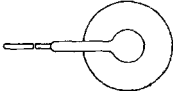
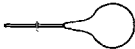


non-linear resistors

VDR-survey

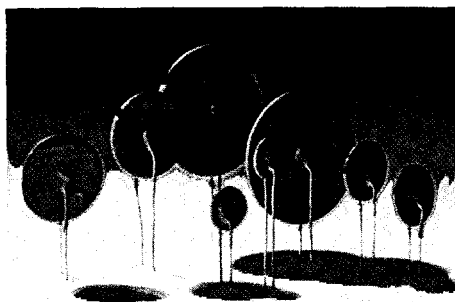
For detailed information
Handbook CM2a

type	voltage V	current mA	dissipation W	β -value	catalogue no.	page
DISC	8 to 330	100 to 1	0,8	0,14 to 0,40	2322 552 0	289
	8 to 330	100 to 1	1	0,14 to 0,40	2322 553 0	
	8 to 330	100 to 1	2	0,14 to 0,40	2322 554 0	
	8 to 330	100 to 1	3	0,14 to 0,40	2322 555 0	
SMALL DISC	2,7 to 15	1	0,25	0,11 to 0,22	2322 581 03 . . .	291
	48	0,05	0,1	0,035	2322 592 90001	290
					2322 592 90003	
	50 to 425			0,035	2322 594 1	291
ROD					2322 564 02 . . .	
	56 to 1300	1 to 10	0,8	0,16 to 0,36	2322 564 03 . . .	290
					2322 564 90 . . .	

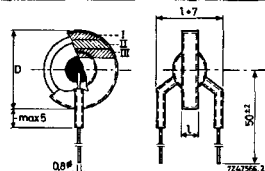
VDR

2322 552 2322 553 — discs
2322 554 2322 555

Very suitable for voltage stabilization, contact protection and spark suppression. These types consist of a disc provided with two tinned solid copper wires.



Series no.	552	553	554	555
Max dissipation	0,8	1	2	3 W
Diameter D	14,5	20	27,5	42,5 mm
Operating temperature range	-25 to 125 °C			
at zero power	0 to 55 °C			
at max power	0,14 to 0,40			
β between 0,3 and 3 x I_{nom}				



Composition of the catalogue no.

2322 ... 0 ...
series no.

tolerance on V:
1 20%, untipped
2 10%, silver tipped

I_{nom} mA	V at I_{nom} V	code in catalogue no.				l mm
		552	553	554	555	
100	8	116	116	116	116	3
	10	118	118	118	118	3
	12	120	120	120	120	3
	15	122	122	122	122	3
	18			124	124	3
	22				126	3
	27				128	3
	33				130	3
10	8	216				3
	10	218	218			3
	12	220	220	220		3
	15	222	222	222		3
	18	224	224	224		3
	22	226	226	226	226	3
	27	228	228	228	228	3
	33	230	230	230	230	3
	39	232	232	232	232	3
	47	234	234	234	234	5
	56	236	236	236	236	5
	68	238	238	238	238	5
	82		240	240	240	5
	100			242	242	5
	120			244	244	5
	150			246	246	5
	180			248	248	5
	220				250	5
	270				252	5
1	56	336				5
	68	338	338			5
	82	340	340			5
	100	342	342			5
	120	344	344			5
	150	346	346	346		5
	180	348	348	348		5
	220	350	350	350	350	5
	270	352	352	352	352	5
	330	354	354	354	354	5

Marking

Each resistor is marked with three coloured bands, indicating the code e.g. 116:

I = brown
II = brown
III = blue

colour code

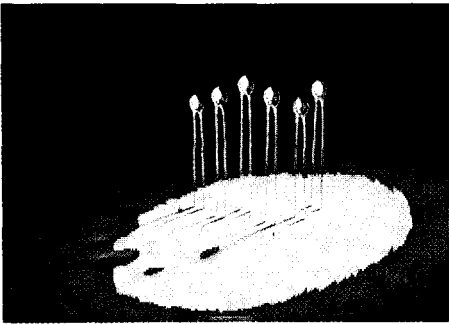
black 0
brown 1
red 2
orange 3
yellow 4
green 5
blue 6
violet 7
grey 8
white 9

non-linear resistors

VDR

2322 564 — rod
2322 592 — small disc

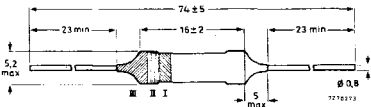
To be used for stabilization of voltages, protection of contacts, etc.
These rods are provided with two axial tinned solid copper wires. They are tan lacquered, but not insulated.



2322 564

$P_{max} = 0,8 \text{ W}$

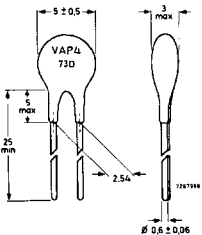
I_{nom} mA	at V V (d.c.)	tolerance on V in %	β -value	colour code; I, II, III	catalogue no. 2322 564
10	470	10	0,20–0,25	green	02582
10	560	10	0,18–0,23	blue	02602
10	680	10	0,18–0,23	violet	02622
10	910	10	0,17–0,22	white	90014
10	1200	20	0,17–0,22	grey	02681
10	1200	10	0,17–0,22	brown	02682
10	1300	10	0,16–0,21	red	90015
2	950	10	0,16–0,21	black, blue	90005
1	56	20	0,29–0,36	orange, orange, blue	03361
1	68	20	0,29–0,36	orange, orange, grey	03381
1	82	20	0,29–0,36	orange, yellow, black	03401
1	100	20	0,25–0,32	orange, yellow, red	03421
1	120	20	0,25–0,32	orange, yellow, yellow	03441
1	150	20	0,22–0,29	orange, yellow, blue	03461
1	180	20	0,22–0,29	orange, yellow, grey	03481
1	220	20	0,21–0,28	orange, green, black	03501
1	270	20	0,21–0,28	orange, green, red	03521
1	300	20	0,18–0,25	yellow	90016



Note: change 1 into 2 for 10% tolerance

2322 592

Norm. d.c. voltage	48	V
Norm. dissipation	0,1	W
Operating temperature range	– 55 to +85	°C
Climatic category		
NF C 20-600, par. 4.3	454(55/085/56)	
β -value between 0,1 and 1 mA	max 0,035	



These VDRs are for relay contact protection in telephone exchanges, etc. and are homologated in France under NF C 93-277/UTE 93-277 and in Belgium under certificate number 73-209.

Catalogue no.
2322 592 90001 — is marked, see drawing.
90003 — is not marked.

2322 581 — small disc
2322 594 — small disc

2322 581: when you need a low β at a low voltage this titanium oxide disc is excellent for your application.

2322 594: zinc oxide disc VDR, especially designed for voltage transient or spark suppression, contact protection, protection against secondary lightning effects, etc.

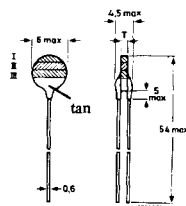


2322 581

Operating temperature range	
at zero power	- 25 to +125 °C
at max power	0 to + 55 °C
Max dissipation	0,25 W
Tolerance on voltage at 1 mA	20 %

nom. voltage at 1 mA V(d.c.)	β -value between	capacitance nF	catalogue no.
2,7	0,16-0,22	40	03041
3,3	0,15-0,21	35	03061
3,9	0,14-0,20	30	03081
4,7	0,13-0,19	25	03101
5,6	0,12-0,18	20	03121
6,8	0,12-0,18	15	03141
8,2	0,11-0,17	15	03161
10	0,11-0,17	15	03181
12	0,11-0,17	12	03201
15	0,11-0,17	10	03221

— shown as I, II, III



Marking

Each resistor is marked with three coloured bands

Example: . 308 .

