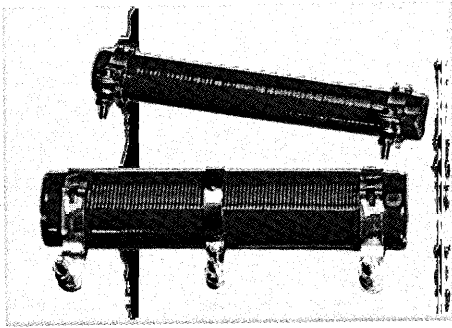


fixed resistors

wirewound

2322 321 to 324 MAINTENANCE TYPES
fixed or adjustable, with side terminals

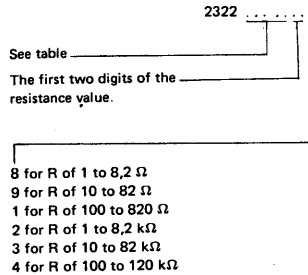


Rated dissipation; $T_{amb} = 40^{\circ}C$
mounted on metal plate
Temperature coefficient
Climatic category IEC 68

P, see table
1,2 P
-50 to +140 ppm/ $^{\circ}C$
55/155/56

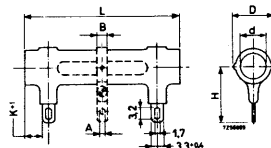
P	coating	resistance range	tolerance	catalogue no.	
				2322 followed by fixed	adjustable
W			%		
8	cement	1 Ω - 100 Ω	10	323 14 ...	-
		110 Ω - 150 Ω	5	323 34 ...	-
10	enamel	160 Ω - 6,8 k Ω	5	321 34 ...	-
		30 Ω - 300 Ω	5	323 32 ...	324 32 ...
16	cement	330 Ω - 12 k Ω	10	321 32 ...	-
		330 Ω - 3,3 k Ω	5	-	322 32 ...
25	enamel	1,5 Ω - 2,7 Ω	10	323 10 ...	324 10 ...
		3 Ω - 620 Ω	5	323 30 ...	324 30 ...
40	cement	680 Ω - 24 k Ω	5	321 30 ...	-
		680 Ω - 6,8 k Ω	5	-	322 30 ...
60	enamel	2,7 Ω - 15 Ω	10	323 08 ...	324 08 ...
		16 Ω - 820 Ω	5	323 28 ...	324 28 ...
100	cement	1 k Ω - 39 k Ω	5	321 28 ...	-
		1 k Ω - 9,1 k Ω	5	-	322 28 ...
160	enamel	4,7 Ω - 1,6 k Ω	5	323 26 ...	324 26 ...
		1,8 k Ω - 75 k Ω	5	321 26 ...	-
250	cement	1,8 k Ω - 18 k Ω	5	-	322 26 ...
		3 Ω - 2,2 k Ω	5	323 24 ...	324 24 ...
100	enamel	2,4 k Ω - 68 k Ω	5	321 24 ...	-
		2,4 k Ω - 24 k Ω	5	-	322 24 ...
160	cement	6,8 Ω - 4,3 k Ω	5	323 23 ...	324 23 ...
		4,7 k Ω - 120 k Ω	5	321 23 ...	-
250	enamel	4,7 k Ω - 47 k Ω	5	-	322 23 ...
		10 Ω - 47 k Ω	5	323 22 ...	324 22 ...
160	cement	16 Ω - 11 k Ω	5	323 21 ...	324 21 ...

Composition of the catalogue no.

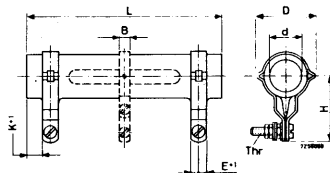


P	L_{max}	D_{max}	d_{min}	K	H	E	B	A	thread
W									
8	26	11,5	5	2,5	14	-	-	-	-
10	41	11,5	4,2	4	14	-	5	2,8	-
16	62	11,5	4,2	4	14	-	5	2,8	-
25	64	16	7,2	4	20	-	6	3,2	-
40	103	16	7,2	4	20	-	6	3,2	-
60	103	32	12,5	6	33	8,5	6	-	M4
100	165	32	12,5	6	33	8,5	6	-	M4
160	165	44	20	8	40	10	8	-	M5
250	256	44	20	8	40	10	8	-	M5

