Resistance thermometers

EPHY MESS
Gesellschaft für Elektro-Physikalische Meßgeräte mbH

Tailor-made sensors. Worldwide.

TAILOR-MADE SENSORS

01.
EPHY-MESS SENSORS ADD EFFICIENCY AND SAFETY TO YOUR SYSTEM

Yours Claudia & Andreas Becker

Rev. 20180108

Globality and loyalty to location

EPHY-MESS GmbH is a competent solution partner of all manufacturers of electrical machines and drive technology. As a medium-sized family owned company, we consult, develop and produce for our customers individual sensor solutions for safety and control requirements.

As a premium manufacturer and distributor of tailor-made industrial measurement and sensor technology, the company has taken a leading position in Germany in its more than 60-year history through precision products and solutions, innovative engineering and continuous exploratory urge.

Always anchored in the vicinity of Wiesbaden, EPHY-MESS has, since the turn of the millennium, risen to become a global provider which now supplies markets in over 40 countries at an export ratio of 40 percent.

02. HOW TO CONTACT EPHY-MESS

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CERTIFIED ACCORDING TO

MEMBER OF TRADE ASSOCIATIONS

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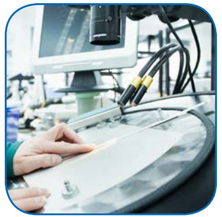
03. CONTENT

		Page
Tailor-made sensors		
01.	Globality and loyalty to location	03
02.	How to contact EPHY-MESS, certificates, trade associations	04
03.	Content	05
04.	Test and measurement	06
05.	Market sectors	08
06.	Business sectors	10
Quality and precision		
07.	Products and points of installation	12
08.	Industrial temperature measurement	14
09.	Platinum measuring resistors	16
10.	Versions of platinum measuring resistors	18
11.	Slot resistance thermometers NWT	22
12.	Slot resistance thermometers NWT bifilar	24
13.	Slot resistance thermometers NWT chip	34
14.	Screw-in resistance thermometers LTH	40
15.	Connection heads according to DIN EN 50446	42
16.	Connection heads type EM12 / 18 / 24 / 38	46
17.	Industrial plug resistance thermometers	50
18.	Cable resistance thermometers WKF	52
19.	Resistance thermometers with screw-in housing	58
20.	Bayonet lock resistance thermometers	60
21.	Sheathed resistance thermometers WT-MI	62
22.	General notes	66
EPHY-MESS technology worldwide		
23.	Research and development	69

04. TEST AND MEASUREMENT



Quality Assurance

Routine testing

Our quality assurance monitors compliance with legal requirements (standards) and technical specifications. At EPHY-MESS each article undergoes tests to control e.g. dimension, tension, pressure, tightness, functionality, insulation and dielectric strength at the final inspection section of the quality department.

In addition in the course of its compliance with standards, each sensor has to fulfill an optical inspection as well as in some cases additionally mechanical testing. The system-optimized, automated and computer-based processes as well as high quality test and measurement equipment ensure accurate measurements and traceable documentation.

Continuous improvement

EPHY-MESS continuously monitors the workflow and production requirements. Our employees present their ideas on how to optimize processes to the product manager. The implementation improves and accelerates the production of our products while maintaining high quality standards.

Relentless testing

Different test criteria are being applied depending on the application. They all include a „relentless“ test procedure. Only products that possess all required properties without any fault can pass the EPHY-MESS quality test. The quality-related measurement and test equipment is calibrated regularly and is subject to continuous, documented monitoring.

- Temperature tests
- Thermal response times
- High voltage acceptance tests
- Insulation resistance tests
- Partial discharge tests
- Microscopic examinations
- Pressure and tensile tests
- Climate tests
- Leak tests
- Vibration characteristics

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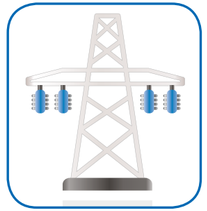
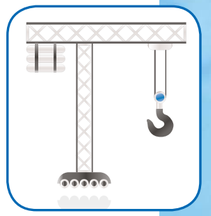
05. OUR MARKET SECTORS





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Market sectors

EPHY-MESS supplies assembled temperature sensors especially for the focused market segments railway technology, renewable energies and the general industrial segment. Following find an overview of the products we offer for your industry.

Each measuring task is carried out under specific operating conditions. Each temperature sensor has a specific mounting situation. EPHY-MESS offers users of any sector and of different industries specific temperature sensors matching the specifications of the application. Customers benefit from continuous availability, individual development and production of optimal matching sensors.
In short: designed and made in Germany

ON TRACK

EPHY-MESS keeps fit rolling stock

Particularly the sensors in high-speed trains must work with absolute reliability under diverse operating conditions. EPHY-MESS temperature sensors, speed sensors and oil level gauges meet these requirements and have proven themselves in world-renowned international train projects.

Forces created by shocks require that the sensor elements possess a special internal structure to ensure the continuous capture of reliable measuring values. Over the years EPHY-MESS has gained valuable experience and a thorough knowledge of this technologically demanding field.

The modular concept - developed especially for rolling stock - enables quick and cost-effective integration of various sensors in a sensor system. Beside temperature sensors, speed sensors can also be integrated in the EPHY-MESS sensor concept. Single modules can be mounted to one completely assembled multi-arm harness.

In addition to high-speed trains, underground and suburban trains as well as buses and hybrid vehicles will also be equipped with EPHY-MESS sensors.

06. BUSINESS SECTORS

FOR THE INDUSTRY

Large range of applications in industrial drive technology

The focus of many industrial applications is the engine. EPHY-MESS sensors monitor the winding temperature of electric motors, generators, gears or transformers and are used for preventive maintenance of induction coils. They are also used in power plants to control cooling water temperature or other critical components such as coils, pipelines as well as thyristors or chokes.

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IN THE WIND

Your specialist for wind power plant temperature sensors

Large wind power plants and difficult to reach offshore facilities require the highest reliability and safety for all components under increasingly critical operating conditions. Reliable continuous temperature control plays an essential role. Standard mounted coil head sensors as well as bearing and slot resistance thermometers are used to monitor temperature in generators or gearboxes and drives. We are constantly collecting and expanding our comprehensive temperature monitoring knowledge for various wind plant concepts. Due to the increased performance, the requirements for control and analysis have changed, so that many different temperature sensor types are used for monitoring tasks in wind power plants today. Against this background own product ideas are developed and discussed with potential customers.

EPHY-MESS is a problem solver and development partner for its customers.