I = orange = 3

II = black = 0

III = grey = 8

colour code

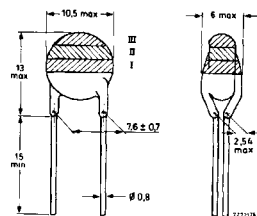
black	0
brown	1
red	2
orange	3
yellow	4
green	5
blue	6
violet	7
grey	8
white	9

2322 594

Operating temperature range	
at zero power	- 25 to +115 °C
at max power	- 25 to + 85 °C
Voltage ratio V_2/V_1 for $I_2/I_1 = 10$	typ 1,08
Max non-repetitive transient energy	8 J
β between 1 mA and 1 A	typ 0,035

working voltage (r.m.s.) V	V_{min} at $I_{peak} =$ 1 mA * V	V_{max} at $I_{peak} =$ 1 A ▲ V	crest working voltage (max) V	catalogue no.
50	82	140	75	18202
60	100	170	95	11012
95	150	255	150	11512
120	190	325	185	11912
135	220	375	210	12212
205	330	560	320	13312
220	350	595	340	13512
245	390	665	380	13912
295	470	800	455	14712
390	620	1055	605	16212
425	680	1160	660	16812

— shown as I, II, III



* Pulse 10 ms.

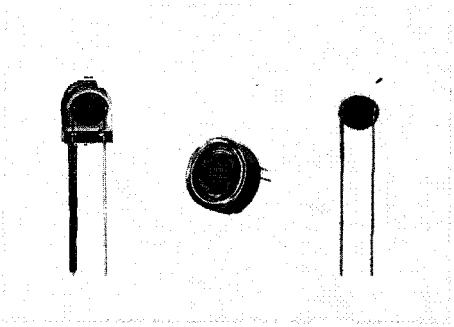
▲ Rectangular pulse; voltage measured after 1 ms.

non-linear resistors

LDR

2322 600

The light dependent resistors are intended for non-critical on-off applications, in which a lamp or a relay is operated either directly (low power) or via a suitable amplifier (high power) e.g. in toys.



P max mW	V _{peak} max V	R _D min MΩ	R _L at 1000 lux 2850 K Ω	catalogue no. 2322 600
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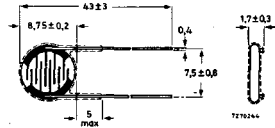
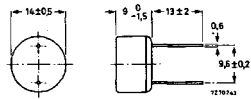
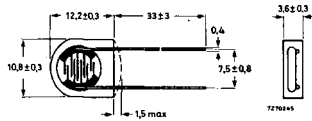
plastic encapsulated

100	150	10	75–300	93001
100	150	1	< 110	93002

200	110	10	75–300	95001
200	110	10	< 250	95003
200	110	1	< 110	95006
200	110	10	< 190	95007

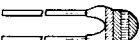
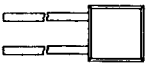
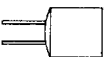
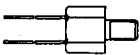
lacquered

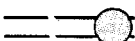
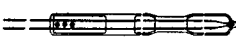
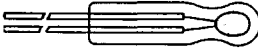
100	150	10	75–300	94001
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NTC thermistors - survey

For detailed information
Handbook CM2a

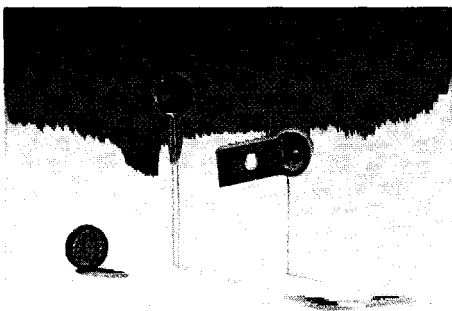
type		catalogue no.	page
DISC		2322 610 0	294
		2322 610 1 2322 642 1	294 297
		2322 611	295
		2322 640 1	296
		2322 643 1 2322 644 1	298
		2322 644 90004 2322 644 90005	298
on metal strip		2322 610 900 ..	294
moulded		2322 640 90004 2322 640 90005	299
in special housing		2322 640 90007	299
		2322 640 90008	299
		2322 642 2	300
ROD		2322 635 2322 636 2322 637	301

type		catalogue no.	page
MINIATURE BEAD			
		2322 634 0	303
		2322 634 1	303
glass encapsulated		2322 627 1	302
		2322 627 2 2322 627 31	302 304
		2322 634 2	303
		2322 634 3	303
		2322 634 4	303
INDIRECTLY HEATED			
		2322 628 01332 2322 628 01334	304

non-linear resistors

NTC thermistors

2322 610 – disc

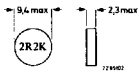


General purpose thermistors.

2322 610 900 . . on metal strip is specially designed for temperature compensation in deflection units.

Resistance range at 25 °C	1,1 to 1300 Ω
Dissipation	max 1 W
Operating temperature range at zero power	- 25 to +125 °C
at max power	0 to + 55 °C

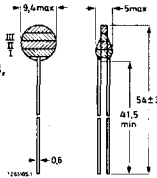
WITHOUT leads



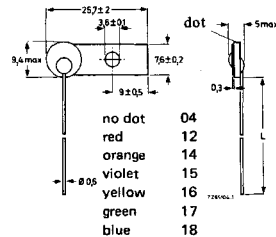
WITH leads

Coloured bands give last three digits of catalogue no. I and II follow standard colour code. III is standard except: gold = 8, black = 9.

Example
228 = red, red, gold



WITH leads, on metal strip



Catalogue no. 2322 610 0 . . .

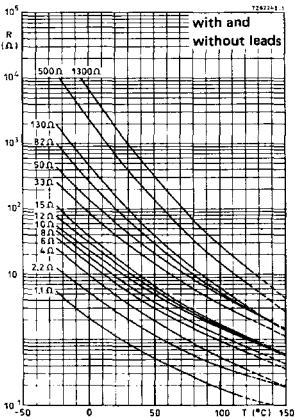
marking	tolerance	
K	10%	2
M	20%	1

Catalogue no. 2322 610 1 . . .

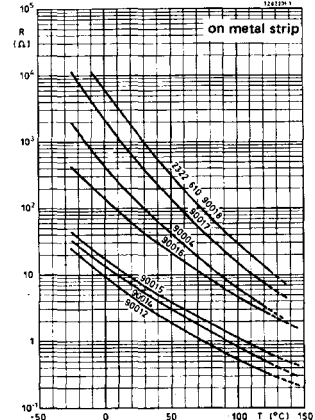
tolerance:	
10% (silver tipped)	2
20% (untipped)	1

Catalogue no. 2322 610 900 . .

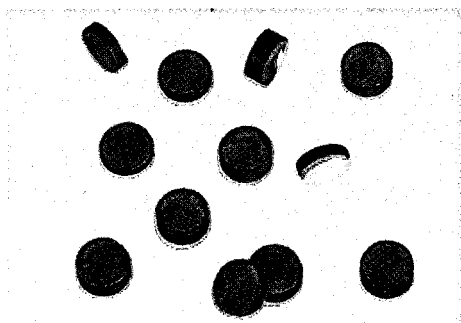
tolerance 20% only



R25 Ω	B25/85 ± 5% K	
1,1	2600	118
2,2	2675	228
4	2800	408
6	2825	608
8	2900	808
10	2950	109
12	3050	129
15	3125	159
33	3250	339
50	3300	509
82	4400	829
130	4600	131
500	5200	501
1300	5450	132



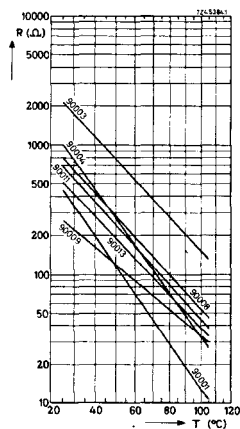
2322 611 – disc



resistance in Ω at					diameter mm	catalogue no.
25 °C	40 °C	50 °C	96,5 °C	100 °C		
270		97 –143		29,5–36,5	$6,9 \pm 0,2$	09
500		92,5–134		12 –15	$6,9 \pm 0,2$	01
500		175 –215		35 –43	$6,9 \pm 0,2$	13
700		207 –264		41,4–48,6	$6,9 \pm 0,2$	11
800		244 –315		48,0–58,6	$6,9 \pm 0,2$	08
1000		221,5–318,5		30 –36	$6,9 \pm 0,2$	04
2200	1030–1310		147–173		$7,0 \pm 0,3$	03

This range of discs has been developed for temperature sensors for the cooling water in motor cars. The NTCs are specified at a medium temperature (40 to 50 °C) and a higher temperature (96,5 to 100 °C), so that a high accuracy at the working temperature is obtained.

They are also suitable for temperature control in household appliances, such as washing machines.



