

POWER METAL FILM RESISTORS

QUICK REFERENCE DATA

Resistance range	1 Ω to 1 M Ω , E24 series			←
Resistance tolerance	$\pm 5\%$			
Max. body temperature (hot spot)	300 °C			
Rated dissipation at $T_{amb} = 70\text{ °C}$				
$R \leq 51\text{ k}\Omega$	2,5 W			
$R > 51\text{ k}\Omega$	2,0 W			
V_{max} (r.m.s.)	750 V			
Basic specification	MIL-R-11804/2, char. G and IEC 115-4			
Climatic category (IEC 68)	55/200/56			
		requirement	typical values	
Stability after, 1000 h max. load climatic tests soldering test	$\Delta R/R$	max. 5%	$R \leq 51\text{ k}\Omega$	$R > 51\text{ k}\Omega$
	$\Delta R/R$	max. 3%	$\leq 2,5\%$	$\leq 2,5\%$
	$\Delta R/R$	max. 1%	$\leq 0,5\%$	$\leq 1\%$
			$\leq 0,1\%$	$\leq 0,1\%$

DESCRIPTION

A homogeneous film of metal alloy is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned connecting wires of electrolytic copper or copper-clad iron are welded to the end-caps, which are force-fitted to the body.

The resistor has a red non-inflammable coating of a protective silicon lacquer which can withstand 500 V (r.m.s.) and is resistant against most of the commonly used cleaning solvents according to MIL-STD-202E, method 215 and IEC 68-2-45.

COMPOSITION OF THE CATALOGUE NUMBER

The diagram shows a resistor with a 5-digit code **2322 192**. The code is divided into two parts: **2322** (style code) and **192** (resistance value). The style code is further divided into **23** (straight copper-clad iron leads, ϕ 0,6) and **22** (cropped and formed copper-clad iron leads ϕ 0,6). The resistance value **192** is divided into **1** (straight copper leads, ϕ 0,8) and **92** (cropped and formed copper leads, ϕ 0,8). The resistance value is also divided into **1** (straight lead version) and **92** (cropped and formed version). The resistance value is also divided into **1** (straight lead version) and **92** (cropped and formed version). The resistance value is also divided into **1** (straight lead version) and **92** (cropped and formed version).

style code

3 = straight copper-clad iron leads, ϕ 0,6

4 = cropped and formed copper-clad iron leads ϕ 0,6

5 = straight copper leads, ϕ 0,8

6 = cropped and formed copper leads, ϕ 0,8

8 for R = 1 to 9,1 Ω

9 for R = 10 to 91 Ω

1 for R = 100 to 910 Ω

2 for R = 1 000 to 9 100 Ω

3 for R = 10 000 to 91 000 Ω

4 for R = 100 000 to 910 000 Ω

5 for R = 1000 000 Ω

mounting height (h), Fig. 2

0 = 8

1 = 15

0 = straight lead version

first two digits of the resistance value (E24 series)

PR52

MECHANICAL DATA

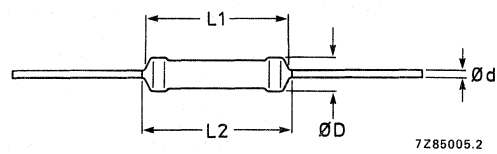


Fig. 1 Version with straight leads, see Table 1.

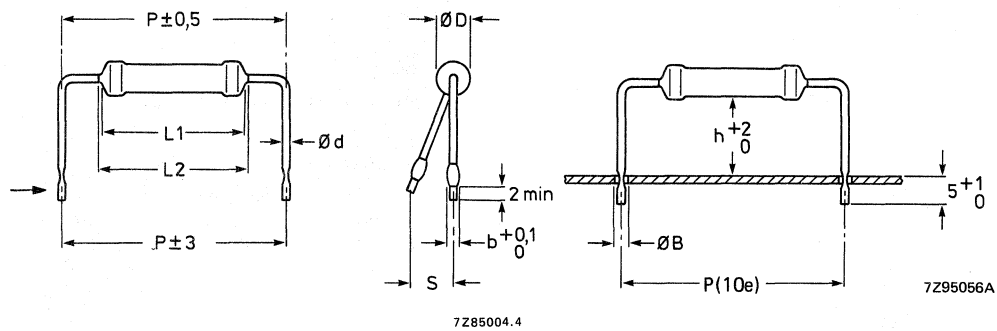


Fig. 2 Version with cropped and formed leads.

Table 1

type	leads	D _{max}	L _{1max}	L _{2max}	d	b	h	S _{max}	P	B φ _{max}
PR52	copper-clad iron	5,2	16,7	17,9	0,6	1,1	8	2	25,4	1,0
		5,2	16,7	17,9	0,6	1,1	15	3	25,4	1,0
	copper	5,2	16,7	17,9	0,8	1,3	8	2	25,4	1,2
		5,2	16,7	17,9	0,8	1,3	15	3	25,4	1,2

Mass 92 g per 100 resistors

Mounting

The resistors must be mounted stress free so as to allow thermal expansion over the wide permissible temperature range. The mounting pitch of version with cropped and formed leads is 10e (25,4 mm).

