

## High Ohmic/High Voltage 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.

### FEATURES

- High pulse loading capability
- Small size.

### APPLICATIONS

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

The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD 202E, method 215" and "IEC 60068-2-45".

TECHNICAL SPECIFICATIONS	
DESCRIPTION	VALUE
Resistance range <sup>(1)</sup>	100 kΩ to 22 MΩ
Resistance tolerance and series: 100 kΩ to 15 MΩ 15 MΩ to 22 MΩ	± 1 %: E24/E96 series; ± 5 %: E24 series ± 5 %: E24 series; ± 10 %: E12 series
Maximum dissipation at T <sub>amb</sub> = 70 °C	0.25 W
Thermal resistance, R <sub>th</sub>	140 K/W
Temperature coefficient	≤ ±200 × 10 <sup>-6</sup> /K
Maximum permissible voltage:	
DC	1600 V
RMS	1150 V
Dielectric withstanding voltage of the insulation for 1 minute	700 V
Basic specifications	IEC 60115-1B
Climatic category (IEC 60068)	55/155/56
Stability after:	
load (1000 hours)	ΔR/R max.: ± 1.5 % + 0.1 Ω
accelerated damp heat test (6 days)	ΔR/R max.: ± 1.5 % + 0.1 Ω
long term damp heat test (56 days)	ΔR/R max.: ± 1.5 % + 0.1 Ω
Noise	max. 5 μV/V

**Note**

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

12NC ORDERING CODE INDICATING RESISTOR TYPE AND PACKAGING							
TYPE	TAPE WIDTH (mm)	TOL. (%)	ORDERING CODE 2322 241 .....				
			BANDOLIER IN AMMOPACK				BANDOLIER ON REEL
			RADIAL TAPED	STRAIGHT LEADS			
			4000 units	1000 units	2000 units	5000 units	
VR25	52	± 1	0....	8....	–	7....	6....
		± 5	36...	13...	–	53...	23...
		± 10		12...	–	52...	22...
26	26	± 5		–	43...	–	–
		± 10		–	42...	–	–

**ORDERING INFORMATION**
**Numeric Ordering Code (12NC)**

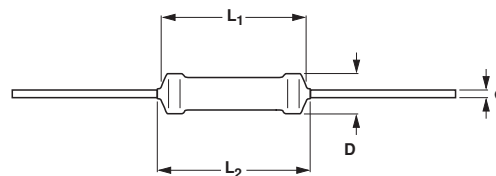
- The resistors have a 12-digit ordering code starting with 2322 241
- The subsequent:
  - first digit for 1 % tolerance products (E24 and E96 series) or 2 digits for 5 % (E24 series) and 10 % (E12 series) indicate the resistor type and packaging.
- The remaining digits indicate the resistance value:
  - 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 to 976 k $\Omega$	4
1 to 9.76 M $\Omega$	5
$\geq 10$ M $\Omega$	6

**Ordering Example**

The ordering code for a VR25, resistor value 7.5 M $\Omega$ , 5 % tolerance, supplied on a bandolier of 1 000 units in ammpack, is: 2322 241 13755.

**DIMENSIONS**


Outline.

**DIMENSIONS - resistor type and relevant physical dimensions**

TYPE	$\varnothing$ D MAX.	L <sub>1</sub> MAX.	L <sub>2</sub> MAX.	$\varnothing$ d
VR25	2.5	6.5	7.5	0.58 ± 0.05

**MASS PER 100 UNITS**

TYPE	MASS (g)
VR25	22

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<sub>1</sub>) 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 60294"*).

**MARKING**

The nominal resistance and tolerance are marked on the resistor using four or five coloured bands in accordance with IEC publication 60062 *"Colour codes for fixed resistors"*.