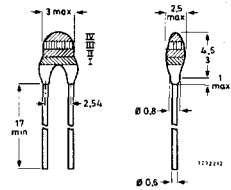
non-linear resistors

NTC thermistors

2322 640 1 – disc

For temperature sensing and temperature control.

Resistance values at 25 °C	4,7 kΩ to 330 kΩ
Maximum dissipation	0,25 W
Dissipation factor	7 mW/ °C
Thermal time constant	13 s
Operating temperature range	
at zero power	- 25 to +125 °C
at maximum power	0 to + 55 °C



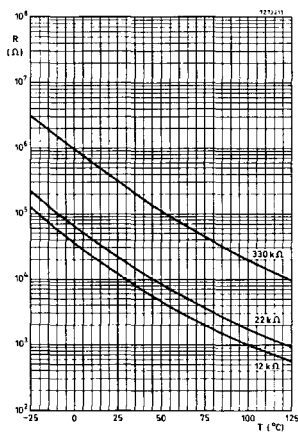
R25	B25/85 ± 5%	temperature coefficient at 25 °C	colour code			catalogue no.	
kΩ	K	%/ °C	I	II	III	R ± 10%	R ± 20%
4,7	3660		yellow	violet	red	2472	1472
12	3700	-4,22	brown	red	orange	2123	1123
22	3700	-4,13	red	red	orange	2223	1223
47	3850		yellow	violet	orange	2473	1473
68	3880		blue	grey	orange	2683	1683
150	4050		brown	green	yellow	2154	1154
330	4150	-4,68	orange	orange	yellow	2334	1334

Band IV
no colour : tolerance 20%
silver : tolerance 10%
white : types 2322 640 19 ...
(see below)

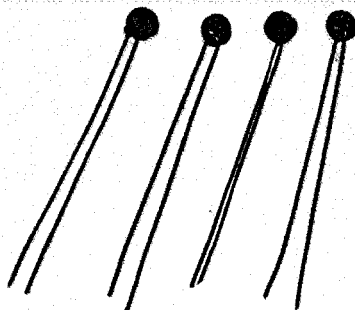
2322 640 19 ...

These thermistors are similar to the other types 2322 640 1 ... except that the nominal resistance is specified between +4 °C and +6 °C and also between +24 °C and +26 °C.

R _{nom} @ +5 ± 1 °C	R _{nom} @ +25 ± 1 °C	catalogue no.
11,1 kΩ	4,7 kΩ	2322 640 19472
28,7	12	19123
51,5	22	19223
114	47	19473
165	68	19683
380	150	19154
830	330	19334



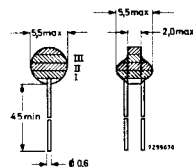
2322 642 1 — disc



Resistance range (E6 series) at 25 °C	3,3 Ω to 330 kΩ
Dissipation at 55 °C	max 0,5 W
Thermal time constant, free air approx.	25 s
Operating temperature range at zero power	−25 to +125 °C

Coloured bands give last three digits of catalogue no. I and II follow standard colour code. III is standard except: gold = 8, black = 9.

Example
338 = orange, orange, gold

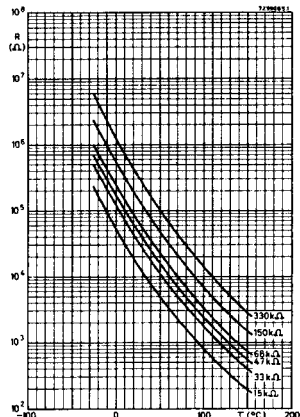
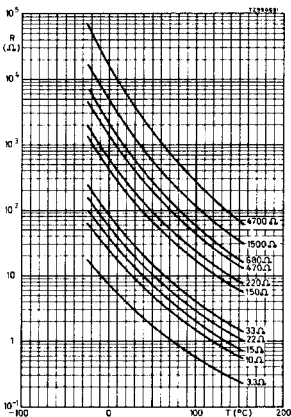


R25 B25/85 catalogue no.
± 5%
K

tolerance on R25:

3,3 Ω	2600	2322 642 1 . 338
4,7	2665	1 . 478
6,8	2730	1 . 688
10	2800	1 . 109
15	2870	1 . 159
22	2935	1 . 229
33	3010	1 . 339
47	3070	1 . 479
68	3135	1 . 689
100	3200	1 . 101
150	3280	1 . 151
220	3350	1 . 221
330	3440	1 . 331
470	3520	1 . 471
680	3600	1 . 681
1 kΩ	3680	1 . 102
15	3775	1 . 152
22	3915	1 . 222
33	4070	1 . 332
47	4200	1 . 472
68	4300	1 . 682
10	4400	1 . 103
15	4375	1 . 153
22	4200	1 . 223
33	4250	1 . 333
47	4325	1 . 473
68	4375	1 . 683
100	4400	1 . 104
150	4600	1 . 154
220	4650	1 . 224
330	4700	1 . 334

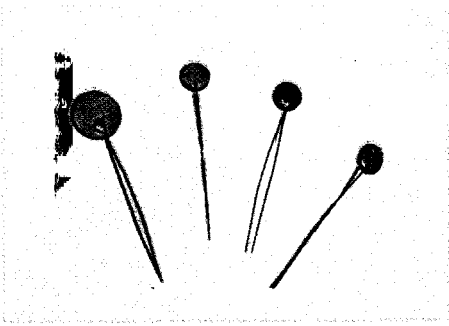
20% (untipped) 1
10% (silver tipped) 2
5% (gold tipped) 3



non-linear resistors

NTC thermistors

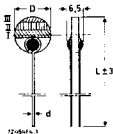
2322 643 1
2322 644 1 – disc
2322 644 9



2322 643 1 and 2322 644 1

Resistance range at 25 °C	150 to 4700 Ω		
Operating temperature range at zero power	– 25 to +125 °C		
2322 ...	643	644	
Dissipation at 25 °C	max	1	1,5 W
Thermal time constant	55	120	s

Coloured bands give last three digits of catalogue no. I and II follow standard colour code. III is standard except: gold = 8, black = 9



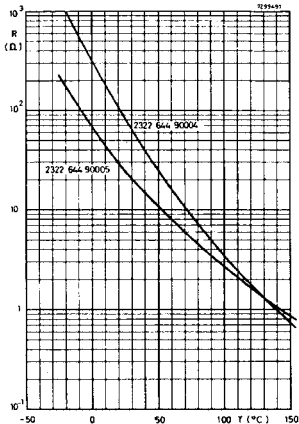
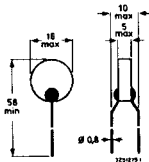
Example
152 = brown, green, red

P _{max}	R ₂₅	B _{25/85} ± 5% K	catalogue no.	tolerance on R ₂₅ :
W	Ω			20% 10% (silver band) 2
1	150	3500	2322 643 1 . 151	
	470	3750	471	
	1500	4000	152	
	4700	4200	472	
1,5	150	3600	2322 644 1 . 151	
	470	3900	471	
	1500	4200	152	
	4700	4300	472	

	D	L	d
2322 643	9 ± 0,6	54	0,6
2322 644	15 ± 0,7	58	0,8

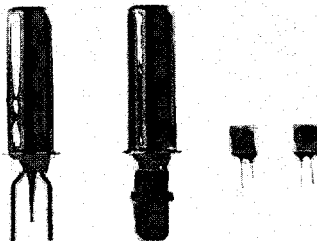
2322 644 9 for surge limitation in tv

Catalogue no. 2322 644	90004	90005
Resistance at 25 °C	82 (± 20%)	> 15 Ω
at T _{amb} = 25 °C; I _{rms} = 1,7 A	< 0,85	Ω
= 2,2 A	—	< 1 Ω
Dissipation factor	19	17 mW/ °C
B _{25/85}	4650	3350 K
Repetitive peak voltage (50–60 Hz) max	345	380 V
Thermal time constant	115	148 s
Operating temperature range		
at zero power	– 25 to +155	°C
at max. power	0 to + 55	°C

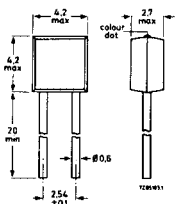


2322 640 9

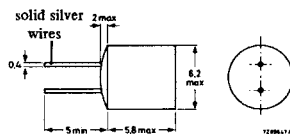
Temperature sensing elements for domestic and professional/industrial applications with rugged housing and great reliability. They can be built-in directly, are resistant to industrial atmospheres, and can also be cast-in.



