

High Ohmic/High Voltage Metal Glaze Led 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.

The encapsulation is resistant to all cleaning solvents in accordance with IEC 60068-2-45.

FEATURES

- Technology: Metal glaze
- $R_{max.} = 22 \text{ M}\Omega$; $U_{max.} = 1600 \text{ V}_{DC}$
- High pulse loading capability (up to 7 kV)
- Small size (0207)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compliant to RoHS Directive 2002/95/EC
- AEC-Q200 qualified



RoHS
COMPLIANT

APPLICATIONS

- Where high resistance, high stability and high reliability at high voltage are required
- High humidity environment
- White goods
- Power supplies

| TECHNICAL SPECIFICATIONS | | |
|---|-----------------|---|
| DESCRIPTION | UNIT | VR25 |
| Resistance Range ⁽¹⁾ | Ω | 100K to 22M |
| Resistance Tolerance 100 k Ω to 15 M Ω 15 M Ω to 22 M Ω | % | ± 1 ; ± 5 ; ± 5 ; ± 10 |
| Resistance Series 100 k Ω to 15 M Ω 15 M Ω to 22 M Ω | | E24/E96 series; E24 series E24 series; E12 series |
| Rated Dissipation, P_{70} | W | 0.25 |
| Thermal Resistance (R_{th}) | K/W | 140 |
| Temperature Coefficient | ppm/K | $\leq \pm 200$ |
| Maximum Permissible Voltage $U_{max.}$ DC RMS | V | 1600 1150 |
| Dielectric Withstanding Voltage of the Insulation for 1 Min | V | 700 |
| Basic Specifications | | IEC 60115-1 |
| Climatic Category (IEC 60068-1) | | 55/155/56 |
| Max. Resistance Change for Resistance Range, $\Delta R_{max.}$, after: Load (1000 h, P_{70}) Long Term Damp Heat Test (56 Days) Soldering (10 s, 260 °C) | | $\pm (1.5 \% R + 0.1 \Omega)$ $\pm (1.5 \% R + 0.1 \Omega)$ $\pm (1.5 \% R + 0.1 \Omega)$ |
| Noise | $\mu\text{V/V}$ | max. 5 |

Note

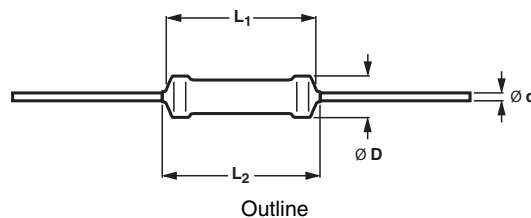
⁽¹⁾ Ohmic values (other than resistance range) are available on request.

| PART NUMBER | | | | | | | | | | | | | | | | |
|---------------------------------------|--|---------------------------------------|------------------------------|---|--|---|---|---|---|---------------------------------------|---|--|---|---|---|---|
| PART NUMBER: VR25000001503JA100 | | | | | | | | | | | | | | | | |
| V | R | 2 | 5 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 3 | J | A | 1 | 0 | 0 |
| MODEL/SIZE VR25000 | VARIANT 0 = Neutral Z = Value overflow (Special) | | TCR/MATERIAL 0 = Standard | | VALUE 3 digit value 1 digit multiplier 3 = *10 ³ 4 = *10 ⁴ 5 = *10 ⁵ | | | TOLERANCE F = ± 1 % J = ± 5 % K = ± 10 % | | PACKAGING (1) A5 A2 R5 N4 | | SPECIAL The 2 digits are used for all special parts. 00 = Standard | | | | |
| PRODUCT DESCRIPTION: VR25 5 % A1 150K | | | | | | | | | | | | | | | | |
| VR25 | | 5 % | | A1 | | 150K | | | | | | | | | | |
| MODEL/SIZE VR25 | | TOLERANCE ± 1 % ± 5 % ± 10 % | | PACKAGING (1) A5 A2 A1 R5 N4 | | RESISTANCE VALUE 150K = 150 kΩ 8M2 = 8.2 MΩ | | | | | | | | | | |

