

## High Ohmic/High Voltage Metal Glaze Leaded 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

- $R_{max.} = 33 \text{ M}\Omega$ ;  $U_{max.} = 3500 \text{ V}_{DC}$
- These resistors meet the safety requirements of:
  - UL1676 (510 k $\Omega$  to 11 M $\Omega$ ); File No: E171160
  - IEC 60065, clause 14.1.a)
  - DIN EN 60065, clause 14.1.a)
  - VDE 0860, clause 14.1.a)
  - CQC, China
- High pulse loading capability (10 kV)
- Small size (0309)
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compliant to RoHS directive 2002/95/EC



RoHS  
COMPLIANT



### APPLICATIONS

- Where high resistance, high stability and high reliability at high voltage are required
- Safety component in combination with high voltage
- White goods
- High humidity environment
- Power supplies

| TECHNICAL SPECIFICATIONS                                    |  |
|---|--|
| DESCRIPTION   | VALUE  |
| Resistance Range <sup>(1)</sup>                             | 100 k $\Omega$ to 33 M $\Omega$  |
| Resistance Tolerance and Series                             | $\pm 1 \%$ : E24/E96 series;<br>$\pm 5 \%$ : E24 series  |
| Rated Dissipation, $P_{70}$                                 | 0.5 W  |
| Thermal Resistance, $R_{th}$                                | 120 K/W  |
| Temperature Coefficient                                     | $\leq \pm 200 \text{ ppm/K}$   |
| Maximum Permissible Voltage $U_{max.}$ :                    |  |
| DC  | 3500 V   |
| RMS   | 2500 V   |
| Dielectric Withstanding Voltage of the Insulation for 1 Min | 700 V  |
| Basic Specifications  | IEC 60115-1  |
| Safety Requirements   | UL1676 (510 k $\Omega$ to 11 M $\Omega$ ); DIN EN 60065, IEC 60065, clause 14.1.a);<br>VDE 0860, clause 14.1.a), CQC |
| Climatic Category (IEC 60068-1)                             | 55/155/56  |
| Stability After:  |  |
| Load (1000 h, $P_{70}$ )                                    | $\Delta R \text{ max.} : \pm (1.5 \% R + 0.1 \Omega)$  |
| Long Term Damp Heat Test (56 Days)                          | $\Delta R \text{ max.} : \pm (1.5 \% R + 0.1 \Omega)$  |
| Soldering (10 s, 260 °C)                                    | $\Delta R \text{ max.} : \pm (1.5 \% R + 0.1 \Omega)$  |
| Noise   | max. 2.5 $\mu\text{V/V}$   |

#### Note

<sup>(1)</sup> Ohmic values (other than resistance range) are available upon request

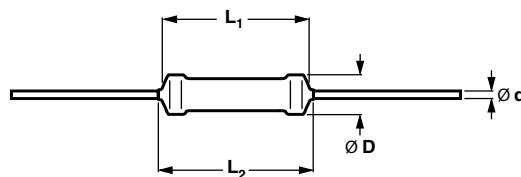
| PART NUMBER                           |   |               |   |                        |               |   |
|---------------------------------------|---|---------------|---|------------------------|---------------|---|
| PART NUMBER: VR3700001503JA100        |   |               |   |                        |               |   |
| V                                     | R   | 3             | 7   | 0                      | 0             | 0   |
| MODEL/SIZE                            | VARIANT                                     | TCR/MATERIAL  | VALUE   | TOLERANCE              | PACKAGING (1) | SPECIAL   |
| VR37000                               | 0 = Neutral<br>Z = Value overflow (Special) | 0 = Standard  | 3 digit value<br>1 digit multiplier<br>MULTIPLIER<br>3 = *10 <sup>3</sup><br>4 = *10 <sup>4</sup><br>5 = *10 <sup>5</sup> | F = ± 1 %<br>J = ± 5 % | A1<br>R5      | The 2 digits are used for all special parts.<br>00 = Standard |
| PRODUCT DESCRIPTION: VR37 5 % A1 150K |   |               |   |                        |               |   |
| VR37                                  | 5 %   | A1            | 150K  |                        |               |   |
| MODEL/SIZE                            | TOLERANCE                                   | PACKAGING (1) | RESISTANCE VALUE  |                        |               |   |
| VR37                                  | ± 1 %<br>± 5 %                              | A1<br>R5      | 150K = 150 kΩ<br>8M2 = 8.2 MΩ   |                        |               |   |

