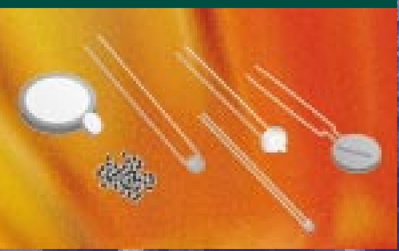
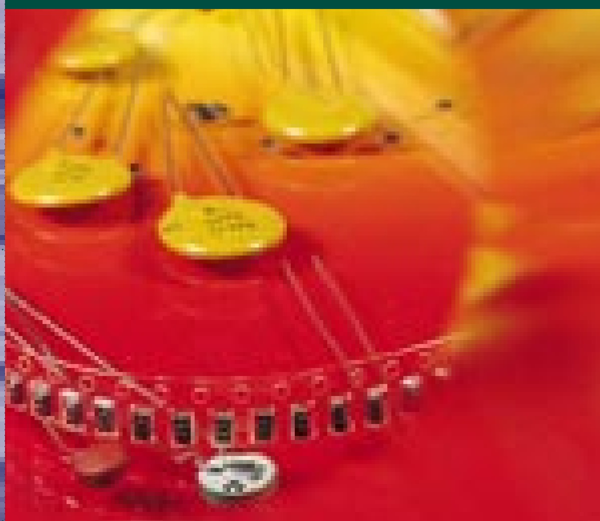
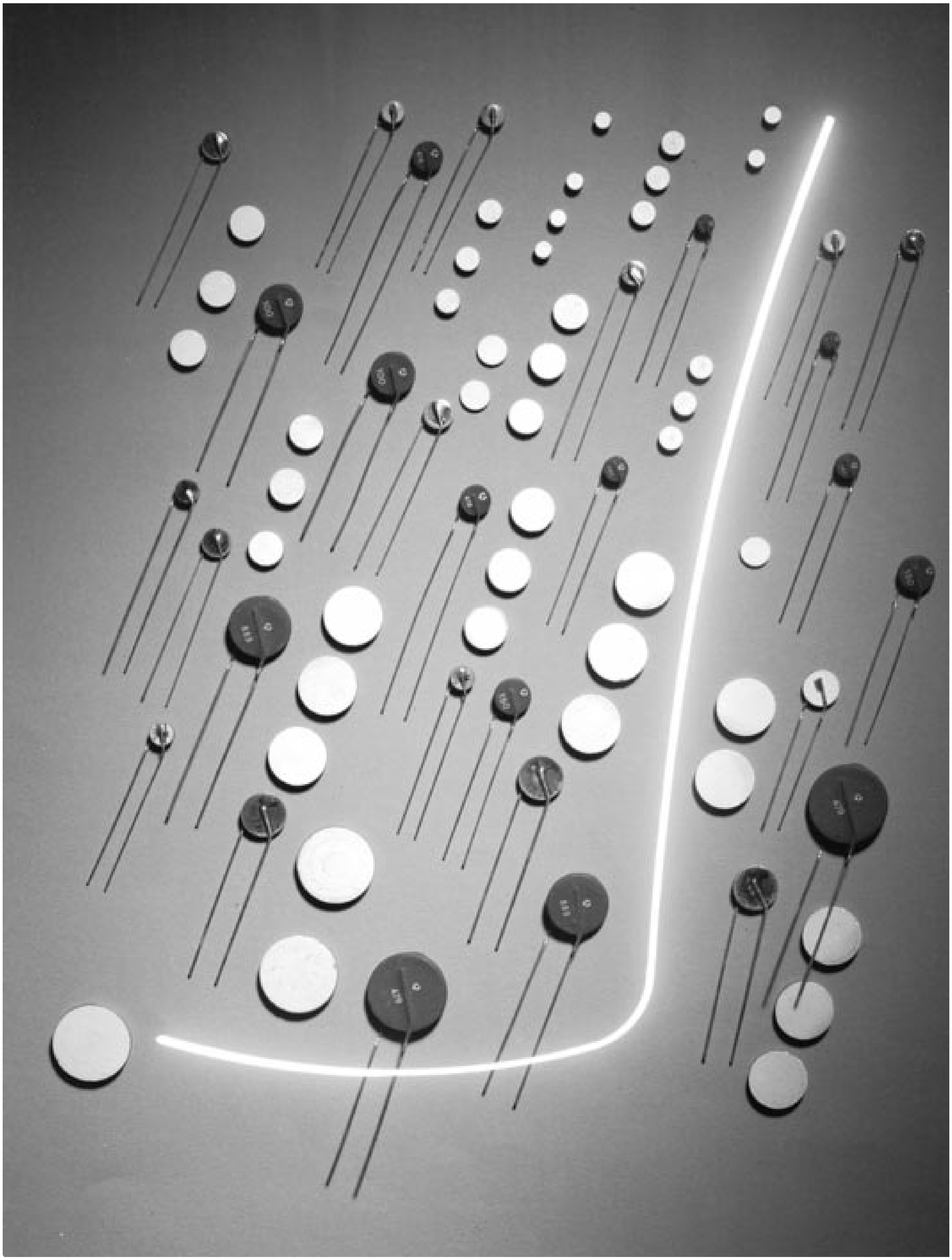
Thermistors NTC - PTC





THOMSON-CSF
PASSIVE COMPONENTS

PTC Thermistors



PTC Electrical characteristics

1 – RESISTANCE - TEMPERATURE CHARACTERISTIC (Log R_T – T)

A positive Temperature Coefficient (PTC) thermistor is a resistor, mainly composed of solid solutions of baryum and strontium titanates. The addition of dopants makes the component semiconductive and gives it the typical resistance - temperature characteristic shown in figure 18.

The PTC exhibits a slight negative temperature coefficient over the normal temperature range, a sharp rise in resistance around the Curie point and, at higher temperature, the coefficient becomes negative again.

Zero power resistance at 25°C ($R_{25°C}$)

The zero power resistance ($R_{25°C}$) is the resistance value measured at 25°C in such conditions that the change in resistance due to the internal generation of heat is negligible with respect to the total error of measurement.

Minimum resistance (R_{min})

R_{min} is the minimum zero power resistance of the resistance - temperature characteristic. It is measured at the temperature T where the temperature coefficient becomes positive.

Switching temperature (T_b)

The switching temperature is defined as the temperature at which the resistance R is twice the minimum resistance

$$R_b = 2\,R_{min}$$

This temperature corresponds to the beginning of the switching ot the thermistor and is physically related to the transition temperature or Curie point.

Temperature coefficient of resistance (α)

The temperature coefficient of resistance α is the value of the slope of the resistance - temperature curve between the switching temperature T_b and any other temperature T_p greater than T_b and located in the increasing resistance range. Thus, the coefficient, expressed in %/°C, is :

$$\alpha = \frac{100}{Tp - Tb}\ \ln\,(R_p / R_b)$$

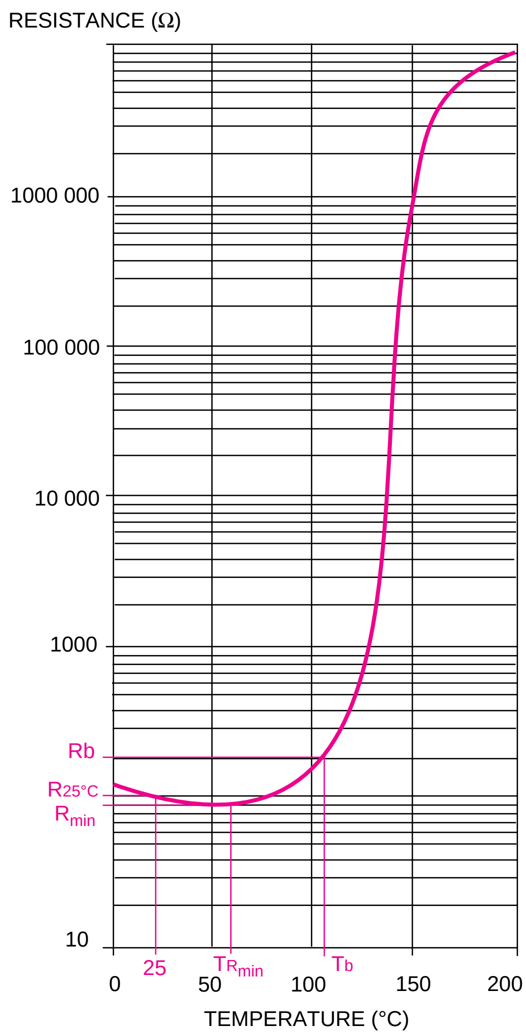


Figure 18 - Resistance - Temperature characteristic of PTC thermistors

PTC Electrical characteristics

2 – CURRENT-VOLTAGE CHARACTERISTIC

The static current-voltage curve defines the relationship between the applied voltage and the obtained current when the thermistor is in a thermal equilibrium state (the Joule - effect heating is balanced by external heat dissipation).

