

High-ohmic/high-voltage resistors

VR25/37/68

FEATURES

- Types VR37 and VR68 meet the safety requirements of:
 - "UL 1676" (range 510 k Ω to 11 M Ω)
 - "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.

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 copper 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		
	VR25	VR37	VR68
Resistance range	100 k Ω to 22 M Ω	100 k Ω to 33 M Ω	100 k Ω to 68 M Ω ⁽¹⁾
Resistance tolerance and series:		$\pm 1\%$: E24/E96 series; $\pm 5\%$: E24 series	$\pm 1\%$: E24/E96 series; $\pm 5\%$: E24 series
100 k Ω to 15 M Ω	$\pm 5\%$: E24 series	–	–
15 M Ω to 22 M Ω	$\pm 10\%$: E12 series	–	–
220 k Ω to 15 M Ω	$\pm 1\%$: E24/E96 series	–	–
Maximum dissipation at $T_{amb} = 70\text{ }^{\circ}\text{C}$	0.25 W	0.5 W	1 W
Thermal resistance, R_{th}	200 K/W	120 K/W	70 K/W
Temperature coefficient	$\leq \pm 200 \times 10^{-6}/\text{K}$		
Maximum permissible voltage:			
DC	1600 V	3500 V	10000 V
RMS	1150 V	2500 V	7000 V
Dielectric withstanding voltage of the insulation for 1 minute	700 V		
Basic specifications	IEC 115-1B		
Safety requirements	–	UL1676 (510 k Ω to 11 M Ω); EN60065; BS60065; VDE 0860; NFC 92-130	
Climatic category (IEC 68)	55/155/56		
Stability after:			
load (1000 hours)	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ –	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ typ. 0.5%	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ typ. 1%
accelerated damp heat test (6 days)	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ –	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ typ. 0.5%	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ typ. 1%
long term damp heat test (56 days)	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ –	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ typ. 0.5%	$\Delta R/R$ max.: $\pm 1.5\% + 0.1\ \Omega$ typ. 0.5%
Noise	max. 5 $\mu\text{V}/\text{V}$	max. 2.5 $\mu\text{V}/\text{V}$; typ. 0.5	

Note

- Values up to 220 M Ω 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
VR25	52	±1	–	241 8....	–	–	–
		±5	–	241 13...	–	241 53...	241 23...
		±10	–	241 12...	–	241 52...	241 22...
	26	±5	–	–	241 43...	–	–
		±10	–	–	241 42...	–	–
VR37	52	±1	–	242 8....	–	–	–
		±5	–	242 13...	–	–	242 23...
VR68	66.7	±1	244 8....	–	–	–	–
		±5	244 13...	–	–	–	–

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) and 10% (E12 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 and 10% 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 $\pm 1\%$, 5% or 10%. The values of the E96/E24/E12 series are in accordance with "IEC publication 63".

Limiting values

TYPE	LIMITING VOLTAGE ⁽¹⁾ (V)		LIMITING POWER (W)
	DC	RMS	
VR25	1600	1150	0.25
VR37	3500	2500	0.5
VR68	10000	7000	1.0

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 °C.

