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EPHY MESS
Gesellschaft für Elektro-Physikalische Meßgeräte mbH

Semiconductor Based Temperature Sensors

- Motor Protection Thermistors (PTC)
- Thermistors (NTC)
- Silicon Sensors (KTY)

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Contents

1 Notes to the use of the Catalogue

Products included in this catalogue represent a general overview of the principally deliverable types of construction and confectioning variations of PTC-, NTC- und KTY- Sensors of EPHY-MESS. At first the individual basic types of construction of the sensors, as well as the technical benchmark figures are presented. An overview of the default deliverable possibilities of confectioning follows. Finally some release devices for the different types of sensors are discussed. The different variations and modifications for one product are separated by the sign "|". Please note that the variations cannot be combined always freely, because, for example, a small collet diameter only allows a specific hose pipe or a special sensor. The confectioning variations shown in the catalogue are standard types of construction. However, any customer specific solutions are practicable. The specification sheets are kept general and normally specify only the benchmark figures. Due to the countless number of possibilities which could result, it is unfortunately not possible to display all variations. In the case of special requirements or desires, please contact our sales department. We would gladly develop with you a temperature sensor according your special requirements. A confectioning of sensors, as set by you, is also possible.

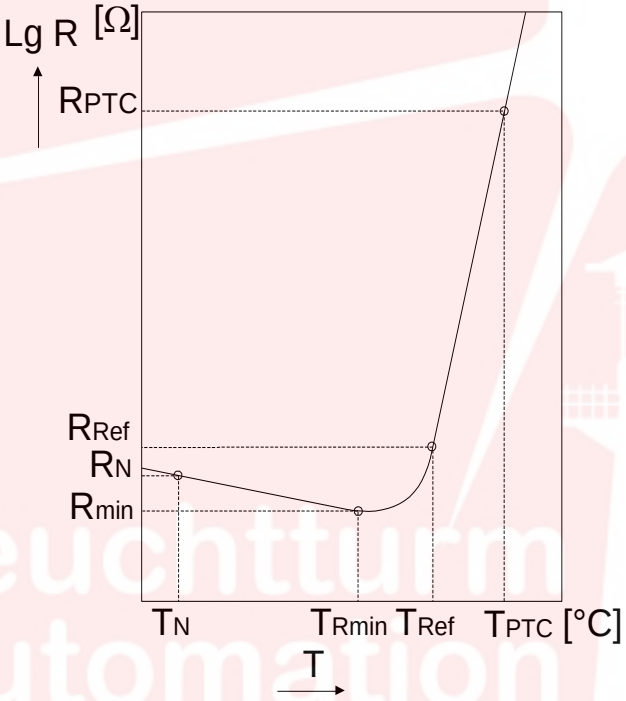
2 Introduction

For the thermal control of electrical machines motor protection (PTC, NTC) thermistors, as well as (NTC) silicon sensors (KTY of the production series 83-1xx and 84-1xx), have stood the test at best. Motor protection PTC thermistors qualify very good for control of a limit temperature. By use of these PTC thermistors and a suitable switching device a reliable overheating protection system can be realised. By means of silicon sensors and NTC in many cases a well-priced temperature measurement can be realised. All sensors are mainly confectioned by EPHY-MESS for the placement inside the winding or slot of electrical machines. But they are also suitable for other tasks of temperature measurement and control.

3 Motor Protection Thermistors (PTC)

3.1 General

A Positive Temperature Coefficient thermistor (PTC) is a semiconductor of endowed, polycrystalline barium titanate ceramic, whose electrical resistance rapidly increases when a certain temperature is exceeded. PTC thermistors deliverable by EPHY-MESS are mainly motor protection thermistors according to DIN 44081 – 82, which are set in the winding of electrical motors, generators and transformers. The typical resistance / temperature characteristic of motor protection thermistors is displayed in the following diagram.



$R_{(PTC)} = f(T_{PTC})$

R_N PTC thermistor resistance at TN

T_N Rated temperature (25°C)

R_{min} Minimum resistance

T_{Rmin} Temperature at R_{min} (beginning of the positive α)

R_{Ref} Reference resistance at T_{Ref}

T_{Ref} Reference temperature (beginning of the steep resistance increase)

R_{PTC} Arbitrary resistance in the steep zone

T_{PTC} to R_{PTC} belonging temperature

T_{NAT} Nominal response temperature for motor protection PTC thermistors defined instead of the reference temperature in the steep zone

Fig. 1: Characteristic response curve flow of motor protection PTC thermistors $R_{PTC} = f(T_{PTC})$

At combination of a motor protection PTC thermistor with a switching device one receives an effective, well-priced and quickly reacting solution for the protection of electrical machines from overheating.

As visible in fig. 1, the resistance value of the PTC thermistor increases steeply after reaching of its reference temperature. For the classification of the sensor one fixes a point in the steep zone of the response curve, the so called nominal response temperature (NAT). It signifies the temperature value, at which the downstream connected release device reacts inside the tolerance range. At the selection of the used PTC, its NAT incl. tolerance has to be chosen so, that it corresponds to the maximum acceptable operation temperature of the motor. The PTC's are also to be connected in series with different NAT inside a measurement circuit. Thereby different ranges of temperature of a machine can be controlled with only one measurement circuit. As soon as at one PTC the by its NAT defined maximum temperature is exceeded, the connected downstream switching device switches the machine off. Furthermore the usage of 2 different NAT is possible, if for example, one wants to realise at a single motor a combination of forewarn and shutoff. However in this case two measurement circuits are necessary.

3.2 Classical Motor Protection Thermistor Type (EPTC / DPTC-SH-xxx)

IECEx: Ex eb IIC, Ex ta IIIC, Ex ia IIC Gb, Ex ia IIIC Gb
ATEX: II 2G Ex e IIC Gb, II 2D Ex ta IIIC Da, II 2G Ex ia IIC Gb, II 2D Ex ia IIIC Db
TR: Ex e II U, Ex tb IIIC Db U, Ex ia IIC U, Ex ia IIIC Db U