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QUALITY AND PRECISION

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07. PRODUCTS AND POINTS OF INSTALLATION

Slot

Bearing

Coil head

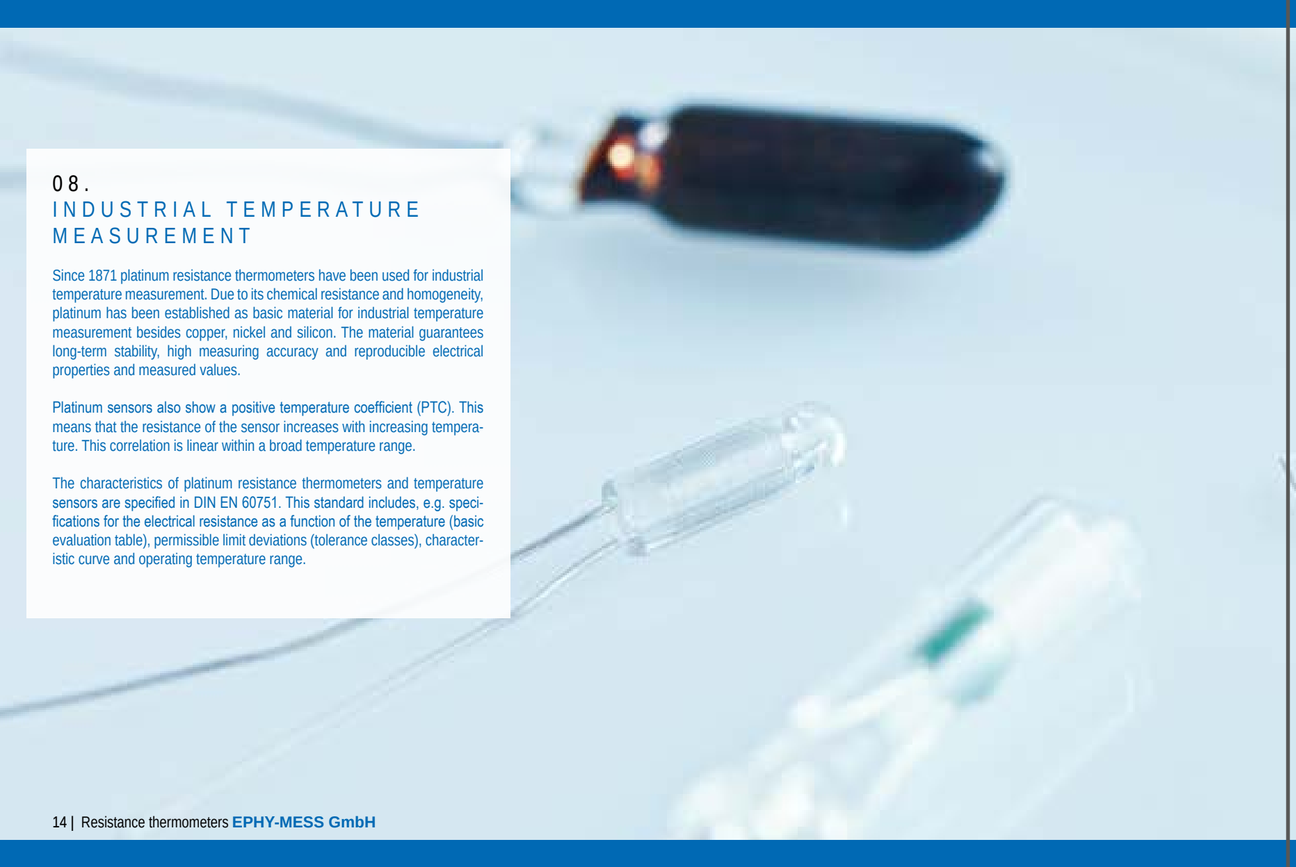
Wheel-set

Brake

Gear

Pitch / Azimuth drive

Control cabinet



08.
INDUSTRIAL TEMPERATURE MEASUREMENT

Since 1871 platinum resistance thermometers have been used for industrial temperature measurement. Due to its chemical resistance and homogeneity, platinum has been established as basic material for industrial temperature measurement besides copper, nickel and silicon. The material guarantees long-term stability, high measuring accuracy and reproducible electrical properties and measured values.

Platinum sensors also show a positive temperature coefficient (PTC). This means that the resistance of the sensor increases with increasing temperature. This correlation is linear within a broad temperature range.

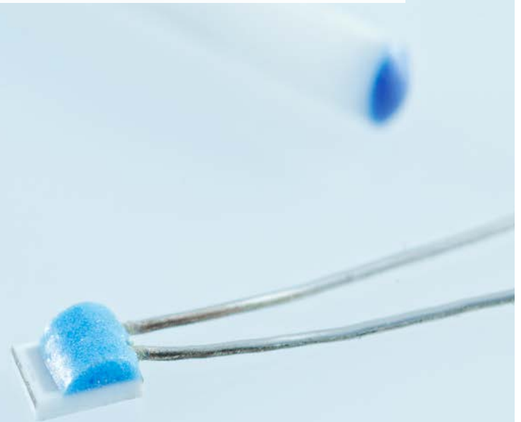
The characteristics of platinum resistance thermometers and temperature sensors are specified in DIN EN 60751. This standard includes, e.g. specifications for the electrical resistance as a function of the temperature (basic evaluation table), permissible limit deviations (tolerance classes), characteristic curve and operating temperature range.

Platinum measuring elements

According to DIN EN 60751, the nominal value is 100 Ω at a nominal temperature of 0°C. We therefore speak of Pt100 temperature sensors. In addition, there are temperature sensors with different nominal values such as, for example, 200 Ω, 500 Ω or 1000 Ω. The higher the nominal resistance, the greater the changes in resistance due to temperature changes.

The sensors are divided into tolerance classes AA, A, B and C. The following table provides an overview of the maximum permissible deviations.

Unit	rated value	class AA	class A	class B	class C
[Ω]	100 Ω / 0°C	± 0.04 Ω/0°C	± 0.06 Ω/0°C	± 0.12 Ω/0°C	± 0.24 Ω/0°C
[°C]	0°C	± 0.10°C/0°C	± 0.15°C/0°C	± 0.30°C/0°C	± 0.60°C/0°C



09.
PLATINUM MEASURING RESISTORS

The following values and equations apply

The standard DIN EN 60751 defines two temperature ranges for platinum resistors and defines them by means of different polynomials. The first temperature range (-200°C to 0°C) is defined by

$$R_{(t)} = R_{(0)} (1 + A\,t + B\,t^2 + C\,(t - 100°C)\,t^3)$$

The second temperature range (0°C to 850°C) by

$$R_{(t)} = R_{(0)} (1 + A\,t + B\,t^2)$$

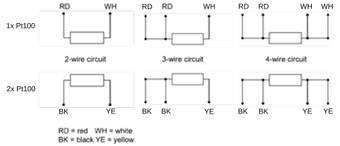
The coefficients are

$A = 3{,}9083 \times 10^{-3}°C^{-1}$
$B = -5{,}775 \times 10^{-7}°C^{-2}$
$C = -4{,}183 \times 10^{-12}°C^{-4}$

Permissible limit deviation for

class AA	in °C = ±(0,10+0,0017 |t|)
class A	in °C = ±(0,15+0,0020 |t|)
class B	in °C = ±(0,30+0,0050 |t|)
class C	in °C = ±(0,60+0,0100 |t|)

Connection diagram for platinum resistance thermometers. Color coding of platinum resistance thermometers is standardized according to DIN EN 60751. Deviations from this color code are possible on customer request.