DERATING

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

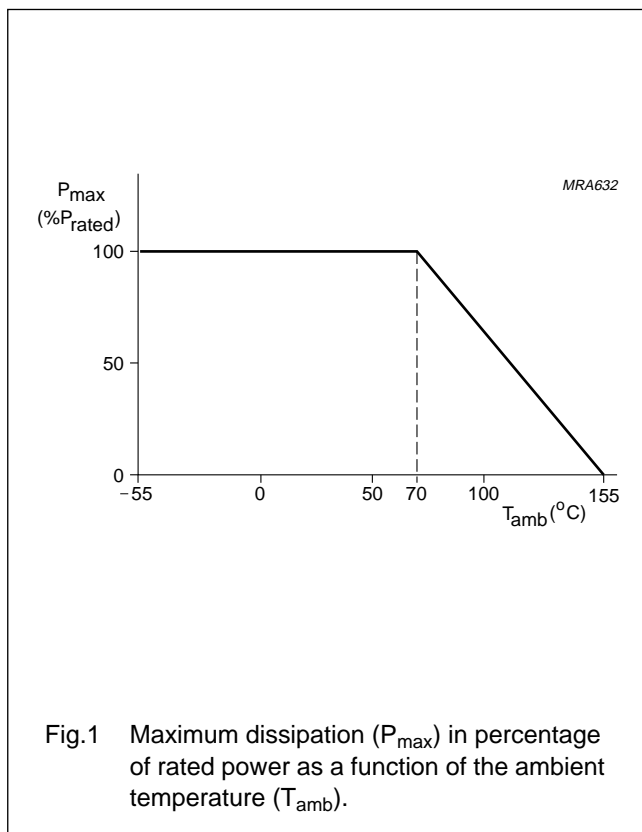


Fig.1 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITY

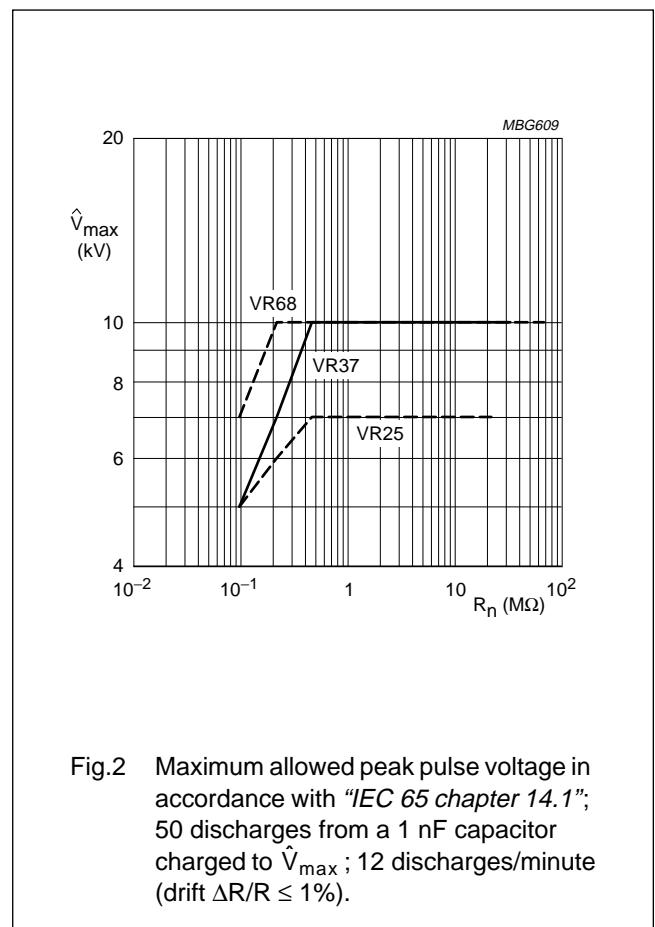
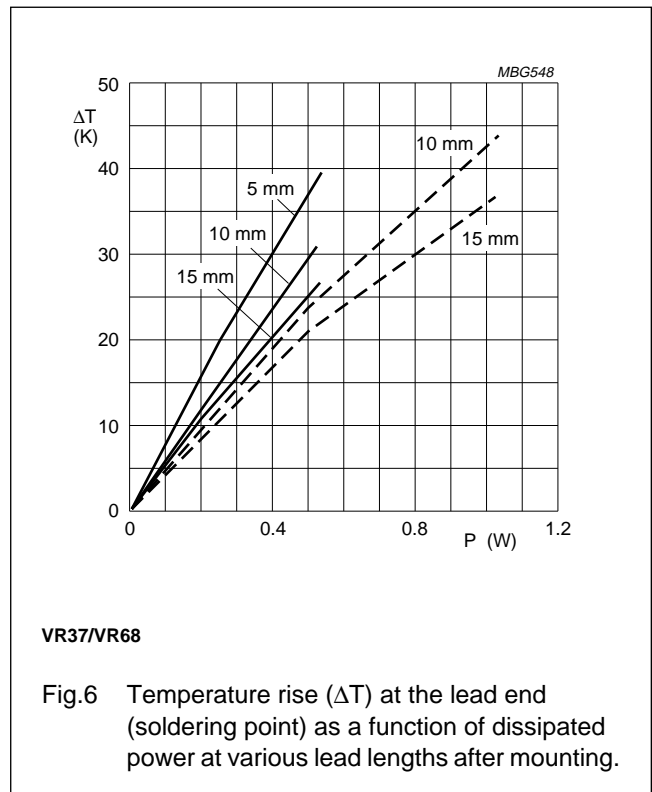
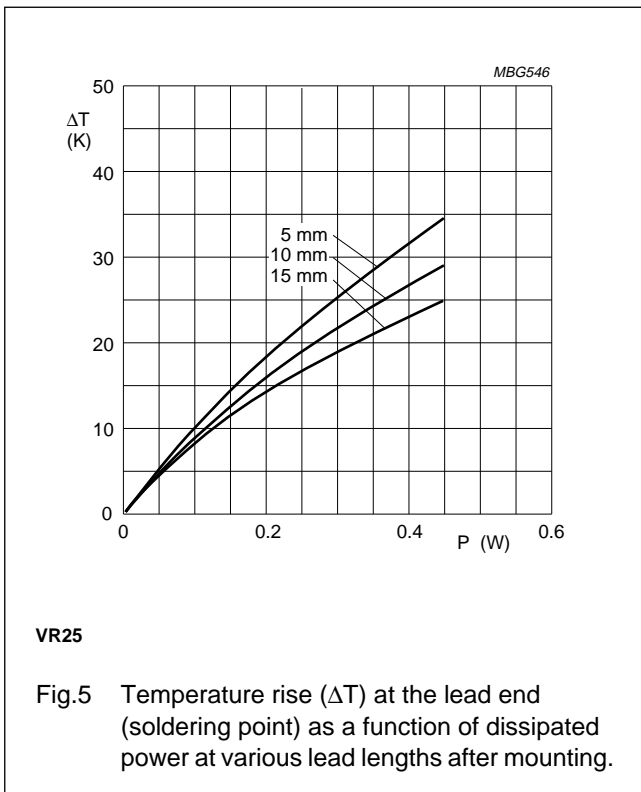