The curve exhibits two zones, as shown in figures 19 and 20 :

- As the voltage increases from zero, the current and the temperature rise until the thermistor reaches the switch point. The I-V curve is approximately a straight line, the resistance is almost constant.

- A further increase of voltage leads to a lower current, resulting in a constant-power dissipation area.

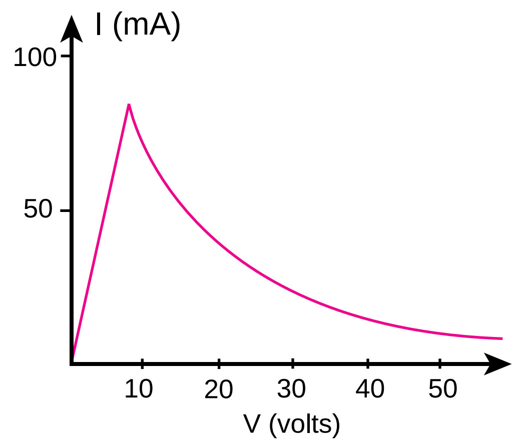


Figure 19 - Current-voltage characteristic of PTC thermistors (linear scale)

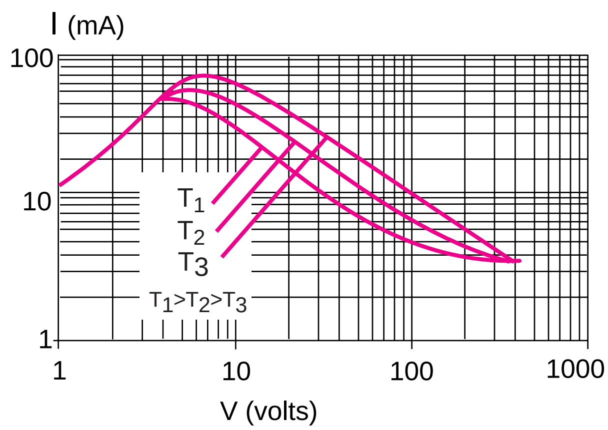


Figure 20 - Current-voltage curves at different ambient temperatures (Log-Log scale)

The current-voltage characteristics are described by the following terms :

Maximum voltage (U_{max})

U_{max} is the maximum voltage that can be applied continuously to the thermistor to guarantee the long term stability.

Operating temperature range

This is the range of ambient temperature at which the thermistor can operate continuously at the maximum voltage.

Residual current (I_{res})

With an operating temperature of 25°C, Ires is the residual current when the maximum rated voltage is applied.

Maximum overload current (I_{mo})

This is the maximum in-rush current that can be accepted by the thermistor.
It may be necessary to limit the current through the thermistor by the use of a series resistor R_S.

Tripping current (I_t)

It is the minimum current value required by the thermistor to trip from its conductive state at ambient temperature (25°C) to its protective high resistance state.

Non - tripping current (I_{nt})

This is the maximum current value for which the thermistor is guaranteed to stay indefinitely in its conductive state.

PTC Electrical characteristics

3 – CURRENT - TIME CHARACTERISTIC

When the applied voltage to a PTC thermistor exceeds the value that corresponds to the top of the I-V curve, the thermistor switches and its dynamic behaviour can be described by the current-time characteristic shown in figures 21 and 22.
Initially, a constant current flows, depending on the nominal resistance of the PTC (I = V/R), then the current decreases strongly as the thermistor changes to its non-conductive state. Finally, a low current balances external dissipation and assumes thermal equilibrium.

The current-time curves depend strongly on the external conditions such as the applied voltage (figure 21) or the ambient temperature (figure 22).

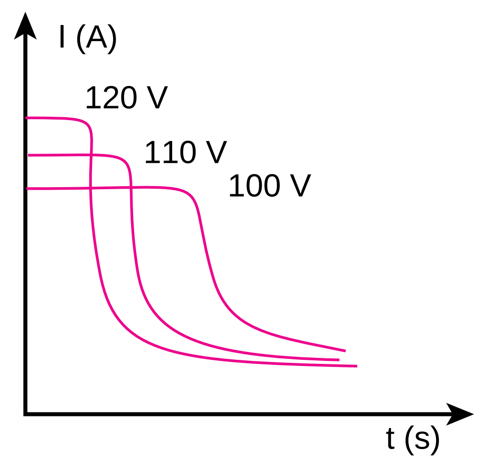


Figure 21 - Current-time characteristic of PTC thermistors - Voltage dependance

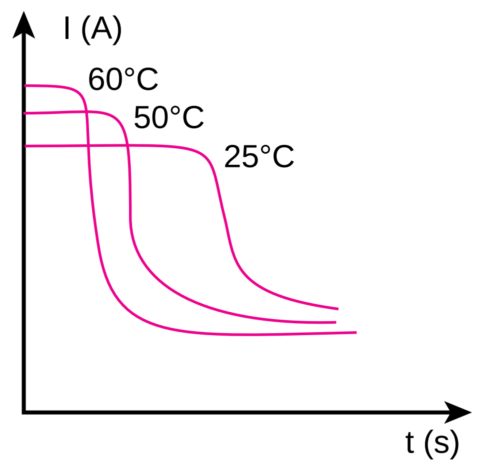


Figure 20 - Current-time characteristic of PTC Ambient temperature dependance

The I-t curves also depend strongly on the thermal properties of the thermistors (volume, dissipation properties, ...) and can be clarified by the parameters hereafter :

Heat capacity (H)

H is the amount of heat required to increase the temperature of the thermistor by 1°C. The value of H is typically about 3 mJ/cm^3/°C.

Thermal time constant (τ)

This is the time required for the temperature of a PTC to change 63.2 % of the difference between its initial and final value when the conditions of the thermal equilibrium are changed. It is equivalent to the ratio H/δ.

Dissipation factor (δ)

This is the ratio of the power dissipated in the environment and the temperature difference between the thermistor and the ambient.
δ is expressed in mW/°C as : $\delta = \frac{P}{T - T_{amb}}$

where :

P = V.I : power applied to the PTC
T_{amb} : ambient temperature
T : temperature of a thermistor submitted to the power P

These thermal characteristics can be used to describe approximately the dynamic behaviour of a PTC thermistor through the following heat balance equation :

$$P\,dt = H\,dt + (T - T_{amb})\,\delta\,dt$$

PTC Application notes

MAIN PTC APPLICATIONS

Characteristic	Application	Examples of use
R (T)	Temperature sensing	Temperature monitoring for heat sinks for power semi-conductors Household appliances.
	Temperature control	
	Over temperature protection	Thermal machine protection
	Temperature compensation	ICs, semiconductors audiovideo equipment
V (I)	Current overload protection Current control	Telecommunication equipment Small transformers Motor circuit protection
	Self-regulating heating element	Dryers, heaters Carburettor preheating External mirror heating
	Liquid level sensing	Automobiles
	Fluid flow sensing	Air blowers (failure detection)
	Constant current	Battery chargers
I (t)	Time delay	Timers Delayed switching of relays
	Motor starting	Electric fans
	Degaussing	Color TV sets
	Arc suppression	Contact protection, switches

PTC Application notes

CURRENT OVERLOAD PROTECTION

A PTC thermistor connected in series with an equipment can protect it when the current (or voltage or ambient temperature) exceeds a critical value (I_1 at T_1 or I_2 at T_2) (figure 23).

Under normal operating conditions, the current remains too low to heat the PTC above its switching temperature.

If the current exceeds the critical value, the power dissipation results in heating the PTC to its switching temperature and reducing the current.