P < 40 W



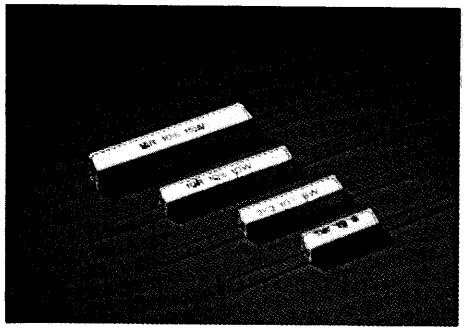
P > 60 W



rectangular wirewound

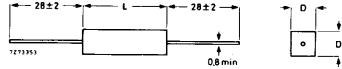
EH05 EH08
EH10 EH15

Resistors especially designed for high dissipation in a small volume. The rectangular package makes mounting quick and simple. Maximum hot-spot temperature of the resistors is 350 °C.



Resistance ranges	from 0,15 Ω to 12 kΩ E12 and E24 series
Resistance tolerance	± 5% or ± 10%
Max body temperature (hot spot)	350 °C
Rated dissipation at T _{amb} = 70 °C	EH05 5 W EH08 7 W EH10 9 W EH15 17 W
Basic specification	IEC 266
Climatic category (IEC 68)	40/200/56
Stability after 1000 h rated dissipation	ΔR/R max 5%

style	D _{max}	L _{max}
EH05	7,2	26
EH08	7,2	36
EH10	7,2	46
EH15	10,2	62



style	rated dissipation (W) at T _{amb} = 70 °C	resistance range Ω	tol. ± %	series	catalogue no.
EH05	5	0,15 - 9,1	10	E12	2306 330 02 ...
		10 - 4700	5	E24	2306 330 03 ...
EH08	7	0,27 - 9,1	10	E12	2306 331 02 ...
		10 - 8200	5	E24	2306 331 03 ...
EH10	9	0,33 - 9,1	10	E12	2306 332 02 ...
		10 - 10000	5	E24	2306 332 03 ...
EH15	17	0,47 - 9,1	10	E12	2306 333 02 ...
		10 - 12000	5	E24	2306 333 03 ...

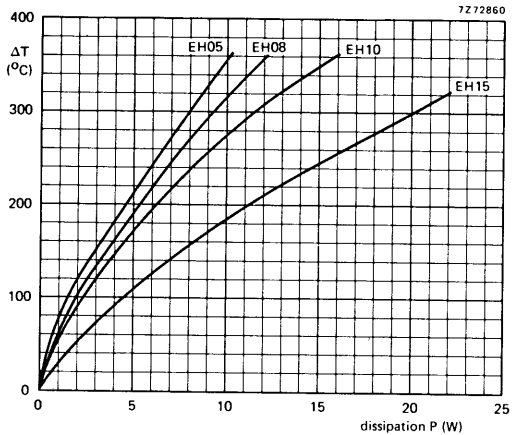
Marking

Each resistor is marked with:
resistance value (R for Ω, K for kΩ)
e.g. 27 Ω = 27R
15 kΩ = 15K
tolerance on resistance in ± %
rated dissipation at T_{amb} = 40 °C
date of manufacture

Composition of the catalogue no.

In the above-mentioned catalogue no. replace the first two dots by the first two digits of the resistance value. Replace the third dot by a figure according to the following table:

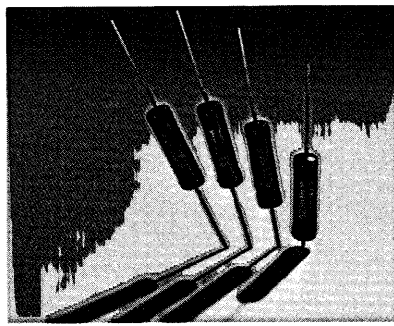
0,15 -	0,91 Ω : 7
1 -	9,1 Ω : 8
10 -	91 Ω : 9
100 -	910 Ω : 1
1 000 -	9 100 Ω : 2
10 000 -	16 000 Ω : 3



ΔT = temperature rise of resistor body.

fixed resistors

enamelled wirewound

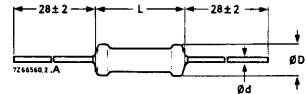


WR0617E WR0825E MAINTENANCE TYPES
WR0842E WR0865E

These resistors have a permissible hot-spot temperature of 400 °C. The leads are of a special material with high thermal resistance to counter temperature effects of the solder joint. The coating is a high quality vitreous enamel.