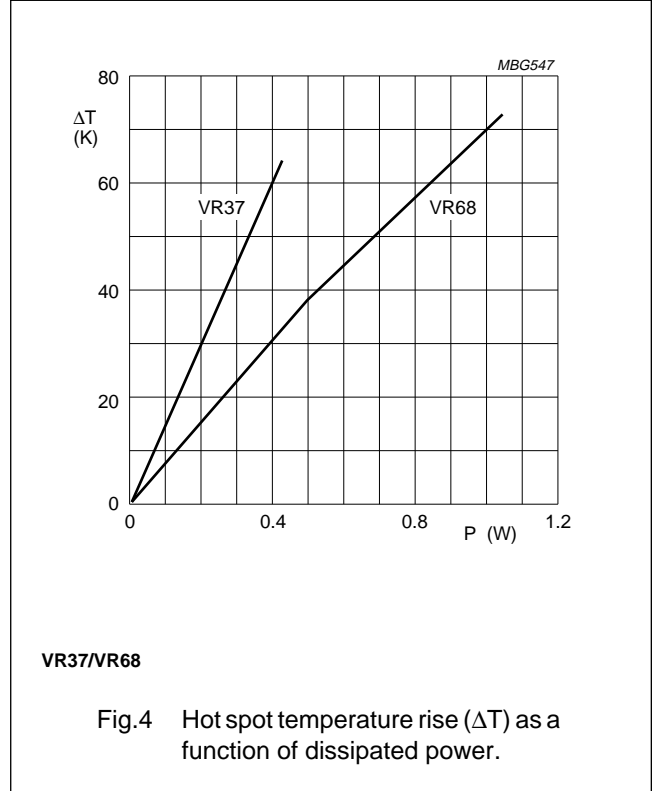
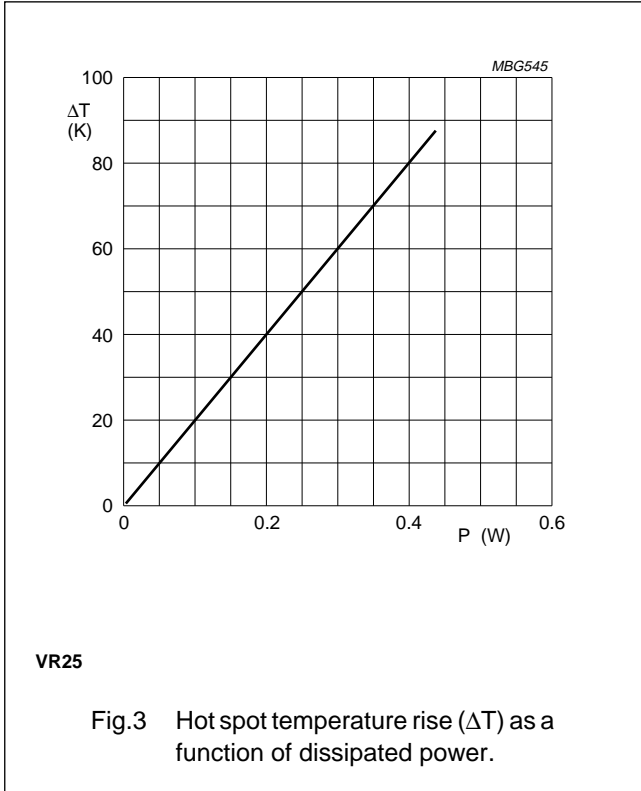


Fig.2 Maximum allowed peak pulse voltage in accordance with "IEC 65 chapter 14.1"; 50 discharges from a 1 nF capacitor charged to \hat{V}_{max} ; 12 discharges/minute (drift $\Delta R/R \leq 1\%$).

