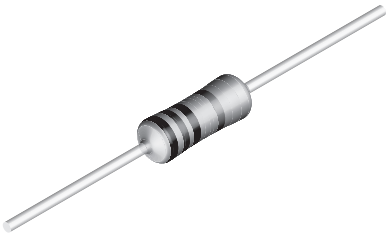
High Voltage Surge Resistor



A metal glazed film is deposited on a high grade ceramic body. After that caps are applied to the rods and tinned electrolytic copper wires are welded to these 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 according to "MIL-STD 202E, method 215" and "IEC 60068-2-45".

FEATURES

- High pulse-loading (10 kV as specified) capability (flashes)
- Good replacement for carbon-composite resistors
- 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

- Application in overload and high voltage pulse hazard circuits (TV-sets, monitors), high power electronic ballasts

TECHNICAL SPECIFICATIONS

DESCRIPTION	VALUE	
Resistance Range	47 Ω to 820 Ω	1 kΩ to 10 kΩ
Resistance Tolerance and Series	47 Ω to 180 Ω: ± 20 %; E12 series 220 Ω to 10 kΩ: ± 10 %; ± 20 %; E12 series	
Maximum Dissipation at T_{amb} = 70 °C	0.5 W	
Thermal Resistance, R_{th}	120 K/W	
Temperature Coefficient	47 Ω to 180 Ω: 0 to + 1500 x 10^{-6}/K 220 Ω to 910 Ω: 0 to + 600 x 10^{-6}/K	- 600 to + 200 x 10^{-6}/K
Voltage Coefficient	0 to + 350 x 10^{-6}/V	± 50 x 10^{-6}/V
Maximum Permissible Voltage	$V = \sqrt{Pn \times R}$	
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)	ΔR max.: ± (3.0 % R + 0.10 Ω)	
Climatic Test	ΔR max.: ± (3.0 % R + 0.10 Ω)	
Soldering	ΔR max.: ± (1.0 % R + 0.10 Ω)	
High Voltage Test for R-Value > 3.3 kΩ, 10 kV; 1 nF; 50 x 12/Min	$\Delta R/R$ max.: ± 20 % (typical value ± 10 %)	
ESD Contact Discharge 12 kV; 100 Pulses	$\Delta R/R$ max.: ± 20 % (typical value: ± 10 %)	

12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2322 245
- The subsequent 2 digits indicate the resistor type and packing
- The remaining digits indicate the resistance value:
  - The first 2 digits indicate the resistance value
  - The last digit indicates the resistance decade

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
47 to 82 Ω	9
100 to 820 Ω	1
1 to 9.1 kΩ	2
10 kΩ	3

12NC Example

The 12NC for a LSR37, resistor value 1.5 kΩ, 10 % tolerance, supplied on a bandolier of 1000 units in ammopack, is: 2322 245 12152.

12NC - resistor type and packaging			
TYPE	**TOLERANCE (%)**	**ORDERING CODE 2322 245 .....**	
		1000 UNITS IN AMMOPACK	**5000 UNITS ON REEL**
LSR37	± 10	12...	22...
	± 20	11...	21...

PART NUMBER

PART NUMBER: LSR3700001002KA100

L	S	R	3	7	0	0	0	0	1	0	0	2	K	A	1	0	0

MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
LSR3700	**0** = Neutral **Z** = Value overflow (Special)	**0** = Standard	**3 digit value** **1 digit multiplier** MULTIPLIER **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$	**K** = ± 10 % **M** = ± 20 %	**A1** **R5**	The 2 digits are used for all special parts. **00** = Standard

PRODUCT DESCRIPTION: LSR37 10 % A1 10K

LSR37	**10 %**	**A1**	**10K**
MODEL/SIZE	TOLERANCE	PACKAGING (1)	RESISTANCE VALUE
LSR37	± **10** % ± **20** %	**A1** **R5**	**220R** = 220 Ω **1K2** = 1.2 kΩ