Resistance range	from 4,7 Ω to 100 kΩ E24 series	
Resistance tolerance	± 5%	
Max. body temperature (hot spot)	400 °C	
Rated dissipation at T _{amb} = 70 °C	WR0617 E	4,2 W
	WR0825 E	7 W
	WR0842 E	11 W
	WR0865 E	17 W
Basic specification	IEC 266, type 2	
Climatic category (IEC 68)	55/200/56	
Stability after 1000 h max. load	ΔR/R max. 5%	

style	D _{max}	L _{max}	d
WR0617E	6	19	0,7
WR0825E	8	27	0,8
WR0842E	8	44	0,8
WR0865E	8	67	0,8



style	rated dissipation at T _{amb} = 70 °C W	resistance range Ω	catalogue no.
WR0617E	4,2	4,7 - 4 700	2322 330 22 ...
WR0825E	7	6,8 - 27 000	2322 330 32 ...
WR0842E	11	10 - 56 000	2322 330 42 ...
WR0865E	17	15 - 100 000	2322 330 52 ...

Marking

Each resistor is marked with:

resistance value (R for Ω, K for kΩ)

e.g. 27 Ω = 27R

27 kΩ = 27K

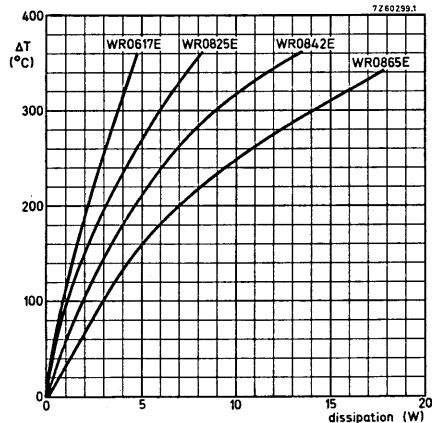
tolerance

style

Composition of the catalogue no.

In the above-mentioned catalogue no. replace the first two dots by the first two digits of the resistance value. Replace the third dot by a figure according to the following table:

4,7 -	9,1 Ω: 8
10 -	91 Ω: 9
100 -	910 Ω: 1
1 000 -	9 100 Ω: 2
10 000 -	91 000 Ω: 3
	100 000 Ω: 4



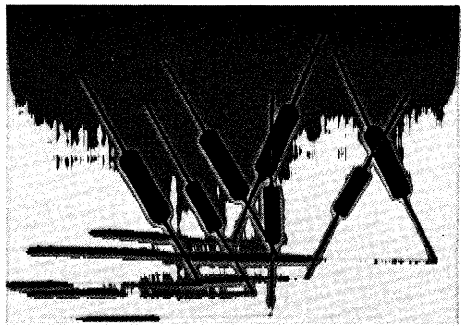
ΔT = temperature rise of resistor body.

cemented wirewound

AC04 AC05 AC07
AC10 AC15 AC20

These wirewound resistors are specially designed to dissipate high loads in a small volume.

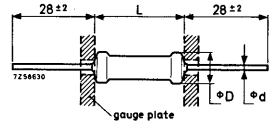
The resistor is coated with a green silicon cement which is non-inflammable and cannot drip at high overloads.



Resistance range	from 0,1 Ω to 33 k Ω E24 series
Resistance tolerances	5% and 10%
Maximum body temperature	350 °C
Rated dissipation at $T_{amb} = 40$ °C	AC04 4 W, AC10 10 W AC05 5 W, AC15 15 W AC07 7 W, AC20 20 W
Basic specification	IEC 266
Climatic category (IEC 68)	40/200/56
Stability after load	$\Delta R/R$ max 5%

style	D_{max}	L_{max}	d
AC04	6	19	0,6
AC05	8	19	0,8
AC07	8	27	0,8
AC10	8	44	0,8
AC15	10	51	0,8
AC20	10	67	0,8