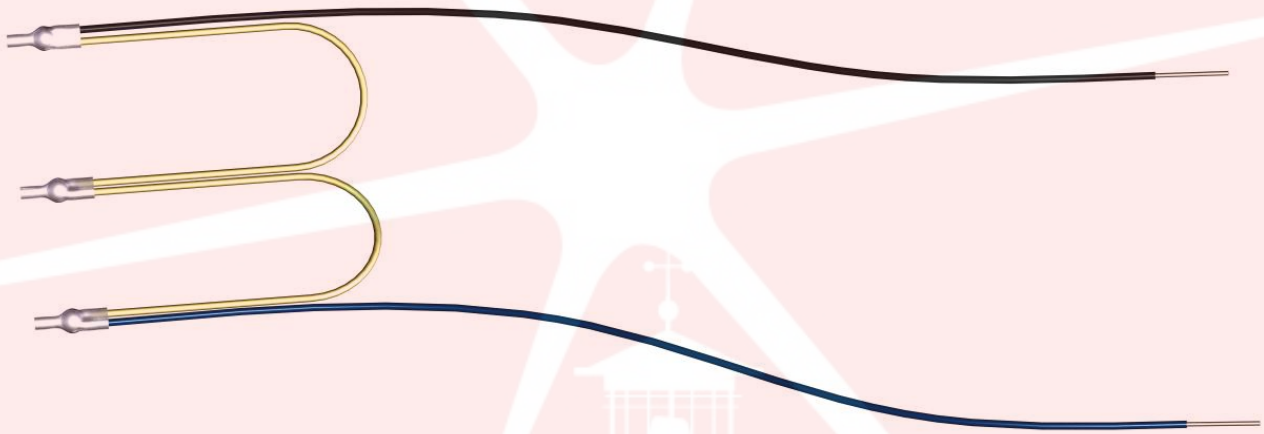


Fig. 2: DPTC-SH-155 standard: KL=500/180/180/500 mm

Designation	EPTC / DPTC-SH-xxx EPTC = single PTC thermistor DPTC = triplet PTC thermistor SH = shrinkage tube coat xxx = (NAT) nominal response temperature [°C]
Construction	EPTC-SH-xxx PTC thermistor pill according to DIN 44081 varnish and shrinkage tube insulated with fix connected single strands DPTC-SH-xxx 3 PTC thermistor pills according to DIN 44082 varnish and shrinkage tube insulated with fix connected single strands boarded in series
UL-approval	UL 1434 (UL file-Nummer E69802) optional incl. NAT 180°C
Measuring element EPTC	
type	single PTC thermistor
material	Bariumtitanat ($BaTiO_3$)
connection	2-wire circuit
resistance value	R<100Ω at metering voltage ≤ 2,5V
tolerance	±5K acc. DIN 44081 (up to/ incl. NAT 160°C) ±7K acc. DIN 44081 (starting at NAT 170°C)
Measuring element DPTC	
type	triple PTC thermistor
material	Bariumtitanat ($BaTiO_3$)
connection	2- wire circuit
resistance value	R<300Ω at metering voltage ≤ 2,5V (bis incl. NAT 180°C) R<350Ω at metering voltage ≤ 2,5V (from NAT 190°C)
tolerance	±5K acc. DIN 44082 (up to/ incl. NAT 160°C) ±7K acc. DIN 44082 (from NAT 170°C)

Electric values EPTC

nominal switching temperature	NAT °C (see above)
max. operating voltage	30VDC valid in the range from 0°C … +40°C
max. measuring voltage	7,5VDC in the range from -25°C up to TNAT +23K
dielectric strength	2,5 kV / AC 50 Hz / 1 min.

Electric values DPTC

nominal switching temperature	NAT °C (see above)
max. operating voltage	30 V DC valid in the range from 0°C … +40°C
max. measuring voltage	7,5 V DC in the range from -25°C up to TNAT +23K
dielectric strength	2,5 kV / AC 50 Hz / 1 min.

Temparature range

operating temperature	-25°C … +200°C; above +200°C a possible self-heating caused by the measuring voltage has to be considered.

Pill size (insulated) Old, former standard pill ø<4mm │ Up-to-date mini pill ø < 3mm

Pill insulation T < 160°C => Kynar® shrinkage tube
T ≥ 160°C => PTFE shrinkage tube

Nominal response temperature 60°C ... +190°C

Colour codes

TNAT [°C]	Colour code
60	WH / GY
70	WH / BN
80	WH / WH
90	GN / GN
100	RD / RD
110	BN / BN
120	GY / GY
130	BU / BU
140	WH / BU
145	WH / BK
150	BK / BK
155	BU / BK
160	BU / RD
170	WH / GN
180	WH / RD
190	BK / GY

Tab. 1: Colour code of motor protection PTC thermistors according to DIN 40080

Connection line Single strands AWG 26/7

Insulation PTFE

Standard cable length[1] EPTC 500mm │ 2000mm
DPTC 500/180/180/500mm │ 2000/300/300/2000mm

[1] Other cable length on request

Colour code	Outside connection according to Tab. 1 Inside connection for DPTC = YE (yellow)
Confectioning variations	ESH/DSH │ SGH │ KH │ AK/ZS │ MH

4 Thermistor (NTC)

4.1 General

A NTC thermistor is according to DIN 44070 resp. IEC 60593 a temperature dependant semiconductor resistor whose value of resistance decreases with growing temperature. The Negative Temperature Coeffizient (NTC) lies at approx. -2... -6%/K and is therewith approx. ten times bigger as for metals. Therefore thermistors are well suitable for the measurement of temperatures. They consist of manganese, iron, cobalt, nickel, copper and zinc oxide; those are admixed with other oxides for chemical stabilisation. These are prepared to a powdery compound and after addition of a plastic binding agent sintered at temperatures of approx. 1000 - 1400°C. Afterwards the polycrystalline semiconductors are pinned and by means of special ageing methods aged for the stabilisation of the resistant values aged.
The change of the resistance in operation can be caused by a change in the temperature of the environment, as well as by self-heating as a result of electrical loading. While using PTC thermistors the response temperature of the protection equipment is defined by the NAT of the PTC, one can adjust the switching point of a NTC at the corresponding switching device.

4.2 Thermistors for Temperature Control Type (K227)

Fig. 3: Motor protection PTC thermistor type K227, 1,8kΩ

Specification	NTC-SH, type K227 B57227 K333A, 1,8kΩ
Special construction	10 kΩ, technical dates on request **ATTENTION:** all here mentioned dates refer to the type 1.8 kΩ
Construction	Thermistor disk with Kynar shrinkage tube insulation and fix connected single strands
Pill dimensions (insulated)	$ø_{max}$= 5 mm x 14 mm
Application	For the thermal control of electrical machines and the temperature measurement inside electrical motors and transformers
Temperature range	-55...155°C
Max. power	200mW at T=25°C

Resistance tolerance	ΔR/RN = ±10%
Nominal resistance (RN)	1.8 kΩ | 10 kΩ special construction
Nominal temperature	100°C
Resistance R25°C	32.762 kΩ
Heat conductance value	5 mW/K (in static air)
Therm. cooling period constant	30 s (in static air)
Heat capacity	150 mJ/K
Insulation resistance (U=100V)	>100 MOhm
Dielectric strength	2.5 kV / AC 50Hz / 1min.
B-value (B25/B100)	4300 K
B-value tolerance	±1.5%
Pill insulation	Kynar® shrinkage tube
Connection line	PTFE single strands
Cable section	AWG26
Colour code	Red / Grey
Cable length (standard)	380mm | 2000mm