When the fault conditions are removed, the PTC cools down and the current flows again.
The PTC can be considered as a resettable fuse.

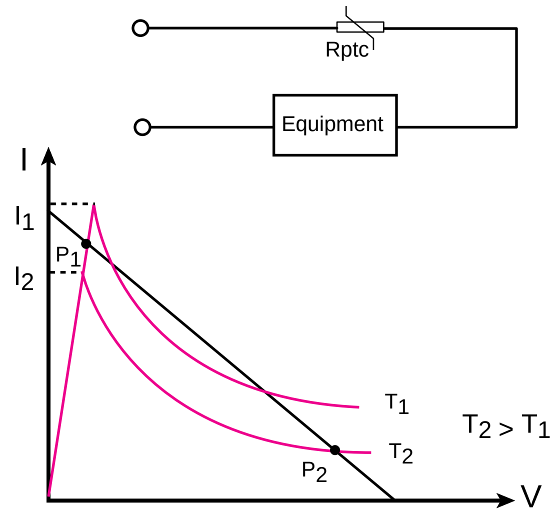


Figure 23

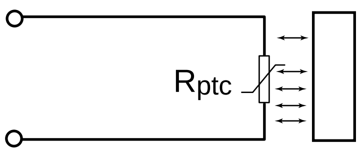


Figure 24

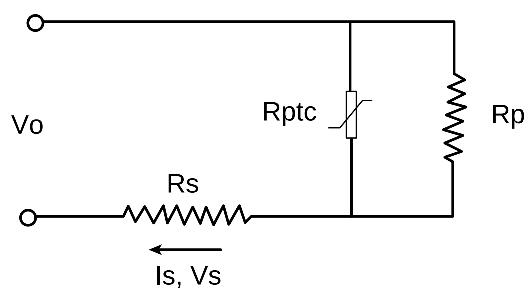
SELF-REGULATING HEATER

The functions of heater and thermostat can be cumulated when using a PTC thermistor (figure 24).
Assuming a sufficient size for the PTC and appropriate dissipation and thermal bonding with the equipment, the Joule effect provides heating and the thermostat function is mainly related to the switching temperature of the thermistor.
Furthermore, voltage or ambient temperature fluctuations are compensated for by an internal change of current and do not lead to a significantly different heating temperature.

CONSTANT CURRENT

By connecting a PTC in parallel with a resistor R_p, it is possible to obtain a nearly constant current Is through R_S over a broad voltage range.

When the voltage Vo is increased, a very small increase of the PTC temperature results in a reduction in current through R_{ptc}, compensating the increase of current through R_p (figure 25).



$$I_S = \frac{V_O - V_S}{R_p} + \delta \frac{(T_{PTC} - T_{amb})}{V_O - V_S}$$

Figure 25

PTC Application notes

MOTOR STARTING

PTC thermistors can be used to protect auxiliary starter winding of induction motors or single-phase motors (figure 26).

At switch-on, most of the line voltage can be applied to the starter winding as the resistance of the PTC is low.

After motor starting, the current heats up the PTC to its switching temperature. The resistance of the PTC rises drastically and the current falls.

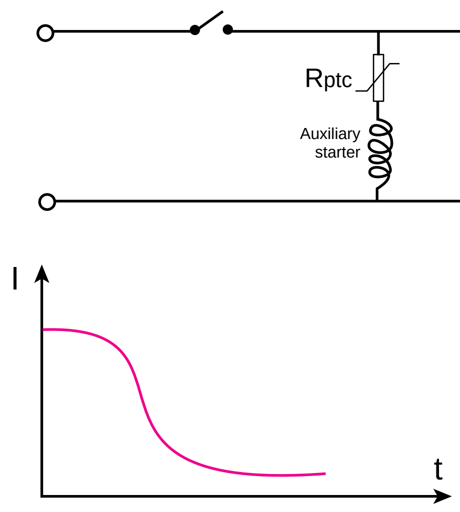


Figure 26

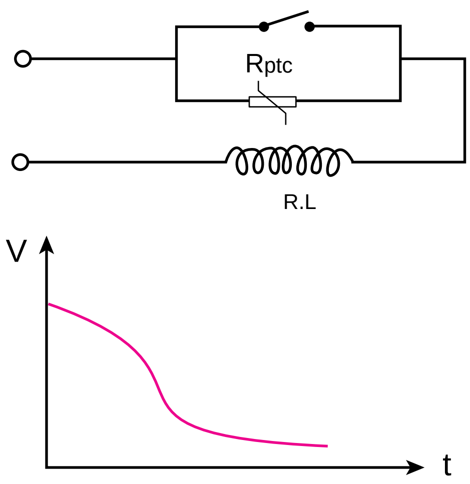


Figure 27

ARC SUPPRESSION

The circuit displayed on figure 27 enables arc suppression.

At switching-off, the current flows through the PTC. The PTC heats up and its resistance rises.

The voltage drop is progressively transfered from the inductive load to PTC, providing effective arc suppression.

TIME DELAY

The time necessary for the PTC to change from a conductive state and low temperature state to a self-heated and high resistive state may be used to provide a time delay in an electronic circuit (figure 28).

When a PTC is connected in series with a relay, the relay is immediately energized at switch-on and remains energized until the PTC heats up and reaches its switching temperature and high resistance state.

If the PTC is connected in parallel, the relay is energized only after a time delay due to the time necessary for heating the thermistor.

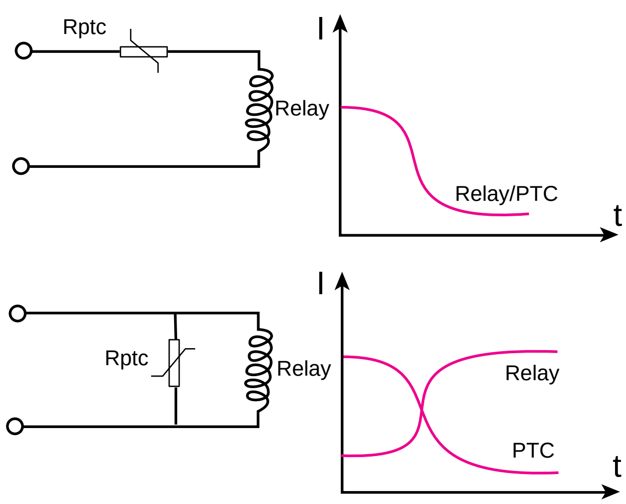


Figure 28

Selection guide

Types	Maximum voltage	Switching temperature	Range of values	Main applications	Page
Standard Series					
PE coated disc 	30 V	130°C	1.1 – 13	- Current overload protection	48
	130 V	110°C	1.8 – 100		49
PG leadlers disc 	265 V	80°C	3.7 – 150	- Over temperature protection	50
	265 V	120°C	3.7 – 220		51
Telecommunication series					
PE - PS leaded disc 	130/ 245 V	Custom design	10 – 70	- Line and handset protection	54
Automotive and industrial series					
PE PS Leaded disc 	Custom design	Custom design	3 – 600	- Overload protection - Delayed switching - Heating elements - Thermostats - Temperature measurement and control	53
PG leadless disc 	Example 12 V to 80 V	Example 80°C to 140°C			

Characteristics of the metallized

1	2	3	4	5	6	7	8	9	10	11	12	13
P	**E**	**0**	**6**	**N**	**N**	**0**	**1**	**0**	**1**	**X**	**–**	**–**

Type (digits 1–2)

PE
PG
PS
PV

Size (digits 3–4)

04
06
08
10
12
16
20

Material code (digit 5)

J : 80°C
M : 110°C
N : 120°C
P : 130°C

Voltage code (digit 6)

B : 30 V
G : 130 V
N : 265 V

Resistance at 25°C (EIA code) (digits 7–10)

Resistance expressed by 2 significant figures

7 th digit : 0 (zero)

8 th and 9 th digits : the 2 significant figures of the resistance value at 25°C.

10 th digit :
– for values ≥ 10 Ω :
  the number of ZEROS to be added to the resistance values
– for values ≥ 1 Ω and ≤ 9.9 Ω :
  the figure 9 signifying that the resistance value is to be multiplied by 0.1
– for values < 1 Ω : the figure 8 signifying that the resistance values is to be multiplied by 0.01.
  Examples : 1000 Ω : 0102
  8.2 Ω : 0829
  0.47 Ω : 0478

Resistance expressed by 3 significant figures

7 th, 8 th and 9 th digits : the 3 significant figures of the resistance value at 25°C.