**Notes**

(1) Please refer to table PACKAGING

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

| PACKAGING |              |           |      |        |      |
|-----------|--------------|-----------|------|--------|------|
| MODEL     | TAPING       | AMMO PACK |      | REEL   |      |
|           |              | PIECES    | CODE | PIECES | CODE |
| VR37      | Axial, 52 mm | 1000      | A1   | 5000   | R5   |

**DIMENSIONS**


Outline

| DIMENSIONS - resistor type and relevant physical dimensions |                     |                     |                     |            |
|---|---------------------|---------------------|---------------------|------------|
| TYPE  | Ø D <sub>max.</sub> | L <sub>1</sub> max. | L <sub>2</sub> max. | Ø d        |
| VR37  | 4.0                 | 9.0                 | 10.0                | 0.7 ± 0.03 |

| MASS PER UNIT |           |
|---------------|-----------|
| TYPE          | MASS (mg) |
| VR37          | 457       |

**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 ( $L_1$ ) 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  $\pm 1\%$  or

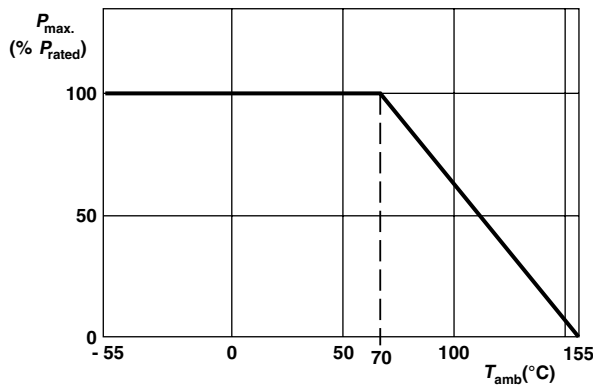
5%. The values of the E96/E24 series are in accordance with IEC 60063.

| LIMITING VALUES |   |      |                                 |
|-----------------|---|------|---------------------------------|
| TYPE            | LIMITING VOLTAGE <sup>(1)</sup><br>$U_{max.}$ |      | LIMITING POWER, $P_{70}$<br>(W) |
|                 | DC  | RMS  |                                 |
| VR37            | 3500  | 2500 | 0.5                             |

