C; 90 % to 95 % RH; loaded with 0.01 P_{70} (steps: 0 V to 100 V) | $\Delta R_{max.} : \pm 1.5 \% R$ |
| 4.25.1 | | Endurance (at 70 °C) | 1000 h; loaded with P_{70} or $U_{max.}$; 1.5 h ON and 0.5 h OFF | $\Delta R_{max.} : \pm 1.5 \% R$ |
| 4.26 | | Active flammability "cheese-cloth test" | Steps of: 5 / 10 / 16 / 25 / 40 x P_{70} duration 5 min | No flaming of gauze cylinder |
| 4.35 | | Passive flammability "needle-flame test" | Application of test flame for 20 s | No ignition of product; no ignition of under-layer; burning time less than 30 s |

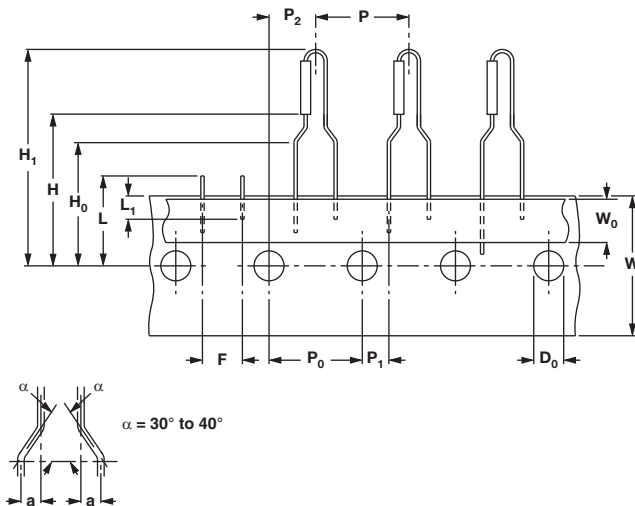
DIMENSIONS



| DIMENSIONS - Leaded resistor types, mass, and relevant physical dimensions | | | | | |
|--|-----------------------------|-----------------|-----------------|----------------------|-----------|
| TYPE | $\varnothing D_{max.}$ (mm) | L_1 max. (mm) | L_2 max. (mm) | $\varnothing d$ (mm) | MASS (mg) |
| VR25 | 2.5 | 6.5 | 7.5 | 0.58 ± 0.05 | 212 |

VR25 WITH RADIAL TAPING

Lead Spacing ($F = 4.8$ mm), Size 0207



| DIMENSIONS in millimeters | | |
|---------------------------|-------|---------------------|
| Pitch of components | P | 12.7 ± 1.0 |
| Lead spacing | F | $4.8 + 0.7 / - 0.0$ |
| Width of carrier tape | W | 18.0 ± 0.5 |
| Body to hole center | H | 19.5 ± 1.0 |
| Height for cutting (max.) | L | 11 |
| Height for bending | H_0 | 16.5 ± 0.5 |
| Component height (max.) | H_1 | 29 |



HISTORICAL 12NC INFORMATION

- The resistors have a 12-digit numeric code starting with
 - 2322 241 refers to VR25
- The subsequent first digit for 1 % tolerance products (E24 and E96 series) or 2 digits for 5 % (E24 series) and 10 % (E12 series) indicate the resistor type and packing
- The remaining digits indicate the resistance value:
 - The first 3 digits for 1 % or 2 digits for 5 % and 10 % tolerance products indicate the resistance value
 - The last digit indicates the resistance decade

Last Digit of 12NC Indicating Resistance Decade

| RESISTANCE DECADE | LAST DIGIT |
|-------------------|------------|
| 100 kΩ to 976 kΩ | 4 |
| 1 MΩ to 9.76 MΩ | 5 |
| ≥ 10 MΩ | 6 |

Historical 12NC Example

- The 12NC for a VR25, resistor value 7.5 MΩ, 5 % tolerance, supplied on a bandoleer of 1000 units in ammopack, is: 2322 241 13755.

| 12NC CODING FOR VR25 - Resistor type and packaging | | | | | |
|---|---------------|--|----------------|------------|-------------------|
| TYPE | TOLERANCE (%) | VR25 CODING STARTS WITH 2322 241 | | | |
| | | BANDOLIER IN AMMOPACK | | | BANDOLIER ON REEL |
| | | RADIAL TAPED | STRAIGHT LEADS | | |
| | | 4000 UNITS | 52 mm | 52 mm | 52 mm |
| | | 1000 UNITS | 5000 UNITS | 5000 UNITS | 5000 UNITS |
| VR25 | ± 1 | 0.... | 8.... | 7.... | 6.... |
| | ± 5 | 36... | 13... | 53... | 23... |
| | ± 10 | 38... | 12... | 52... | 22... |



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.