Characteristic curve

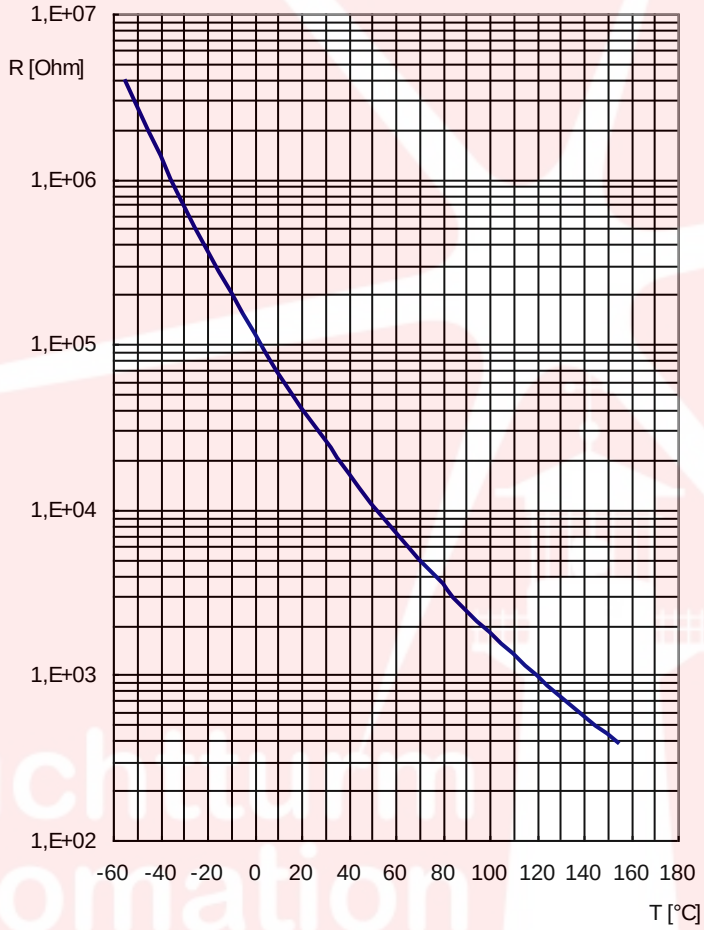


Fig. 4: Characteristic curve NTC K227, 1,8kOhm

Confectioning variations ESH/DSH | SGH | KH | AK/ZS | MH

5 Silicon Sensors

5.1 General

Silicon sensors of the KTY production series are like diodes built semiconductors. Their operation temperature range extends from –55°....+ 175°C (KTY 83 series), resp. from 40°...+300°C (KTY84 series), what is sufficient for the most industrial measuring purposes. They have, just as PTC thermistors, a positive temperature coefficient but in contrary to them they show an approximate linear characteristic line. Their resistance response is comparable with this of a precision resistor with a big temperature coefficient. The range of application is the measuring of temperatures and control of limit values. The range of tolerance at reference temperature lies according to the construction between 3 and 5%, what is compared with a Pt100 relatively inexact. But for many applications, as e.g. motor protection, this is completely sufficient, because in this case the sensors operate mostly relatively close to their nominal temperature (for KTY84-1xx) and at this applications a degree more or less is not important. For this reason, in industry they are a very common and a low priced alternative for the classical Pt100. By EPHY-MESS confectioned sensors base on the KTY production series 83-1xx and 84-1xx. On customers request, other KTY types are available.

5.2 Sensor Production Series 83-1xx and 84-1xx

5.2.1 KTY-Sensor Production Series 83-1xx

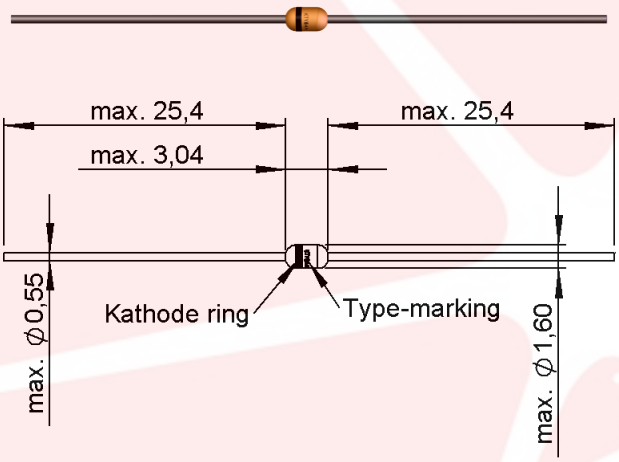


Fig. 5: Silicon KTY 83-1xx sensor

Designation	Silicon KTY83-1xx xx = tolerance range (see Tab. 2:)
Construction[1]	Silicon sensor in DO-34 housing with axial connection rods
Type labelling	Printed type number on DO-34 housing (see Tab. 2:)
Connection labelling	Black cathode ring Remark: The side of the cathode is marked with a black colour ring. This side has to be connected due to the polarity dependence of the sensor with the negative potential of the measuring appliance.
Measuring range	-55°C...175°C
Nominal resistance	1000 Ω
Nominal temperature	25°C
Measuring current	1mA
Max. acceptable constant current	
Id_{max} in air (25°C)	10 mA
Id_{max} in air (175°C)	2mA

[1] Dimensions see Fig 5

Tolerance range

Type	Type labelling	Tolerance	Tolerance range R_N =1000Ω T_N = 25°C
KTY83–110	KTY83A	±1%	990... 1010 Ω
KTY83-120	KTY83C	±2%	980... 1020 Ω
KTY83-121	KTY83D	-2%	980... 1000 Ω
KTY83-122	KTY83E	+2%	1000... 1020 Ω
KTY83-150	KTY83H	±5%	950... 1050 Ω
KTY83-151	KTY83K	-5%	950... 1000 Ω
KTY83-152	KTY83N	+5%	1000... 1050 Ω

Tab. 2: Tolerances of KTY 83-1xx

Temperature coefficient α25 0.76%/K

Resistance ratio R100 / R25 = 1.67 ±0.02

R55 / R25 = 0.50 ±0.01

Thermal time constant T
Inside static air 20 s
Inside resting water 1 s
Inside flowing water 0.5 s

Housing / dimensions Diode glass housing DO-34 (compare Fig. 5:)

Confectioning variations ESH/DSH | KH | MH | SGH | AK/ZS

Characteristic curve

$R_T = R_N [1+A (\vartheta-\vartheta_N) + B (\vartheta-\vartheta_N)^2]$

R_N = nominal resistance

ϑ_N = nominal temperature (25°C)

ϑ = temperature [°C]