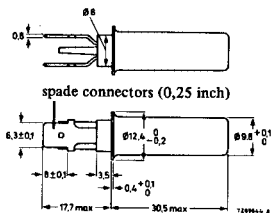
Catalogue no. 2322 640	90004	90005	90007	90008	
Resistance at:					Ω
+ 25 °C	12000 $\pm$ 7%	—	12000 $\pm$ 7%	215000 approx.	
+ 90 °C	—	—	—	22000 $\pm$ 10%	Ω
+ 100 °C	950 $\pm$ 5%	16700 $\pm$ 7%	950 $\pm$ 5%	—	Ω
+ 200 °C	—	1120 $\pm$ 7%	—	—	Ω
+ 320 °C	—	—	—	235 $\pm$ 75	Ω
Dissipation max	0,25	0,25	—	—	W
B25/85	3750	4300	3750	—	K
B50/150	—	—	—	4000 $\pm$ 5%	K
Operation temperature range					°C
at zero power	- 10 to + 125	- 25 to +100	- 25 to +125	0 to 250	
at max power	0 to + 55	0 to + 25	—	0 to 350	°C
Application area	general purpose	high temperature control	washing machines	hotplates	



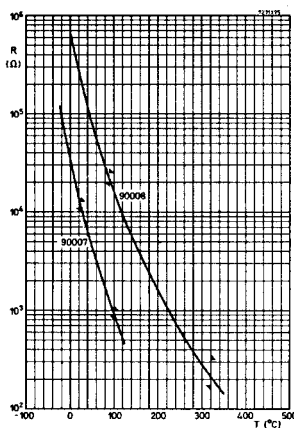
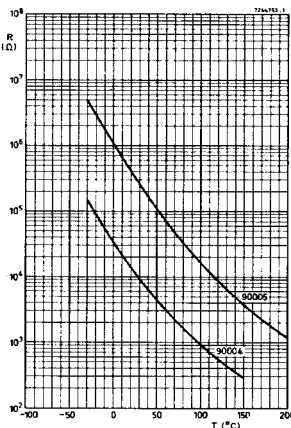
2322 640 90004 (grey dot)
2322 640 90005 (black dot)
in a moulded package



2322 640 90008 in a ceramic package



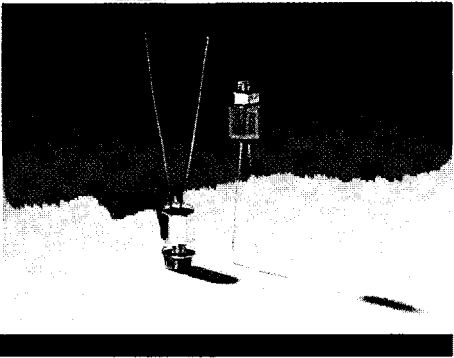
2322 640 90007
in a stainless steel package



non-linear resistors

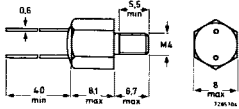
NTC thermistors

2322 642 2



Thanks to their high insulation resistance and good thermal contact these devices can be used in many control applications such as in sensing output stages, heater panels, etc.

Resistance range (E6) at 25 °C	3,3 Ω to 330 kΩ
Dissipation max	0,5 W
B25/85	2600 to 4700 K
Thermal time constant	20 s
Dissipation factor	25 mW/ °C
Operating temperature range at zero power	– 25 to +100 °C
at max power	0 to + 55 °C



Catalogue no.

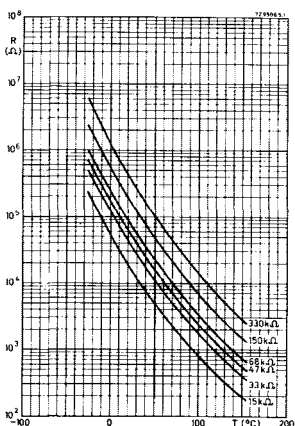
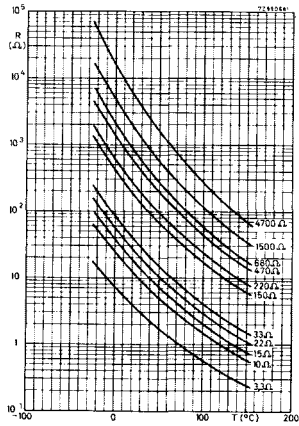
2322 642 2 . . .

R25 B25/85
± 5%
K

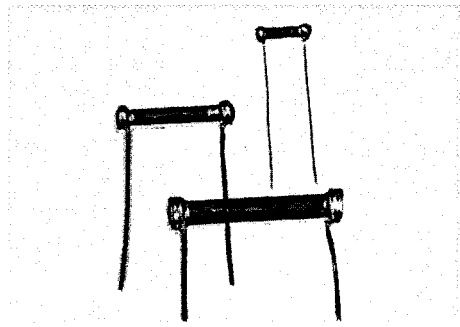
tolerance on R25:

- 20% 1
- 10% 2
- 5% 3

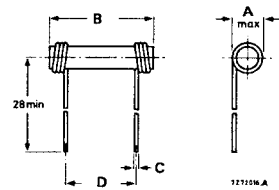
3,3 Ω	2600	338
4,7	2665	478
6,8	2730	688
10	2800	109
15	2870	159
22	2935	229
33	3010	339
47	3070	479
68	3135	689
100	3200	101
150	3280	151
220	3350	221
330	3440	331
470	3520	471
680	3600	681
1 kΩ	3680	102
1,5	3775	152
2,2	3915	222
3,3	4070	332
4,7	4200	472
6,8	4300	682
10	4400	103
15	4375	153
22	4200	223
33	4250	333
47	4325	473
68	4375	683
100	4400	104
150	4600	154
220	4650	224
330	4700	334



2322 635 to 637 — rods



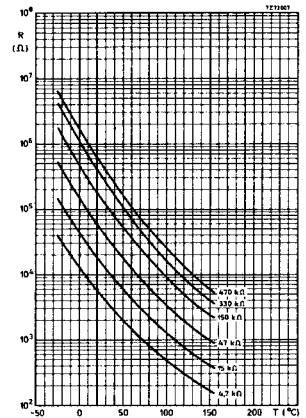
P_{max} at $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$ W	R_{25} $\pm 20\%$ k Ω	$B_{25/85}$ $\pm 5\%$ K	dissipation factor mW/ $^{\circ}\text{C}$	thermal time constant s	catalogue no.
0,6	4,7	3300	5	30	2322 635 01472
	15	3600			153
	47	3925			473
	150	4075			154
	330	4250			334
	470	4300			474
1,5	4,7	3250	10	55	2322 636 01472
	15	3550			153
	47	4000			473
	150	4150			154
2,3	4,7	3200	17	105	2322 637 01472
	15	3550			153
	47	3750			473
	150	4200			154



series	A(max)	B ± 1	C	D $\pm 0,8$
635	3,7	11	0,4	7,6
636	5,2	21	0,8	15,2
637	6,7	31	0,8	25,4

max operating temperature 155 $^{\circ}\text{C}$.

colour code	k Ω
orange	4,7
green	15
blue	47
white	150
yellow/blue	330
yellow/orange	470



non-linear resistors

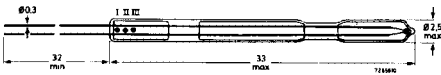
NTC thermistors

- 2322 627 1 – miniature beads
- 2322 627 2 – in glass envelope

Miniature thermistors are used for temperature sensing, temperature compensation, air-flow measurements, vacuum measurements, delaying relays, and in medical science for temperature and breathing measurements.