10 th digit :
– for values > 100 Ω :
  the number of ZEROS to be added to the resistance value
– for values > 10 Ω and < 100 Ω :
  the figure 9 signifying that the resistance value is to be multiplied by 0.1
– for values > 1 Ω and < 10 Ω :
  the figure 8 signifying that the capacitance value is to be multiplied by 0.01.
  Examples : 196 Ω : 1960
  47.2 Ω : 4729

Tolerance on resistance at 25°C (digit 11)

X : ± 25%

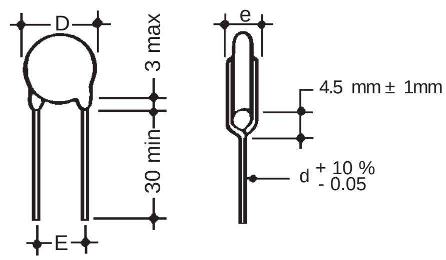
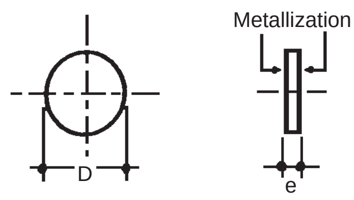
Suffix (digits 12–13)

For specific types (telecommunication, automotive, industrial), see specification on pages 52 and 53.

Disc PTC - Overload protection : PE - PG

Maximum voltage : 30 V / Switching temperature : 130°C

Well suited for overload protection and delayed switching, the PTC thermistors of the 30 V / 130°C series will be of particular interest in automotive and consumer applications.

Types	PE	PG
Finish	Coated disc	Leadless disc for soldering or clamping
Dimensions (mm)		
Marking	Thomson logo / Rated resistance	On packaging only

Particular characteristics :

Reference	Rn ± 25 % ( )	Int* at 25°C (mA)	It* at 25°C (mA)	Imo (A)	Ires at 25°C (mA)	Dimensions (mm) PE Dmax	PE emax	PE d	PE E	PG Dmax	PG emax
P■03 PB 0130 X --	13	100	200	0.7	40	4.2	3.5	0.5	5	4	1.5
P■04 PB 0130 X --	13	125	250	1.5	40	5.3	4.5	0.6	5	4.8	3
P■06 PB 0609 X --	6	220	440	2	50	7.2	4	0.6	5	6.5	2.5
P■08 PB 0409 X --	4	300	600	3	60	9	4	0.6	5	8.2	2.5
P■10 PB 0259 X --	2.5	400	800	4.3	70	11	4	0.6	5	10.2	2.5
P■12 PB 0189 X --	1.8	500	1000	5.5	80	13	4	0.8	7.6	12	2.5
P■16 PB 0119 X --	1.1	800	1600	8	100	17.5	4	0.8	7.6	16.5	2.5

*Int and It values are given for PE serie only. For PG serie, these values strongly depend on the assembly mode.

- ■ = E for leaded disc
- ■ = G for leadless disc

Rn : Nominal resistance at 25°C
Int : Maximum non tripping current
It : Minimum tripping current
Imo : Maximum overload current
Ires : Residual current at V max (typical value)

Ordering example

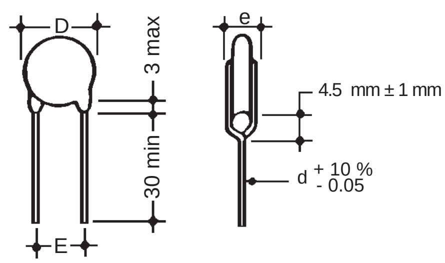
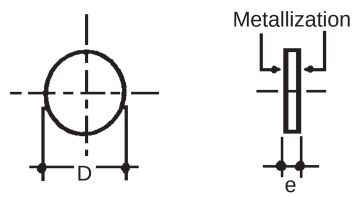
PE 04 P B 0130 X - -

- Type
- Size
- Material : P
- Voltage : 30 V
- Rn : 13 Ω
- Tolerance : X ± 25 %

Disc PTC - Overload protection : PE - PG

Maximum voltage : 130 V / Switching temperature : 110°C

These PTC thermistors are widely used to protect circuit component at the load and power supply sides (110-130 V) against overcurrent. They provide one of the most efficient solution to limit the current when abnormal energy flows through the circuit.

Types	**PE**	**PG**
Finish	Coated disc	Leadless disc for soldering or clamping
Dimensions (mm)		
Marking	Thomson logo / Rated resistance	On packaging only

Particular characteristics :

Reference	Rn ± 25 % ( )	Int* at 25°C (mA)	It* at 25°C (mA)	Imo (A)	Ires at 25°C (mA)	Dimensions (mm) PE Dmax	PE emax	PE d	PE E	PG Dmax	PG emax
P■04 MG 0101 X --	100	45	90	0.35	8	5.3	5	0.6	5	4.8	3.5
P■04 MG 0700 X --	70	50	100	0.4	8	5.3	4.5	0.6	5	4.8	3
P■04 MG 0550 X --	55	60	120	0.45	8	5.3	4.5	0.6	5	4.8	3
P■04 MG 0350 X --	35	75	150	0.5	8.5	5.3	4.5	0.6	5	4.8	3
P■06 MG 0250 X --	25	95	190	1	10	7.2	4.5	0.6	5	6.5	3
P■06 MG 0150 X --	15	125	250	1.3	10.5	7.2	4.5	0.6	5	6.5	3
P■08 MG 0100 X --	10	170	340	2	11.5	9	4.5	0.6	5	8.2	3
P■10 MG 0709 X --	7	210	420	2.8	14	11	4.5	0.6	5	10.2	3
P■12 MG 0459 X --	4.5	280	560	4.5	18	13	5	0.8	7.6	12	3
P■16 MG 0309 X --	3	400	800	7	25	17.5	5	0.8	7.6	16.5	3
P■20 MG 0189 X --	1.8	650	1300	11	30	22	5	0.8	7.6	21	3

*Int and It values are given for PE serie only. For PG serie, these values strongly depend on the assembly mode.

■ = E for leaded disc
■ = G for leadless disc

Rn : Nominal resistance at 25°C
Int : Maximum non tripping current
It : Minimum tripping current
Imo : Maximum overload current
Ires : Residual current at V max (typical value)

Ordering example

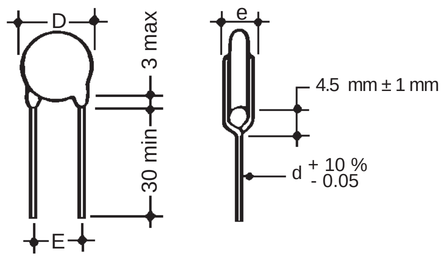
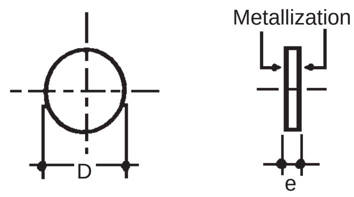
PG 08 M G 0100 X - -

Type — PG
Size — 08
Material : M
Voltage : 130 V — G
Rn : 10 Ω — 0100
Tolerance : X ± 25 %

Disc PTC - Overload protection : PE - PG

Maximum voltage : 265 V / Switching temperature : 80°C

Designed for higher operating voltage (265 V), this PTC series offers a good protection of instrument inputs against over-current and is able to limit or control the temperature to around 80°C.

Types	PE	PG
Finish	Coated disc	Leadless disc for soldering or clamping
Dimensions (mm)		
Marking	Thomson logo / Rated resistance	On packaging only

Particular characteristics :

Reference	Rn ± 25 % ( )	Int* at 25°C (mA)	It* at 25°C (mA)	Imo (A)	Ires at 25°C (mA)	Dimensions (mm)					
						PE				PG	
						Dmax	emax	d	E	Dmax	emax
P■04 JN 0151 X --	150	28	56	0.25	5	5.3	5	0.6	5	4.8	3.5
P■04 JN 0101 X --	100	35	70	0.25	5	5.3	5	0.6	5	4.8	3.5
P■06 JN 0700 X --	70	40	80	0.5	5	7.2	5	0.6	5	6.5	3.5
P■08 JN 0250 X --	25	75	150	0.9	6	9	5	0.6	5	8.2	3.5
P■10 JN 0150 X --	15	110	220	1.5	7	11	5	0.6	5	10.2	3.5
P■12 JN 0100 X HB	10	135	270	2.2	8	13	5	0.6	5	12	3.5
P■12 JN 0100 X --	10	150	300	2.2	8	13	5	0.8	7.6	12	3.5
P■16 JN 0609 X --	6	200	400	3.5	12	17.5	6	0.8	7.6	16.5	4
P■20 JN 0379 X --	3.7	300	600	5	16	22	6	0.8	7.6	21	4

*Int and It values are given for PE serie only. For PG serie, these values strongly depend on the assembly mode.