Notes:

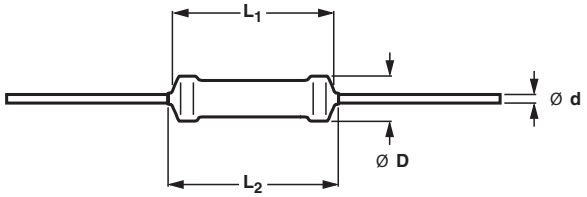
(1) Please refer to table PACKAGING

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

PACKAGING

CODE	PIECES	DESCRIPTION	MODEL/SIZE
A1	1000	Bandolier in ammopack straight leads	LSR37
R5	5000	Bandolier on reel straight leads	

DIMENSIONS



Outline

DIMENSIONS - resistor type and relevant physical dimensions				
TYPE	Ø $D_{max.}$	$L_{1\ max.}$	$L_{2\ max.}$	Ø d
LSR37	4.0	9.0	10.0	0.7 ± 0.03

MASS PER 100 UNITS	
TYPE	MASS (g)
LSR37	45.7

MARKING

The nominal resistance and tolerance are marked on the resistor using colored bands in accordance with IEC publication 60062 “Color codes for fixed resistors”.

Three bands are used for 20 % tolerance with no indication for the tolerance. Four bands are used for 10 % tolerance.

Grey is used instead of silver for 10 % 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 rated resistance (nominal resistance) are taken from the E12 series with a tolerance of 10 % or 20 %. The values of the E12 series are in accordance with “IEC publication 60063”.

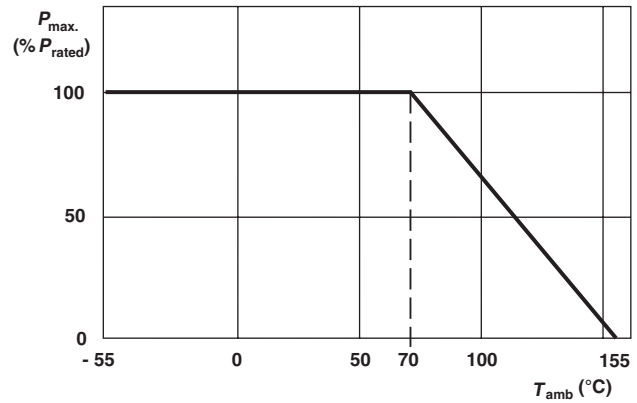
The limiting voltage DC is not applicable, because the maximum rated voltage for the maximum R_n-value of 10 kΩ at Pn = 0.5 W is only 70.7 V.

LIMITING VALUES		
TYPE	LIMITING VOLTAGE (1) (V)	LIMITING POWER (W)
LSR37	$V = \sqrt{Pn \times R}$	0.5

Notes:

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

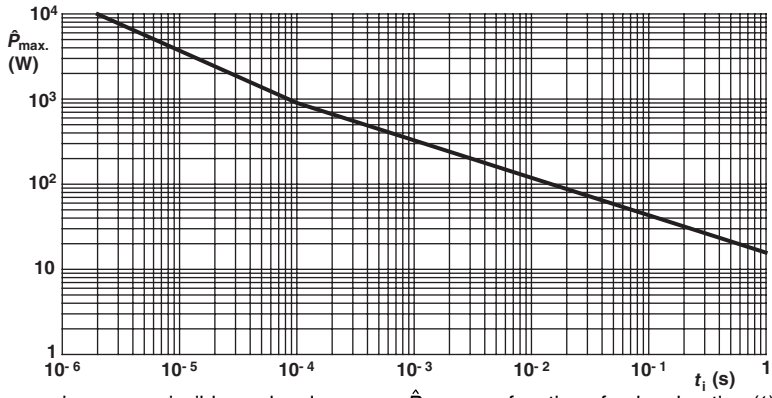
- The maximum permissible hot-spot temperature is 155 °C



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}).