Resistance range (E6 series) at 25 °C	680 Ω to 680 kΩ
B _{25/85}	2200 to 4400 K
Max dissipation	100 mW
Dissipation factor	0,7 mW/ °C
Thermal time constant	
2322 627 1	14 s
2322 627 2	10 s
Operating temperature range	
at zero power	–25 to +200 °C
at max power	0 to +55 °C

2322 627 1

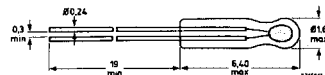


coloured dots I, II, III
stand for code in table

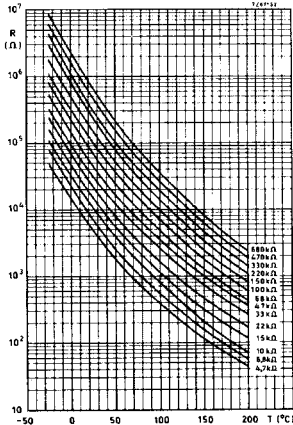
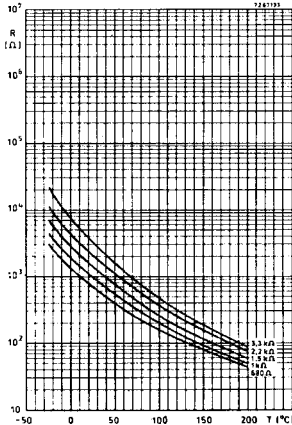
example: 681 I blue
II grey
III brown

tolerance 10% = silver dotted

2322 627 2



This device is not code-marked.
The catalogue no. is marked on
each box of 100 pieces.

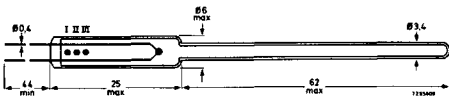
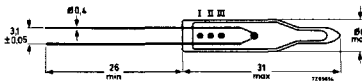
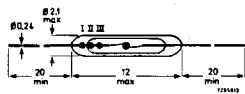
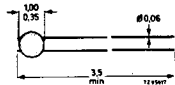
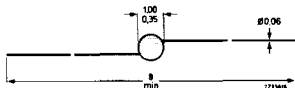
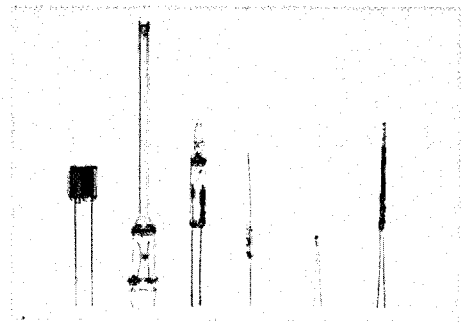


First dot in catalogue no.
stands for tolerance on R₂₅
1 = 20%
2 = 10%
Last three digits = code shown below

R ₂₅	B _{25/85} ± 5% K	code
680 Ω	2200 *	681
1 kΩ	2375 *	102
1,5	2500 *	152
2,2	2600 *	222
3,3	2750 *	332
4,7	3725	472
6,8	3775	682
10	3875	103
15	3800	153
22	3850	223
33	3800	333
47	3850	473
68	3900	683
100	3975	104
150	4050	154
220	4200	224
330	4275	334
470	4350	474
680	4400	684

* For 2322 627 2 tolerance 10%.

2322 634 — miniature beads



dissipation max mW	dissipation factor mW/°C	thermal time constant s	catalogue no. 2322 634
--------------------------	--------------------------------	-------------------------------	---------------------------

-	-	-	0
---	---	---	---

-	-	-	1
---	---	---	---

60	0,4	9	2
----	-----	---	---

20	0,11	6	3
----	------	---	---

-	-	-	4
---	---	---	---

tolerance
on R25:
20% = 1
10% = 2

For last three
digits see code
on previous page

non-linear resistors

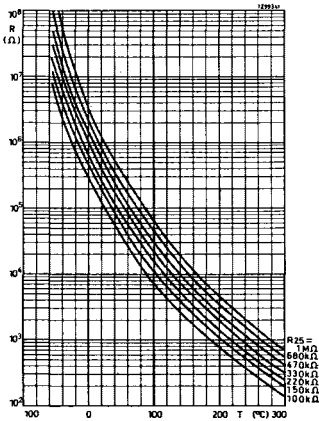
NTC thermistors

- 2322 627 31— miniature bead
- 2322 628 — miniature bead indirectly heated

2322 627 31

Resistance range (E6 series) at 25 °C	100 kΩ to 1 MΩ
Dissipation max	100 mW
B25/85	3800 to 4200 K
Operating temperature range at zero power	− 55 to +300 °C
at max power	0 to + 55 °C

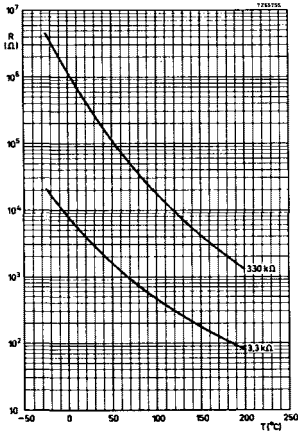
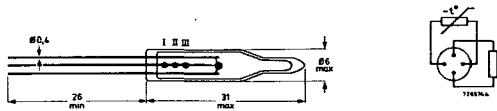
R25 ± 20%	B25/85 ± 5% K	catalogue no.
		2322 627 31 ...
100 kΩ	3800	104
150	3880	154
220	3920	224
330	3980	334
470	4030	474
680	4100	684
1 MΩ	4200	105



2322 628

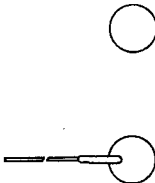
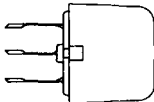
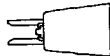
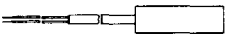
Operating temperature range at zero power	− 25 to +200 °C
at max power	0 to + 55 °C
Thermistor: dissipation (W _h = 0) max	35 mW
dissipation factor	0,18 mW/°C
thermal time constant	15 s
Heater: resistance (± 10%)	100 Ω
dissipation (W _{th} = 0) max	35 mW

R25 ± 20%	B25/85	colour code	catalogue no.
kΩ	K	I II III	
3,3	2750	orange orange red	2322 628 01332
330	4275	orange orange yellow	2322 628 01334



PTC thermistors - survey

For detailed information
Handbook CM2a

type	R ₂₅ Ω	switch temperature °C	maximum voltage	dissipation factor mW/ °C	temperature coefficient %/ °C	catalogue no.	page
DISC							
	70 to 100	105	400 V(r.m.s.)	11,5	35	2322 662 93006	312
	250 ± 25%	6	25 V(d.c.)	6	5	660 91001	306
	50 to 60 ±30%	30 to 105	25 V(d.c.)	7	7 to 40	660 91006 to 9	306
	750 to 1500	115	245 V(r.m.s.)	7	26	660 93001	312
	30 to 50 ± 15 Ω	25 to 110	40–50 V(d.c.)	6–8,5	9 to 75	661 91002 to 5	307
	36 to 50	115	180 V(d.c.)	13	35	662 91001	308
	45 to 60	75	265 V(r.m.s.)	20	20	662 93036	308
	80 to 120	75	265 V(r.m.s.)	15,3	35	662 93066	308
	14 to 26	125	245 V(r.m.s.)	21	28	663 93003	313
	≤ 0,6	85	16 V(d.c.)	27	10	664 91086	313
	30 to 250	70 to 150	25 V(d.c.)	5,7	18 to 38	672 91002 to 35	316
DUAL DISC for degaussing							
	25 and 8 30 and 8	75	245 V(r.m.s.) 265 V(r.m.s.)	13,5	25 25	662 98001 662 98003	309
	6 and 3,5	75	140 V(r.m.s.)	13,5	20	662 98006	
	40 and 1000 to 6000		265 V(r.m.s.)			662 98009	
MINIATURE for level control							
	70 to 250	160	19 V(d.c.)	2 to 6	35	670 90023	310
MOTOR PROTECTION DISC							
	30 to 250	68 to 137	15 V(d.c.)	7	18 to 38	672 92045 to 53	310
DISC for compensation of telephone line variations							
	115 ± 25	97	33 V(d.c.)	3,9	10	672 98001	311
HEATING ELEMENT							
			265 V(r.m.s.)			680 90001	311
PTCs for overload protection							
	1,65 to 1500	115	60, 245, 265 V	3,5–20			314–315