A, B = constants A = 7.635 10-3

B = 1.731 10-5

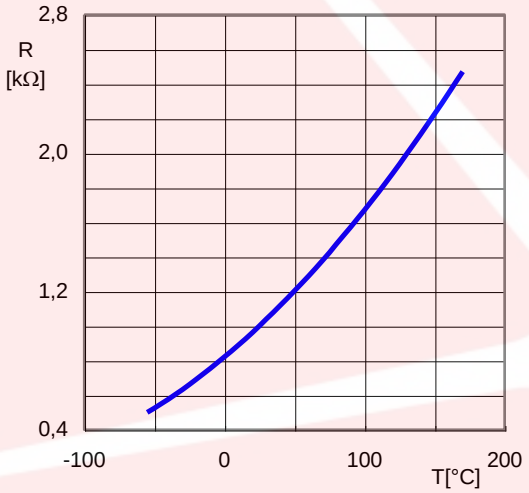


Fig. 6: R(T) characteristic curve of KTY 83-1xx

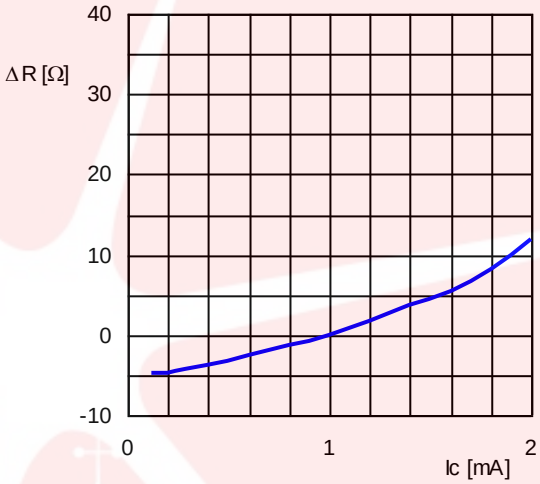


Fig. 7: Resistance deviation dependent of the measuring current

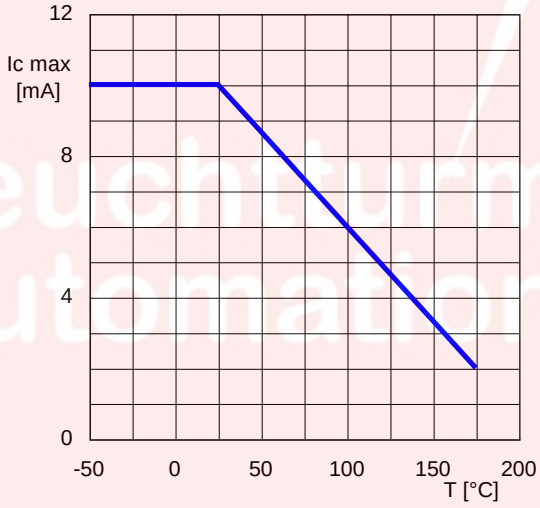


Fig. 8: Max. current in dependence of the temperature

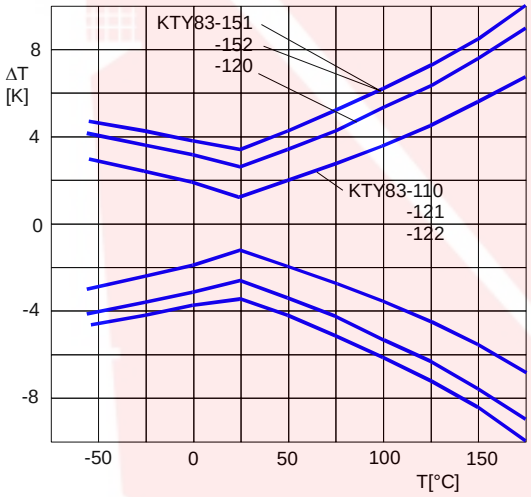


Fig. 9: Max. measuring error in dependence of the temperature

5.2.2 KTY Sensor Production Series 84-1xx

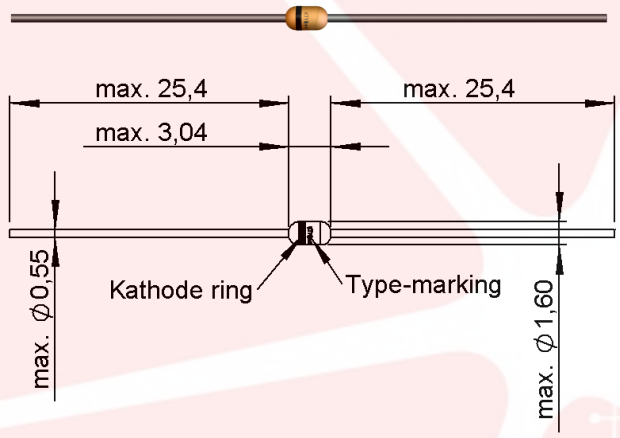


Fig. 10: Silicon KTY production series 84-1xx

Designation	Silicon KTY84-1xx xx = tolerance range (see Tab. 3:)
Construction	Silicon sensor in DO-34 housing with axial connection rods
Type labelling	Printed type number on DO-34 housing (see Tab. 3:)
Connection labelling	Black cathode ring Remark: The side of the cathode is marked with a black colour ring. This side has to be connected due to the polarity dependence of the sensor with the negative potential of the measuring appliance.
Colour code[1]	(+) = yellow (-) = green
Measuring range	-40°C ... +300°C
Nominal resistance	1000 Ω
Nominal temperature	100°C
Measuring current	2 mA
Max. acceptable constant current	
ID_{max} inside air (25°C)	10 mA
ID_{max} inside air (300°C)	2 mA

[1] At confectioning variations of Ephy-Mess

Tolerance range

Type	Type labelling	Tolerance	Tolerance range R_{Nenn} = 1000Ω T_{Nenn} = 100°C
KTY84-130	KTY84L	± 3%	970....1030 Ω
KTY84-150	KTY84M	±5%	950...1050 Ω
KTY84-151	KTY84O	-5%	950…1000 Ω
KTY84-152	KTY84P	+5%	1000…1050 Ω

Tab. 3: Tolerances of KTY 84-1xx

Temperature coefficient $\alpha 25 = 0.61\%/K$

Resistance ratio
R250/R100 = 2.166±0.055
R25/R100 = 0.603 ±0.08

Thermal time constant T
Inside static air 20 s
Inside resting water 1 s
Inside flowing water 0.5 s

Housing / dimensions Diode glass housing DO-34 (compare Fig. 10:)

Confectioning variations ESH/DSH | KH | MH | SGH | AK/ZS

Characteristic curve
$R_T = R_N [1+A (\vartheta-\vartheta_N) + B (\vartheta-\vartheta_N)^2]$
R_N = nominal resistance
ϑ_N = nominal temperature (100°C)
ϑ = temperature [°C]
A, B = constants A = 6.229 10-3
B = 1.159 10-5

