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 MΩ; $U_{max.}$ = 3500 V_{DC}
- These resistors meet the safety requirements of:
  UL1676 (510 kΩ to 11 MΩ); 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 [(1)]	100 kΩ to 33 MΩ
Resistance Tolerance and Series	± 1 %: E24/E96 series; ± 5 %: E24 series
Rated Dissipation, P_{70}	0.5 W
Thermal Resistance, R_{th}	120 K/W
Temperature Coefficient	≤ ± 200 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 kΩ to 11 MΩ); DIN EN 60065, IEC 60065, clause 14.1.a); VDE 0860, clause 14.1.a), CQC
Climatic Category (IEC 60068-1)	55/155/56
Stability After:	
Load (1000 h, P_{70})	ΔR max.: ± (1.5 % R + 0.1 Ω)
Long Term Damp Heat Test (56 Days)	ΔR max.: ± (1.5 % R + 0.1 Ω)
Soldering (10 s, 260 °C)	ΔR max.: ± (1.5 % R + 0.1 Ω)
Noise	max. 2.5 µV/V

Note
(1) Ohmic values (other than resistance range) are available upon request

PART NUMBER

PART NUMBER: VR37000001503JA100

V	R	3	7	0	0	0	0	0	1	5	0	3	J	A	1	0	0

MODEL/SIZE	VARIANT	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
VR37000	**0** = Neutral **Z** = Value overflow (Special)	**0** = Standard	**3 digit value** **1 digit multiplier** MULTIPLIER **3** = $*10^3$ **4** = $*10^4$ **5** = $*10^5$	**F** = ± 1 % **J** = ± 5 %	**A1** **R5**	The 2 digits are used for all special parts. **00** = Standard

PRODUCT DESCRIPTION: VR37 5 % A1 150K

VR37	5 %	A1	150K
MODEL/SIZE	TOLERANCE	PACKAGING (1)	RESISTANCE VALUE
VR37	± **1** % ± **5** %	**A1** **R5**	**150K** = 150 kΩ **8M2** = 8.2 MΩ

Notes

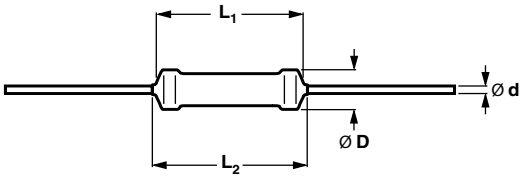
(1) Please refer to table PACKAGING

- 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 $D_{max.}$	$L_{1\ max.}$	$L_{2\ max.}$	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 ± 1 % or 5 %. The values of the E96/E24 series are in accordance with IEC 60063.

LIMITING VALUES

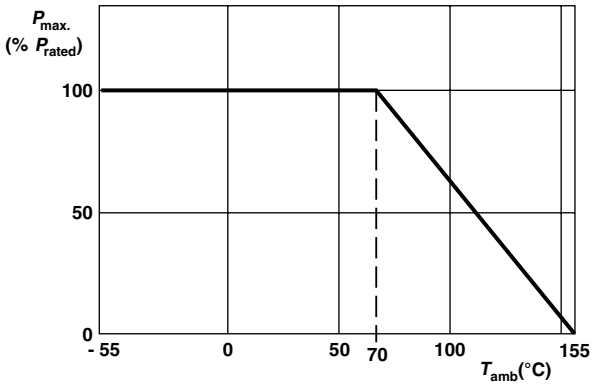
TYPE	LIMITING VOLTAGE [1] $U_{max.}$		LIMITING POWER, P_{70} (W)
	DC	RMS	
VR37	3500	2500	0.5

Notes

[1] The maximum voltage that may be continuously applied to the resistor element, see IEC 60115-1

