

# High Ohmic/High Voltage Metal Glaze Led 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

- Technology: Metal glaze
- $R_{max.} = 22 \text{ M}\Omega$ ;  $U_{max.} = 1600 \text{ V}_{DC}$
- High pulse loading capability (up to 7 kV)
- Small size (0207)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compliant to RoHS Directive 2002/95/EC
- AEC-Q200 qualified



**RoHS**  
COMPLIANT

## APPLICATIONS

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

TECHNICAL SPECIFICATIONS		
DESCRIPTION	UNIT	VR25
Resistance Range <sup>(1)</sup>	$\Omega$	100K to 22M
Resistance Tolerance 100 k $\Omega$ to 15 M $\Omega$ 15 M $\Omega$ to 22 M $\Omega$	%	$\pm 1$ ; $\pm 5$ ; $\pm 5$ ; $\pm 10$
Resistance Series 100 k $\Omega$ to 15 M $\Omega$ 15 M $\Omega$ to 22 M $\Omega$		E24/E96 series; E24 series E24 series; E12 series
Rated Dissipation, $P_{70}$	W	0.25
Thermal Resistance ( $R_{th}$ )	K/W	140
Temperature Coefficient	ppm/K	$\leq \pm 200$
Maximum Permissible Voltage $U_{max.}$ DC RMS	V	1600 1150
Dielectric Withstanding Voltage of the Insulation for 1 Min	V	700
Basic Specifications		IEC 60115-1
Climatic Category (IEC 60068-1)		55/155/56
Max. Resistance Change for Resistance Range, $\Delta R_{max.}$ , after: Load (1000 h, $P_{70}$ ) Long Term Damp Heat Test (56 Days) Soldering (10 s, 260 °C)		$\pm (1.5 \% R + 0.1 \Omega)$ $\pm (1.5 \% R + 0.1 \Omega)$ $\pm (1.5 \% R + 0.1 \Omega)$
Noise	$\mu\text{V/V}$	max. 5

### Note

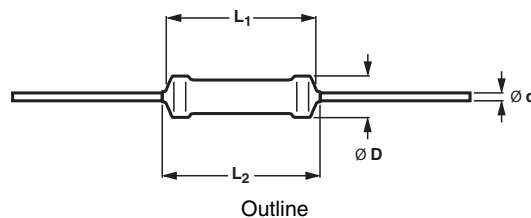
<sup>(1)</sup> Ohmic values (other than resistance range) are available on request.

PART NUMBER						
PART NUMBER: VR25000001503JA100						
V	R	2	5	0	0	0
MODEL/SIZE VR25000	VARIANT 0 = Neutral Z = Value overflow (Special)	TCR/MATERIAL 0 = Standard	VALUE 3 digit value 1 digit multiplier 3 = *10 <sup>3</sup> 4 = *10 <sup>4</sup> 5 = *10 <sup>5</sup>	TOLERANCE F = ± 1 % J = ± 5 % K = ± 10 %	PACKAGING (1) A5 A2 R5 N4	SPECIAL The 2 digits are used for all special parts. 00 = Standard
PRODUCT DESCRIPTION: VR25 5 % A1 150K						
VR25	5 %	A1	150K			
MODEL/SIZE VR25	TOLERANCE ± 1 % ± 5 % ± 10 %	PACKAGING (1) A5 A2 A1 R5 N4	RESISTANCE VALUE 150K = 150 kΩ 8M2 = 8.2 MΩ			

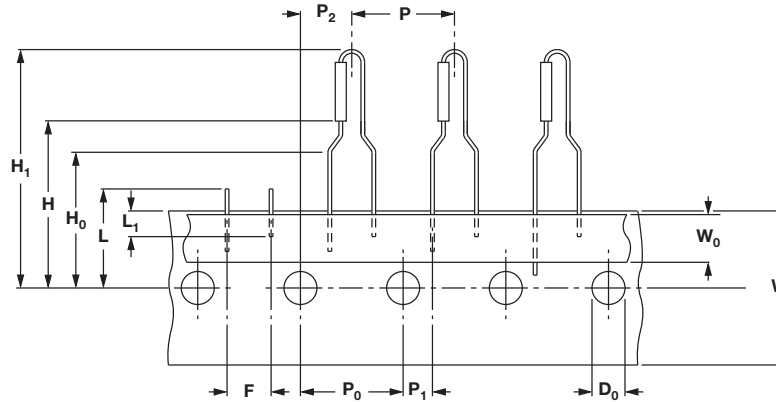
**Notes**

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products
- (1) Please refer to table PACKAGING