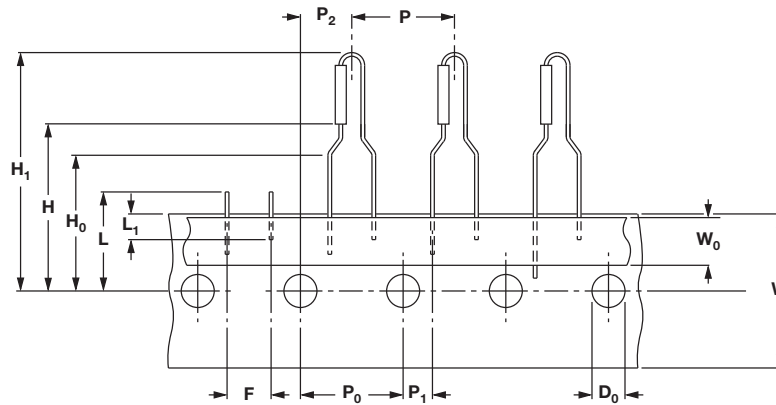
Notes

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products
- (1) Please refer to table PACKAGING

| PACKAGING | | | | | |
|-----------|--------------|----------|------|--------|------|
| MODEL | TAPING | AMMOPACK | | REEL | |
| | | PIECES | CODE | PIECES | CODE |
| VR25 | Axial, 26 mm | 2000 | A2 | - | - |
| | Axial, 52 mm | 5000 | A5 | 5000 | R5 |
| | | 1000 | A1 | - | - |
| | Radial | 4000 | N4 | - | - |

DIMENSIONS


| DIMENSIONS - Resistor type and relevant physical dimensions | | | | |
|---|---------------------|---------------------|---------------------|-------------|
| TYPE | Ø D _{max.} | L ₁ max. | L ₂ max. | Ø d |
| VR25 | 2.5 | 6.5 | 7.5 | 0.58 ± 0.05 |

PRODUCTS WITH RADIAL LEADS

DIMENSIONS - RADIAL TAPING

| SYMBOL | PARAMETER | VALUE | TOLERANCE | UNIT |
|----------------|---|-------|-----------|------|
| P | Pitch of components | 12.7 | ± 1.0 | mm |
| P ₀ | Feed-hole pitch | 12.7 | ± 0.2 | mm |
| P ₁ | Feed-hole centre to lead at topside at the tape | 3.85 | ± 0.5 | mm |
| P ₂ | Feed-hole center to body center | 6.35 | ± 1.0 | mm |
| F | Lead-to-lead distance | 4.8 | + 0.7/- 0 | mm |
| W | Tape width | 18.0 | ± 0.5 | mm |
| W ₀ | Minimum hold down tape width | 5.5 | - | mm |
| H ₁ | Component height | 29 | Max. | mm |
| H ₀ | Lead wire clinch height | 16.5 | ± 0.5 | mm |
| H | Height of component from tape center | 19.5 | ± 1 | mm |
| D ₀ | Feed-hole diameter | 4.0 | ± 0.2 | mm |
| L | Maximum length of snapped lead | 11.0 | - | mm |
| L ₁ | Minimum lead wire (tape portion) shortest lead | 2.5 | - | mm |

Note

- Please refer document number 28721 "Packaging" for more detail

MASS PER UNIT

| TYPE | MASS (mg) |
|-------------|-----------|
| VR25, 52 mm | 212 |
| VR25, 26 mm | 148 |

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC 60062, marking codes for resistors and capacitors.

Yellow and grey are used instead of gold and silver because metal particles in the lacquer could affect high-voltage properties.

OUTLINES

The length of the body (L₁) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation (IEC 60294).

**FUNCTIONAL PERFORMANCE
PRODUCT CHARACTERIZATION**

Standard values of nominal resistance are taken from the E96/E24/E12 series for resistors with a tolerance of ± 1 %, 5 %, or 10 %. The values of the E96/E24/E12 series are in accordance with IEC 60063.

LIMITING VALUES

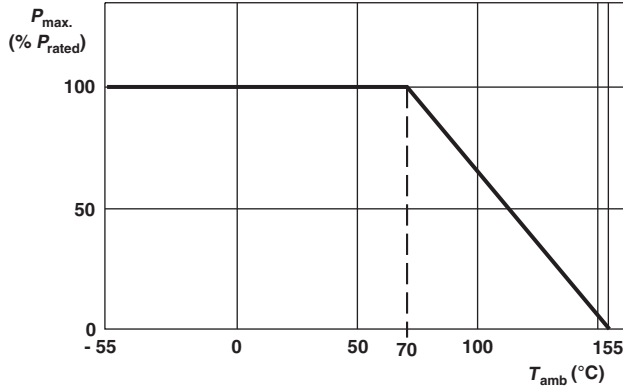
| TYPE | LIMITING VOLTAGE ⁽¹⁾ U _{max.} | | LIMITING POWER P ₇₀ (W) |
|------|--|------|---------------------------------------|
| | DC | RMS | |
| VR25 | 1600 | 1150 | 0.25 |