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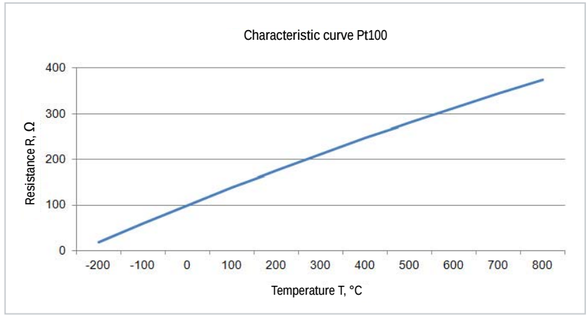

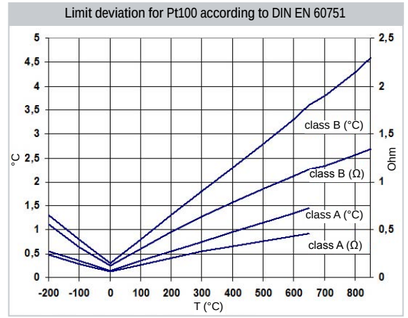

Limit deviation for Pt100 Ω thermometers

Temperature	class AA		class A		class B	
°C	°C	Ω	°C	Ω	°C	Ω
-200	-	-	±0,55	±0,24	±1,3	±0,56
-100	-	-	±0,35	±0,14	±0,8	±0,32
0	±0,10	±0,04	±0,15	±0,06	±0,3	±0,12
100	±0,27	±0,10	±0,35	±0,13	±0,8	±0,30
200	±0,44	±0,16	±0,55	±0,20	±1,3	±0,48
300	±0,61	±0,21	±0,75	±0,27	±1,8	±0,64
400	±0,78	±0,26	±0,95	±0,33	±2,3	±0,79
500	-	-	±1,15	±0,38	±2,8	±0,93
600	-	-	±1,35	±0,43	±3,3	±1,06
650	-	-	±1,45	±0,46	±3,6	±1,13
700	-	-	-	-	±3,8	±1,17
800	-	-	-	-	±4,3	±1,28
850	-	-	-	-	±4,6	±1,34

Legend

$R_{(t)}$ [Ω]	= reistance at temperatur t
$R_{(0)}$ [Ω]	= rated/nominal value at 0°C
T [°C]	= temperature
|t| [°C]	= absolute value of the temperature

10.
VERSIONS OF PLATINUM MEASURING RESISTORS

Wire-wound platinum temperature sensors as well as platinum chip sensors manufactured in thin-film technology are installed as temperature-sensitive detectors inside the resistance thermometers.

In the following five common basic measuring resistors available from EPHY-MESS are being described. These platinum measuring resistors are assembled in various thermometer designs to meet different application requirements.

M-OK

Measuring resistor M-OK

construction	platinum layer applied by means of thin-film technology onto ceramic substrate; fitted with contact wires and covered with a protective layer; rectangular shape
measuring range	-70°C ... +500°C
contact wires	Pt clad Ni-wire, length approx. 10 mm - 15 mm
dimensions	from about 1.0 x 1.25 x 1.6 (thickness x width x length in mm)
response time	from about 7 s, according to dimensions air stream (v = 2 m/s): $t_{0.9}$ = 7.0 s - 10.0 s

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M-MK

Measuring resistor M-MK

construction	platinum thin-film resistor sealed in a ceramic housing, cylindrical shape, flat sensor tip
measuring range	-50°C ... +400°C
contact wires	Pt clad Ni-wire, length approx. 10 mm - 20 mm
dimensions	ø from about 2 mm, length depending on diameter
response time	from about 20 s, depending on the dimensions and construction air stream (v = 2m/s): $t_{0.9}$ = 20.0 s

M-MG

Measuring resistor M-MG

construction	platinum thin-film resistor fitted in a glass housing with contact wires; cylindrical shape, round sensor tip
measuring range	-50°C ... +400°C | +500°C
contact wires	Pt clad Ni-wire, length approx. 10 mm - 15 mm
dimensions	ø from about 1.6 mm, length depending on diameter
response time	from about 10 s, according to dimensions air stream (v = 1 m/s): $t_{0.9}$ = 10.0 s

M-KK

Measuring resistor M-KK

construction	Platinum wire wound around a spindle, insulated with ceramics; cylindrical shape, round sensor tip
measuring range	-200°C ... +600°C | +800°C
contact wires	Pt clad Ni-wire, length approx. 10 mm - 20 mm
dimensions	ø from about 0.8 mm, length depending on diameter
response time	from about 12 s, according to dimensions air stream (v = 2 m/s): $t_{0,9}$ = 12.0 s

Rev. 20180108

M-GL

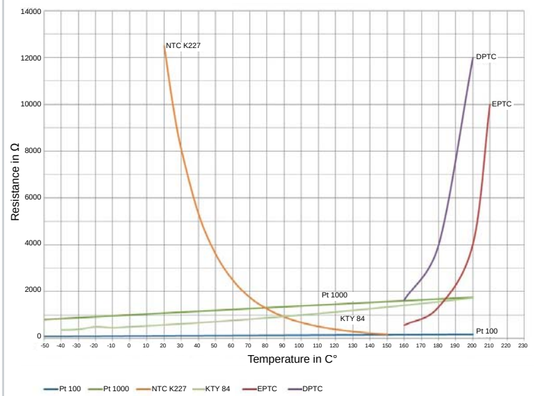
Measuring resistor M-GL

Model I) Platinum wire wound around a glass spindle; it is fitted with contact wires and sealed in hardened glass, cylindrical shape, round sensor tip

Model II) Platinum wire wound around a glass spindle; it is fitted with pull-relieved contact wires and sealed in soft glass, cylindrical shape

measuring range	-200°C ... +400°C
contact wires	Pt clad Ni-wire, length approx. 10 mm - 15 mm
dimensions	ø from about 1.3 mm, length depending on diameter
response time	from about 23 s, according to dimensions air stream (v = 2m/s): $t_{0,9}$ = 23.0 s

Characteristic curves of resistors and semiconductors



11.
SLOT RESISTANCE THERMOMETERS NWT

To ensure safe operation and a long service life, electrical machines must be protected against permanent thermal overload. Protective systems based on thermometers, such as slot resistance thermometers and the corresponding actuating devices, are used for this purpose.

Slot resistance thermometers (NWT) are installed in the winding slots of electric motors and generators. Special versions can also be used on planar and curved surfaces due to their flexibility and shape.

In general

Depending on the design, a distinction is made between slot resistance thermometers (NWT) with bifilar winding (carrier body with applied platinum wire winding) and chip slot resistance thermometers (with built-in thin-film measuring resistor). Depending on the application, the versions are designed as rigid, flexible or as highly flexible slot resistance thermometers.

Usually, the sensor designs are relatively tolerant to mechanical loads and deformation. The thermometers are resistant to vacuum impregnation and are insulated to high voltages. Therefore it is possible to integrate the thermometers in the assembly of the machines during the production process. By using additional insulating materials, the dielectric strength can be further increased. Finally, the motor winding is impregnated together with the integrated slot resistance thermometer.

All sensor dimensions can generally be customized. This ensures a perfect match with the slot sizes. The direct integration and installation of thermometers into the slots allows continuous temperature control and therefore the use of motors at optimized operating condition close to the limit. The temperature control increases the optimal power efficiency.

All thermometers can be ordered in 3- or 4-wire circuit to avoid measurement errors due to long cables. The additional wires enable compensation of the cable resistances and increase the accuracy of the measurement. To fulfill measuring redundancy, two independent thermometer wirings can be used. Certified configurations are available for use in hazardous areas.