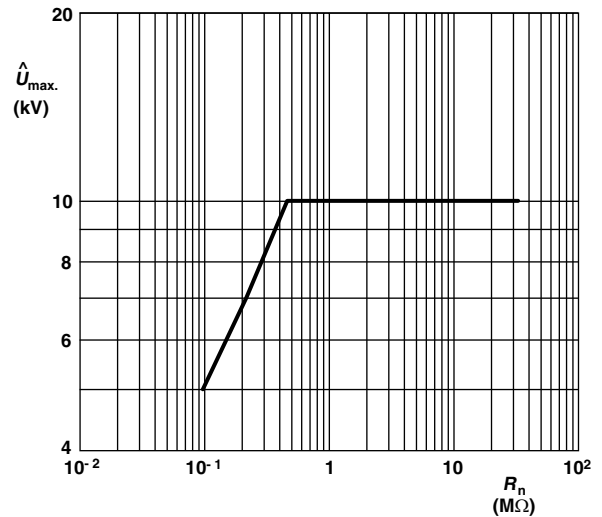
**Notes**

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

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



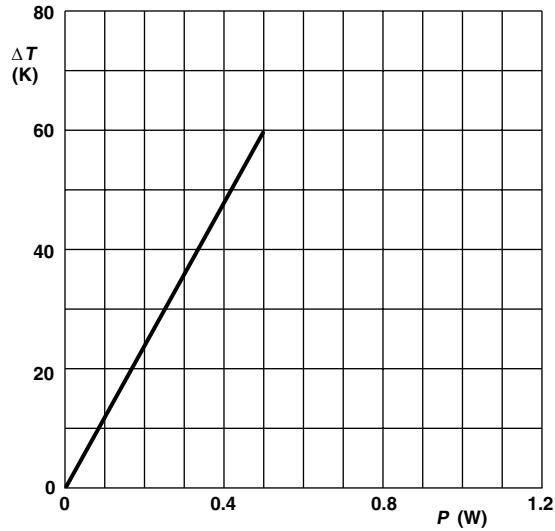
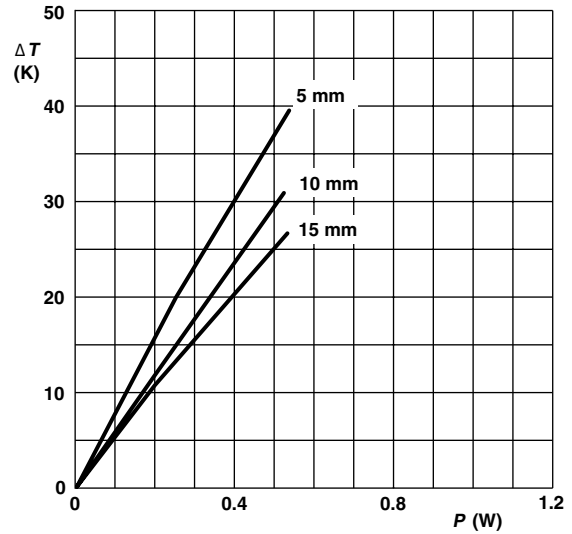
Maximum dissipation ( $P_{max.}$ ) in percentage of rated power as a function of the ambient temperature ( $T_{amb}$ )



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/minute (drift  $\Delta R/R \leq 2\%$ )

**Derating**

**Pulse Loading Capability**


 Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power

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

### Application Information

### 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 0.7 mm; load 10 N; 10 s   | Number of failures < $10 \times 10^{-6}$                     |
| 4.16.3                           | 21 (Ub)                 | Bending half number of samples | Ø 0.7 mm; load 5 N; $4 \times 90^\circ$   | Number of failures < $10 \times 10^{-6}$                     |
| 4.16.4                           | 21 (Uc)                 | Torsion other half of samples  | $3 \times 360^\circ$ in opposite directions   | No damage<br>$\Delta R$ max.: $\pm (0.5 \% R + 0.05 \Omega)$ |
| 4.17                             | 20 (Ta)                 | Solderability                  | 2 s; 235 °C: Solder bath method; SnPb40<br>3 s; 245 °C: Solder bath method; SnAg3Cu0.5  | Good tinning ( $\geq 95 \%$ 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 ( $\geq 95 \%$ covered); no damage              |
| 4.18                             | 20 (Tb)                 | Resistance to soldering heat   | Thermal shock: 10 s; 260 °C; 3 mm from body   | $\Delta R$ max.: $\pm (0.5 \% R + 0.05 \Omega)$              |
| 4.19                             | 14 (Na)                 | Rapid change of temperature    | 30 min at - 55 °C and 30 min at + 155 °C; 5 cycles  | $\Delta R$ max.: $\pm (0.5 \% R + 0.05 \Omega)$              |