Marking

Each resistor is marked with:

- resistance value (R for Ω, K for kΩ and M for MΩ).
- tolerance on resistance in %.

Example: 27 R ± 5%.

ELECTRICAL DATA**Standard values of rated resistance and tolerance**

Standard values of rated resistance (nominal resistance) are taken from the E24 series within the range 2,2 Ω to 1 M Ω . E24 series of values is given in the table "Standard series of values in a decade" at the back of the handbook. The tolerance on the rated resistance is $\pm 5\%$.

Table 2

type	leads			mounting height (h, Fig. 2)	resistance range	catalogue number 2322 followed by
	style	dia. mm	material			
PR52	straight	0,6	copper-clad iron	—	1 Ω to 1 M Ω	192 3 . . 0 .
		0,8	copper	—		192 5 . . 0 .
	cropped and formed	0,6	copper-clad iron	8	1 Ω to 1 M Ω	192 4 . . 0 .
		0,8	copper	8		192 6 . . 0 .
		0,6	copper-clad iron	15		192 4 . . 1 .
		0,6	copper	15		192 6 . . 1 .

To complete the catalogue number, see Composition of the Catalogue Number. For quantities and packing see Standard packaging.

Temperature coefficient

$R \geq 10 \Omega$

max. $\pm 250 \cdot 10^{-6}/K$

$R < 10 \Omega$

max. $\pm 350 \cdot 10^{-6}/K$

Maximum body temperature (hot spot)

300 $^{\circ}C$

Rated dissipation at $T_{amb} = 70^{\circ}C$

$R \leq 51 k\Omega$ 2,5 W

$R > 51 k\Omega$ 2,0 W

Dielectric withstanding r.m.s. voltage of the installation for 1 min

min. 500 V

Maximum voltage (r.m.s.)

750 V

Basic specification

IEC 115-4 and MIL-R-11804/E, char. G

Climatic category (IEC 68)

55/200/56

Temperature rise (ΔT) of the resistor body as a function of dissipation

see Figs 4 and 5

Lead length (l) as a function of dissipation with temperature rise at end of lead (soldering place) as parameter

see Figs 6 and 7

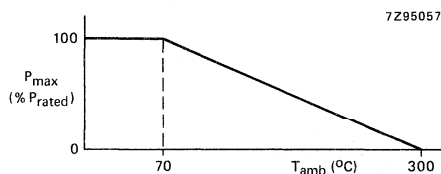


Fig. 3 Maximum dissipation (P_{max}) as a function of the ambient temperature (T_{amb}).

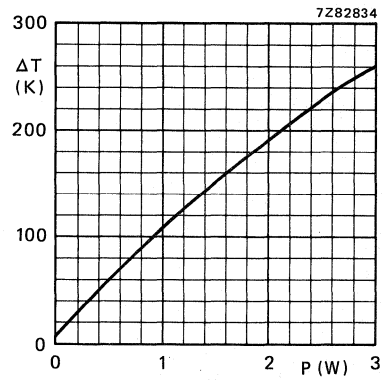


Fig. 4 Hot-spot temperature rise (ΔT) versus dissipated power (P) copper-clad iron leads $\phi = 0,6$ mm.

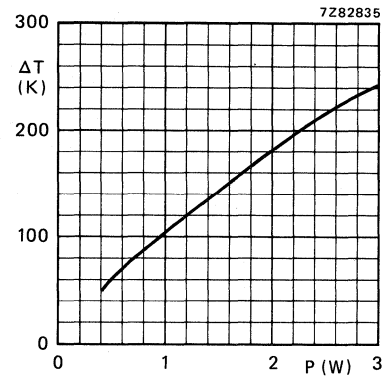


Fig. 5 Hot-spot temperature rise (ΔT) versus dissipated power (P), copper leads $\phi = 0,8$ mm.

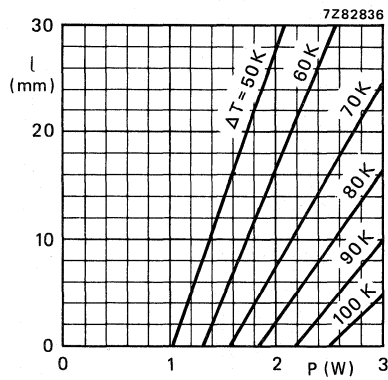


Fig. 6 Lead length l versus dissipated power with ΔT as a parameter, copper-clad iron leads $\phi = 0,6$ mm.