non-linear resistors

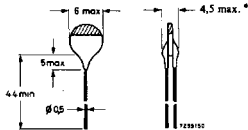
PTC thermistors

2322 660 – disc

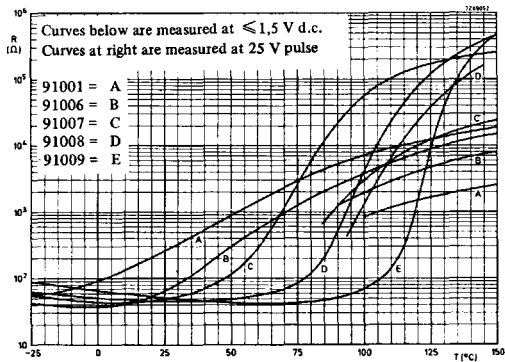
Catalogue no. 2322 660	91001	91006	91007	91008	91009	
Resistance at 25 °C; V(d.c.) < 1,5 V	250	60	50	50	50	Ω
tolerance	25	30	30	30	30	%
Switch temperature	+ 6	+ 30	+ 50	+ 80	+ 105	°C
Temperature coefficient	+ 5	+ 7	+ 16	+ 23	+ 40	% / °C
Thermal time constant	17	20	18	18	—	s
Dissipation factor	6	7				mW / °C
Max d.c. voltage	25	25				V
Operating temperature range						
at zero power	— 25 to +155		— 10 to +125			°C
at max voltage	0 to + 55		0 to + 55			°C

colour
code

- none 91001
- red 91006
- orange 91007
- yellow 91008
- green 91009

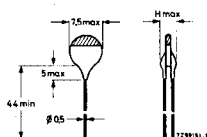


* For 91001 3,2 mm max.



2322 661 – disc

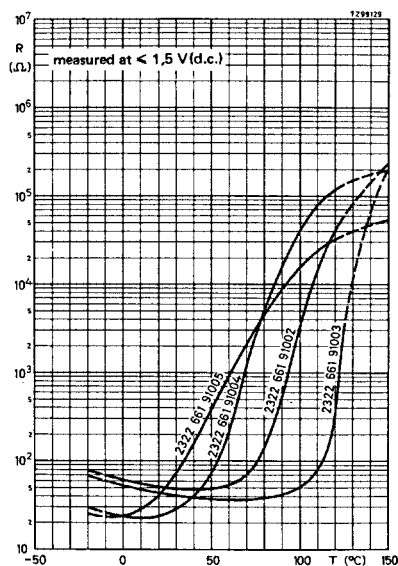
Catalogue no. 2322 661	91002	91003	91004	91005	
Resistance at 25 °C; V(d.c.) < 1,5 V tolerance 15%	50	40	30	50	Ω
Switch temperature	+80	+110	+45	+25	°C
Temperature coefficient	18	75	16	9	% / °C
Thermal time constant	50	50	50	40	s
Dissipation factor	8,5	8,5	8,5	6	mW / °C
Max d.c. voltage	50	50	50	40	V
Operating temperature range					
at zero power			-10 to +125		°C
at max voltage			0 to + 55		°C



H_{max}
For 91002, 03, 04: 6,5 mm
For 91005: 5,5 mm

colour code

yellow 91002
green 91003
orange 91004
red 91005



non-linear resistors

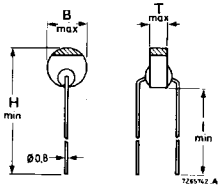
PTC thermistors

2322 662 – disc

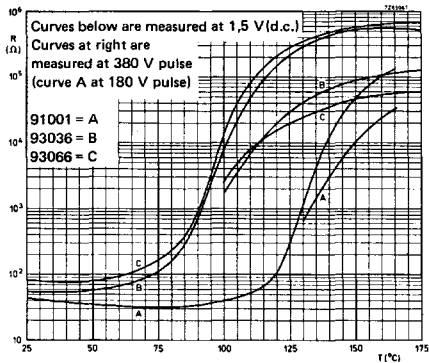
662 91001 is designed for contact protection for telegraphy relays.
The other two PTC thermistors are used as the de-gaussing element in colour tv receivers, but have far wider applications as protective and delay devices.



Catalogue no. 2322 662	91001	93036	93066	
Resistance at 25 °C; V(d.c.) ≤ 1,5 V	36–50	45–60	80–120	Ω
Switch temperature	115	75	75	°C
Temperature coefficient	35	20	35	%/ °C
Dissipation factor	13	20	15,3	mW/ °C
Max d.c. voltage	180	—	—	V
Max r.m.s. voltage	—	265	265	V
Operating temperature range				
at zero power	0 to +155	- 25 to +155		°C
at max. voltage	0 to + 55	0 to + 60		°C



	colour code	T	B	H	I
91001	none	4,8	10,8	45	34
93036	green	6,5	12,6	51	38,4
93066	red	5,5	10,5	52	41,5

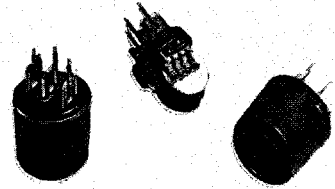


2322 662 98 – dual degaussing thermistors

Intended for use in colour tv.

Because of the excellent thermal contact between the two discs inside the package, the stabilized current through the coil is limited to 2 mA.

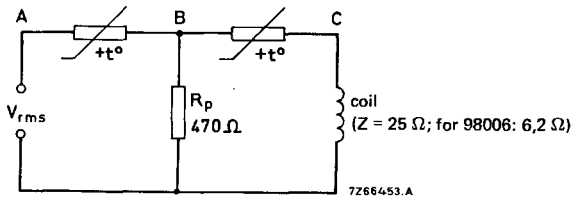
The assembly is constructed for p.c.b. mounting.



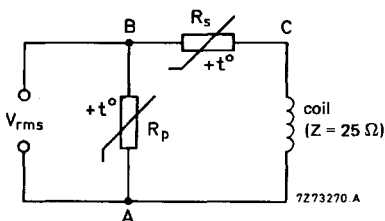
Catalogue no. 2322 662	98001	98003	98006	98009	
Resistance at 25 °C; V(d.c.) ≤ 1,5 V *	25	30	—	—	Ω
Current through degaussing coil:					
min inrush peak current	5 (V _{rms} = 200 V)	5 (V _{rms} = 220 V)	9	5 (V _{rms} = 200 V)	A
max idle peak current after:					
5 s	70	70	140	70	mA
30 s	5	5	10	5	mA
3 minutes	2	2	2	2	mA
Switch temperature	75	75	75	—	°C
Temperature coefficient	25	25	20	—	%/°C
Dissipation factor	13,5	13,5	13,5	—	mW/°C
Max r.m.s. voltage	245	265	140	265	V
Operating temperature range					
at zero power		25 to +155		–25 to +125	°C
at max voltage		0 to +60		0 to +60	°C

* Values for mains PTC; coil PTC = 8 Ω

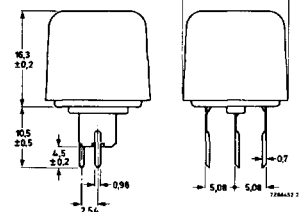
Circuit diagrams
for 98001; 98003 and 98006



for 98009



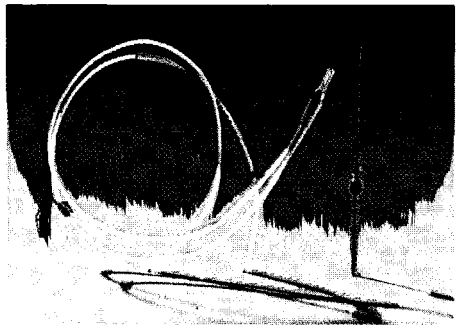
catalogue no.
on top



non-linear resistors

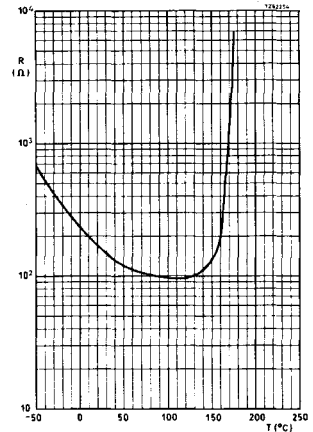
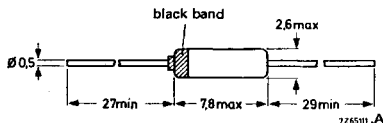
PTC thermistors

