High Ohmic (up to 22 MΩ)/ High Voltage (up to 1.6 kV) 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 "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- High pulse loading capability (up to 7 kV)
- Small size (0204)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)

APPLICATIONS

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

TECHNICAL SPECIFICATIONS

DESCRIPTION	VALUE
Resistance Range (1)	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_{amb} = 70 °C	0.25 W
Thermal Resistance, R_{th}	140 K/W
Temperature Coefficient	≤ ± 200 x 10^{-6}/K
Maximum Permissible Voltage: DC RMS	 1600 V 1150 V
Dielectric Withstanding Voltage of the Insulation for 1 Min	700 V
Basic Specifications	IEC 60115-1B
Climatic Category (IEC 60068)	55/155/56
Stability After: Load (1000 h) Accelerated Damp Heat Test (6 Days) Long Term Damp Heat Test (56 Days)	 ΔR max.: ± (1.5 % R + 0.1 Ω) ΔR max.: ± (1.5 % R + 0.1 Ω) ΔR max.: ± (1.5 % R + 0.1 Ω)
Noise	max. 5 µV/V

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

12NC INFORMATION

- The resistors have a 12-digit numeric 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 packing.
- 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 kΩ	4
1 to 9.76 MΩ	5
≥ 10 MΩ	6

12NC Example
The 12NC for a VR25, resistor value 7.5 MΩ, 5 % tolerance, supplied on a bandolier of 1000 units in ammopack, is: 2322 241 13755.

12NC - resistor type and packaging

TYPE	TOL. (%)	ORDERING CODE 2322 241				
		BANDOLIER IN AMMOPACK				BANDOLIER ON REEL
		RADIAL TAPED	STRAIGHT LEADS			
		4000 units	52 mm	26 mm	52 mm	52 mm
			1000 units	2000 units	5000 units	5000 units
VR25	± 1	0....	8....	-	7....	6....
	± 5	36...	13...	43...	53...	23...
	± 10	38...	12...	42...	52...	22...

PART NUMBER

PART NUMBER: VR25000001503JA100

V	R	2	5	0	0	0	0	0	1	5	0	3	J	A	1	0	0

MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
VR25000	**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 % **K** = ± 10 %	**A5** **A2** **A1** **R5** **N4**	The 2 digits are used for all special parts. **00** = Standard

PRODUCT DESCRIPTION: VR25 5 % A1 150K

VR25	5 %	A1	150K
MODEL/SIZE	TOLERANCE	PACKAGING (1)	RESISTANCE VALUE
VR25	± **1** % ± **5** % ± **10** %	**A5** **A2** **A1** **R5** **N4**	**150K** = 150 kΩ **8M2** = 8.2 MΩ

Notes:

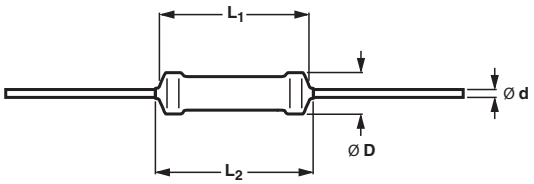
(1) Please refer to table PACKAGING

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

PACKAGING

CODE	PIECES	DESCRIPTION	MODEL/SIZE
A5	5000	Bandolier in ammopack straight leads 52 mm	VR25
A2	2000	Bandolier in ammopack straight leads 26 mm	
A1	1000	Bandolier in ammopack straight leads 52 mm	
R5	5000	Bandolier on reel straight leads 52 mm	
N4	4000	Bandolier in ammopack radial taped	

DIMENSIONS



Outline

DIMENSIONS - resistor type and relevant physical dimensions				
TYPE	Ø $D_{max.}$	$L_{1\ max.}$	$L_{2\ max.}$	Ø d
VR25	2.5	6.5	7.5	0.58 ± 0.05

MASS PER 100 UNITS	
TYPE	MASS (g)
VR25 52 mm	21.2
VR25 26 mm	14.8

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC publication 60062 *"Color 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 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 %, 5 % or 10 %. The values of the E96/E24/E12 series are in accordance with "IEC publication 60063".

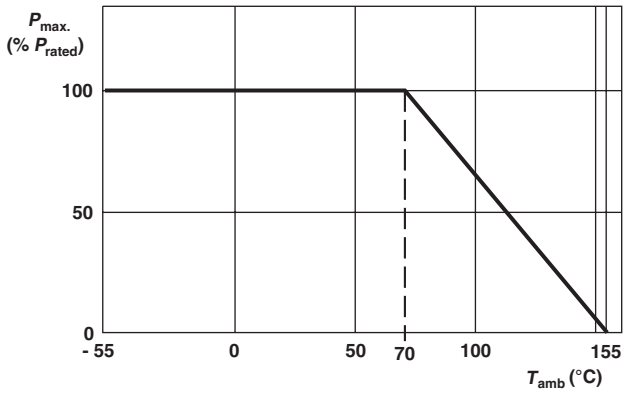
LIMITING VALUES			
TYPE	LIMITING VOLTAGE (1) (V)		LIMITING POWER (W)
	DC	RMS	
VR25	1600	1150	0.25