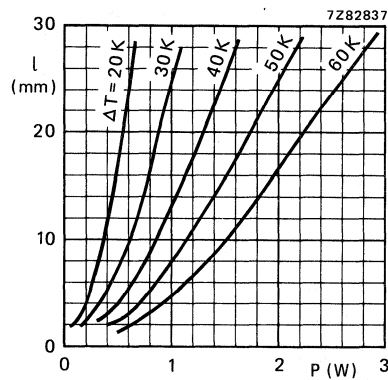


Fig. 7 Lead length l versus dissipated power with ΔT as a parameter, copper leads $\phi = 0,8$ mm.

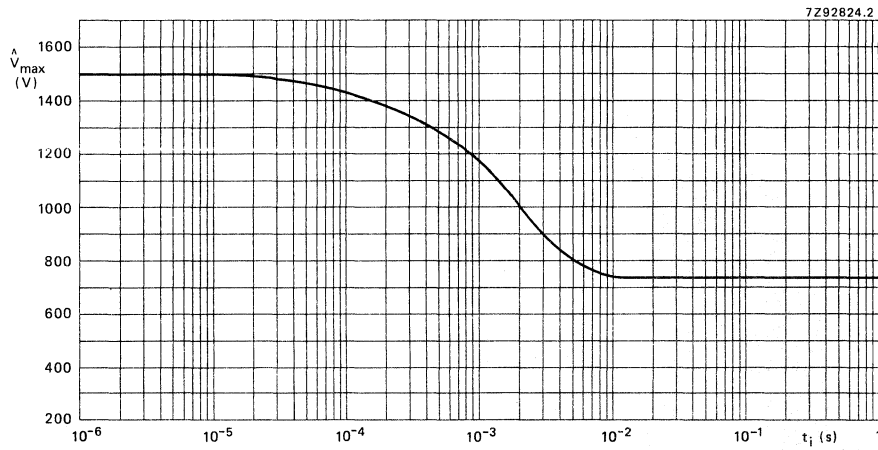


Fig. 8 Max. permissible peak pulse voltage ($\hat{V}_{\max}$) versus pulse duration (t_i).

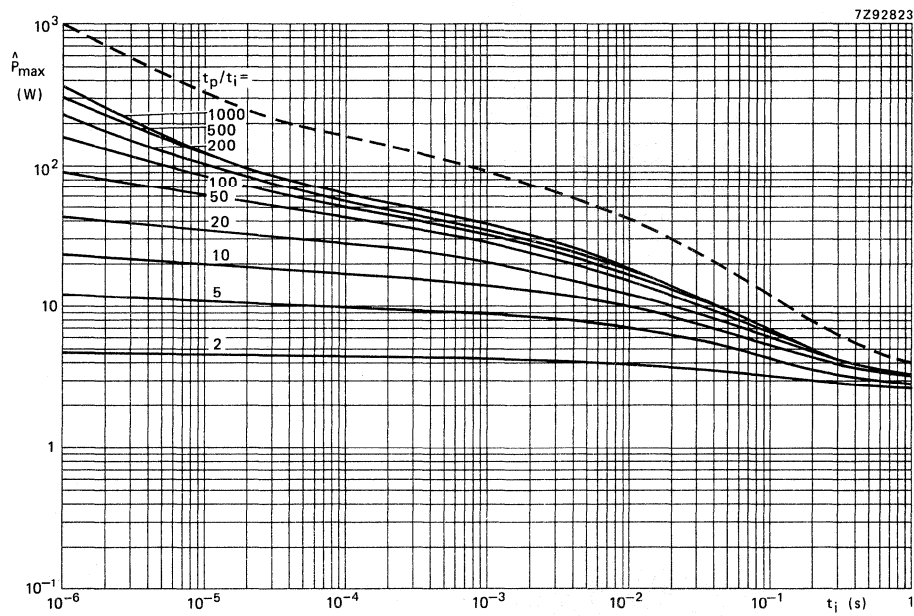


Fig. 9 Max. permissible peak pulse power ($\hat{P}_{\max}$) versus pulse duration (t_i).

TESTS AND REQUIREMENTS

Essentially all tests are carried out according to the schedule of IEC publication 115-1, category 55/200/56 (rated temperature range -55 to $+200$ °C; damp heat, long term, 56 days) and along the lines of IEC publication 68, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". In the following table the tests are listed with reference to the relevant clauses of IEC publications 115-1 and 68; a short description is also given of the test procedure and requirements. In some instances deviations from the IEC recommendation were necessary for our method of specifying.