12.
SLOT RESISTANCE THERMOMETERS NWT BIFLAR

Slot resistance thermometers with bifilar measuring winding allow the determination of temperature over the entire active length of the measuring winding. Optimum measurement results are obtained by adapting the dimensions to the respective slot design of electric motors or generators. The low heat capacity guarantees an almost instantaneous thermal coupling. For technical reasons, the platinum wire itself is wound with glass fibre twice.

Customized configurations

The different versions of bifilar wound slot resistance thermometers support particularly the special requirements of high-voltage machines. The wide range of possible thermometer sizes allows the adaptation to almost any engine size. The measuring winding is fed with the lowest possible measuring current. The bifilar winding prevents the occurrence of induced voltages, which could lead otherwise to measurement errors. The thermometers are usually designed as Pt100.

Slot resistance thermometers with bifilar measuring winding made of platinum wire (alternatively Ni or Cu wire) allow the temperature detection over the complete length of the detector whereas slot resistance thermometers with chip sensors determine the temperature locally at the point of their installation in the slot. As a result, the temperature within the slot is monitored as a whole. The thermometers can be designed as single (1x Pt100) or double slot thermometers (2x Pt100).

Versions of bifilar wound NWT's

NWT-SH
flexible slot resistance thermometer made of hard glass fibre

NWT-ST
rigid slot resistance thermometers with mica insulation made of Phlogopit

NWT-ST / ZS
rigid slot resistance thermometer stabilized by glass fibre

NWT-A
shielded, rigid slot resistance thermometers (with Cu-braid)

NWT-DSH / A
shielded, flexible slot resistance thermometer with shrinking tube insulation (with Cu-braid)

NWT-FLEX
highly flexible slot resistance thermometer (without carrier body)

NWT-F
extremely thin foil resistance thermometer (without bifilar winding)

The respective technical specifications and special features are described in detail in the following sections.

N W T - S H

Flexible slot resistance thermometer with shrinking tube insulation. The glass fibre insulated platinum wire is bifilar wound around a carrier body to form a measuring winding. It is placed in an insulating pre-formed housing made of flexible hard glass fibre and sealed with casting compound. The NWT and its cable outlet are covered with a single or double PTFE shrinking tube insulation depending on the required dielectric strenght. The connection lines are joined in a 2-, 3- or 4-wire circuit on to the measuring winding in a strain relieved manner. The temperature is measured at about 2/3 of the sensor length.

Features

- flexible design allows adaptation to slot unevenness
- bending radius > 100 mm
- as single or double Pt100 version available
- patented strain relief between sensor and supply line
- pressure released measuring winding
- vacuum impregnation resistant

General technical data

measuring range
-60°C ... +200°C // Ex: +180°C

mode of connection
2-, 3-, 4- wire circuit

tolerance class
AA, A, B (acc. DIN EN 60751)

sensor insulation
silicon or expoxy hard glass fibre, single Teflon® (PTFE / FEP) shrinking tube (ESH), double shrinking tube (DSH)

dielectric strength
0.5 kV to 3.2 kV / AC 50 Hz / 1 min. (ESH)
0.5 kV to 5 kV / AC 50 Hz / 1 min. (DSH)

supply line

E1	single litzes
Sx	hose line with x single litzes
Gx	screened hose line with x single litzes
FSx	flat hose line with x single litzes
VL	stranded line

material
PTFE / FEP or peek connection line

cross section
AWG26 to AWG20

dimensions

thickness	from	2 mm ± 0.3 mm
width	from	7 mm ± 0.5 mm
length	from	80 mm ± 5 mm

Certificates

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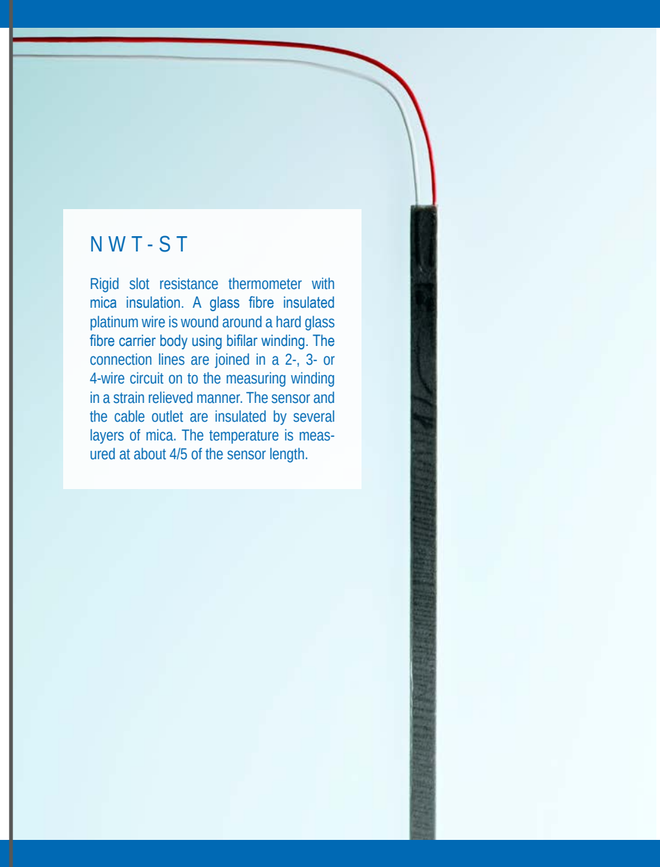

N W T - S T

Rigid slot resistance thermometer with mica insulation. A glass fibre insulated platinum wire is wound around a hard glass fibre carrier body using bifilar winding. The connection lines are joined in a 2-, 3- or 4-wire circuit on to the measuring winding in a strain relieved manner. The sensor and the cable outlet are insulated by several layers of mica. The temperature is measured at about 4/5 of the sensor length.

Features

- good dielectric strength through mica insulation
- construction height starting with 1 mm thickness
- single and double versions available
- optionally with platinum, copper or nickel measuring winding
- vacuum impregnation resistant

General technical data

measuring range
-60°C ... +200°C // Ex: +180°C

mode of connection
2-, 3-, 4- wire circuit

tolerance class
A, B (acc. DIN EN 60751)

sensor insulation
phlogopit mica

dielectric strength
0.5 kV to 2.5 kV / AC 50 Hz / 1 min.

supply line

E1	single litzes
Sx	hose line with x single litzes
Gx	screened hose line with x single litzes
FSx	flat hose line
VL	stranded line

material
PTFE / FEP , Peek or silicone connection line

cross section
AWG30 to AWG20

dimensions

thickness	from	1 mm ± 0.3 mm
width	from	5 mm ± 0.5 mm
length	from	60 mm ± 2 mm

Certificates

N W T - S T / Z S

Rigid slot resistance thermometer stabilized by glass fibre. For this sensor a platinum wire is bifilar wound around a hard glass fibre carrier body to form a measuring winding. The special strain relieved mounted connection line is available in 2-, 3- or 4- wire circuit. The inner carrier body is insulated by several layers of mica paper.

The slot resistance thermometer is laminated with woven glass fibre which is soaked in resin to increase the mechanical stability. This design provides greater rigidity to the carrier body. Therefore the sensor can be inserted into the slot without damage - even at increased pressure.