PACKAGING					
MODEL	TAPING	AMMOPACK		REEL	
		PIECES	CODE	PIECES	CODE
VR25	Axial, 26 mm	2000	A2	-	-
	Axial, 52 mm	5000	A5	5000	R5
		1000	A1	-	-
	Radial	4000	N4	-	-

**DIMENSIONS**


DIMENSIONS - Resistor type and relevant physical dimensions				
TYPE	Ø D <sub>max.</sub>	L <sub>1</sub> max.	L <sub>2</sub> max.	Ø d
VR25	2.5	6.5	7.5	0.58 ± 0.05

**PRODUCTS WITH RADIAL LEADS**


DIMENSIONS - RADIAL TAPING				
SYMBOL	PARAMETER	VALUE	TOLERANCE	UNIT
P	Pitch of components	12.7	± 1.0	mm
P <sub>0</sub>	Feed-hole pitch	12.7	± 0.2	mm
P <sub>1</sub>	Feed-hole centre to lead at topside at the tape	3.85	± 0.5	mm
P <sub>2</sub>	Feed-hole center to body center	6.35	± 1.0	mm
F	Lead-to-lead distance	4.8	+ 0.7/- 0	mm
W	Tape width	18.0	± 0.5	mm
W <sub>0</sub>	Minimum hold down tape width	5.5	-	mm
H <sub>1</sub>	Component height	29	Max.	mm
H <sub>0</sub>	Lead wire clinch height	16.5	± 0.5	mm
H	Height of component from tape center	19.5	± 1	mm
D <sub>0</sub>	Feed-hole diameter	4.0	± 0.2	mm
L	Maximum length of snipped lead	11.0	-	mm
L <sub>1</sub>	Minimum lead wire (tape portion) shortest lead	2.5	-	mm

**Note**

- Please refer document number 28721 "Packaging" for more detail

MASS PER UNIT	
TYPE	MASS (mg)
VR25, 52 mm	212
VR25, 26 mm	148

**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<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 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 60063.

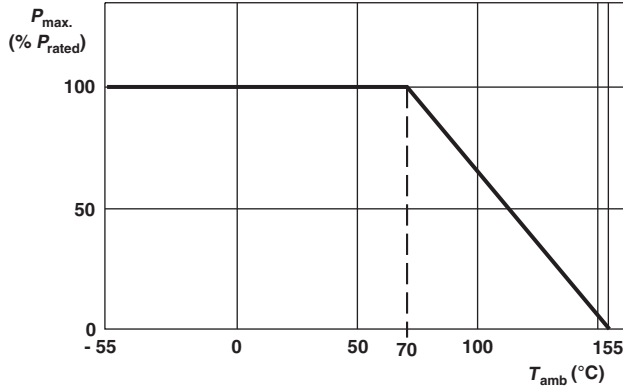
LIMITING VALUES			
TYPE	LIMITING VOLTAGE <sup>(1)</sup> U <sub>max.</sub>		LIMITING POWER P <sub>70</sub> (W)
	DC	RMS	
VR25	1600	1150	0.25

**Notes**

- The maximum permissible hot-spot temperature is 155 °C
- <sup>(1)</sup> The maximum voltage that may be continuously applied to the resistor element, see IEC 60115-1