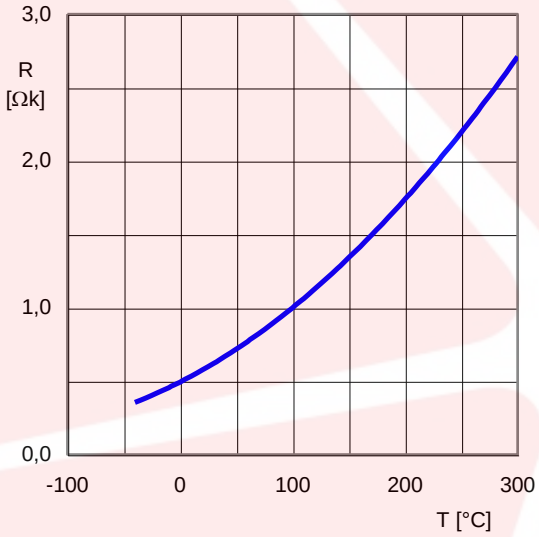


Fig. 11: R(T) characteristic curve of KTY 84-1xx

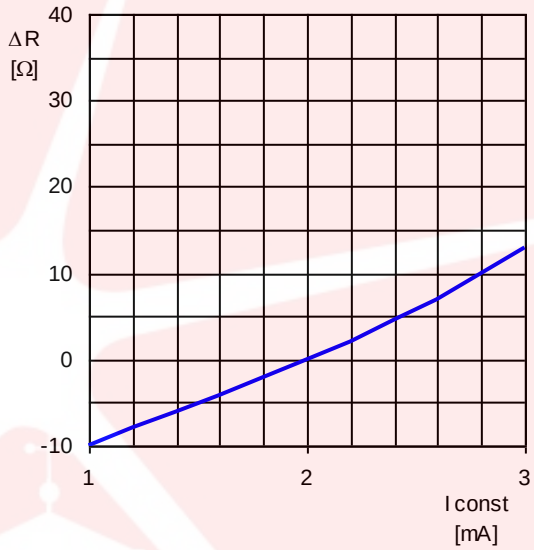


Fig. 12: Resistance deviation dependent of the measuring current

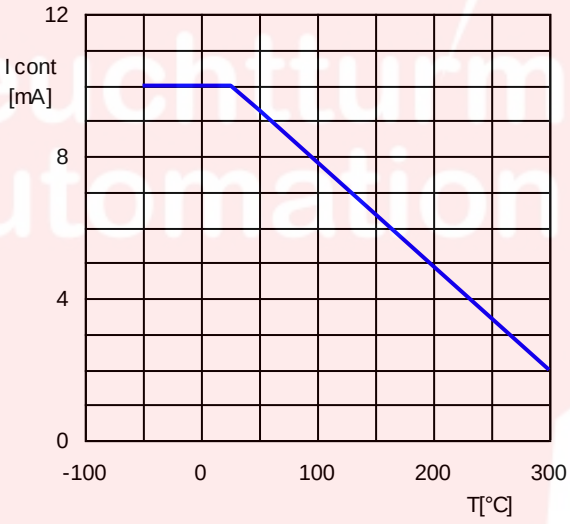


Fig. 13: Max. current in dependence of the temperature

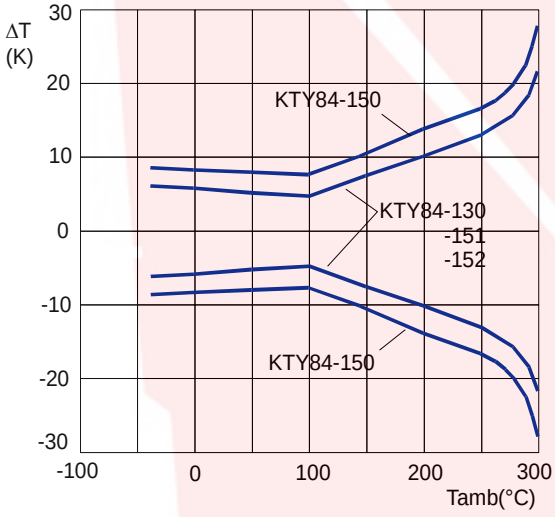


Fig. 14: Max. measuring error in dependence of the temperature

6 Confectioning variations

The following table gives a general view over the different confectioning variations of the single basic sensors.

Designation	Construction	PTC	DPTC	NTC	KTY
XXX-ESH	XXX-Sensor with a single layer of shrinkable tube and a fix connected supply line	XXX	XXX	XXX	XXX
XXX-DSH	XXX-Sensor with a double layer of shrinkable tube and a fix connected supply line	XXX	XXX	XXX	XXX
XXX-MH	XXX-Sensor built into a metall sleeve with fix connected supply line	XXX		XXX	XXX
XXX-KH	XXX-Sensor sealed into a ceramic sleeve with fix connected supply line	XXX	XXX	XXX	XXX
XXX-SGH	XXX-Sensor built into a screw housing with fix connected supply line	XXX		XXX	XXX
XXX-AK	XXX-Sensor built in a HGW intake body (AK). Closed with cover disk and additional insulated with PTFE shrinkage tube. Fix connected supply line.	XXX		XXX	XXX
XXX-ZS	XXX-Sensor buitd into a ZS housing	XXX		XXX	XXX

Tab. 4: Confectioning variations of basic sensors

6.1 Confectioning variations with Ex certification according to ATEX

Typ	Bauform	Sensor	IEC Ex	ATEX	TR
PR-SPA-EX-WKF	XXX - ESH XXX - DSH XXX – MH XXX - KH XXX - SGH	PTC*| KTY83/84	Ex eb IIC Ex ta IIIC Ex ia IIC Gb Ex ia IIIC Gb	II 2G Ex e IIC Gb II 2D Ex ta IIIC Da II 2G Ex ia IIC Gb II 2D Ex ia IIIC Db	Ex e II U Ex tb IIIC Db U Ex ia IIC U Ex ia IIIC Db U
PR-SPA-EX-NWT	XXX – AK XXX - ZS	PTC*| KTY83/84			

*acc. DIN 44081-82

Tab. 5: Confectioning variations with Ex certification according to IECEx, ATEX and TR certification

6.2 Confectioned Shrinkage Tube Insulated Sensors Type (XXX-XSH)

IECEx: Ex eb IIC, Ex ta IIIC, Ex ia IIC Gb, Ex ia IIIC Gb
ATEX: II 2G Ex e IIC Gb, II 2D Ex ta IIIC Da, II 2G Ex ia IIC Gb, II 2D Ex ia IIIC Db
TR: Ex e II U, Ex tb IIIC Db U, Ex ia IIC U, Ex ia IIIC Db U

Fig. 15: KTY-ESH with Teflon single litz wires

Specification	XXX/XSH XXX = PTC | NTC | KTY, (see basic sensors) X =E = single shrinkage tube insulated X =D = double shrinkage tube insulated
Construction	Measuring sensor, single or double layer insulated by means of shrinkage tube with fix connected connection line
Temperature sensor	EPTC/ DPTC | NTC | KTY (also as Pt100 available)
Measuring range	Dependent on the used sensor
Max. operation temperature*	175°C | 190°C | 260°C *) Dependent on the used sensor
Sensor insulation	1) ESH single-layer insulated 2) DSH double-layer insulated
Dimensions*	From approx. ø3mm x length from approx. 10mm *) dependent on the used sensor and wire
Material	Kynar | Kynarflex | PTFE shrinkage tube
Connection line	Shrinkage tube | teflon flat cable shrinkage tube Screened shrinkage tube | PTFE single strands
Insulation	Silicon | teflon | spun glass
Cable section*	AWG 20 | 22 | 24 | 26 | 28 | 30 *) section at SL /FSL dependent on type
Cable length	Upon customers request
Cable ends	Partly stripped | cable collets | blank | solder plated
Colour code	At PTC according to Tab. 1: | on customer's request
Dielectric strength*	Without | $R_{(iso)}$ 500V ≥ 200MΩ | 1.5 kV / AC 50 Hz / 1 min. | 2.5 kV / AC 50 Hz / 1 min.*) Only at DSH
Special constructions	Waterproofed construction (IP 66) Screened construction (XXX-DSH-A) Dielectric strength up to 8 kV Optional with IECEx, ATEX or TR-certification* *) not available for NTC