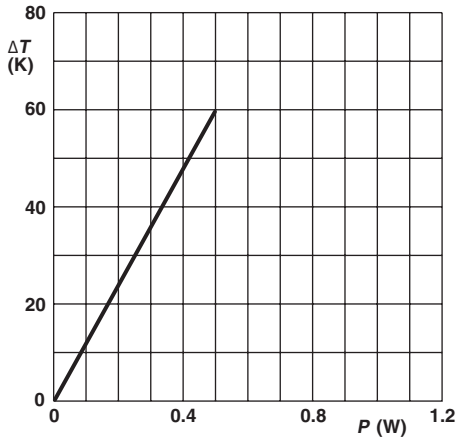
Derating



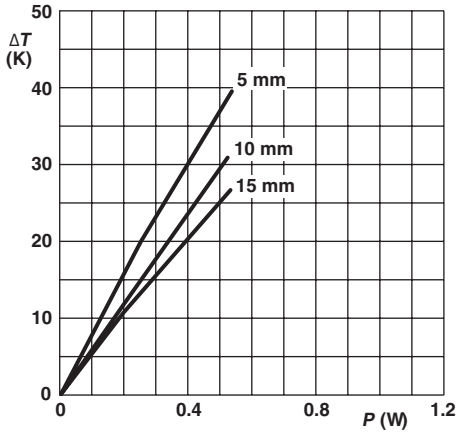
Pulse on a regular basis; maximum permissible peak pulse power $\hat{P}_{max.}$ as a function of pulse duration (t_i) for single pulse condition

Pulse Loading Capability

The resistors with straight leads are suitable for processing on automatic insertion equipment and cutting and bending machines. the minimum pitch for this type is 6e (15 mm). For temperature rise at soldering place see figures below.



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 0.7 mm; load 10 N; 10 s	number of failures < 10×10^{-6}
4.16.3	21 (Ub)	bending half number of samples	Ø 0.7 mm; load 5 N; 4 x 90°	number of failures < 10×10^{-6}
4.16.4	21 (Uc)	torsion other half of samples	3 x 360° in opposite directions	no damage ΔR max.: ± (1.0 % R + 0.10 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.: ± (1.0 % R + 0.10 Ω)
4.19	14 (Na)	rapid change of temperature	30 min at - 55 °C and 30 min at + 155 °C; 5 cycles	ΔR max.: ± (1.0 % R + 0.10 Ω)
4.20	29 (Eb)	bump	3 x 1500 bumps in 3 directions; 40 g	no damage ΔR max.: ± (1.0 % R + 0.10 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.: ± (1.0 % R + 0.10 Ω)

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	**IEC 60068-2 TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS**
4.23		climatic sequence:		R_{ins} min.: 10^3 MΩ ΔR max.: ± (3.0 % R + 0.10 Ω)
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	
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.: ± (3.0 % R + 0.10 Ω)
4.25.1		endurance	1000 h at 70 °C; Pn or $V_{max.}$	ΔR max.: ± (3.0 % R + 0.10 Ω)
4.8.4		temperature coefficient	47 Ω to 180 Ω	0 to + 1500 x 10^{-6}/K
			220 Ω to 910 Ω	0 to + 600 x 10^{-6}/K
			1 kΩ to 10 kΩ	- 600 to + 200 x 10^{-6}/K
4.7		voltage proof on insulation	700 V_{RMS} during 1 min; V-block method	no breakdown
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; 10 cycles; 5 s ON and 45 s OFF	ΔR max.: ± (2.5 % R + 0.10 Ω)
		high voltage pulse 10 kV; 1 nF; 50 x 12/min	for R_n > 3.3 kΩ	$\Delta R/R$ max.: ± 20 % (typical value ± 10 %)
		12 kV ESD test; 100 pulses	ESD contact discharge	$\Delta R/R$ max.: ± 20 % (typical value: ± 10 %)
4.26		active flammability "cheese-cloth test"	5 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.