■ = E for leaded disc
■ = G for leadless disc

Rn : Nominal resistance at 25°C
Int : Maximum non tripping current
It : Minimum tripping current
Imo : Maximum overload current
Ires : Residual current at V max (typical value)

Ordering example

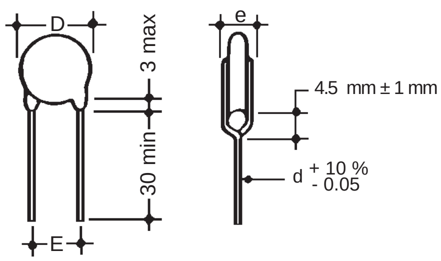
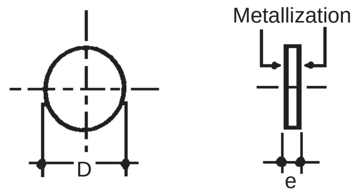
PE 12 J N 0100 X HB

- Type
- Size
- Material : J
- Voltage : 265 V
- Rn : 10 Ω
- Tolerance : X ± 25 %
- Suffix HB : lead spacing 5 mm

Disc PTC - Overload protection : PE - PG

Maximum voltage : 265 V / Switching temperature : 120°C

High performances and high quality of these thermistors enable them to meet the more demanding specifications for overload protection of 220-265 V supplied equipment : UL approved.

Types	PE	PG
Finish	Coated disc	Leadless disc for soldering or clamping
Dimensions (mm)		
Marking	Thomson logo / Rated resistance	On packaging only

Particular characteristics :

UL	Reference	Rn ± 25 % ( )	Int* at 25°C (mA)	It* at 25°C (mA)	Imo (A)	Ires at 25°C (mA)	Dimensions (mm) PE Dmax	emax	d	E	PG Dmax	emax
*	P■04 NN 0221 X --	220	35	70	0.25	5	5.6	5	0.6	5	4.8	3.5
*	P■04 NN 0151 X --	150	45	90	0.25	5	5.6	5	0.6	5	4.8	3.5
*	P■06 NN 0121 X --	120	52	104	0.5	6	7.2	5	0.6	5	6.5	3.5
*	P■06 NN 0101 X --	100	58	116	0.5	6	7.2	5	0.6	5	6.5	3.5
*	P■06 NN 0700 X --	70	65	130	0.5	6	7.2	5	0.6	5	6.5	3.5
*	P■06 NN 0680 X --	68	65	130	0.5	6	7.2	5	0.6	5	6.5	3.5
*	P■08 NN 0550 X --	55	80	160	0.9	8	9	5	0.6	5	8.2	3.5
*	P■08 NN 0470 X --	47	85	170	0.9	8	9	5	0.6	5	8.2	3.5
*	P■08 NN 0450 X --	45	85	170	0.9	8	9	5	0.6	5	8.2	3.5
*	P■08 NN 0350 X --	35	90	180	0.9	8	9	5	0.6	5	8.2	3.5
*	P■08 NN 0330 X --	33	90	180	0.9	8	9	5	0.6	5	8.2	3.5
*	P■08 NN 0250 X --	25	100	200	0.9	8	9	5	0.6	5	8.2	3.5
*	P■08 NN 0220 X --	22	105	210	0.9	8	9	5	0.6	5	8.2	3.5
*	P■10 NN 0150 X --	15	135	270	1.5	9	11.5	5	0.6	5	10.2	3.5
*	P■12 NN 0100 X HB	10	180	360	2.2	10	13.5	5	0.6	5	12	3.5
*	P■12 NN 0100 X --	10	225	450	2.2	12	13.5	5	0.8	7.6	12	3.5
*	P■16 NN 0689 X --	6.8	300	600	3.5	16	17.5	6	0.8	7.6	16.5	4
*	P■16 NN 0609 X --	6	310	620	3.5	16	17.5	6	0.8	7.6	16.5	4
*	P■20 NN 0479 X --	4.7	400	800	5	20	22	6	0.8	7.6	21	4
*	P■20 NN 0379 X --	3.7	460	920	5	20	22	6	0.8	7.6	21	4

*Int and It values are given for PE serie only. For PG serie, these values strongly depend on the assembly mode.

■ = E for leaded disc
■ = G for leadless disc

Rn : Nominal resistance at 25°C
Int : Maximum non tripping current
It : Minimum tripping current
Imo : Maximum overload current
Ires : Residual current at V max (typical value)

Ordering example

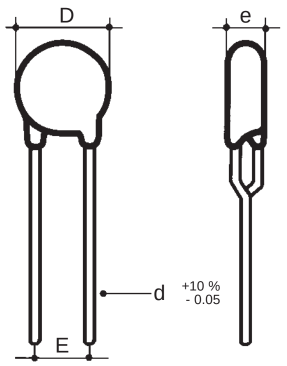
PE 04 N N 0221 X - -

Type
Size
Material : N
Voltage : 265 V
Rn : 220 Ω
Tolerance : X ± 25 %

Disc PTC - Telecommunications series : PE - PS

Approved by well known telephone manufacturers, these custom-designed PTC thermistors are widely used to protect supplying current circuits and calling detection systems.

High reliability, precisely defined operating parameters make these PTC thermistors high quality components for circuit protection in severe environmental conditions.



Packaging : on tape and reel.

Quantity : 1500 parts per reel.

Particular characteristics :

Reference	V_{max} Rms	Rn	Tolerance on Rn	Dimensions (mm)				
				D_{max}	e_{max}	d	E	Finish
PS 06 N - 0005 ---	130	70	+ 10 % - 15 %	6.4	4	0.6	5	Uncoated
PS 06 N - 0015 ---	245	70	+ 10 % - 15 %	6.4	4	0.6	5	Uncoated
PE 10 -- 0019 ---	245	16	± 25 %	11	4.5	0.6	5	Coated
PE 10 -- 0020 ---	245	10	± 20 %	11	4.5	0.6	5	Coated
PS 08 -- 0021 ---*	245	25	± 15 %	8.3	4	0.6	5	Uncoated
PE 08 -- 0022 ---	245	25	± 25 %	9	5	0.6	5	Coated

* per reel ^{3}R = 1 max
Individual data sheet : upon request

Ordering example

PE 10 - - 0020 - - -

Type
LCC P/N

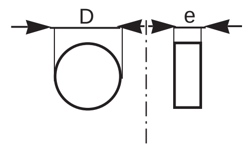
Industrial and automotive PTC thermistors

Ceramic PTC thermistors are used today in a wide range of applications including current overload protection, delayed switching, temperature measurement and control, heating elements and thermostats.

Depending on the application, the shape, dimensions and electrical characteristics may be designed in different ways.

We give below some non-limiting examples of designs applying to specific applications which illustrate our expertise in meeting any of your requirements.