6.3 Confectioned Sensors in Ceramic Collet Type (XXX-KH)

IECEx: Ex eb IIC, Ex ta IIIC, Ex ia IIC Gb, Ex ia IIIC Gb
ATEX: II 2G Ex e IIC Gb, II 2D Ex ta IIIC Da, II 2G Ex ia IIC Gb, II 2D Ex ia IIIC Db
TR: Ex e II U, Ex tb IIIC Db U, Ex ia IIC U, Ex ia IIIC Db U

Fig. 16: XXX-KH, top: 4,9x30mm / below: 3x15mm

Specification	XXX-KH XXX= EPTC/DPTC | NTC | KTY KH = ceramic collet
Construction	Basic sensor with fix connected connection line shed in ceramic collet/s
Sensors	EPTC/DPTC | NTC | KTY
Protection collet	Ceramic protection collet
Material	Al2O3 ceramic
Dimensions	

Type	Dimensions
HÜ-KH-EFG*	ø3 x 15 mm
HÜ-KH-EFG	ø4 x 25 mm
HÜ-KH-ERG**	ø4.9 x 16 mm
HÜ-KH-ERG	ø4.9 x 30 mm

*) EFG = single sided flat closed
**) ERG = single sided round closed

Tab. 6: Dimensions of ceramic collets

Connection line	Shrinkage tube | screened shrinkage tube | PTFE single strands
Insulation	Teflon | silicone | spun glass
Cable section*	AWG 20 / 22 / 24 / 26 / 28 / 30 *) For SL dependent on type
Cable lenght	On customer's request
Cable ends	Partly stripped | cable collets | blank | solder plated
Colour code	For PTC according to Tab. 1: | on customer's request
Dielectric strength	$R_{(iso)}$ 500V ≥ 200MΩ | up to 5 kV / AC 50 Hz / 1 min.
Special construction	With varnish glass filament tube (LGLS) as nick protection

6.4 Confectioned Sensors in Metal Collet Type (XXX-MH)

IECEx: Ex eb IIC, Ex ta IIIC, Ex ia IIC Gb, Ex ia IIIC Gb
ATEX: II 2G Ex e IIC Gb, II 2D Ex ta IIIC Da, II 2G Ex ia IIC Gb, II 2D Ex ia IIIC Db
TR: Ex e II U, Ex tb IIIC Db U, Ex ia IIC U, Ex ia IIIC Db U

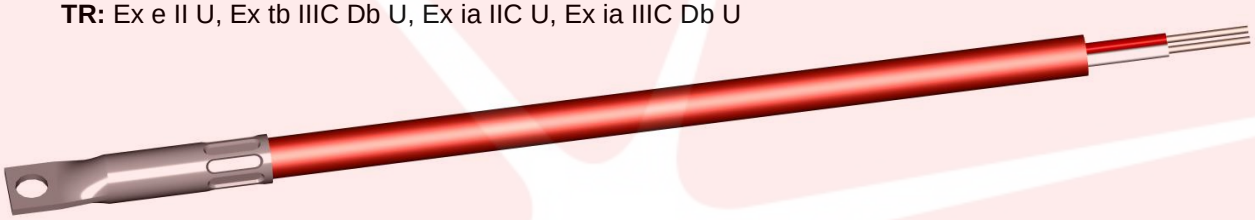


Fig. 17: XXX-MH with mounting hole and fix connected supply line

Specification	XXX-MH XXX = EPTC | NTC | KTY MH = metal collet
Construction	Basic sensor built in metal collet, with fix connected connection line
Sensors	EPTC| NTC | KTY
Protection collet	Metallic protection collet
Material	V2A | brass
Cable connection*	Beaded | rolled | shed *) Dependent on cable type
Dimensions*	ø min 3 x length min 20mm *) dependent on connection line and used sensor
Connection line	Shrinkage tube | screened shrinkage tube | PTFE single strands
Insulation	Silicone | Teflon | spun glass
Cable section*	AWG 20 / 22 / 24 / 26 / 28 / 30 *) for SL dependent on type
Cable lenght	On customer's request
Cable ends	Partly stripped |cable collets |blank | solder plated
Colour code	For PTC according to Tab. 1: |on customer's request
Dielectric strength	Without | $R_{(iso)}$ 500V ≥ 200MΩ |2kV / AC 50Hz / 1min.
Special construction	Screened construction With mounting hole M4

6.5 Thermometer for Screwing In Type (XXX-SGH)

IECEx: Ex eb IIC, Ex ta IIIC, Ex ia IIC Gb, Ex ia IIIC Gb
ATEX: II 2G Ex e IIC Gb, II 2D Ex ta IIIC Da, II 2G Ex ia IIC Gb, II 2D Ex ia IIIC Db
TR: Ex e II U, Ex tb IIIC Db U, Ex ia IIC U, Ex ia IIIC Db U

Fig. 18: Left: XXX-SGH construction A with PTFE single strands)
Middle: XXX-SGH construction A with fix shed connector
Right: XXX-SGH construction B with silicone insulated hose liner

Designation	Thermometer for screwing in, screw housing XXX-SGH XXX = PTC | NTC | KTY SGH = screw housing
Construction	**Construction (A):** Basic sensor shed in brass or aluminium screw housing, with fix connected connection line **Construction (B):** Basic sensor in VA collet with fix or shiftable screwing
Measuring range	Dependent on used sensor
Max. operation temperature*	180°C | 260°C *) Dependent on used sensor
Sensors	PTC | NTC | KTY

Screw housing construction A

Material	Thread x mounting length[1]	SW x height
Brass	M4 x 7,5mm	SW 7x10mm
Brass	M4 x 6mm	SW 7x10mm
Brass	M5 x 7,5mm	SW8x10mm
Brass	M6 x 7,5mm	SW10x10mm
Brass	M6 x 7,5mm	SW 8x15mm
Brass	M8 x 8mm	SW19x24mm[2]
Brass	M8 x 7,5mm	SW13x10mm
Aluminium	M4 x 6mm	SW8x8mm
Aluminium	M5 x 6mm	SW8x12mm

Tab. 7: Dimensions of standard screw housings

Screwings construction B

Ø-VA collet [mm]	mounting length [mm]	VA-VSB
4mm 5mm 6mm (standard) 8mm	from 20	M10x1 G1/4“ G3/8“ G1/2“

Tab. 8: Collets ø and screwings

Connection line	Shrinkage tube │ PTFE single strands
Insulation	Silicone │ Teflon │ spun glass
Cable length	On customer’s request
Cable ends	Partly stripped │ cable collets │ blank │ solder plated
Colour code	For PTC according to Tab. 1: │ on customer’s request
Dielectric strength	Without │ $R_{(iso)}$ 500V ≥ 200MΩ │ 2kV / AC / 50Hz 1min.