Features

- rigid, mechanically extremely robust design
- suitable for „hammering“ the thermometer into the slot
- wedge design available
- particularly suitable for subsequent mounting
- single and double thermometers available

General technical data

measuring range
-60°C ... +200°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit
tolerance class
B (acc. DIN EN 60751)
sensor insulation
mica, glass fibre
dielectric strength
0.5 kV to 3 kV / AC 50 Hz / 1 min.

supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes
FSx flat hose line
VL stranded line
material
PTFE / FEP connection line
cross section
AWG26 to AWG20
dimensions

thickness	from	2.3 mm ± 0.3 mm
width	from	8 mm ± 0.3 mm
length	from	100 mm ± 5 mm

Certificates

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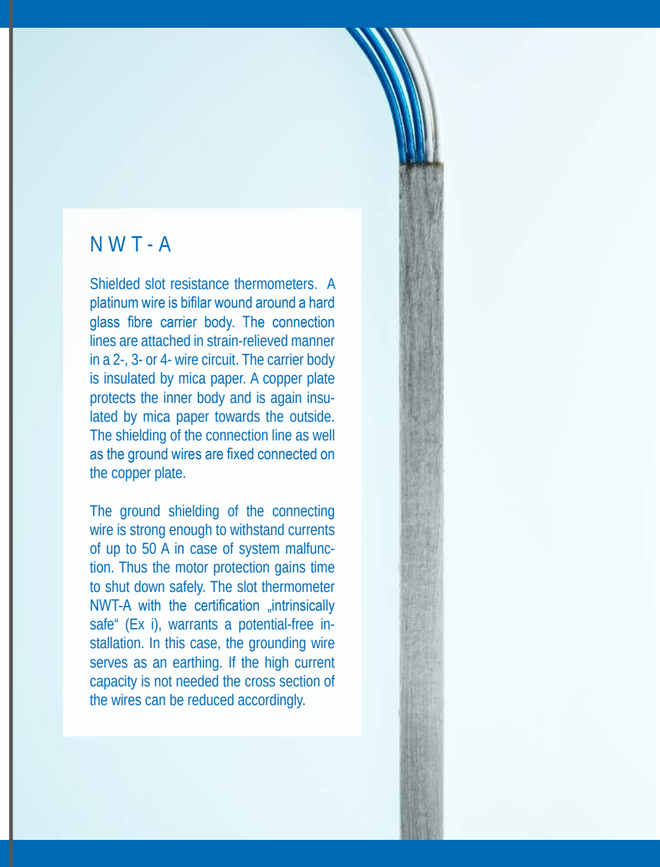


N W T - A

Shielded slot resistance thermometers. A platinum wire is bifilar wound around a hard glass fibre carrier body. The connection lines are attached in strain-relieved manner in a 2-, 3- or 4- wire circuit. The carrier body is insulated by mica paper. A copper plate protects the inner body and is again insulated by mica paper towards the outside. The shielding of the connection line as well as the ground wires are fixed connected on the copper plate.

The ground shielding of the connecting wire is strong enough to withstand currents of up to 50 A in case of system malfunction. Thus the motor protection gains time to shut down safely. The slot thermometer NWT-A with the certification „intrinsically safe“ (Ex i), warrants a potential-free installation. In this case, the grounding wire serves as an earthing. If the high current capacity is not needed the cross section of the wires can be reduced accordingly.

Features

- completely shielded design (sensor and cable)
- current carrying capacity of the shield up to 50A
- with ground wire
- copper braid shielding
- vacuum impregnation resistant

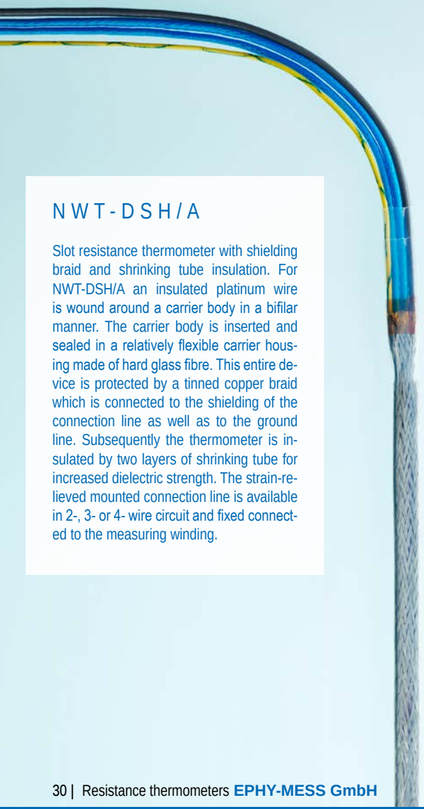
General technical data

measuring range
-60°C ... +200°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit
tolerance class
A, B (acc. DIN EN 60751)
sensor insulation
phlogopit mica
shielding
sensor: copper braid
wire: silver-plated copper braid
max. current intensity
50 A
dielectric strength
0.5 kV to 2.5 kV / AC 50 Hz / 1 min

supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes
VL stranded line
material
PTFE / FEP connection line
cross section
AWG26 to AWG20
ground wire
a) standard ground wire on the same side as connection line
b) special ground wire on the opposite side of connection line
cross section AWG14 and AWG20
dimensions

thickness	from	2.5 mm ± 0.3 mm
width	from	8 mm ± 0.5 mm
length	from	150 mm ± 3 mm

Certificates



NWT-DSH/A

Slot resistance thermometer with shielding braid and shrinking tube insulation. For NWT-DSH/A an insulated platinum wire is wound around a carrier body in a bifilar manner. The carrier body is inserted and sealed in a relatively flexible carrier housing made of hard glass fibre. This entire device is protected by a tinned copper braid which is connected to the shielding of the connection line as well as to the ground line. Subsequently the thermometer is insulated by two layers of shrinking tube for increased dielectric strength. The strain-relieved mounted connection line is available in 2-, 3- or 4- wire circuit and fixed connected to the measuring winding.

Features

- flexible design, allows adaption to slot unevenness
- patented strain relief between sensor and cable
- pressure-compensated measuring winding

General technical data

measuring range
-60°C ... +180°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit
tolerance class
A, B (acc. DIN EN 60751)
sensor insulation
Teflon® shrinking tube (PTFE / FEP)
shielding
silver-plated copper braid
max. current intensity
6 A
dielectric strength
0.5 kV to 3 kV / AC 50 Hz / 1 min.

supply line
G1 shielded single litz wires, fixed connected, copper silver plated / PTFE
Gx screened hose line with x single litzes
Sx hose line with x single litzes
material
PTFE / FEP connection line
cross section
AWG26 to AWG20
ground wire
single litz wires, fixed connected
copper silver plated / PTFE, AWG20
dimensions

thickness	from	2.7 mm ± 0.5 mm
width	from	9 mm ± 0.5 mm*)
length	from	150 mm ± 2 mm

