

## High-ohmic/high-voltage resistors

VR37

## FEATURES

- These resistors meet the safety requirements of:
  - “UL 1676” (range 510 kΩ to 11 MΩ)
  - “EN60065”
  - “BS60065” (U.K.)
  - “NFC 92-130” (France)
  - “VDE 0860” (Germany)
- High pulse loading capability
- Small size.

## 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.

## DESCRIPTION

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 “MIL-STD 202E” method 215 and “IEC 68-2-45”.

## QUICK REFERENCE DATA

DESCRIPTION	VALUE
Resistance range	100 kΩ to 33 MΩ; note 1
Resistance tolerance and series	±1%: E24/E96 series; ±5%: E24 series
Maximum dissipation at T <sub>amb</sub> = 70 °C	0.5 W
Thermal resistance, R <sub>th</sub>	120 K/W
Temperature coefficient	≤ ±200 × 10 <sup>-6</sup> /K
Maximum permissible voltage:	
DC	3500 V
RMS	2500 V
Dielectric withstanding voltage of the insulation for 1 minute	700 V
Basic specifications	IEC 115-1B
Safety requirements	UL1676 (510 kΩ to 11 MΩ); EN60065; BS60065; VDE 0860; NFC 92-130
Climatic category (IEC 68)	55/155/56
Stability after:	
load (1000 hours)	ΔR/R max.: ±1.5% +0.1 Ω; typ. 0.5%
accelerated damp heat test (6 days)	ΔR/R max.: ±1.5% +0.1 Ω; typ. 0.5%
long term damp heat test (56 days)	ΔR/R max.: ±1.5% +0.1 Ω; typ. 0.5%
Noise	max. 2.5 μV/V; typ. 0.5

## Note

1. Values up to 100 MΩ are available upon request.

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## ORDERING INFORMATION

**Table 1** Ordering code indicating resistor type and packaging

TYPE	TAPE WIDTH (mm)	TOL. (%)	ORDERING CODE 2322 ... ..				
			BANDOLIER IN AMMOPACK				BANDOLIER ON REEL
			500 units	1 000 units	2 000 units	5 000 units	5 000 units
VR37	52	±1	–	242 8....	–	–	–
		±5	–	242 13...	–	–	242 23...

### Ordering code (12NC)

- The resistors have a 12-digit ordering code starting with 2322
- The subsequent:
  - 4 digits for 1% tolerance products (E24 and E96 series)
  - or 5 digits for 5% (E24 series) indicate the resistor type and packaging; see Table 1.
- 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 in accordance with Table 2.

**Table 2** Last digit of 12NC

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

### ORDERING EXAMPLE

The ordering code for a VR37, resistor value 7.5 MΩ, 5% tolerance, supplied on a bandolier of 1000 units in ammopack, is: 2322 242 13755.

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## FUNCTIONAL DESCRIPTION

### 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 publication 63".

### Limiting values

TYPE	LIMITING VOLTAGE <sup>(1)</sup> (V)		LIMITING POWER (W)
	DC	RMS	
VR37	3500	2500	0.5

### Note

1. The maximum voltage that may be continuously applied to the resistor element, see "IEC publication 115-1".

The maximum permissible hot-spot temperature is  $155\text{ }^{\circ}\text{C}$ .

### DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

### PULSE LOADING CAPABILITY

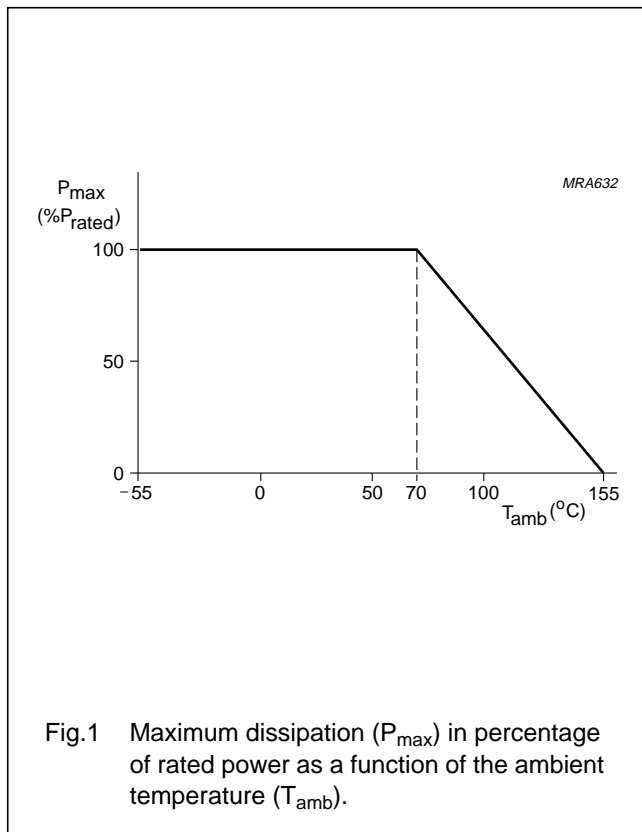


Fig.1 Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the ambient temperature ( $T_{amb}$ ).

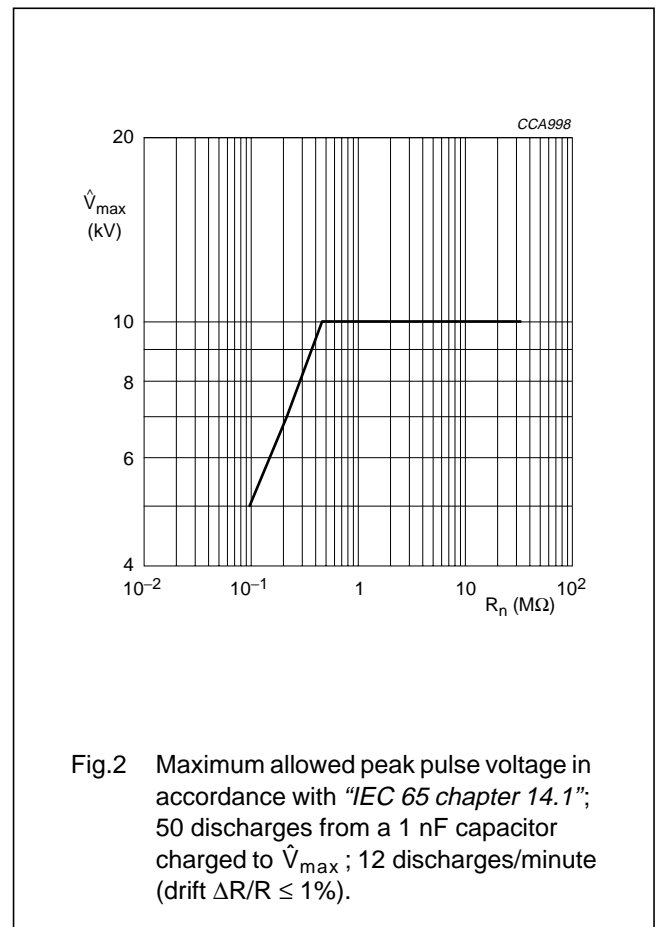
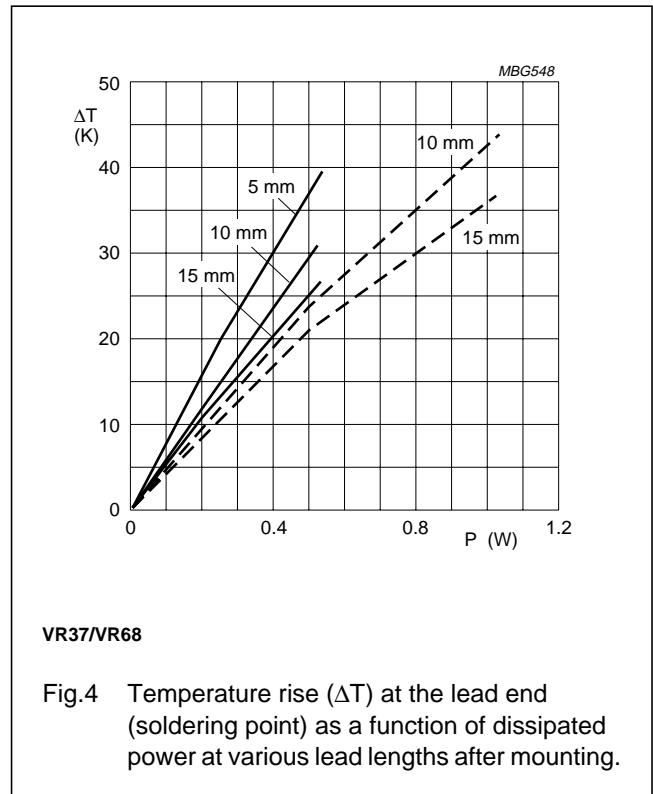
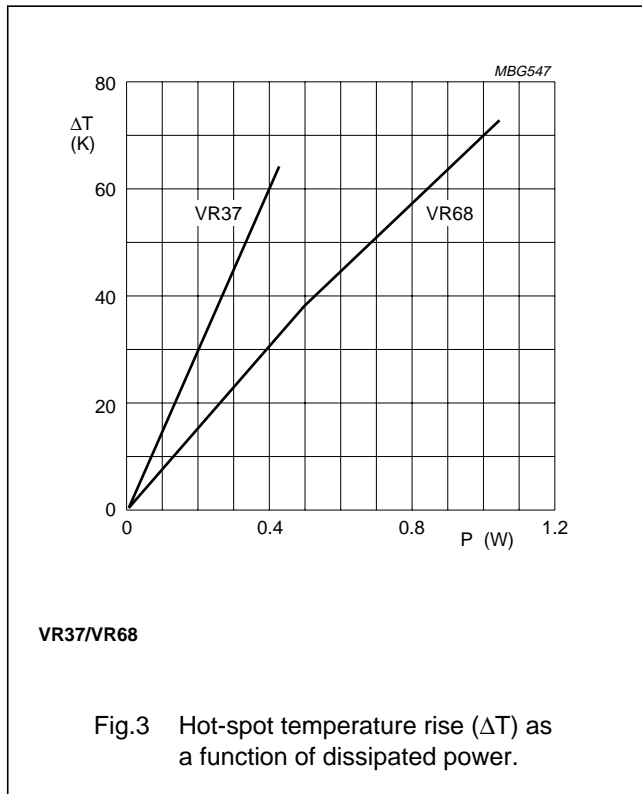