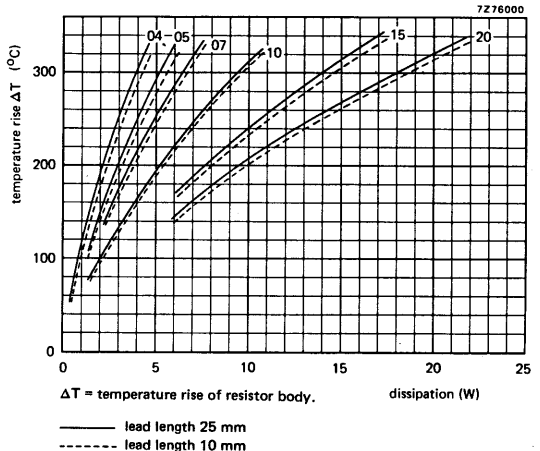
style	rated dissipation (W)		resistance range Ω	tol. %	series	catalogue no. 2322 329
	$T_{amb} = 40$ °C	$T_{amb} = 70$ °C				
AC04	4	3,5	0,18 - 8,2 10 - 4700	10 5	E12 E24	34 ... 04 ...
AC05	5	4,7	0,18 - 8,2 10 - 5600	10 5	E12 E24	35 ... 05 ...
AC07	7	5,8	0,10 - 8,2 10 - 10 000	10 5	E12 E24	37 ... 07 ...
AC10	10	8,4	0,68 - 8,2 10 - 15 000	10 5	E12 E24	40 ... 10 ...
AC15	15	12,5	0,82 - 8,2 10 - 22 000	10 5	E12 E24	45 ... 15 ...
AC20	20	16	1,2 - 8,2 10 - 33 000	10 5	E12 E24	50 ... 20 ...



Composition of the catalogue no.

In the catalogue no. (table above) replace the first two dots by the first two digits of the resistance value. Replace the third dot by a figure according to the following table:

0,1 -	0,82 Ω :	7
1 -	8,2 Ω :	8
10 -	91 Ω :	9
100 -	910 Ω :	1
1 000 -	9 100 Ω :	2
10 000 -	33 000 Ω :	3



fixed resistors

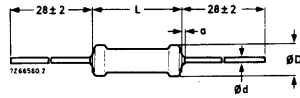
high voltage

VR37 VR68

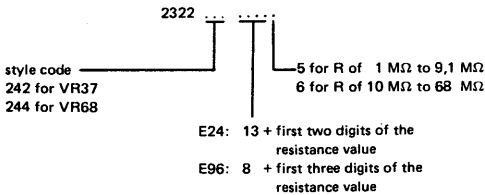
A range of metal glazed resistors especially intended for stability and reliability at high voltages. They are commonly used as protection resistors in tv and radio touch control systems.

Resistance range, VR37	1 M Ω to 33 M Ω , E24 and E96	
VR68	1 M Ω to 68 M Ω , E24 and E96	
Resistance tolerance	$\pm 1\%$ (E96) and $\pm 5\%$ (E24)	
Max body temperature (hot spot)	155 $^{\circ}\text{C}$	
Temperature coefficient	± 200 ppm/ $^{\circ}\text{C}$	
Rated dissipation at $T_{\text{amb}} = 70^{\circ}\text{C}$	VR37	0,5 W
	VR68	1,0 W
Limiting voltage, VR37	3500 V(d.c.) or 2500 V(r.m.s.)	
VR68	10000 V(d.c.) or 7000 V(r.m.s.)	
Dielectric withstanding voltage of the insulation for 1 minute	min 700 V(r.m.s.)	
Basic specification	IEC 115, type 1B	
Climatic category (IEC 68)	55/155/56	
Noise	0,5 $\mu\text{V/V}$	
Stability after:	VR37	VR68
1000 h max load	ΔR 0,5%	ΔR 1%

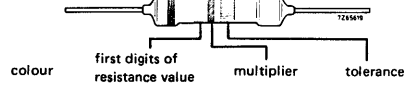
style	L_{max}	D_{max}	a_{max}	d
VR37	10	3,7	1,0	0,7
VR68	18	6,8	1,2	0,8



Composition of the catalogue no.



E24 series



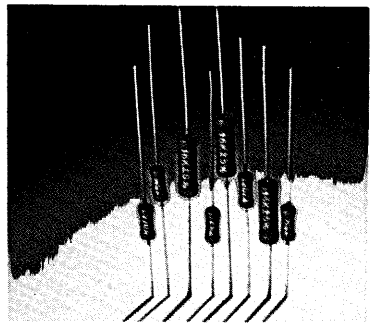
colour	first digits of resistance value	multiplier	tolerance
black	0		
brown	1		$\pm 1\%$
red	2		
orange	3		
yellow	4		$\pm 5\%$
green	5	100 000 x	
blue	6	1 000 000 x	
violet	7		
grey	8		
white	9		