2322 670 90023 — for oil-tank measurements
2322 672 920 — for protection of motors
against excessive temperatures



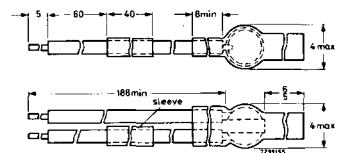
2322 670 90023

	still air -25 °C	still fuel oil +50 °C	
Current at 12 V(d.c.)	< 39	> 45	mA
16 V(d.c.)	< 30	> 36	mA
18 V(d.c.)	< 27	> 33	mA
Dissipation factor	2	6,25	mW/°C
Max d.c. voltage at 75 °C	19		V
Switch temperature	160		°C
Operating temperature range			
at zero power	-55 to +125		°C
at max. voltage: still air	-25 to +75		°C
still fuel oil	-25 to +50		°C



2322 672 920

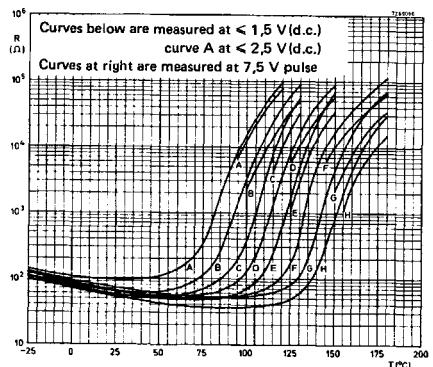
Resistance at T _{ref} * - 5 °C; V < 1,5 V(d.c.)	< 550	Ω
+ 5 °C	> 1330	Ω
+ 15 °C; V _{pulse} = 7,5 V	> 4000	Ω
Dissipation factor	7	mW/°C
Max d.c. voltage	15	V
Operating temperature range		
at zero power	-20 to (T _{ref} +30) °C	
at max voltage	-20 to (T _{ref} +15) °C	



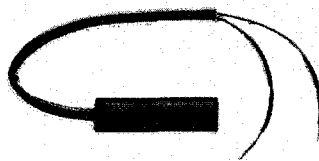
last 5 digits of catalogue no.
are printed on sleeve

T _{ref} *	T _{switch}	temperature coefficient %/°C	catalogue no.	curve
°C	°C			
80	68	18	2322 672 92045	A
90	75	21	92046	B
100	88	31	92047	C
110	99	33	92048	D
120	113	38	92049	E
130	123	27	92051	F
140	130	33	92052	G
150	137	33	92053	H

* Temperature at which the thermistor makes
the protective system operative.



2322 680 90001 — heating element
2322 672 98001 — telephone line current
stabilizer (TPE)

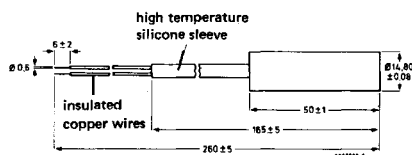


Heating element 2322 680 90001

2322 680 90001

Voltage range (r.m.s.)	100 to 265 V
Max inrush power at 220 V	500 W
Steady-state power (in test tube) approx.	18 W
Time to reach 130 °C (in test tube) approx.	4,4 minutes
Ambient temperature range at zero power and max voltage	-25 to +60 °C
Dielectric withstanding voltage (r.m.s.) between terminals and coating	> 4 kV

A heating element with a high initial dissipation going to a stabilized temperature of 161 °C (in standard test tube). Intended for hair curling tongs.

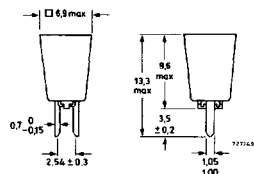


2322 672 98001 (TPE)

For resistances of up to 1000 Ω in telephone lines, the subscriber current will be within 31,5 mA and 48 mA.

Current compensation by selecting the right resistor is not necessary; it can be done automatically by a TPE.

Resistance at 25 °C	115 Ω
155 °C	> 15 kΩ
Switch temperature approx.	97 °C
Max d.c. voltage	33 V
Operating temperature range at zero power	-25 to +155 °C
at maximum voltage	+5 to +55 °C



non-linear resistors

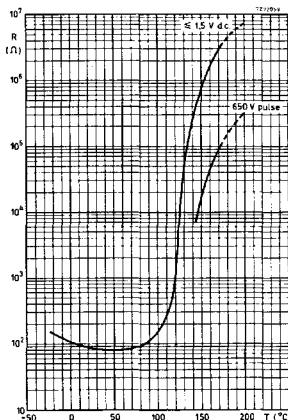
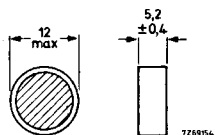
PTC thermistors

2322 662 93006 — discs
2322 660 93001 — discs

662 93006 is suitable for fluorescent lamp starter
660 93001 is suitable for stair-well lighting control

2322 662 93006

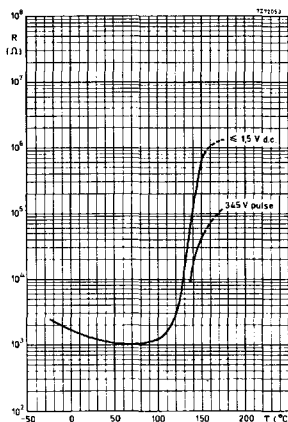
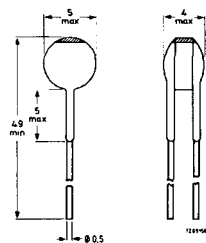
Resistance value at +25 °C	70 to 100 Ω
Resistance value at +200 °C	
V pulse = 650 V	140 k Ω
Switch temperature	+100 to +110 °C
Temperature coefficient	+35%/°C
Maximum r.m.s. voltage	400 V
Dissipation factor	11,5 mW/°C
Operating temperature range	
at zero power	-25 to +175 °C
at maximum voltage	0 to +85 °C



Typical resistance/temperature characteristics

2322 660 93001

Resistance value at +25 °C	750 to 1500 Ω
Resistance value at +175 °C	
V pulse = 345 V	70 k Ω
Switch temperature	+115 °C
Temperature coefficient	+26%/°C
Maximum r.m.s. voltage	245 V
Dissipation factor	7 mW/°C
Operating temperature range	
at zero power	-25 to +155 °C
at maximum voltage	0 to +55 °C

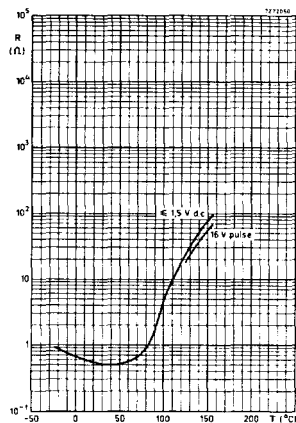
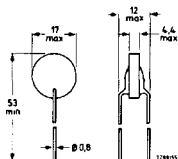


2322 663 93003 — discs
2322 664 91086

663 93003 is suitable for overheat protection in the ballast of a fluorescent lamp system.
 664 91086 for protection purposes in relay coils, loudspeakers, etc.

2322 663 93003

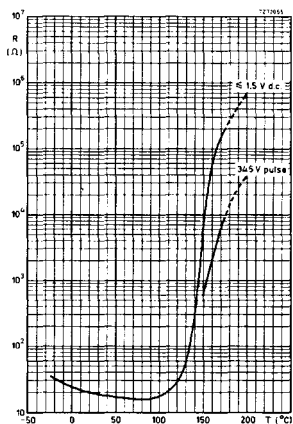
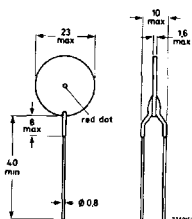
Resistance value at +25 °C	14 to 26 Ω
Resistance value at +200 °C	
V _{pulse} = 345 V	min 20 kΩ
Switch temperature	+125 °C
Temperature coefficient	+28%/°C
Maximum r.m.s. voltage	245 V
Dissipation factor	21 mW/°C
Operating temperature range	
at zero power	-25 to +175 °C
at maximum voltage	0 to +80 °C



Typical resistance/temperature characteristics

2322 664 91086

Resistance value at +25 °C	max 0,6 Ω
Resistance value at +150 °C	
V _{pulse} = 16 V	min 40 Ω
Switch temperature	+85 °C
Temperature coefficient	+10%/°C
Maximum d.c. voltage	16 V
Dissipation factor	27 mW/°C
Operating temperature range	
at zero power	-25 to +155 °C
at maximum voltage	-25 to + 55 °C



non-linear resistors

PTC thermistors for overload protection

This range of PTCs is suitable for current-sensitive switching, or overload protection at current switching levels from the milliampere region to more than one ampere, with circuit supply voltages up to 240 V.