[1] For all diamaters ≥ 6mm, the sensor is placed inside the screw base for a better thermal linking
[2] with shed connector (4-pole) see 0

6.6 Slot Resistance Thermometer Type (ZS; AK; E-NTS-ZS; KTY-ZS)

IECEx: Ex eb IIC, Ex ta IIIC, Ex ia IIC Gb, Ex ia IIIC Gb
ATEX: II 2G Ex e IIC Gb, II 2D Ex ta IIIC Da, II 2G Ex ia IIC Gb, II 2D Ex ia IIIC Db
TR: Ex e II U, Ex tb IIIC Db U, Ex ia IIC U, Ex ia IIIC Db U

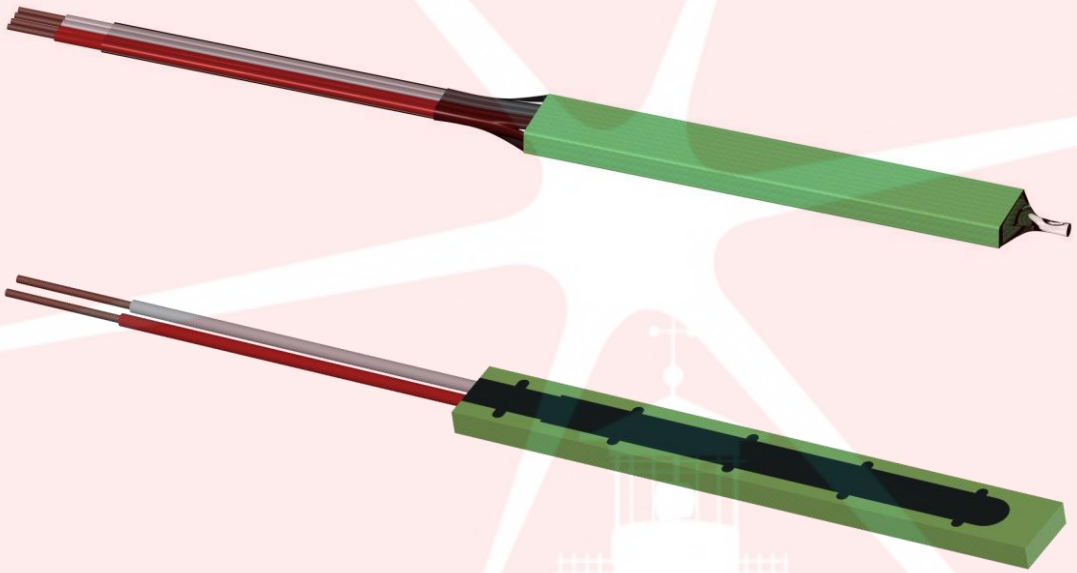


Fig. 19: Above: XXX-ZS with flat cable shrinkage tube
Below: XXX-AK with PTFE single strands

Designation	XXX-ZS slot resistance thermometer XXX-AK slot resistance thermometer (E-NTS-ZS) Ex e version (only PTC) (KTY-ZS) Ex e version (only KTY) ZS = intermediate slide AK = intake body XXX = PTC | NTC | KTY
Construction	**(ZS)** Basic sensor with fix connected connection line, fixed by means of bridge and directly shed in epoxy resin intermediate slide housing **(AK)** Basic sensor built in and shed in HGW intake body of silicon. Closed with cover disk and additional insulated with PTFE shrinkage tube. Fix connected connection line.
Measuring range	Dependent on used sensor
Max. operation temperature[1]	180°C | 200°C
Sensors	PTC | NTC | KTY (also as Pt100 available)
Intake body (ZS)	Epoxy resin intermediate slide, rigid
Material	Epoxy resin
Dimensions[2]	D(min.)=3±0,3 mm x B(min.) =4±0,3 mm x L(min.) =20±3 mm

[1] Dependent on used sensor
[2] Dependent on used sensor and cable

Intake body (AK)	HGW intake body, flexible
Material	Silicon glass fabric-base laminate
Dimensions[1]	D(min.)=3±0,3 B(min.) =5±0,3mm L(min.) =20±3mm *) depends on the used sensor
Insulation	PTFE shrinkage tube single or double layer
Connection line	Shrinkage tube │ Teflon flat cable shrinkage tube │ PTFE single strands
Insulation	Teflon │ silicone
Colour code	For PTC according to Tab. 1: │ on customer's request
Section[2]	AWG20 │ 24 │ 26 │ 28 │ customers request *) When hose line cross-section depending of the type
Cable length	On customer's request
Cable ends	Partly stripped │ cable collets │ blank │ solder plated
Dielectric strength	Without │up to 5kV / AC 50Hz / 1min.│ on customer's request
Special construction	Ex e certificated versions according to IEC EX and ATEX*) **) *) not for NTC) **) only E-NTS-ZS │KTY-ZS │XXX-AK-ESH

[1] Dependent on used sensor
[2] At shrinkage tube section dependent of type

7 Switching Devices for PTC Thermistors and KTY Sensors

7.1 General

The by PTC thermistors or temperature measuring sensors controlled switching devices ensure primarily the thermal overload protection of electrical machines. The switching point of the protection appliance is defined for PTC thermistors by whose nominal response temperature (NAT). For KTY sensors it is adjustable on the device.

By EPHY-MESS supplied PTC thermistor switching devices can be used together with all motor protection PTC thermistors according to DIN 44081/82. The KTY switching device is compatible with all sensors of the production series KTY84-1xx.

7.2 Operating and Application Fields of PTC Thermistor Switching Devices

After mounting of the PTC thermistor sensors into the winding heads of the to get protected motors, the connection with the switching device takes place. The number of the to get connected PTC thermistors is only limited by the total resistance R25 of the switching device. If in one of the to get controlled parts or areas the temperature increases over the nominal response temperature of the respective PTC sensor e.g. by

- blocking rotor
- aggravated starting
- counter current operation
- low-voltage or phases deficit

so the PTC sensor becomes high-resistive and the release device shuts off the motor contactor over a relay. According to the type of the release device, a switch-back occurs after cooling of approx. 2-5K. For particular cases of an application, an independent restart is not suggested or not acceptable. For such cases, there are release devices with restart blocking (locking, manual reset) available. For this construction, a manual unlocking has to occur for the restart of the machine after a thermal shutoff e.g. after a mains voltage failure of the output relay without locking switches on again. The relay output of the EPHY-MESS release devices is constructed as a potential-free change-over contact. All devices operate by the holding-current principle, what ensures a shutoff of the machine at mains voltage failure, sensor or cable breaking.

Temperature control systems based on PTC thermistor and release devices are not only well suited for the classical motor protection, but also for any kind of temperature controls at which an action has to be ensured after exceeding a temperature threshold value.