E96 series



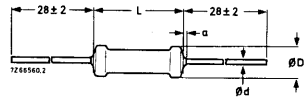
metal film-power

PR37 PR52



Resistance range, PR37	10 Ω to 10 kΩ, E24 series	
PR52	10 Ω to 27 kΩ, E24 series	
Resistance tolerance	± 5%	
Max body temperature (hot spot)	300 °C	
Rated dissipation at T _{amb} = 70 °C	PR37	1,6 W
	PR52	2,5 W
Basic specification	MIL-R-11804/2B, char. G	
Climatic category (IEC 68)	55/200/56	
Stability after:	requirement	typical value
1000 h max load	ΔR < 5%	ΔR 2,5%

style	L _{max}	D _{max}	a _{max}	d _{max}
PR37	10,0	3,7	1	0,6
PR52	16,7	5,2	1,2	0,6

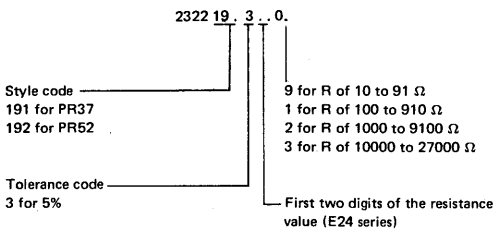


Marking

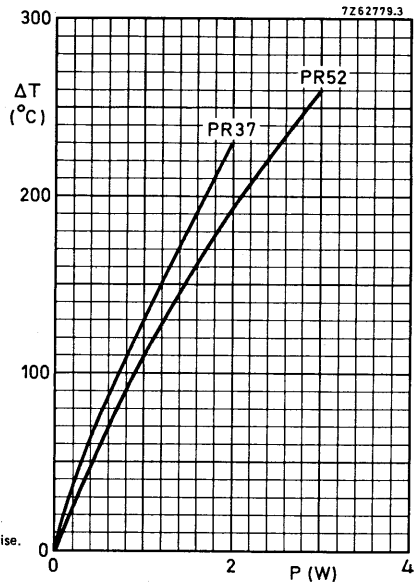
Each resistor is marked with:

- resistance value (R for Ω, K for kΩ)
- tolerance on resistance
- e.g. for 27 Ω: 27 R ± 5%
- for 3,9 kΩ: 3K9 ± 5%

Composition of the catalogue no.



Example:
PR52, 240 Ω, 5%
catalogue no. 2322 192 32401



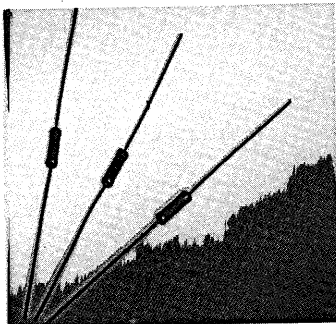
ΔT = hot-spot temperature rise.

fixed resistors

metal film-lacquered

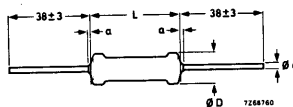
MR24E/C/D MR34E/C/D
MR54E/C/D MR74E/C/D

These resistors are intended for demanding applications where MIL-STD is required. They meet MIL-R-10509F in all respects and can be supplied with tolerances down to 0,1% and, to special order, in non-standard resistance values.



Resistance ranges	from 10 Ω to 1 MΩ, E96, E192 series		
Resistance tolerances	0,1 0,25 0,5 1%		
Rated dissipation at T _{amb} = 125 °C	MR24E/C	0,1 W	
	MR34E/C	0,125 W	
	MR54E/C	0,25 W	
	MR74E/C	0,5 W	
at T _{amb} = 70 °C	MR24D	0,125 W	
	MR34D	0,25 W	
	MR54D	0,5 W	
	MR74D	0,75 W	
Basic specification	MIL-R-10509F		
Stability after load	ΔR/R max. 0,5% +0,05 Ω		

style	D _{max}	L _{max}	d	a _{max}
MR24 E/C/D	2,5	6,5	0,6	1
MR34 E/C/D	3,1	10,5	0,6	1
MR54 E/C/D	5,2	16,5	0,6	1
MR74 E/C/D	6,8	20,5	0,8	1



Marking: (to MIL-R-10509 F)

Each resistor is marked with:

MIL style

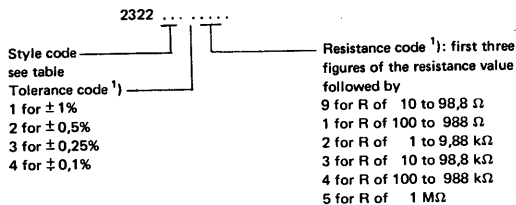
value and tolerance in MIL code

manufacturers' identification symbol

style	max. voltage	rated dissipation	resistance range and tolerance	maximum temperature coefficient	MIL style	style code
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V(r.m.s.) W		at 125 °C	0,1/0,25/0,5%	E192 series	±		
MR24E	200	0,1	1% E96 series	49,9 Ω-100 kΩ	25	RN55E	160
MR24C	200	0,1		49,9 Ω-100 kΩ	50	RN55C	161
MR34E	250	0,125		49,9 Ω-499 kΩ	25	RN60E	163
MR34C	250	0,125		49,9 Ω-499 kΩ	50	RN60C	164
MR54E	300	0,25		49,9 Ω- 1 MΩ	25	RN65E	166
MR54C	300	0,25		49,9 Ω- 1 MΩ	50	RN65C	167
MR74E	350	0,5		24,9 Ω- 1 MΩ	25	RN70E	169
MR74C	350	0,5		24,9 Ω- 1 MΩ	50	RN70C	170
		at 70 °C	1% E96 series	±			
MR24D	200	0,125		10 Ω-301 kΩ	100	RN55D	162
MR34D	300	0,25		10 Ω- 1 MΩ	100	RN60D	165
MR54D	350	0,5		10 Ω- 1 MΩ	100	RN65D	168
MR74D	500	0,75		10 Ω- 1 MΩ	100	RN70D	171

Composition of the catalogue no.



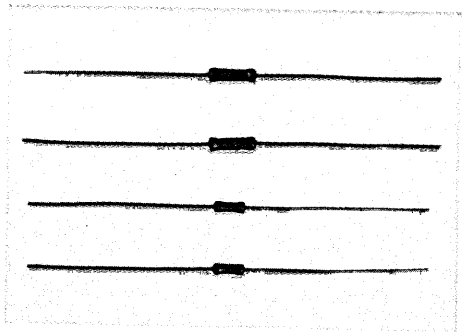
Example

Style MR24E, 261 kΩ, 0,25%; catalogue no. 2322 160 32614.

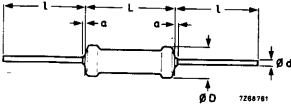
¹⁾ Where following values occur, use numbers shown below.

value Ω	last 5 digits of the catalogue no.
	0,1% 0,25% 0,5% 1%
29,9	92102 92122
39,9	92103 92123
49,9	92104 92124 92134 92144
59,9	92105 92125
69,9	92106 92126
79,9	92107 92127
89,9	92108 92128
99,9	92109 92129

A professional style of resistor that is also widely used in consumer equipment. It meets the high standards required for test and measuring equipment and for communications equipment etc. The lacquer is non-inflammable and is resistant to all the usual cleansing solvents.



style	D _{max}	L _{max}	l	d	a _{max}
MR25	2,5	6,5	28 ± 2	0,6	1
MR30	3	10	28 ± 2	0,6	1
MR52	5,2	16,5	38 ± 3	0,6	1



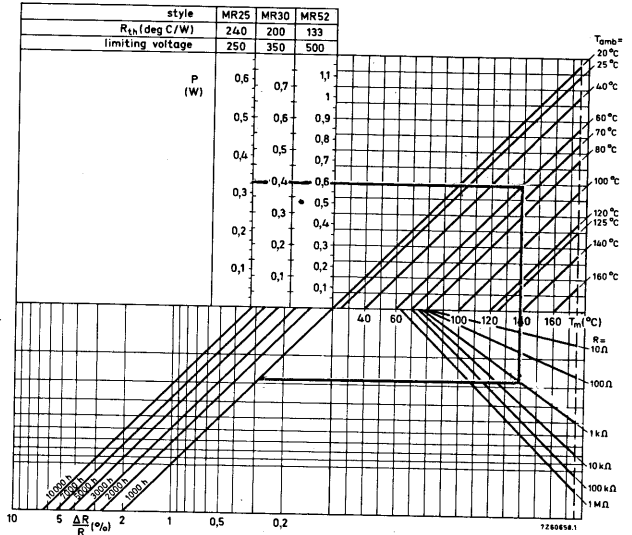
Nomogram to find style or stability

Example

What is the stability of a 1 kΩ metal film resistor, style MR25, operating at 0,33 W in an ambient of 60 °C? Find 0,33 W on MR25 style column. Follow the line right, down, left, to where it intersects the 1000 h line.

$\Delta R/R$ is 0,28% over 1000 working hours.

Use the reverse procedure to find right style for a given stability and dissipation.