| TEST PROCEDURES AND REQUIREMENTS |  |   |   |   |
|----------------------------------|--|---|---|---|
| IEC 60115-1 CLAUSE               | IEC 60068-2- TEST METHOD                         | TEST  | PROCEDURE   | REQUIREMENTS  |
| 4.20                             | 29 (Eb)  | Bump  | 3 x 1500 bumps in 3 directions; 40 g  | No damage<br>$\Delta R \text{ max.: } \pm (0.5 \% R + 0.05 \Omega)$                                   |
| 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<br>$\Delta R \text{ max.: } \pm (0.5 \% R + 0.05 \Omega)$                                   |
| 4.23                             | 2 (Ba)<br>30 (Db)<br>1 (Aa)<br>13 (M)<br>30 (Db) | Climatic sequence:                            |   |   |
| 4.23.2                           |  | Dry heat                                      | 16 h; 155 °C  |   |
| 4.23.3                           |  | Damp heat (accelerated) 1 <sup>st</sup> cycle | 24 h; 55 °C; 90 % to 100 % RH   |   |
| 4.23.4                           |  | Cold  | 2 h; - 55 °C  |   |
| 4.23.5                           |  | Low air pressure                              | 2 h; 8.5 kPa; 15 °C to 35 °C  |   |
| 4.23.6                           |  | Damp heat (accelerated) remaining cycles      | 5 days; 55 °C; 95 % to 100 % RH   | $R_{\text{ins min.: } 10^3 \text{ M}\Omega}$<br>$\Delta R \text{ max.: } \pm (1.5 \% R + 0.1 \Omega)$ |
| 4.24                             | 78 (Cab)   | Damp heat (steady state)                      | 56 days; 40 °C; 90 % to 95 % RH; dissipation 0.01 $P_{70}$ ; limiting voltage $U = 100 V_{DC}$                                  | $\Delta R \text{ max.: } \pm (1.5 \% R + 0.1 \Omega)$   |
| 4.25.1                           |  | Endurance                                     | 1000 h at 70 °C; $P_{70}$ or $U_{\text{max}}$   | $\Delta R \text{ max.: } \pm (1.5 \% R + 0.1 \Omega)$   |
| 4.8                              |  | Temperature coefficient                       | Between - 55 °C and + 155 °C  | $\leq \pm 200 \text{ ppm/K}$  |
| 4.7                              |  | Voltage proof on insulation                   | $U_{\text{RMS}} = 700 \text{ V}$ during 1 min; V-block method   | No breakdown  |
| 4.12                             |  | Noise   | IEC 60195   | Max. 2.5 $\mu\text{V/V}$  |
| 4.6.1.1                          |  | Insulation resistance                         | $U = 500 V_{DC}$ during 1 min; V-block method   | $R_{\text{ins min.: } 10^4 \text{ M}\Omega}$  |
| 4.13                             |  | Short time overload                           | Room temperature; dissipation $6.25 \times P_{70}$ (voltage not more than 2 x limiting voltage); 10 cycles; 5 s ON and 45 s OFF | $\Delta R \text{ max.: } \pm (2.0 \% R + 0.05 \Omega)$  |

**12NC INFORMATION FOR HISTORICAL CODING REFERENCE**

- The resistors have a 12-digit numeric code starting with 2322 242.
- The subsequent: first digit for 1 % tolerance products (E24 and E96 series) or 2 digits for 5 % (E24 series) indicate the resistor type and packaging
- The remaining digits indicate the resistance value:
  - The first 3 digits for 1 % or 2 digits for 5 % 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 k $\Omega$ to 976 k $\Omega$ | 4          |
| 1 M $\Omega$ to 9.76 M $\Omega$  | 5          |
| $\geq 10 \text{ M}\Omega$        | 6          |

**12NC Example**

The 12NC for a VR37, resistor value 7.5 M $\Omega$ , 5 % tolerance, supplied on a bandolier of 1000 units in ammpack, is: 2322 242 13755.

| 12NC - Resistor type and packaging |                 |          |                       |                   |
|------------------------------------|-----------------|----------|-----------------------|-------------------|
| TYPE                               | TAPE WIDTH (mm) | TOL. (%) | 2322 242 .....        |                   |
|                                    |                 |          | BANDOLIER IN AMMOPACK | BANDOLIER ON REEL |
|                                    |                 |          | 1000 units            | 5000 units        |
| VR37                               | 52              | $\pm 1$  | 8....                 | 6....             |
|                                    |                 | $\pm 5$  | 13...                 | 23...             |



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