*) max. dimensions at cable entry +2 mm

Certificates

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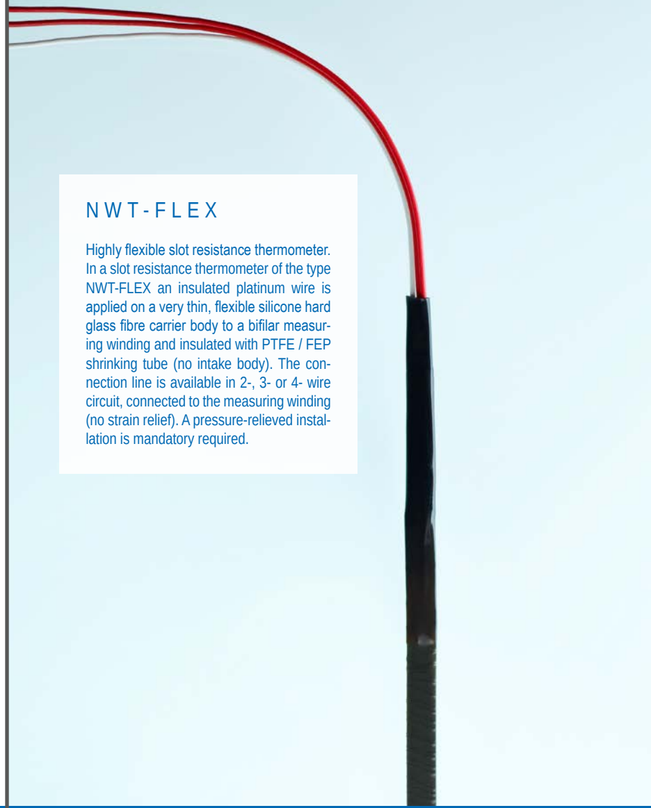


NWT-FLEX

Highly flexible slot resistance thermometer. In a slot resistance thermometer of the type NWT-FLEX an insulated platinum wire is applied on a very thin, flexible silicone hard glass fibre carrier body to a bifilar measuring winding and insulated with PTFE / FEP shrinking tube (no intake body). The connection line is available in 2-, 3- or 4- wire circuit, connected to the measuring winding (no strain relief). A pressure-relieved installation is mandatory required.

Features

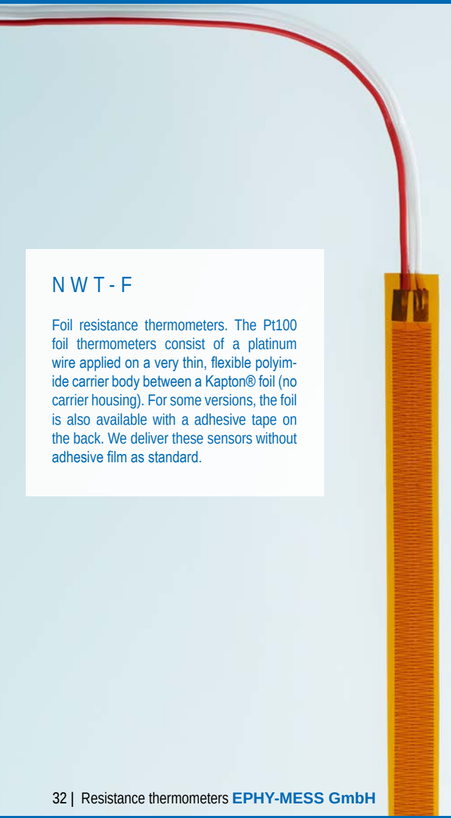
- highly flexible design, extremely adjustable to slot unevenness
- very thin installation height from approx. 1.2 mm thickness available
- simple, optimized cost structure
- must be installed with absolutely no tensile and pressure loading

General technical data

measuring range
-60°C ... +180°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit
tolerance class
B (acc. DIN EN 60751)
sensor insulation
Teflon® shrinking tube (PTFE / FEP)
Kynar® shrinking tube (PVDF)
dielectric strength
0.5 kV to 1.5 kV / AC 50 Hz / 1 min.
supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes
FSx flat hose line
VL stranded line

material
PTFE / FEP connection line
cross section
AWG30 to AWG20
dimensions

thickness	from	1.2 mm ± 0.3 mm
width	from	4 mm ± 0.3 mm
length	from	100 mm ± 5 mm



N W T - F

Foil resistance thermometers. The Pt100 foil thermometers consist of a platinum wire applied on a very thin, flexible polyimide carrier body between a Kapton® foil (no carrier housing). For some versions, the foil is also available with a adhesive tape on the back. We deliver these sensors without adhesive film as standard.

Features

- flexible, very thin construction
- very short response time
- easy assembly also single-sided adhesive
- for small and inaccessible places
- for slightly curved surfaces
- various cable versions can be soldered to the single litzes for extension

General technical data

measuring range
-200°C ... +200°C // -20°C ... +177°C

mode of connection
2-, 3-, 4- wire circuit

sensor insulation
Kapton® foil

insulation resistance
$R_{(is)}$ > 10 MΩ / 500 V DC

supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes

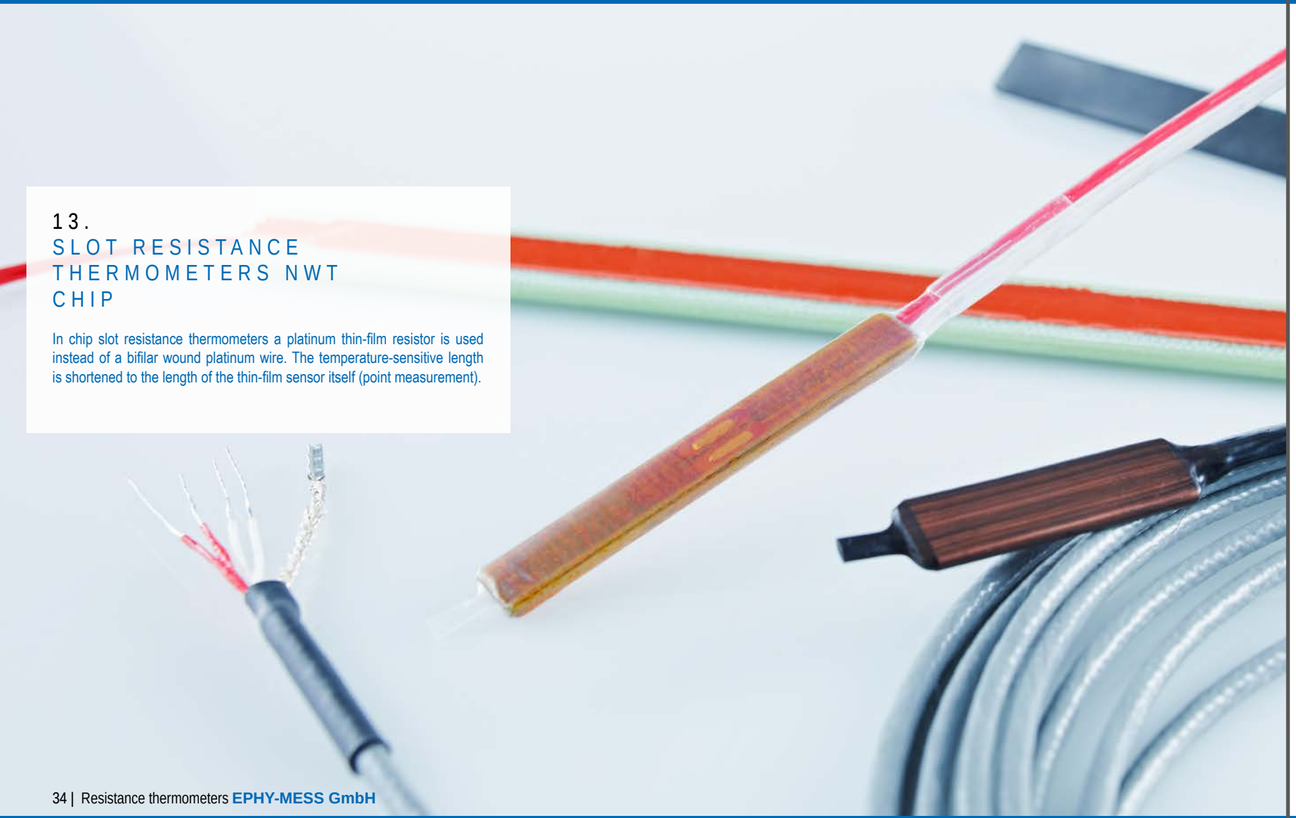
material
PTFE / FEP connection line

cross section
AWG28

dimensions
version A
thickness 0.7 mm / 0.8 mm (with adhesion)
width 8 mm ± 0.8 mm
length 8 mm ± 0.8 mm
version B
thickness 2 mm ± 0.5 mm
width 10 mm ± 0.8 mm
length 102 mm ± 0.8 mm