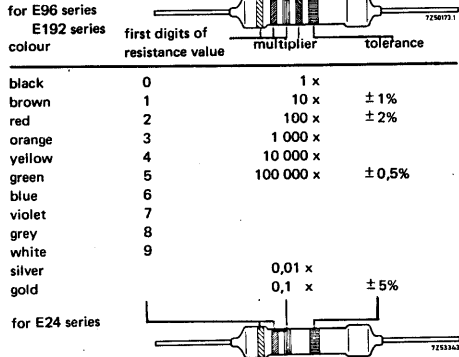


fixed resistors

metal film-lacquered

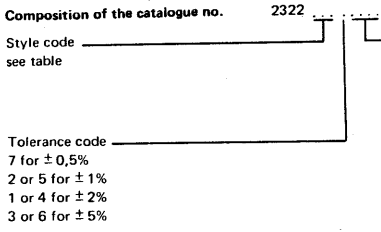
MR25 MR30 MR52

Resistance ranges	from 1 Ω to 1 MΩ E24, E96 and E192 series
Resistance tolerance	± 0,5, ± 1, ± 2, ± 5%
Temperature coefficient	± 50, ± 100, ± 200 ppm/°C
Abs. max. dissipation at T _{amb} = 70 °C	MR25 0,4 W MR30 0,5 W MR52 0,75W
Basic specification	IEC 115-1
Climatic category (IEC68)	55/155/56
Stability after load	see nomogram



style	limiting voltage (r.m.s) V	rated dissipation at 70 °C W	resistance range	tolerance	series	temperature coefficient ± ppm/°C	catalogue no. 2322
				± %			followed by
MR25	250	0,4	4,99 Ω - 681 kΩ	0,5	E192	50 ¹⁾	151 7
	250		4,99 Ω - 681 kΩ	1	E96 + E24	50 ¹⁾	151 5
	250		1 Ω - 680 kΩ	2	E24	100	151 4
	250		1 Ω - 680 kΩ	5	E24	200	151 6
MR25 on reel	250	0,4	4,99 Ω - 681 kΩ	1	E96	50 ¹⁾	151 2
	250		1 Ω - 680 kΩ	2	E24	100	151 1
	250		1 Ω - 680 kΩ	5	E24	200	151 3
MR30	350	0,5	4,99 Ω - 1 MΩ	0,5	E192	50 ¹⁾	152 7
	350		4,99 Ω - 1 MΩ	1	E96 + E24	50 ¹⁾	152 5
	350		5,1 Ω - 1 MΩ	2	E24	100	152 4
	350		5,1 Ω - 1 MΩ	5	E24	200	152 6
MR30 on reel	350	0,5	4,99 Ω - 1 MΩ	1	E96	50 ¹⁾	152 2
	350		5,1 Ω - 1 MΩ	2	E24	100	152 1
	350		5,1 Ω - 1 MΩ	5	E24	200	152 3
MR52	500	0,75	4,99 Ω - 1 MΩ	1	E96	100	153 5

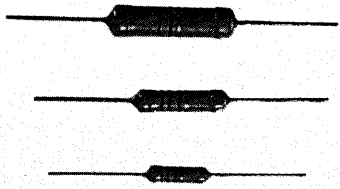
¹⁾ For values ≤ 49,9 Ω: 100 ppm/°C.



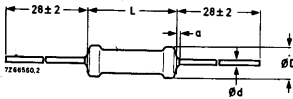
Resistance code: first three figures of the resistance value followed by

8 for R of 1 to 9,76 Ω
9 for R of 10 to 97,6 Ω
1 for R of 100 to 976 Ω
2 for R of 1 to 9,76 kΩ
3 for R of 10 to 97,6 kΩ
4 for R of 100 to 976 kΩ
5 for R of 1 MΩ

Example
The catalogue no. of an MR30 resistor of 3650 Ω with a tolerance of 1% is 2322 152 53652.

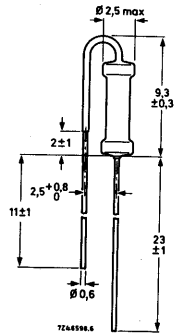


style	D _{max}	L _{max}	d	a _{max}
CR16	1,6	4,0	0,4	1,0
CR25	2,5	6,8	0,6	1,0
CR37	3,7	10	0,7	1,0
CR52	5,2	16,5	0,8	1,2
CR68	6,8	18	0,8	1,2
CR93	9,0	31,7	0,8	1,2



Style CR25A

The bent lead is partly covered with an insulating lacquer having a breakdown voltage of at least 50 V (d.c.)