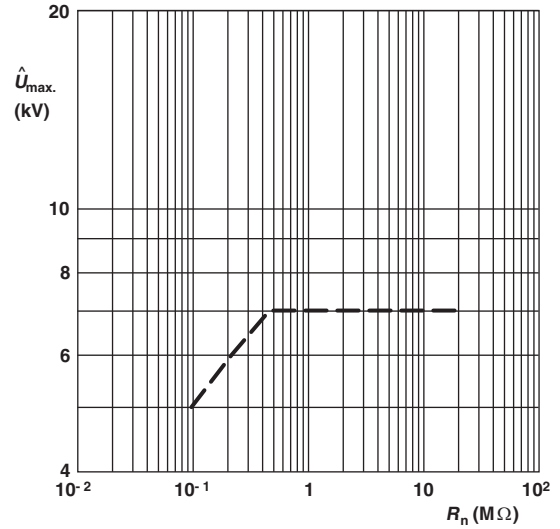
**DERATING**

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



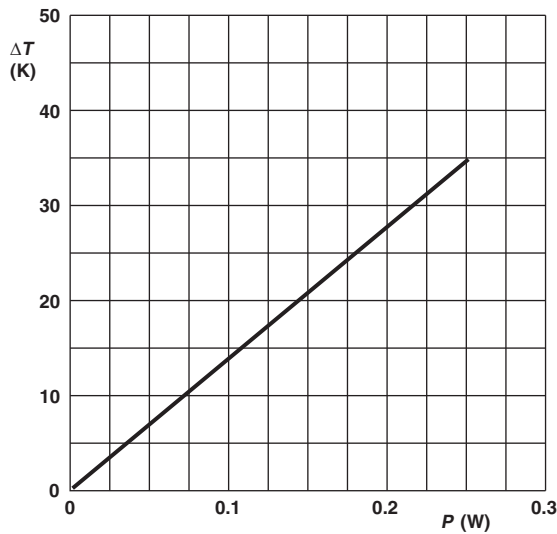
Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the ambient temperature ( $T_{amb}$ )

**PULSE LOADING CAPABILITY**

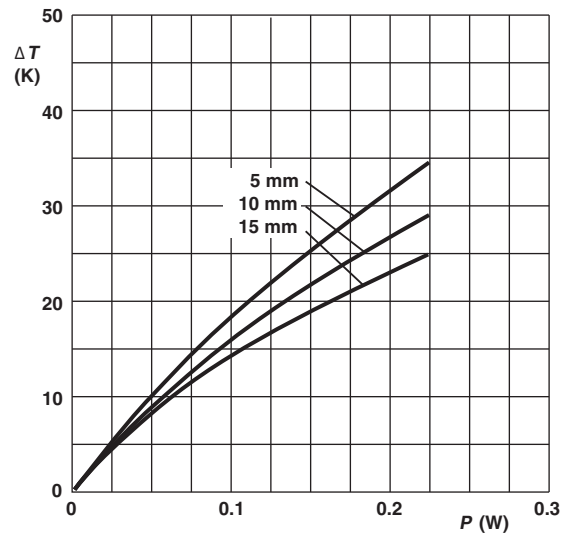


Maximum allowed peak pulse voltage in accordance with IEC 60065, 14.1.a; 50 discharges from a 1 nF capacitor charged to  $\hat{U}_{max}$ ; 12 discharges/min (drift  $\Delta R/R \leq 2\%$ )

**APPLICATION INFORMATION**



Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power



Temperature rise ( $\Delta T$ ) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting



**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 0.6 mm; load 10 N; 10 s	Number of failures < 10 x 10 <sup>-6</sup>
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 <sup>-6</sup>
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: 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	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 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) 1 <sup>st</sup> 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 <sub>ins</sub> min.: 10 <sup>3</sup> 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 <sub>70</sub> ; limiting voltage U = 100 V <sub>DC</sub>	ΔR max.: ± (1.5 % R + 0.1 Ω)
4.25.1		Endurance	1000 h at 70 °C; P <sub>70</sub> or U <sub>max.</sub>	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 <sub>RMS</sub> = 700 V during 1 min; V-block method	No breakdown
4.12		Noise	IEC 60195	Max. 5 μV/V
4.6.1.1		Insulation resistance	U = 500 V <sub>DC</sub> during 1 min; V-block method	R <sub>ins</sub> min.: 10 <sup>4</sup> MΩ
4.13		Short time overload	Room temperature; dissipation 6.25 x P <sub>70</sub> (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)



TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2- TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.26		Active flammability "cheese-cloth test"	Steps of: 5/10/16/25/40 x P <sub>70</sub> duration 5 min	No flaming of gauze cylinder
4.35		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

**12NC INFORMATION FOR HISTORICAL CODING REFERENCE**

- 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 kΩ to 976 kΩ	4
1 MΩ 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 ammpack, is: 2322 241 13755.

12NC - Resistor type and packaging						
TYPE	TOL. (%)	2322 241 .....				
		BANDOLIER IN AMMOPACK				BANDOLIER ON REEL
		RADIAL TAPED	STRAIGHT LEADS			52 mm
			4000 UNITS	52 mm	26 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...



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