Rev. 20180108

Space for your notes



13.
SLOT RESISTANCE THERMOMETERS NWT CHIP

In chip slot resistance thermometers a platinum thin-film resistor is used instead of a bifilar wound platinum wire. The temperature-sensitive length is shortened to the length of the thin-film sensor itself (point measurement).

Customized configurations

Chip slot resistance thermometers (Chip-NWT) offered by EPHY-MESS are used in the slot of the stator winding of electric machines. Beside bifilar wound slot resistance thermometers (average value sensors) chip slot resistance thermometers have become an alternative to measure the temperature of constructively known hotspots (point measurement).

In this product, a platinum thin-film measuring resistor type M-OK is used instead of a bifilar wound platinum wire. Normally Pt100 and Pt1000 chip measuring resistors are used. For most measurement applications this is completely sufficient, because requirements mostly refer to the design (slot) and not to the active measuring length. Their low net weight and small dimensions allow very fast response times. In addition, high nominal values can also be achieved concurrent with the smallest dimensions. Alternatively, thermocouples, PTC or NTC thermistors as well as KTY silicon sensors can be used as measuring elements.

Almost every thermometer version (except NTC) is also deliverable in certified versions according to IECEx and ATEX or according to TR-, UL/CSA regulations. Generally these thermometers can be also used for all measurements on surfaces or in measuring locations difficult to access.

Versions of Chip-NWTs

M-OK / AK
flexible chip-type NWT contained in silicone carrier housing

M-OK / ZS
rigid, extremely solid chip-type NWT cast into an epoxy intermediate slider case

M-OK / KS
flexible, extremely thin chip-type NWT in moulded PESU housing

Multispot
thermometer with multiple chip measuring resistors

The respective technical specifications and special features are described in detail in the following sections.

M-OK/AK

Flexible chip slot resistance thermometer in carrier housing. For this temperature sensor type M-OK/AK a platinum thin-film measuring resistor is directly connected to the supply line and is mounted pressure-compensated in a carrier housing made of silicone hard glass fibres. Covered with a small plate and sealed with cold curing silicone the sensor can be insulated with a PTFE shrinking tube and Kapton® foil.

Features

- adjustable to almost each slot dimension
- bending radius > 100 mm at a length starting from 150 mm
- resistant to loads such as shock, vibration and pressure
- resistant against standard impregnation, curing or drying processes

General technical data

measuring range
-60°C ... +180°C // Ex: +180°C

mode of connection
2-, 3-, 4- wire circuit

tolerance class
AA, A, B (acc. DIN EN 60751)

sensor insulation
silicone hard glass fibre carrier body, Teflon® shrinking tube (PTFE / FEP), Kynar® shrinking tube (PVDF), Kapton® foil

dielectric strength
0.5 kV to 5 kV / AC 50 Hz / 1 min.

supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes
FSx flat hose line
VL stranded line

material
PTFE / FEP, silicone or peek connection line

cross section
AWG30 to AWG20

dimensions

thickness	from	2 mm ± 0.3 mm
width	from	5 mm ± 0.3 mm
length	from	30 mm ± 3 mm

Certificates

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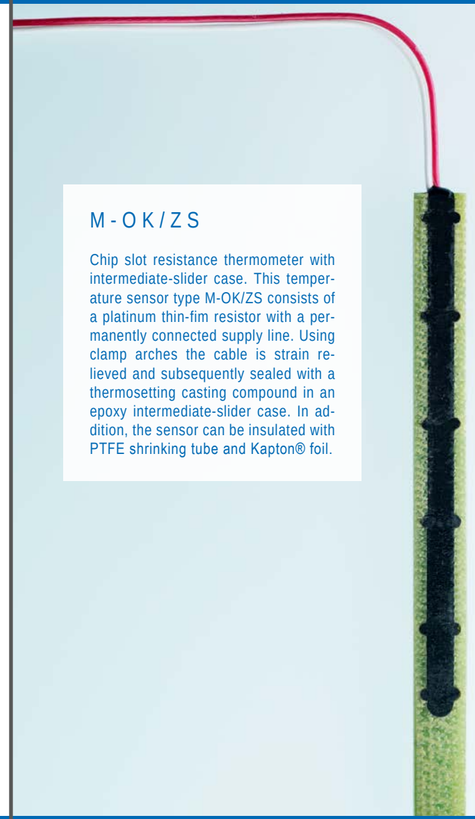


M-OK/ZS

Chip slot resistance thermometer with intermediate-slider case. This temperature sensor type M-OK/ZS consists of a platinum thin-fim resistor with a permanently connected supply line. Using clamp arches the cable is strain relieved and subsequently sealed with a thermosetting casting compound in an epoxy intermediate-slider case. In addition, the sensor can be insulated with PTFE shrinking tube and Kapton® foil.

Features

- very robust version
- resistant to mechanical loads
- resistant to loads such as shock, pressure and vibration
- particularly suitable for subsequent mounting

General technical data

measuring range
-60°C ... +250°C // Ex: +180°C

mode of connection
2-, 3-, 4- wire circuit

tolerance class
AA, A, B (acc. DIN EN 60751)

sensor insulation
hard glass fibre, optional with Kynar® shrinking tube (PVDF), Kapton® foil

dielectric strength
0.5 kV to 3 kV / AC 50 Hz / 1 min.

supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes
FSx flat hose line
VL stranded line

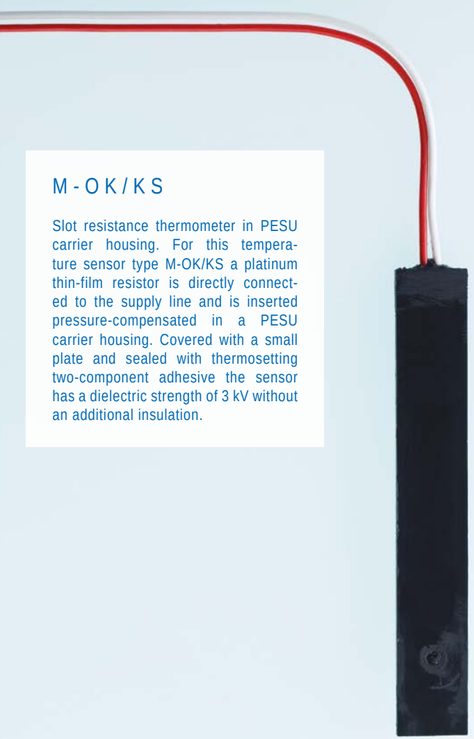
material
PTFE / FEP, peek, radox or silicone connection line

cross section
AWG30 to AWG22

dimensions

thickness	from	1.5 mm ± 0.3 mm
width	from	6 mm ± 0.3 mm
length	from	20 mm ± 3 mm

Certificates



M-OK/KS

Slot resistance thermometer in PESU carrier housing. For this temperature sensor type M-OK/KS a platinum thin-film resistor is directly connected to the supply line and is inserted pressure-compensated in a PESU carrier housing. Covered with a small plate and sealed with thermosetting two-component adhesive the sensor has a dielectric strength of 3 kV without an additional insulation.