Fig.2 Maximum allowed peak pulse voltage in accordance with "IEC 65 chapter 14.1"; 50 discharges from a 1 nF capacitor charged to  $\hat{V}_{max}$ ; 12 discharges/minute (drift  $\Delta R/R \leq 1\%$ ).

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## Application information



## MECHANICAL DATA

### Mass per 100 units

TYPE	MASS (g)
VR37	48

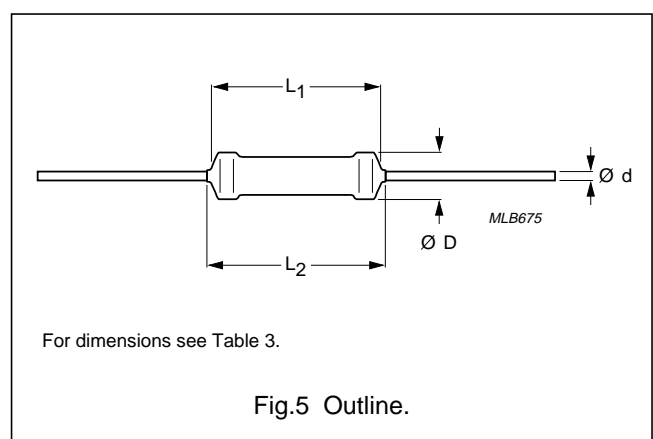
### Marking

The nominal resistance and tolerance are marked on the resistor using four or five coloured bands in accordance with IEC publication 62 "Colour codes for fixed resistors".