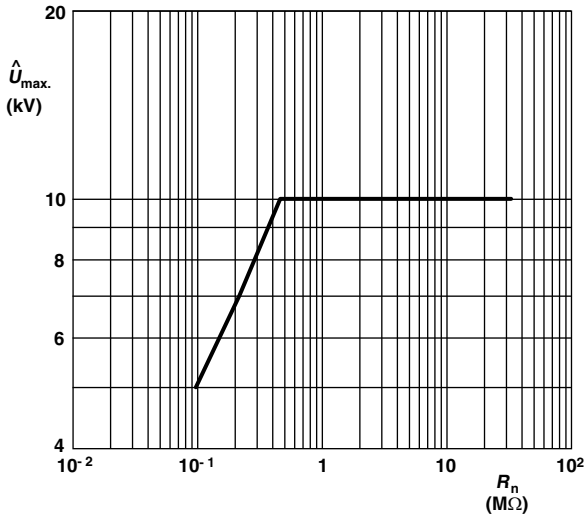
- The maximum permissible hot-spot temperature is 155 °C

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



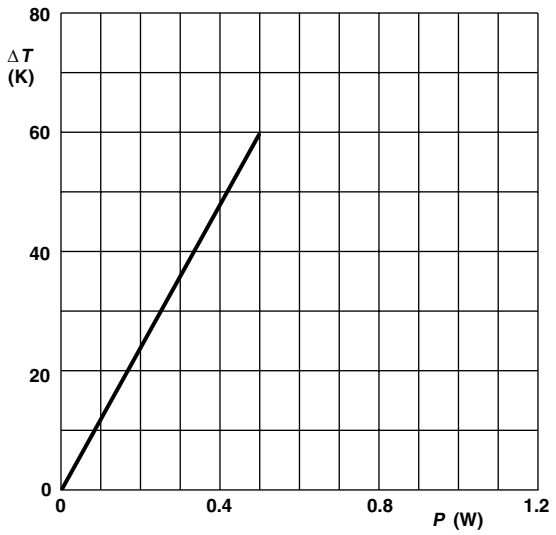
Maximum dissipation ($P_{max.}$) in percentage of rated power as a function of the ambient temperature (T_{amb})

Derating

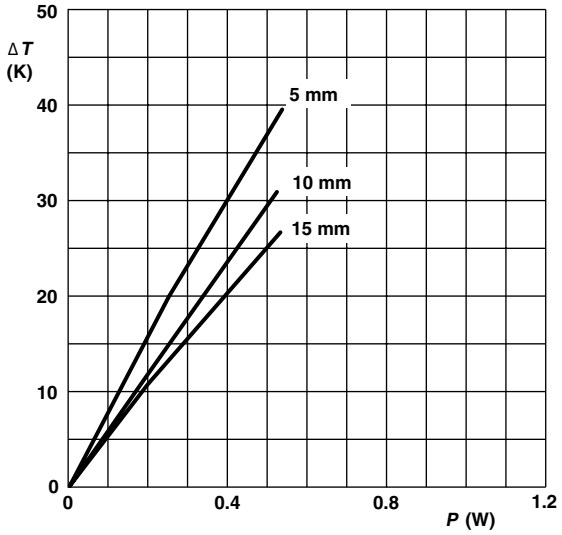


Maximum allowed peak pulse voltage in accordance with IEC 60065, 14.1.a); 50 discharges from a 1 nF capacitor charged to $\hat{U}_{max.}$; 12 discharges/minute (drift $\Delta R/R \leq 2$ %)

Pulse Loading Capability



Hot-spot temperature rise (Δ*T*) as a function of dissipated power



Temperature rise (Δ*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 x 10^{-6}
4.16.3	21 (Ub)	Bending half number of samples	Ø 0.7 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 Δ*R* 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	Δ*R* 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	Δ*R* max.: ± (0.5 % *R* + 0.05 Ω)

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 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) 1st 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. 2.5 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)

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 kΩ to 976 kΩ	4
1 MΩ to 9.76 MΩ	5
≥ 10 MΩ	6

12NC Example

The 12NC for a VR37, resistor value 7.5 MΩ, 5 % tolerance, supplied on a bandolier of 1000 units in ammopack, 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	± 1	8....	6....
		± 5	13...	23...

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