Notes:

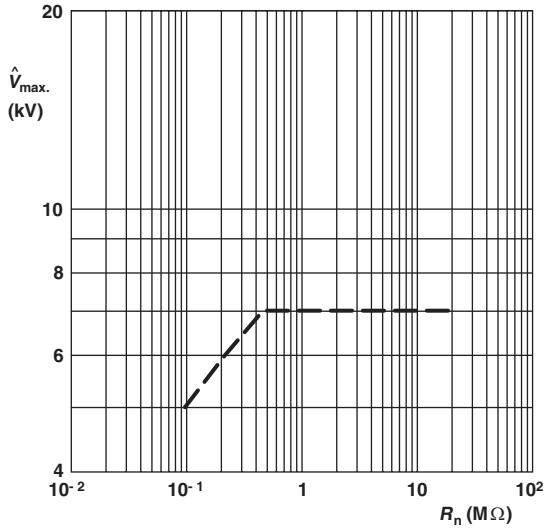
(1) The maximum voltage that may be continuously applied to the resistor element, see "IEC publication 60115-1"

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

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



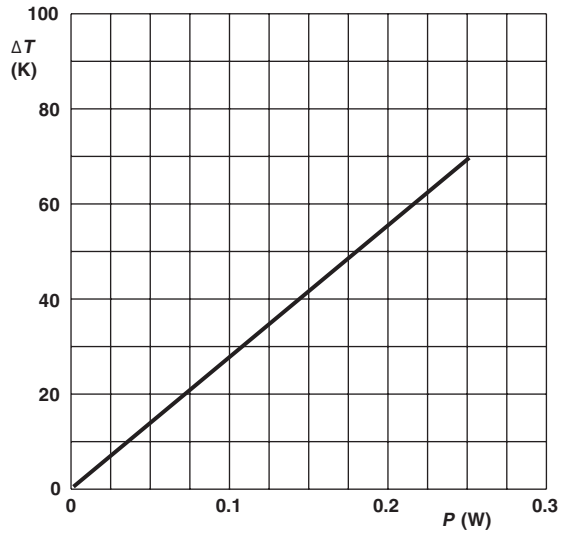
Maximum dissipation ($P_{max.}$) in percentage of rated power as a function of the ambient temperature (T_{amb})



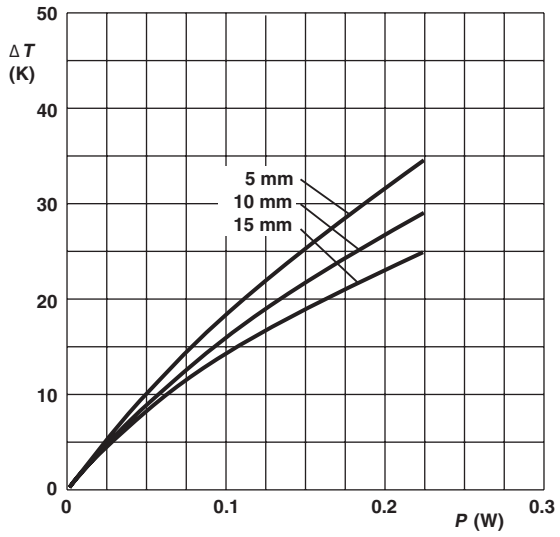
Maximum allowed peak pulse voltage in accordance with "IEC 60065 chapter 14.1"; 50 discharges from a 1 nF capacitor charged to $\hat{V}_{max.}$; 12 discharges/min (drift $\Delta R/R \leq 2$ %)

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	Ø 0.6 mm; load 10 N; 10 s	number of failures < 10 x 10^{-6}
4.16.3	21 (Ub)	bending half number of samples	Ø 0.6 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 ΔR max.: ± (0.5 % R + 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 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	ΔR max.: ± (0.5 % R + 0.05 Ω)
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 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)

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	**IEC 60068-2 TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS**
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 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)
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95 % RH; dissipation 0.01 Pn; limiting voltage 100 V (DC)	ΔR max.: ± (1.5 % R + 0.1 Ω)
4.25.1		endurance	1000 h at 70 °C; Pn or $V_{max.}$	ΔR max.: ± (1.5 % R + 0.1 Ω)
4.8.4		temperature coefficient	between - 55 °C and + 155 °C (TCR x 10^{-6}/K)	≤ ± 200
4.7		voltage proof on insulation	700 V_{RMS} during 1 min; V-block method	no breakdown
4.12		noise	"IEC publication 60195"	max. 5 µV/V
4.6.1.1		insulation resistance	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 Pn (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)
4.26		active flammability "cheese-cloth test"	steps of: 5/10/16/25/40 x Pn_{RMS} duration 5 min	no flaming of gauze cylinder
OTHER TEST IN ACCORDANCE WITH IEC 60695				
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

Disclaimer

All product specifications and data are subject to change without notice.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.