Table 4

IEC 115-1 clause	IEC 68 test method	test	procedure	requirements
4.16		Robustness of terminations		
4.16.2	Ua	Tensile all samples	load 10N; 10s	number of failures < 10 ppm
4.16.3	Ub	Bending half number of samples	load 5N; 4 x 90°	
4.16.4	Uc	Torsion other half number of samples	3 x 360° in opposite directions	
4.17	Ta	Soldering	solderability: 2 s 230 °C, flux 600	good tinning. no damage
4.18	Tb		thermal shock: 3 s 350 °C, 6 mm from body	ΔR max. 0,5% + 0,05 Ω
4.19	Na	Rapid change of temperature	$\frac{1}{2}$ h -55 °C/ $\frac{1}{2}$ h $+155$ °C. 5 cycles	ΔR max. 2% no damage
4.20	Eb	Bump	3 x 1500 bumps in three directions, 40g	no damage ΔR max. 0,5% + 0,05 Ω
4.22	Fc	Vibration	frequency 10-500 Hz, displacement 1,5 mm or acceleration 10g, three dimensions; total 6 h (3 x 2 h)	no damage ΔR max. 0,5% + 0,05 Ω

IEC 115-1 clause	IEC 68 test method	test	procedure	requirements
4.23		Climatic sequence		
4.23.2	Ba	Dry heat	16 h, 155 °C	
4.23.3	Db	Damp heat (accel.) 1st cycle	24 h; 55 °C; 95-100% R.H.	
4.23.4	Aa	Cold	2 h; -55 °C	
4.23.5	M	Low air pressure	1 h; 8,5 kPa; 15-35 °C	
4.23.6	Db	Damp heat (accel.) remaining cycles	5 days; 55 °C; 95-100% R.H.	R_{ins} min. 1000 M Ω ΔR max. 3%
4.24.2	Ca	Damp heat steady state	56 days; 40 °C; 90-95% R.H. dissipation 0,01 P_n	R_{ins} min. 1000 M Ω ΔR max. 3%
4.25.1	—	Endurance	1000 hours; 70 °C P_n or V_{max}	ΔR max. 5%
4.8.4.2	—	Temperature coefficient	between -55 °C and + 155 °C	$R \leq 10 \Omega \leq \pm 350 \cdot 10^{-6}/K$ $R > 10 \Omega \leq \pm 250 \cdot 10^{-6}/K$
4.7	—	Voltage proof on insulation	500 (r.m.s.) during 1 min., V. block method	no breakdown
4.12	—	Noise	IEC publication 195	
4.6.1.1	—	Insulation resistance	500 V (r.m.s.) during 1 minute V block method	min. 10^6 M Ω
*	—	Pulse load		see Figs 8 and 9

* See 2nd amendment to IEC 115-1 and present 40 Central Office 532 & 533.

PR52

STANDARD PACKAGING

type and style	quantity per box	
	on bandolier ammopack	bulk loose
straight leads	500	
cropped and formed leads, $h = 8 \text{ mm}$ $h = 15 \text{ mm}$		500 250

Dimensions of bandolier

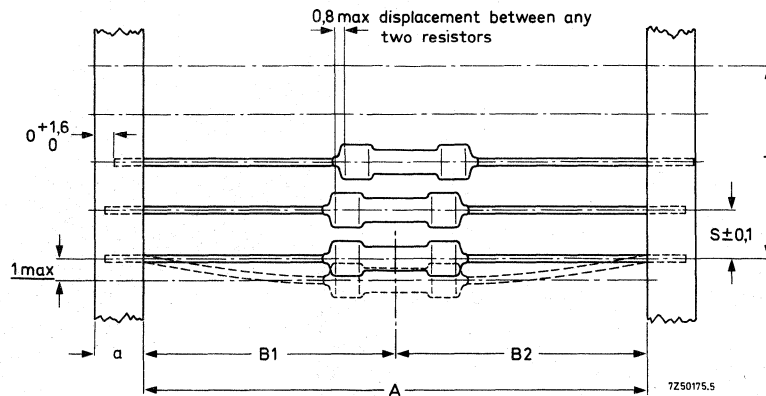
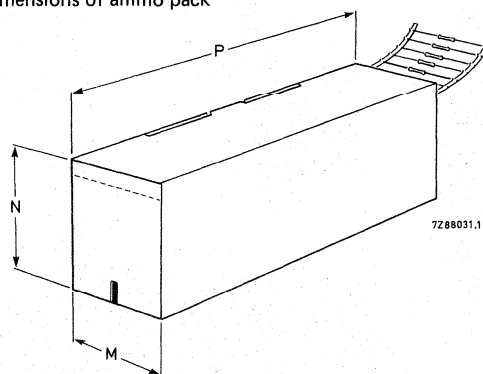


Fig. 10.

type	a $\pm 0,5$	A $\pm 1,5$	B1 — B2 $\pm \text{max.}$	S (spacing)	T (max. deviation of spacing)
PR52	6	80	1,2	10	1 mm per 10 spacings 0,5 mm per 5 spacings

Dimensions of ammo pack



M	N	P
99	77	259