Notes

- The maximum permissible hot-spot temperature is 155 °C
- ⁽¹⁾ The maximum voltage that may be continuously applied to the resistor element, see IEC 60115-1

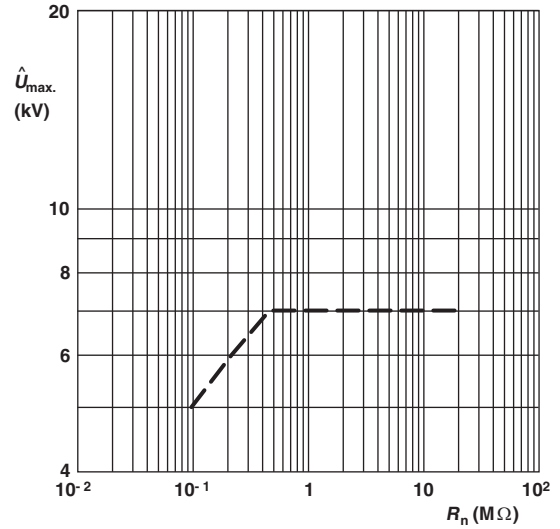
DERATING

The power that the resistor can dissipate depends on the operating temperature.



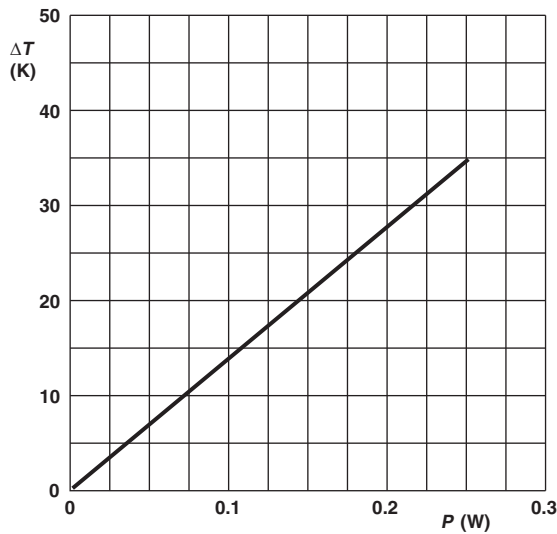
Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb})

PULSE LOADING CAPABILITY

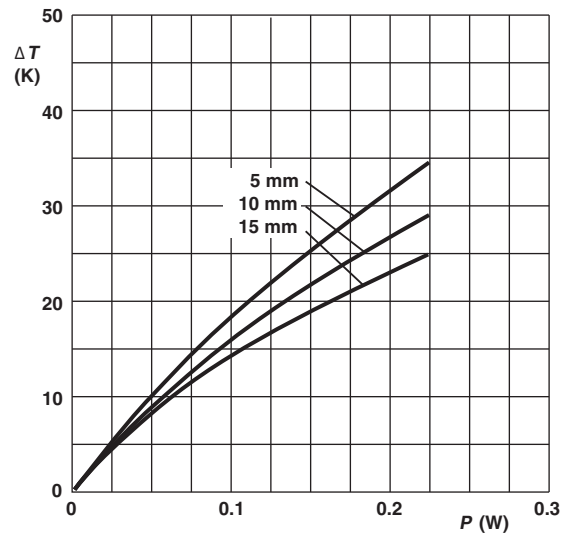


Maximum allowed peak pulse voltage in accordance with IEC 60065, 14.1.a; 50 discharges from a 1 nF capacitor charged to \hat{U}_{max} ; 12 discharges/min (drift $\Delta R/R \leq 2\%$)

APPLICATION INFORMATION



Hot-spot temperature rise (ΔT) as a function of dissipated power



Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC 60115-1 specification, category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days).

The tests are carried out in accordance with IEC 60068-2-xx. Test method under standard atmospheric conditions according to IEC 60068-1, 5.3.