Types

Type	PE	PS	PG
Finish	Resin-coated disc	uncoated disc	Leadless disc
Dimensions	D e 35 min ø 0.6 $^{+10\%}_{-0.05}$ 5.08		

Overload protection - Delayed switching

Type	Diam. (D) (mm)	Thick. (e) (mm)	V_{max} (V)	R25°C (Ohms)	³R25°C (%)	Tb (°C)	Int (mA)	It (mA)	Imo (A)	Ires (mA)	tb (s)
PV 08 -- 1007 ---	9 max	3.5 max	20	1.8	25	125	450	900	2.5	80	10
PE 06 -- 1020 ---	6.5 max	3 max	30	3.0	25	140	400	600	4.5	50	0.260
PE 04 -- 1019 ---	5 max	3 max	30	6.0	25	140	270	400	2.5	45	0.230
PE 06 -- 1021 ---	8 max	5 max	30	8.2	20	115	180				
PE 08 -- 1031 ---	9 max	3.5 max	80	9.4	25	110	150	300	1.3	20	3
PE 04 -- 1032 ---	6.5 max	3.5 max	40	125	25	110	40	80	0.35	8	
PE 04 -- 1041 ---	6.5 max	5 max	420	600	25	120	20	40	0.2		

Heating elements and thermostats – Measurement and control

Type	Diam. (D) (mm)	Thick. (e) (mm)	V_{max} (V)	R25°C (Ohms)	³R25°C (%)	T1 (°C)	R1 (Ohms)	T2 (°C)	R2 (Ohms)	T3 (°C)	R3 (Ohms)
PG 08 -- 1008 ---	8.0 + 0.5	1.0 $^{+0.2}_{-0.1}$	30	8.0	25	105	<2R25°C	115	>2R25°C		
PG 08 -- 1017 ---	8.0 + 0.5	1.0 ± 0.1	30	8.0	25	75	<2R25°C	85	>2R25°C		
PG 08 -- 1015 ---	8.0 + 0.5	1.2 $^{+0.2}_{-0.1}$		12.5	16	90	<50	110	>1 k	125	>20 k
PS 06 -- 1005 ---	7 max	2.5 max	30	12.5	20	50	<2R25°C	60	>2R25°C	100	>1 k
PS 04 -- 1009 ---	4.7 ± 0.3	1.05 ± 0.3	80	25.0	25	95	<2R25°C	105	>2R25°C		
PV 04 -- 1014 ---	5.5 max	3.5 max	12	80.0	25	80	<200	100	>200	125	>6 k

Individual data-sheet, marking, lead configuration, packaging, ... upon request.

Resistance - Temperature characteristics

30 V / 130°C RANGE

RESISTANCE (Ω)

TEMPERATURE (°C)

130 V / 110°C RANGE

RESISTANCE (Ω)

TEMPERATURE (°C)

265 V / 80°C RANGE

RESISTANCE (Ω)

TEMPERATURE (°C)

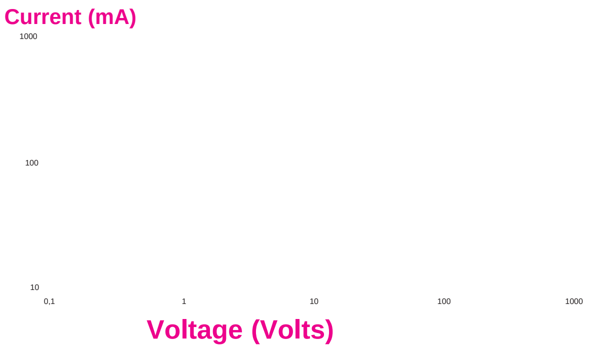
265V / 120°C RANGE

RESISTANCE (Ω)

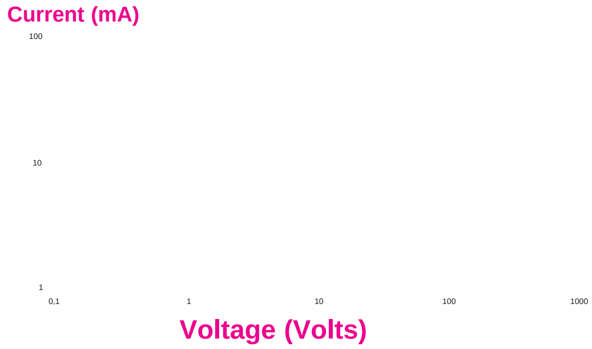
TEMPERATURE (°C)

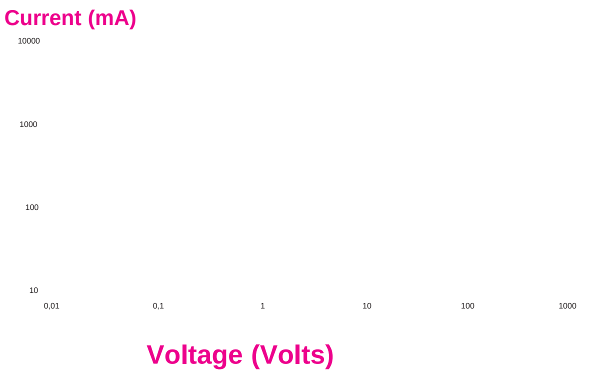
Current - Voltage characteristics

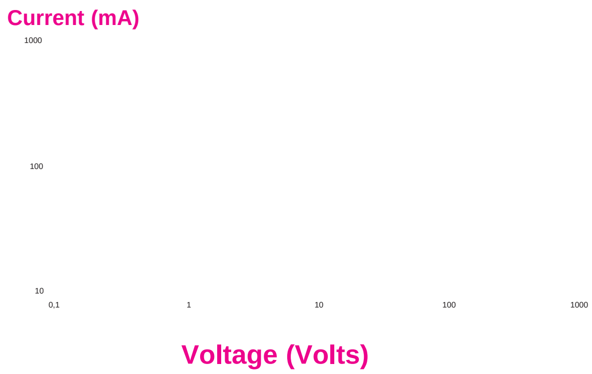
30 V / 130°C RANGE



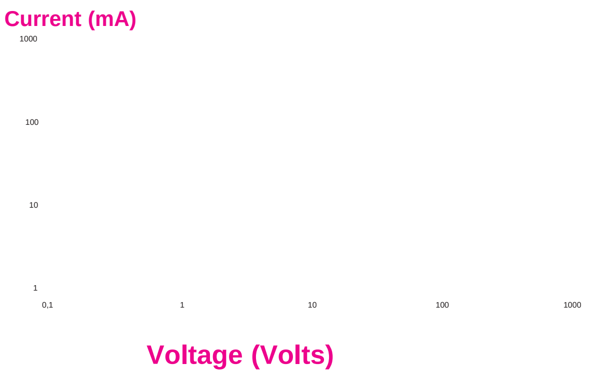
130 V / 110°C RANGE



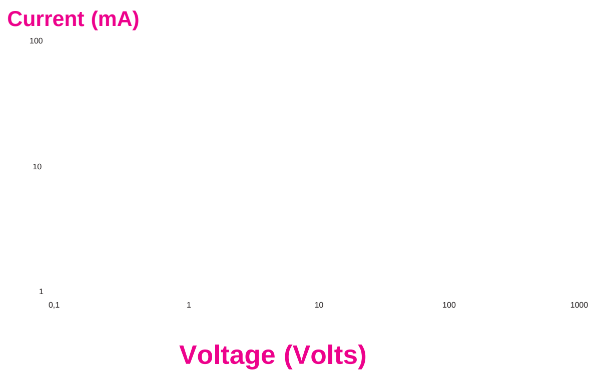


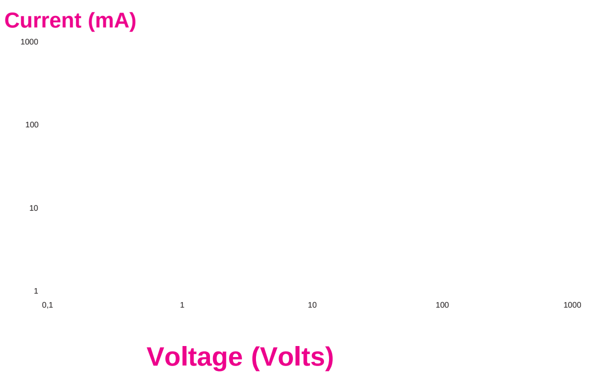


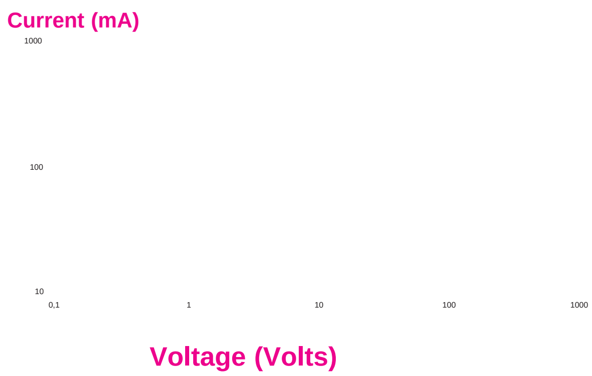
265 V / 80°C RANGE



265 V / 120°C RANGE







Manufacturing process for PTC Thermistors

Process step	Control
Incoming goods	Weighing : every batch
Powder preparation	
Powder testing	Every batch by sampling. Resistance/temperature characteristic, voltage/current characteristic, physical characteristics
Pressing	Weight, thickness, visual inspection : every batch by sampling
Sintering	Thermal cycle : every batch
Electrical test	Every batch by sampling. Resistance/temperature characteristic, voltage/current characteristic, physical characteristics
Metallization	Visual inspection : every batch
Soldering	Visual inspection : every batch
Cleaning	
Coating	Thermal cycle, visual inspection
Marking	Visual inspection : every batch
Polymerization	Thermal cycle : every batch
Lead cutting	
Final control	Electrical : every batch 100 %
Quality control	Every batch by sampling : visual inspection, dimensions, resistance, voltage withstanding
Packaging	Bulk - on tape
Quality acceptance	Every batch : QA report
Shipping consignment	
Outgoing shipping - Inspection	Every batch, every shipment : packaging, documentation