Low-voltage PTC thermistors

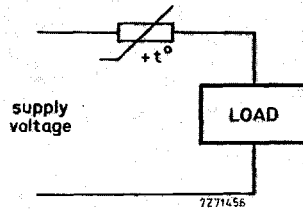
catalogue no.	I _{stat} peak A	V _{max} V	R ₂₅ Ω	T ₅ °C	D mW/°C	τ s	I _{res} mA	R _s min Ω	dimensions (next page) style	line
2322 664 91002	0,95	60	1,65	115	20	39	75	4,5	a	8
2322 664 91003	0,83	60	1,65	115	15	47	60	4,5	b	8
2322 663 91002	0,70	60	2,3	115	15	33	55	4	a	9
2322 663 91003	0,59	60	2,3	115	10	42	45	4	b	9
2322 662 91006	0,49	60	3,7	115	12	26	45	2,5	a	10
2322 662 91007	0,39	60	3,7	115	7,5	35	30	2,5	b	10
2322 662 91004	0,38	60	5,6	115	11	22	40	0,5	a	11
2322 662 91005	0,29	60	5,6	115	6,5	30	25	0,5	b	11
2322 661 91019	0,28	60	9,4	115	10	18	35	0	a	12
2322 661 91021	0,20	60	9,4	115	5	24	20	0	b	12
2322 660 91016	0,15	60	25	115	9	11	30	0	a	13
2322 660 91017	0,11	60	25	115	4	14	15	0	b	13
2322 672 91015	0,11	60	55	115	8,5	10	30	0	a	14
2322 672 91016	0,07	60	55	115	3,5	10	15	0	b	14

220 V/240 V PTC thermistors

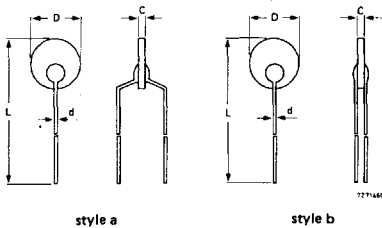
catalogue no.	I _{stat} peak A	V _{max} V	R ₂₅ Ω	T ₅ °C	D mW/°C	τ s	I _{res} mA	R _s min Ω	dimensions (next page) style	line
2322 664 93014	0,61	245	3,7	115	20	104	25	21	a	1
2322 664 93015	0,56	245	3,7	115	15,5	130	20	21	b	1
2322 663 93006	0,44	265	6	115	16	88	20	20	a	2
2322 663 93007	0,37	245	6	115	11	116	15	19	b	2
2322 662 93017	0,30	265	10	115	12,5	69	20	16	a	3
2322 662 93018	0,24	265	10	115	8	97	10	16	b	3
2322 662 93015	0,24	265	15	115	11	57	15	12	a	4
2322 662 93016	0,18	265	15	115	6,5	83	10	12	b	4
2322 661 93001	0,17	265	25	115	10	47	15	2	a	5
2322 661 93002	0,13	265	25	115	5,5	68	8	2	b	5
2322 660 93005	0,10	265	70	115	9	30	15	0	a	6
2322 660 93006	0,065	265	70	115	4	38	6	0	b	6
2322 660 93004	0,07	265	125	115	8	13	7	0	b	15
2322 672 93002	0,065	265	150	115	8,5	27	12	0	a	7
2322 672 93003	0,04	265	150	115	4	27	5	0	b	7
2322 660 93003	0,03	265	600	115	7	17,5	4	0	b	6
2322 660 93001	0,02	265	1125	115	7	17,5	5	0	b	16
2322 660 91004	0,017	265	1500	115	7	17,5	4	0	b	16

All data at 25 °C.

V_{max} is given at T_{amb} = 55 °C.



The principle of PTC overload protection.

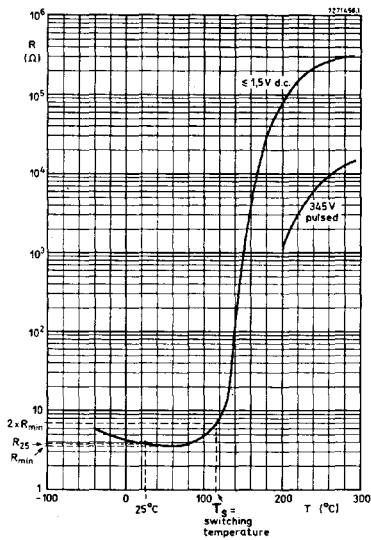


Style a

line	D	L	d	C
1	20	60 ± 10	0,8	2,4
2	16	58 ± 8	0,8	2,4
3	12	56 ± 6	0,8	2,4
4	10	55 ± 5	0,8	2,4
5	8	54 ± 4	0,8	2,4
6	4,5	52,5 ± 2	0,8	2,4
7	3	51,5 ± 1	0,8	2,4
8	20	60 ± 10	0,8	0,9
9	16	58 ± 8	0,8	0,9
10	12	56 ± 6	0,8	0,9
11	10	55 ± 5	0,8	0,9
12	8	54 ± 4	0,8	0,9
13	4,5	52,5 ± 2	0,8	0,9
14	3	51,5 ± 1	0,8	0,9

Style b

line	D	L	d	C
1	20	60 ± 10	0,5	2,4
2	16	58 ± 8	0,5	2,4
3	12	56 ± 6	0,5	2,4
4	10	55 ± 5	0,5	2,4
5	8	54 ± 4	0,5	2,4
6	4,6	52,5 ± 2	0,5	2,4
7	3	51,5 ± 1	0,5	2,4
8	20	60 ± 10	0,5	0,9
9	16	58 ± 8	0,5	0,9
10	12	56 ± 6	0,5	0,9
11	10	55 ± 5	0,5	0,9
12	8	54 ± 4	0,5	0,9
13	4,6	52,5 ± 2	0,5	0,9
14	3	51,5 ± 1	0,5	0,9
15	4,6	52,5 ± 2	0,6	2,4
16	4,6	52,5 ± 2	0,5	2,0



Resistance/temperature characteristic

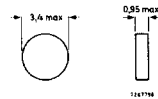
non-linear resistors

PTC thermistors

2322 672 91 – disc

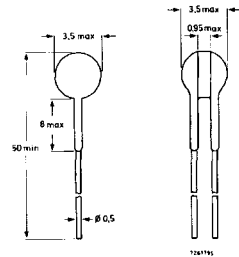
Intended as temperature sensors in domestic appliances,
fire alarms, car electronics.

Resistance value between -20 and $(T_s - 10)^\circ\text{C}$	30 to 250 Ω
Resistance value at $(T_s + 25)^\circ\text{C}$ and $V_{\text{pulse}} = 7,5\text{ V}$	$> 4000\ \Omega$
Switch temperature, T_s	70 to 150°C
Temperature coefficient	18 to $38\%/^\circ\text{C}$
Maximum d.c. voltage	25 V
Dissipation factor (version with leads)	$5,7\text{ mW}/^\circ\text{C}$
Operating temperature range at zero power	-25 to $(T_s + 40)^\circ\text{C}$
at maximum voltage	0 to $(T_s + 25)^\circ\text{C}$



version without leads

T_s $^\circ\text{C}$	temperature coefficient $\%/^\circ\text{C}$	balance voltage V(d.c.)	voltage dependence β at $(T_s + 25)^\circ\text{C}$	colour code for version with leads	catalogue no. 2322 672	
					with leads	without leads
70	18	19	0,32	violet	91002	91026
80	21	27	0,40	grey	91003	91027
90	31	16	0,36	white	91004	91028
100	33	17	0,35	black	91005	91029
110	38	11	0,36	brown	91006	91031
120	27	34	0,38	red	91007	91032
130	33	13	0,34	orange	91008	91033
140	33	20	0,35	yellow	91009	91034
150	23	20	0,31	green	91011	91035



version with leads