**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 publication 60063"*.

**LIMITING VALUES**

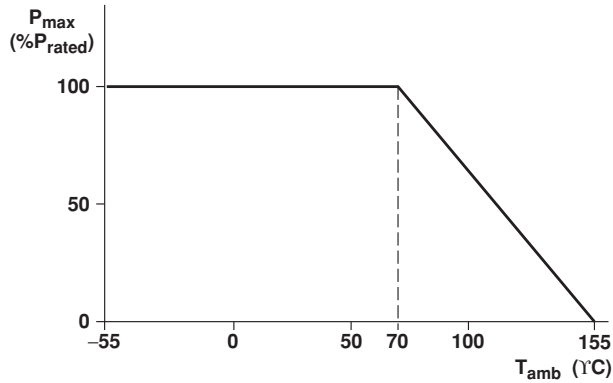
TYPE	LIMITING VOLTAGE <sup>(1)</sup> (V)		LIMITING POWER (W)
	DC	RMS	
VR25	1 600	1 150	0.25

**Note**

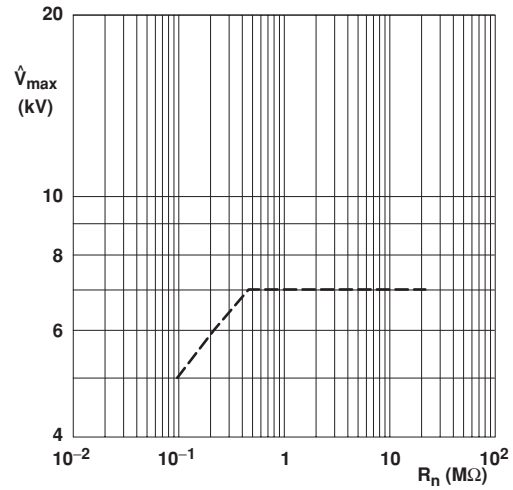
1. The maximum voltage that may be continuously applied to the resistor element, see *"IEC publication 60115-1"*.

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

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



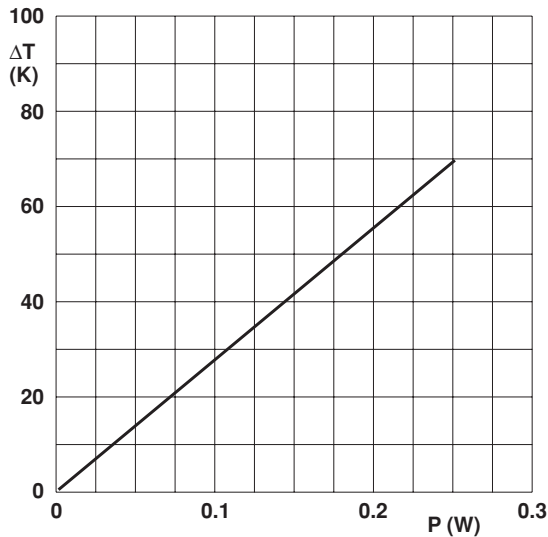
Maximum dissipation (P<sub>max</sub>) in percentage of rated power as a function of the ambient temperature (T<sub>amb</sub>).



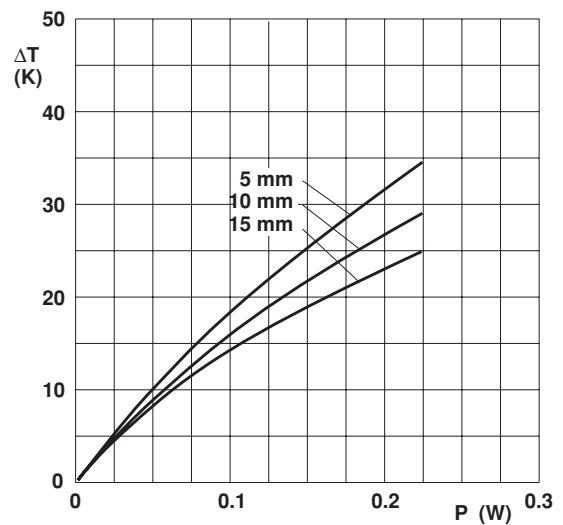
Maximum allowed peak pulse voltage in accordance with "IEC 60065 chapter 14.1"; 50 discharges from a 1 nF capacitor charged to V<sub>max</sub>; 12 discharges/minute (drift ΔR/R ≤ 2 %).