PTC Reliability

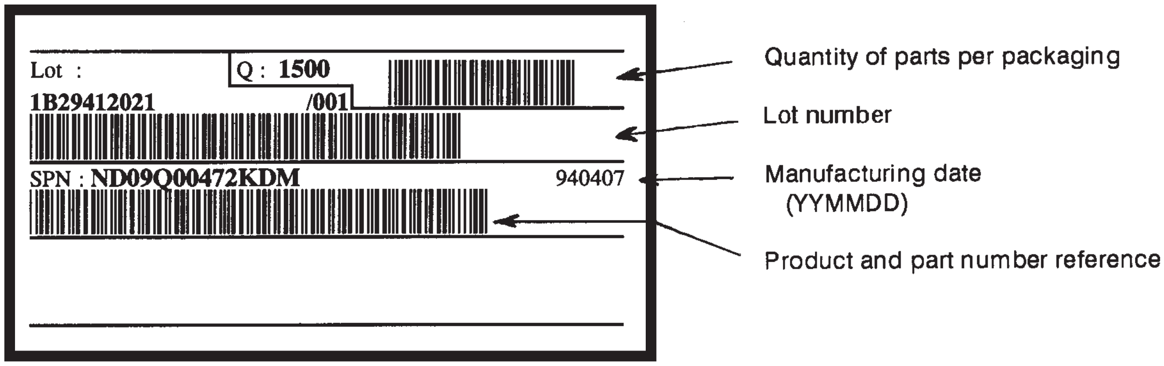
Test	Conditions of test	Performance requirements
Robustness of terminations	Tensile strength : 10 N bending : 5 N	No visual damage ^{3}R/R < 5 %
Solderability	235°C ± 5°C 2 s	> 95 % of the surface of the lead wires covered
Resistance to soldering heat	260°C ± 5°C 10 s	No visual damage ^{3}R/R < 5 %
AUTOMOTIVE AND TELECOMMUNICATION PROTECTION		
Endurance at maximum operating temperature at zero-power dissipation	1000 h/155°C	No visual damage ^{3}R/R < 10 %
Intermittent load life at maximum power	150 cycles 1 mn ”off” 9 min ”on” at I_{max} and V_{max}	No visual damage ^{3}R/R < 10 %
Damp heat, steady-state	85°C 85 % R.H. 56 days	No visual damage ^{3}R/R < 10 %
Salt spray	96 h 35 ± 2°C salt concentration 5 %	No visual damage ^{3}R/R < 7 %
INDUSTRIAL PROTECTION		
Endurance at maximum operating temperature at zero-power dissipation	1000 h/155°C	No visual damage ^{3}R/R < 15 %
High temperature load life at maximum voltage	1000 h maximum rated voltage 55°C	No visual damage ^{3}R/R < 20 %
Damp heat, steady-state	95°C 40 % R.H. 56 days	No visual damage ^{3}R/R < 10 %

IDENTIFICATION - TRACEABILITY

On the packaging of all shipped thermistors, you will find a bar code label.

This label gives systematic information on the type of product, part number, lot number, manufacturing date and quantity.

An example is given below :



This information allows complete traceability of the entire manufacturing process, from raw materials to final inspection.

This is extremely useful for any information request, customer complaint or product return.

BULK PACKAGING

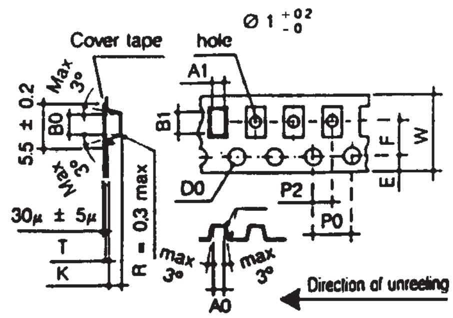
Type	Qty / Box	Type	Qty / Box	Type	Qty / Box
NC 12/20	1000	ND 03	3000	PE 04	1000
NJ 28	2000	ND 06	1500	PE 06	1000
NK 20	5000	ND 09	1500	PE 08	1000
NA/NL 19		NF 08	450	PE 10	800
NA/NL 57		NF 10	450	PE 12	500
NM 06		NF 13	400	PE 16	400
NV 21	according to P/N	NF 15	250	PE 20	250
NV 03		NF 20	150		
NV 06					
NV 09					
NR					

Packaging for automatic insertion - Chip NTC / NC serie

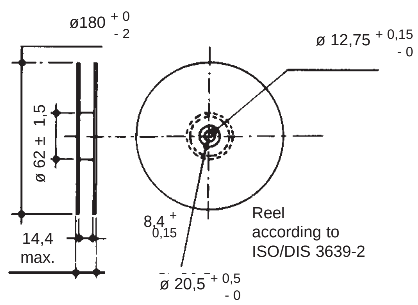
AUTOMATIC INSERTION

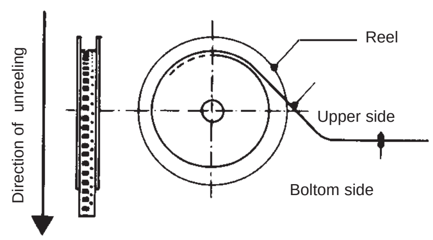
Super 8 plastic tape packaging

The mechanical and dimensional reel characteristics are in accordance with the IEC publication 286-3.



Designation	Symbol	Value	Tolerance
Tape width	W	8	± 0.2
Tape thickness	T	0.4 max.	
Pitch of the sprocket holes	P0	4	± 0.1
Diameter of the sprocket holes	D0	1.5 - 0	+ 0.1
Distance	E	1.75	± 0.1
Distance (centre to centre)	F	3.5	± 0.05
Distance (centre to centre)	P2	2	± 0.1
Sizes of the NC 12 (0805)	A0	1.5	± 0.1
	B0	2.4	± 0.1
	K	1.4 max.	K ± 0.1 (size is adjustable) (K = t1 + 0.2)
NC 20 (1206)	A0	1.95	± 0.1
	B0	3.55	± 0.1
	K	1.5 max.	K ± 0.1 (size is adjustable) (K = t1 + 0.2)





Quantity per reel

Type	Suffix	Qty per reel
NC 12	BA BE	4000 2000
NC 20	BA BE	3000 1500

Packaging for automatic insertion - Disc NTC - PTC

PACKAGING AND KINK SUFFIXES

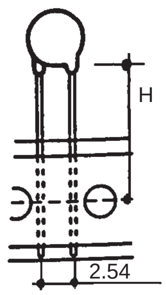
Tables below indicate the suffixes to specify when ordering to get the required kink and packaging. For devices on tape, it is necessary to specify the height (H or Ho) which is the distance between the tape axis (sprocket holes axis) and the seating plane on the printed circuit board. The following types can be ordered on tape either in AMMOPACK (fan folder) or on REEL in accordance with IEC 286-2.

– Straight leads :
H represents the distance between the sprocket holes axis and the bottom plane of component body (base of resin or base of stand off).

– Kinked leads and flat leads :
Ho represents the distance between the sprocket holes axis and the base on the knee (kinked leads) or the bottom of the flat part (flat leads).