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Application information



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MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
VR25	25
VR37	48
VR68	148

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").

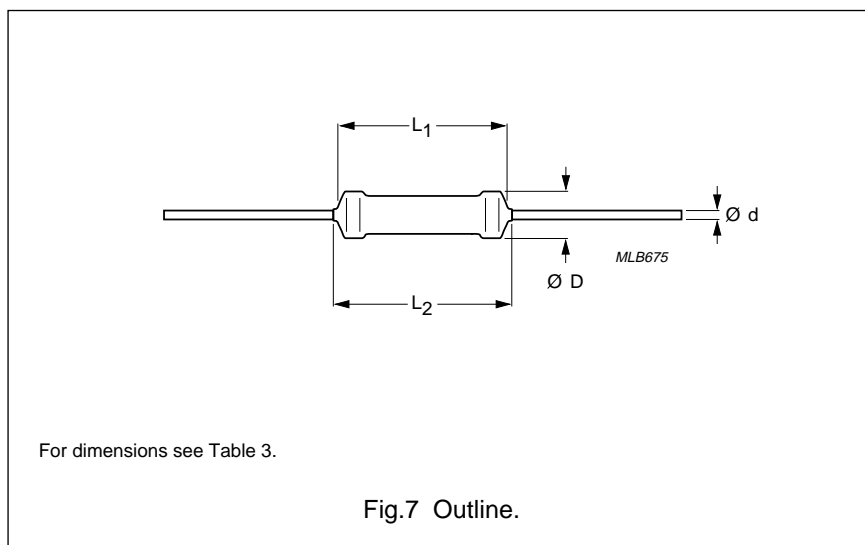


Table 3 Resistor type and relevant physical dimensions; see Fig.7

TYPE	ØD MAX. (mm)	L ₁ MAX. (mm)	L ₂ MAX. (mm)	Ød (mm)
VR25	2.5	6.5	7.5	0.6
VR37	4.0	9.0	10.0	0.7
VR68	6.8	18.0	19.0	0.8

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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		
				VR25	VR37	VR68
4.16	U	robustness of terminations:				
4.16.2	Ua	tensile all samples	∅0.5 mm; load 10 N; 10 s			number of failures <10 × 10 ⁻⁶
4.16.3	Ub	bending half number of samples	∅0.5 mm; load 5 N; 4 × 90°			number of failures <10 × 10 ⁻⁶
4.16.4	Uc	torsion other half of samples	3 × 360° in opposite directions			no damage ΔR/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			ΔR/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			ΔR/R max.: ±0.5% +0.05 Ω
4.20	Eb	bump	3 × 1500 bumps in 3 directions; 40 g			no damage ΔR/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 ΔR/R max.: ±0.5% +0.05 Ω
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 MΩ ΔR/R max.: ±1.5% +0.1 Ω

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IEC 115-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS		
				VR25	VR37	VR68
4.24.2	Ca	damp heat (steady state)	56 days; 40 °C; 90 to 95% RH; dissipation 0.01 P _n ; limiting voltage 16 V (DC)	ΔR/R max.: ±1.5% +0.1 Ω		
4.25.1		endurance	1000 hours at 70 °C; P _n or V _{max}	ΔR/R max.: ±1.5% +0.1 Ω		
4.8.4		temperature coefficient	between -55 °C and +155 °C (TC × 10 ⁻⁶ /K)	≤ ±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. 5 μV/V	max. 2.5 μV/V	
4.6.1.1		insulation resistance	500 V (DC or RMS) during 1 minute; V-block method	R _{ins} min.: 10 ⁴ MΩ		
4.13		short time overload	room temperature; dissipation 6.25 × P _n (voltage not more than 2 × limiting voltage; 10000 V max.); 10 cycles; 5 s on and 45 s off	ΔR/R max.: ±0.5% +0.05 Ω		