In the Test Procedures and Requirements table 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. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

All soldering tests are performed with mildly activated flux.

| TEST PROCEDURES AND REQUIREMENTS | | | | |
|----------------------------------|--------------------------|---|---|---|
| IEC 60115-1 CLAUSE | IEC 60068-2- TEST METHOD | TEST | PROCEDURE | REQUIREMENTS |
| 4.16 | | Robustness of terminations: | | |
| 4.16.2 | 21 (Ua1) | Tensile all samples | Ø 0.6 mm; load 10 N; 10 s | Number of failures < 10 x 10 ⁻⁶ |
| 4.16.3 | 21 (Ub) | Bending half number of samples | Ø 0.6 mm; load 5 N; 4 x 90° | Number of failures < 10 x 10 ⁻⁶ |
| 4.16.4 | 21 (Uc) | Torsion other half of samples | 3 x 360° in opposite directions | No damage ΔR max.: ± (0.5 % R + 0.05 Ω) |
| 4.17 | 20 (Ta) | Solderability | 2 s; 235 °C: Solder bath method; SnPb40 3 s; 245 °C: Solder bath method; SnAg3Cu0.5 | Good tinning (≥ 95 % covered); no damage |
| | | Solderability (after aging) | 8 h steam or 16 h 155 °C; leads immersed 6 mm; for 2 s at 235 °C; solder bath (SnPb40) for 3 s at 245 °C; solder bath (SnAg3Cu0.5) method | Good tinning (≥ 95 % covered); no damage |
| 4.18 | 20 (Tb) | Resistance to soldering heat | Thermal shock: 10 s; 260 °C; 3 mm from body | ΔR max.: ± (0.5 % R + 0.05 Ω) |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min at - 55 °C and 30 min at + 155 °C; 5 cycles | ΔR max.: ± (0.5 % R + 0.05 Ω) |
| 4.20 | 29 (Eb) | Bump | 3 x 1500 bumps in 3 directions; 40 g | No damage ΔR max.: ± (0.5 % R + 0.05 Ω) |
| 4.22 | 6 (Fc) | Vibration | Frequency 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h) | No damage ΔR max.: ± (0.5 % R + 0.05 Ω) |
| 4.23 | | Climatic sequence: | | |
| 4.23.2 | 2 (Ba) | Dry heat | 16 h; 155 °C | |
| 4.23.3 | 30 (Db) | Damp heat (accelerated) 1 st cycle | 24 h; 55 °C; 90 % to 100 % RH | |
| 4.23.4 | 1 (Aa) | 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 (accelerated) remaining cycles | 5 days; 55 °C; 95 % to 100 % RH | R _{ins} min.: 10 ³ MΩ ΔR max.: ± (1.5 % R + 0.1 Ω) |
| 4.24 | 78 (Cab) | Damp heat (steady state) | 56 days; 40 °C; 90 % to 95 % RH; dissipation 0.01 P ₇₀ ; limiting voltage U = 100 V _{DC} | ΔR max.: ± (1.5 % R + 0.1 Ω) |
| 4.25.1 | | Endurance | 1000 h at 70 °C; P ₇₀ or U _{max.} | ΔR max.: ± (1.5 % R + 0.1 Ω) |
| 4.8 | | Temperature coefficient | Between - 55 °C and + 155 °C | ≤ ± 200 ppm/K |
| 4.7 | | Voltage proof on insulation | U _{RMS} = 700 V during 1 min; V-block method | No breakdown |
| 4.12 | | Noise | IEC 60195 | Max. 5 μV/V |
| 4.6.1.1 | | Insulation resistance | U = 500 V _{DC} during 1 min; V-block method | R _{ins} min.: 10 ⁴ MΩ |
| 4.13 | | Short time overload | Room temperature; dissipation 6.25 x P ₇₀ (voltage not more than 2 x limiting voltage); 10 cycles; 5 s ON and 45 s OFF | ΔR max.: ± (2.0 % R + 0.05 Ω) |



| TEST PROCEDURES AND REQUIREMENTS | | | | |
|----------------------------------|--------------------------|--|--|---|
| IEC 60115-1 CLAUSE | IEC 60068-2- TEST METHOD | TEST | PROCEDURE | REQUIREMENTS |
| 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 |

12NC INFORMATION FOR HISTORICAL CODING REFERENCE

- The resistors have a 12-digit numeric code starting with 2322 241
- 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 |

12NC Example

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

| 12NC - Resistor type and packaging | | | | | | |
|------------------------------------|----------|-----------------------|----------------|------------|------------|-------------------|
| TYPE | TOL. (%) | 2322 241 | | | | |
| | | BANDOLIER IN AMMOPACK | | | | BANDOLIER ON REEL |
| | | RADIAL TAPED | STRAIGHT LEADS | | | 52 mm |
| | | | 4000 UNITS | 52 mm | 26 mm | |
| | | 1000 UNITS | 2000 UNITS | 5000 UNITS | 5000 UNITS | |
| VR25 | ± 1 | 0... | 8... | - | 7... | 6... |
| | ± 5 | 36... | 13... | 43... | 53... | 23... |
| | ± 10 | 38... | 12... | 42... | 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.