NTC

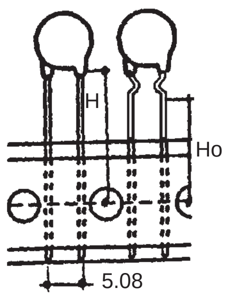
Type
ND 03



Suffix	H	Leads	Packaging
CA	16 ± 0.5	Straight	AMMOPACK
CB	16 ± 0.5	Straight	REEL
CC	19.5 ± 0.5	Straight	AMMOPACK
CD	19.5 ± 0.5	Straight	REEL

NTC

Types
NS
ND
NV
06/09

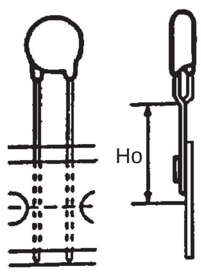


Suffix	H or Ho	Leads	Packaging
DA	16 ± 0.5	Straight	AMMOPACK
DB	16 ± 0.5	Straight	REEL
DC	19.5 ± 0.5	Straight	AMMOPACK
DD	19.5 ± 0.5	Straight	REEL
DL	16 ± 0.5	Kinked	AMMOPACK
DM	16 ± 0.5	Kinked	REEL
DN	19.5 ± 0.5	Kinded	AMMOPACK
DP	19.5 ± 0.5	Kinked	REEL

PTC

Types

PE 04
PE 06
PE 08
PE 10



Suffix	Ho	Leads	Packaging
D5	16 ± 0.5	Kinked	REEL
D6	19.5 ± 0.5	Kinked	REEL
D7	16 ± 0.5	Kinked	AMMOPACK
D8	19.5 ± 0.5	Kinked	AMMOPACK

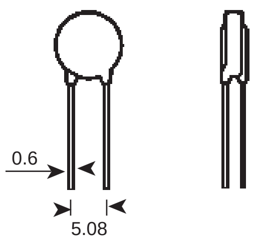
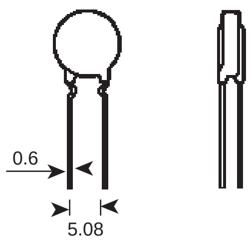
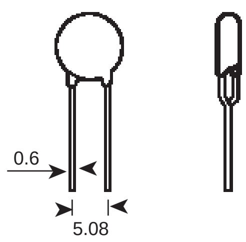
PACKAGING QUANTITIES

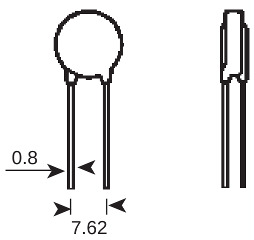
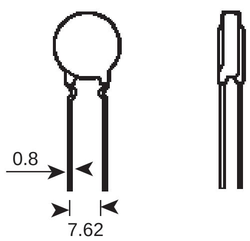
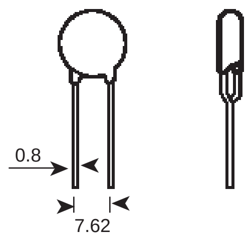
Quantity per size			
Product	**Type**	**AMMOPACK**	**REEL**
NTC	ND 03 ND - NV 06 ND - NV 09	3000 1500 1500	3000 1500 1500
PTC	PE 04 - 06 - 08 - 10	1500	1500

Packaging for automatic insertion - Disc NTC / NF serie

PACKAGING AND KINK SUFFIXES

For following types can be ordered on tape either in AMMOPACK (fan folder) or on REEL in accordance with IEC 286-2.

Types	NF08					
Leads	Straight		Kinked (type 1)		Kinked (type 2)	
Dimensions						
Packaging	Ammopack	Reel	Ammopack	Reel	Ammopack	Reel
Ho = 16	DA	DB	DQ	DR	D7	D5
Ho = 19.5	DC	DD	DS	DT	D8	D6

Types	NF08 / 10 / 13					
Leads	Straight		Kinked (type 1)		Kinked (type 2)	
Dimensions						
Packaging	Ammopack	Reel	Ammopack	Reel	Ammopack	Reel
Ho = 16	EA	EN	EC	EF	EQ	ER
Ho = 19.5	EB	ED				

PACKAGING QUANTITIES

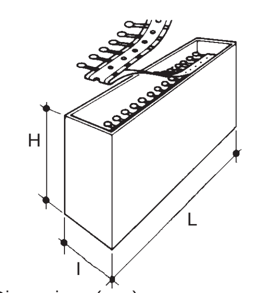
Type	Ammopack	Reel
NF08 (5.08) NF08 (7.62)	1000 750	1000 750
NF10 (5.08) NF10 (7.62)	– 750	– 750
NF13 (7.62)	750	750
NF15 (7.62)	–	–
NF20 (7.62)	–	–

TAPING CHARACTERISTICS

Missing components

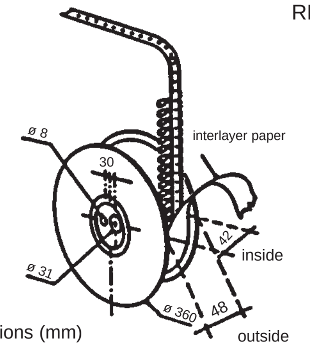
A maximum of 3 consecutive components may be missing from the bandolier, surrounded by at least 6 filled positions. The number of missing components may not exceed 0.5 % of the total per packing module.

The beginning and the end of tape exhibit 8 or 9 blank positions.

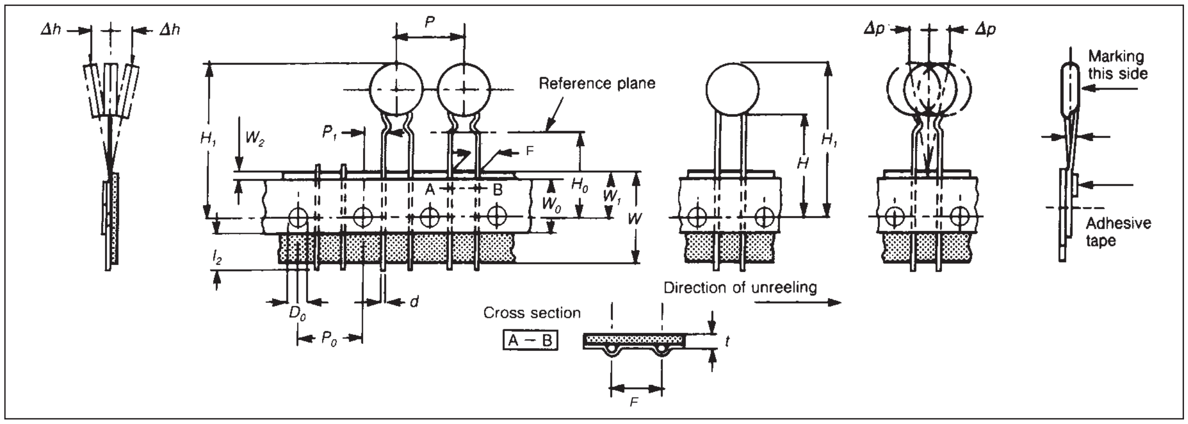


Dimensions (mm)

L	H	l
330	46	290



Dimensions (mm)



Value	Tolerance		Dimensions characteristics
18	+ 1 / - 0.5	W	Leading tape width
6	± 0.3	W_0	Adhesive tape width
9	+ 0.75 / - 0.5	W_1	Sprocket hole position
3 max.		W_2	Distance between the top of the tape and the adhesive
4	± 0.2	D_0	Diameter of sprocket hole
16/19.5	± 0.5	H_0	Distance between the tape axis and the seating plan of the component
		H_1	Distance between the tape axis and the top of component body

Value		Tolerance		Dimensions characteristics
12.7		± 0.2	P_0	Sprocket holes pitch
254		± 1	–	Distance between 21 consecutive holes 20 pitches
0.7		± 0.2	t	Total thickness of tape
2.54	5.08	+ 0.6 / - 0.1	F	Lead spacing
5.08	3.85	± 0.7	P_1	Distance between the sprocket hole axis and the lead axis
12.7		± 1.0	P	Spacing of components
0.5	0.6	± 5 %	d	Lead diameter
0		± 1.3	³P	Verticality of components
0		± 2	³h	Alignment of components