7.3 PTC Thermistor Release Devices

7.3.1 Release Device Type (INT69)

Fig. 20: PTC thermistor release device INT69

Designation	PTC thermistor release device INT69 / 69V V = locking
Construction	Release device in standard or miniature construction with an alteration relay. Optional with or without locking
Supply voltage	220V AC 50Hz
Special constructions	From 12 – 60VDC, to 24 – 380VAC
Ambient temperature	-30°C ... +70°C
Sensors	Motor protection PTC thermistor DIN 44081/82
Quantity	1 to 9 PTC thermistors[1] in series (R25ges < 1800Ohm)
Measuring circuits	1
Relay	1 potential-free alteration contact
Switching capacity	250 VAC max. 6A, 300 VA ind.
Installation	Top hat rail │ screw mounting
Dimensions	
Standard	68 x 33 x 80mm
Mini	68 x 33 x 50mm
IP-Protection class	IP20, clamps IP00
Locking	With (INT69V) │ without (INT69)

[1] Identical or different NAT

Circuit diagram

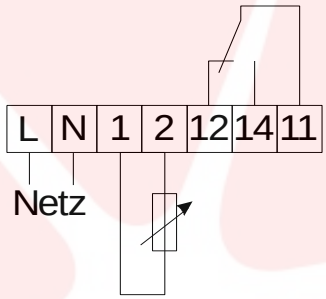


Fig. 21: Circuit diagram INT69

Clamps allocation

Power supply[1]: L / N

Sensor clamps: 1 / 2
polarity doesn't matter

Relay clamps: 12 / 14 / 11
11 / 12 closed if:
sensor temperature > adjusted switching temperature
sensor or cable breaking
breakdown of the supply voltage

11 / 12 opened if:
sensor temperature < adjusted switching temperature &
supply voltage applied

11 / 14 closed if:
sensor temperature < switching temperature & supply voltage applied

11 / 14 opened if:
sensor temperature > adjusted switching temperature
sensor or cable breaking
breakdown of the supply voltage

[1] See available supply voltage

7.3.2 Release Device Type (TÜS100)

Fig. 22: PTC thermistor release device TÜS100R

Designation	TÜS 100 ZEM xxx, TÜS 100R ZEM xxx R = with manual reset xxx = supply voltage
Construction	PTC thermistor release device with potential-free switch contact, optional with or without locking for connection of motor protection PTC thermistor
Supply voltage	220V AC │ 110V DC │ 24V DC
Ambient temperature	-30....70°C
Sensors	PTC thermistor according to DIN 44081/82
Measuring circuits	1
Quantity	1 to 6 PTC thermistor[1] in series (R25ges < 1500Ohm)
Relay	1 alteration contact
Switching capacity	250V AC | max. 6 A | 300VA ind.
Locking	With (TÜS100R) │ without (TÜS100)
Installation	Top hat rail and screw mounting
Dimensions	68 x 33 x 50mm
IP-Protection class	IP20, clamps IP00
Weight	Approximate 105g

[1] Identical or different NAT

Circuit diagram

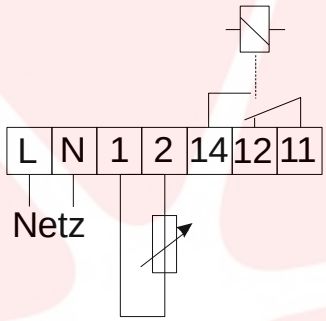


Fig. 23: Circuit diagram TÜS-100

Clamps allocation

Power supply[1]: L / N

Sensor clamps: 1 / 2
polarity doesn't matter

Relais clamps: 14 / 12 / 11
11 / 12 closed if:
sensor temperature > adjusted switching temperature
sensor or cable breaking
breakdown of the supply voltage

11 / 12 opened if:
sensor temperature < adjusted switching temperature &
supply voltage applied

11 / 14 closed if:
sensor temperature < switching temperature & supply
voltage applied

11 / 14 opened if:
sensor temperature > adjusted switching temperature
sensor or cable breaking
breakdown of the supply voltage

[1] See available supply voltages

7.3.3 PTC Release Device with ATEX Approval Type MS(R)

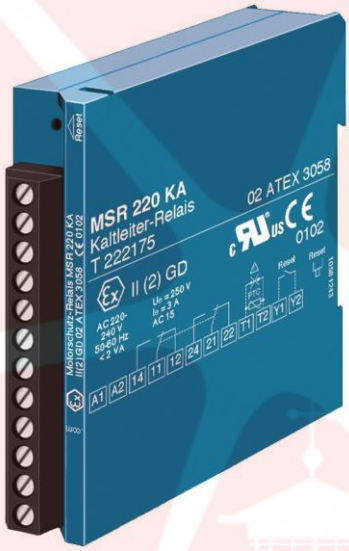


Fig. 24: PTC switch device MSR 220KA

Designation	MS(R) 220 KA (R) = with manual reset
Construction	ATEX approved PTC release device with switch relais, electively with or without manual reset. Suitable for PTC acc. to DIN
Protection	II (2 GD)
Supply voltage	220V AC │ 24V DC
Ambient temperature	-20°C ... +55°C
Sensors	PTC acc. to DIN 44081/82
Measurement circuits	1
Quantity	1 up to 6 PTC[1] in serial, (switch value <4000Ω)
Relais	1 or 2 alternation contacts
Reset	With for type MSR │ without for type MS
Mounting	35mm DIN-rail
Dimension (HxWxT)	75 x 22.5 x 110mm
IP-Protection class	Housing IP30, clamps IP20
Weight	Approximate 150g

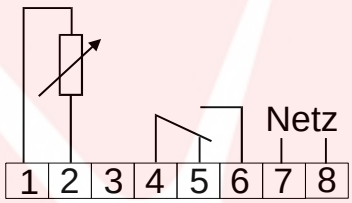
[1] Same or different NAT

7.4 KTY Release Device Type (KTY 04.01-R)

Fig. 25: KTY –release device KTY 04.01-R

Designation	Release device KTY 04.01-R
Construction	KTY- release device with mains and faults display, self control regarding sensor breaking and voltage breakdown (based on the holding-current principle). Adjustable switchoff temperature. A potential-free relay alteration contact
Supply voltage	230V AC 50Hz (±10%).
Ambient temperature	-20°C ... +60°C
Sensors	
Type	KTY 84-130 / -150 / -151 / -152
Quantity	1
Measuring circuits	1
Relais	1 potential-free alteration contact
Switching capacity	250V AC max. 6A, 300VA ind.
Adjustable switching range	60°C ...+260°C
Switch-back	10K ±2.5K below switchoff temperature
Installation	top hat rail and screw mounting
Dimensions	75 x 45 x 107.5mm
IP-Protection class	Housing IP40, connection clamps IP00
Weight	Approximate 195g

Circuit diagram



Clamps allocation

Sensor clamps: 1 / 2
Polarity[1] 1 = (+) colour code: yellow
2 = (-) colour code: green

Relay clamps: 4 / 5 / 6

4 / 5 closed if:
sensor temperature > adjusted switching temperature
sensor or cable breaking
breakdown of the supply voltage

4 / 5 opened if:
sensor temperature < adjusted switching temperature & supply voltage applied

4 / 6 closed if:
sensor temperature < switching temperature & supply voltage applied

4 / 6 opened if:
sensor temperature > adjusted switching temperature
sensor or cable breaking
breakdown of the supply voltage

Power supply: 7 / 8
230VAC / 50-60 Hz

[1] Colour code of EPHY-MESS KTY84-1xx sensors

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