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 publication 294").



**Table 3** Resistor type and relevant physical dimensions; see Fig.5

TYPE	ØD MAX. (mm)	L <sub>1</sub> MAX. (mm)	L <sub>2</sub> MAX. (mm)	Ød (mm)
VR37	4.0	9.0	10.0	0.7

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**TESTS AND REQUIREMENTS**

Essentially all tests are carried out in accordance with the schedule of "IEC publication 115-1", category **LCT/UCT/56** (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, **56** days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 68,

*"Recommended basic climatic and mechanical robustness testing procedure for electronic components"* and under standard atmospheric conditions according to "IEC 68-1", subclause 5.3.

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).

In Table 4 the tests and requirements are listed with reference to the relevant clauses of "IEC publications 115-1 and 68"; 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.

**Table 4** Test procedures and requirements

IEC 115-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.16	U	robustness of terminations:		
4.16.2	Ua	tensile all samples	∅0.7 mm; load 10 N; 10 s	number of failures <math>10 \times 10^{-6}</math>
4.16.3	Ub	bending half number of samples	∅0.7 mm; load 5 N; 4 × 90°	number of failures <math>10 \times 10^{-6}</math>
4.16.4	Uc	torsion other half of samples	3 × 360° in opposite directions	no damage $\Delta R/R$ max.: ±0.5% +0.05 Ω
4.17	Ta	solderability	2 s; 235 °C; flux 600	good tinning; no damage
4.18	Tb	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body	$\Delta R/R$ max.: ±0.5% +0.05 Ω
4.19	Na	rapid change of temperature	30 minutes at -55 °C and 30 minutes at +155 °C; 5 cycles	$\Delta R/R$ max.: ±0.5% +0.05 Ω
4.20	Eb	bump	3 × 1500 bumps in 3 directions; 40 g	no damage $\Delta R/R$ max.: ±0.5% +0.05 Ω
4.22	Fc	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 hours (3 × 2 hours)	no damage $\Delta R/R$ max.: ±0.5% +0.05 Ω

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IEC 115-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.23		climatic sequence:		
4.23.2	Ba	dry heat	16 hours; 155 °C	
4.23.3	Db	damp heat (accelerated) 1st cycle	24 hours; 55 °C; 90 to 100% RH	
4.23.4	Aa	cold	2 hours; -55 °C	
4.23.5	M	low air pressure	2 hours; 8.5 kPa; 15 to 35 °C	
4.23.6	Db	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100% RH	$R_{ins}$ min.: $10^3$ M $\Omega$ $\Delta R/R$ max.: $\pm 1.5\% + 0.1 \Omega$
4.24.2	Ca	damp heat (steady state)	56 days; 40 °C; 90 to 95% RH; dissipation $0.01 P_n$ ; limiting voltage 100 V (DC)	$\Delta R/R$ max.: $\pm 1.5\% + 0.1 \Omega$
4.25.1		endurance	1000 hours at 70 °C; $P_n$ or $V_{max}$	$\Delta R/R$ max.: $\pm 1.5\% + 0.1 \Omega$
4.8.4		temperature coefficient	between -55 °C and +155 °C ( $TC \times 10^{-6}/K$ )	$\leq \pm 200$
4.7		voltage proof on insulation	700 V (RMS) during 1 minute; V-block method	no breakdown
4.12		noise	IEC publication 195	max. 2.5 $\mu V/V$
4.6.1.1		insulation resistance	500 V (DC or RMS) during 1 minute; V-block method	$R_{ins}$ min.: $10^4$ M $\Omega$
4.13		short time overload	room temperature; dissipation $6.25 \times P_n$ (voltage not more than $2 \times$ limiting voltage); 10 cycles; 5 s on and 45 s off	$\Delta R/R$ max.: $\pm 0.5\% + 0.05 \Omega$