**Derating**

**Pulse Loading Capability**



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.

**Application Information**



**TESTS AND REQUIREMENTS**

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", 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 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2"; 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	21 (U)	robustness of terminations:		
4.16.2	21 (Ua1)	tensile all samples	∅0.6 mm; load 10 N; 10 s	number of failures < 10 × 10 <sup>-6</sup>
4.16.3	21 (Ub)	bending half number of samples	∅0.6 mm; load 5 N; 4 × 90°	number of failures < 10 × 10 <sup>-6</sup>
4.16.4	21 (Uc)	torsion other half of samples	3 × 360° in opposite directions	no damage ΔR/R max.: ±0.5 % + 0.05 Ω
4.17	20 (Ta)	solderability	2 s; 235 °C	good tinning; no damage
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 3 mm from body	ΔR/R max.: ±0.5 % + 0.05 Ω



<b>TEST PROCEDURES AND REQUIREMENTS</b>				
<b>IEC 60115-1 CLAUSE</b>	<b>IEC 60068-2 TEST METHOD</b>	<b>TEST</b>	<b>PROCEDURE</b>	<b>REQUIREMENTS</b>
4.19	14 (Na)	rapid change of temperature	30 minutes at – 55 °C and 30 minutes at +155 °C; 5 cycles	$\Delta R/R$ max.: $\pm 0.5 \% + 0.05 \Omega$
4.20	29 (Eb)	bump	3 × 1500 bumps in 3 directions; 40 g	no damage $\Delta R/R$ max.: $\pm 0.5 \% + 0.05 \Omega$
4.22	6 (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.: $\pm 0.5 \% + 0.05 \Omega$
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	16 hours; 155 °C	
4.23.3	30 (Db)	damp heat (accelerated) 1 <sup>st</sup> cycle	24 hours; 55 °C; 90 to 100 % RH	
4.23.4	1 (Aa)	cold	2 hours; – 55 °C	
4.23.5	13 (M)	low air pressure	2 hours; 8.5 kPa; 15 to 35 °C	
4.23.6	30 (Db)	damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100 % RH	$R_{ins}$ min.: $10^3 M\Omega$ $\Delta R/R$ max.: $\pm 1.5 \% + 0.1 \Omega$
4.24.2	3 (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.: $\pm 1.5 \% + 0.1 \Omega$



<b>TEST PROCEDURES AND REQUIREMENTS</b>				
<b>IEC 60115-1 CLAUSE</b>	<b>IEC 60068-2 TEST METHOD</b>	<b>TEST</b>	<b>PROCEDURE</b>	<b>REQUIREMENTS</b>
4.25.1		endurance	1000 hours at 70 °C; P <sub>n</sub> or V <sub>max</sub>	ΔR/R max.: ± 1.5 % + 0.1 Ω
4.8.4		temperature coefficient	between –55 °C and + 155 °C (TC × 10 <sup>-6</sup> /K)	≤ ±200
4.7		voltage proof on insulation	700 V (RMS) during 1 minute; V-block method	no breakdown
4.12		noise	<i>"IEC publication 60195"</i>	max. 5 μV/V
4.6.1.1		insulation resistance	500 V (DC) during 1 minute; V-block method	R <sub>ins</sub> min.: 10 <sup>4</sup> MΩ
4.13		short time overload	room temperature; dissipation 6.25 × P <sub>n</sub> (voltage not more than 2 × limiting voltage); 10 cycles; 5 s on and 45 s off	ΔR/R max.: ±2.0 % + 0.05 Ω
4.26		active flammability "Cheese-cloth test"	steps of: 5/10/16/25/40 × P <sub>n</sub> (RMS) duration 5 minutes	no flaming of gauze cylinder
<b>OTHER TEST IN ACCORDANCE WITH IEC 60695</b>				
2.2		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