Nomogram to find style or stability

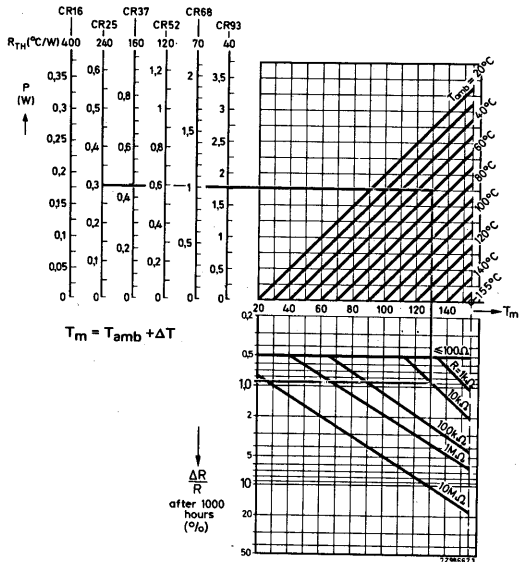
Example

What is the stability of a 10 kΩ resistor, style CR25, operating at 0,3 W in an ambient of 60 °C ?

Find 0,3 W on CR25 style column.

Follow the line right, down, left, to the stability axis. ΔR/R is 1% over 1000 working hours.

Use the reverse procedure to find right style for a given stability and dissipation.




fixed resistors

carbon film

CR16 CR25 CR37
CR52 CR68 CR93

For detailed information
Handbook CM2a

Resistance ranges	from 1 Ω to 10 M Ω ; E12 or E24 series			
Resistance tolerance	5 and 10%			
Abs. max. dissipation at $T_{amb} = 70^\circ\text{C}$	CR16	0,2 W	CR52	0,67 W
	CR25	0,33 W	CR68	1,15 W
	CR37	0,5 W	CR93	2 W
Basic specification	IEC 115-1, 115-2			
Climatic category (IEC 68)	55/155/56			
Stability after load	see nomogram			



colour	first two digits of resistance value	multiplier	tolerance
black	0	1 x	
brown	1	10 x	
red	2	100 x	
orange	3	1 000 x	
yellow	4	10 000 x	
green	5	100 000 x	
blue	6	1 000 000 x	
violet	7		
grey	8		
white	9		
silver			$\pm 10\%$
gold		0,1 x	$\pm 5\%$

style	limiting voltage V(r.m.s.)	rated dissipation at 70 °C W	resistance range	tolerance %	series	catalogue no.
CR16	150	0,2	10 Ω - 220 k Ω	5	E24	2322 210 13 ...
			270 k Ω - 1 M Ω	10	E12	2322 210 12 ...
CR16 on reel			10 Ω - 220 k Ω	5	E24	2322 210 23 ...
			270 k Ω - 1 M Ω	10	E12	2322 210 22 ...
CR25	150	0,33	1 Ω - 1 M Ω	5	E24	2322 211 13 ...
			1,2 M Ω - 10 M Ω	10	E12	2322 211 12 ...
CR25 on reel			1 Ω - 1 M Ω	5	E24	2322 211 23 ...
			1,2 M Ω - 10 M Ω	10	E12	2322 211 22 ...
CR25A	250	0,33	1 Ω - 1 M Ω	5	E24	2322 106 33 ...
			1,2 M Ω - 10 M Ω	10	E12	2322 106 32 ...
CR37	350	0,5	1 Ω - 1 M Ω	5	E24	2322 212 13 ...
			1,2 M Ω - 10 M Ω	10	E12	2322 212 12 ...
CR37 on reel			1 Ω - 1 M Ω	5	E24	2322 212 23 ...
			1,2 M Ω - 10 M Ω	10	E12	2322 212 22 ...
CR52 ¹⁾	500	0,67	1 Ω - 1 M Ω	5	E24	2322 213 13 ...
CR68 ¹⁾	750	1,15	1 Ω - 1 M Ω	5	E24	2322 214 13 ...
CR93 ¹⁾	1000	2	10 Ω - 1 M Ω	5	E24	2322 215 13 ...

¹⁾ For values > 1 M Ω see high-voltage resistors VR37 and VR68

Composition of the catalogue no.

In the above-mentioned catalogue no., replace the first two dots by the first two digits of the resistance value.
Replace the third dot by a figure according to the following table:

1 - 9,1 Ω	8	10 - 91 k Ω	3
10 - 91 Ω	9	100 - 910 k Ω	4
Example Style CR25 (not on reel) 10 Ω , 5% cat. no. 2322 211 13109	1	1 - 9,1 M Ω	5
	2	10 M Ω	6