Features

- cost-effective versions
- for mounting directly in the slots of electrical motors and generators
- high insulation properties
- fast thermal response time

General technical data

measuring range
-60°C ... +180°C // Ex: +180°C

mode of connection
2-, 3- wire circuit

tolerance class
AA, A, B (acc. DIN EN 60751)

sensor insulation
polyethersulfone (PESU) plastic moulded housing

dielectric strength
0.5 kV to 3 kV / AC 50 Hz / 1 min.

supply line

E1	single litzes
Sx	hose line with x single litzes
Gx	screened hose line with x single litzes
FSx	flat hose line

material
PTFE / FEP or peek connection line

cross section
AWG30 to AWG24

dimensions
version A

thickness	2 mm ± 0.2 mm
width	10 mm ± 0.2 mm
length	65 mm ± 1 mm

version B

thickness	2 mm ± 0.2 mm
width	8 mm ± 0.2 mm
length	100 mm ± 1 mm

Certificates

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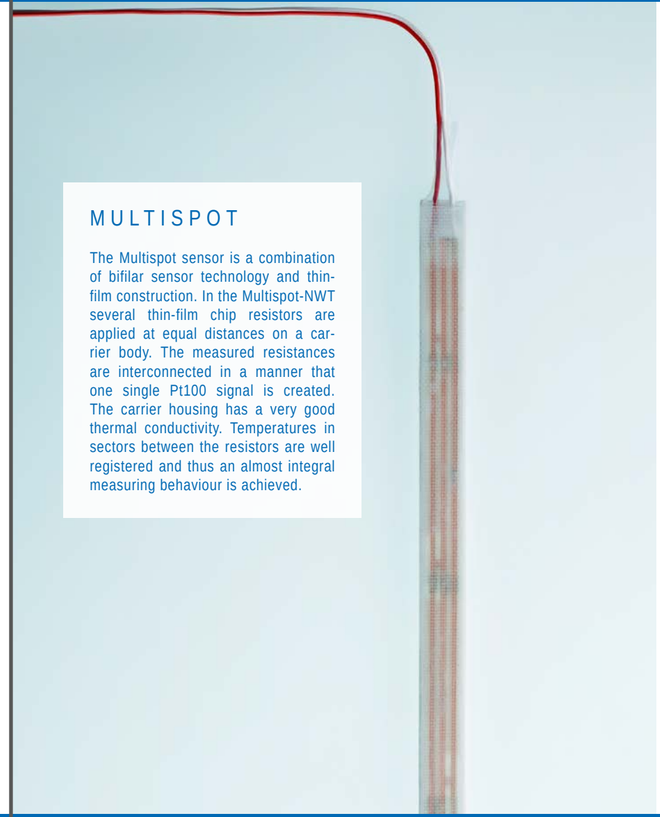


MULTISPOT

The Multispot sensor is a combination of bifilar sensor technology and thin-film construction. In the Multispot-NWT several thin-film chip resistors are applied at equal distances on a carrier body. The measured resistances are interconnected in a manner that one single Pt100 signal is created. The carrier housing has a very good thermal conductivity. Temperatures in sectors between the resistors are well registered and thus an almost integral measuring behaviour is achieved.

Features

- 4x Pt-chip sensors installed
- active measuring length is nearly equal to installation length
- housing from 2 mm thickness and 7 mm width
- two standard versions available, with sensor lengths of 100 mm and 1000 mm
- optional with shielding

General technical data

measuring range
-50°C ... +200°C

mode of connection
2-, 4- wire circuit

tolerance class
AA, A, B (acc. DIN EN 60751)

sensor insulation
silicone hard glass fibre

dielectric strength
0.5 kV to 3 kV / AC 50 Hz / 1 min.

supply line

E1	single litzes
Sx	hose line with x single litzes
G1	screened hoseline
FSx	flat hose line
VL	stranded line

material
PTFE / FEP connection line

cross section
AWG30/7 to AWG20/7

dimensions
version A

thickness	2 mm ± 0.6 mm
width	7 mm ± 0.3 mm
length	100 mm ± 2 mm

version B

thickness	2 mm ± 0.6 mm
width	10 mm ± 0.3 mm
length	500 mm ± 2 mm

14.
SCREW-IN RESISTANCE THERMOMETERS LTH

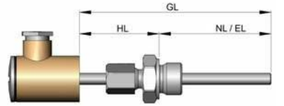
The group of screw-in resistance thermometers includes various thermometers in different housing types. The spectrum ranges from simple screw-in housings with connection wire, over fixed or moveable screw connections up to various connection heads with protection sheath and different process fittings. Using fixed or shiftable screw connections the thermometers are individually adjustable to their installation position and can be assembled simply and quickly. The screw connections can be designed with PTFE clamp ring or with stainless steel cutting ring.

In general

As standard Pt100 measuring resistors according to DIN EN 60751 are used. Versions with Pt500 or Pt1000 resistors are also commonly applied. Transmittters can also be integrated in the connection head. Thermocouples, PTC or NTC thermistors as well as KTY silicon sensors can also be used as measuring elements.

Application areas include temperature monitoring of bearings, temperature measurement in containers and pipelines, particularly in plant construction, in laboratory applications, in the chemical industry as well as in hazardous areas. The resistance thermometers can also be realized as a waterproof sheath resistance thermometer (WT-MI) with bendable, flexible mineral insulated line (MI) and with an operating temperature range from -200°C to +600°C.

Relevant dimensions of screw-in thermometers with connection head are:



Total length (GL)
length from the bottom edge of the protection tube to the bottom edge of the connection head.

Neck tube length (HL)
length from the bottom edge of the head to the seal.

Installation length / Nominal length (EL / NL)
length from the seal to the bottom edge of the protection tube.

The following materials are available:
Head: brass, stainless steel, aluminium, plastic
Protection tube: stainless steel, plastic
Screw connection (VSB): stainless steel, plastic

Deliverable standard designs

Screw-in resistance thermometers with
connection heads acc. to DIN EN 50446
connection heads EM12 / 18 / 24 / 38
screw-in housing
bayonet lock
industry plug
redundant sensors

15.
CONNECTION HEADS ACCORDING TO DIN EN 50446

These sensors are plug-in or screw-in resistance thermometers with a stainless steel protection tube and connection heads in accordance with DIN EN 50446. The sensors are manufactured with permanently installed measuring resistors or replaceable mineral-insulated measuring inserts. In general connection heads type A, B and MA are used as standard types. Connection heads of the shape BUS and BUZ are also available for special applications.

In general

Plug-in or screw-in resistance thermometers with connection heads according to DIN EN 50446 are universally applicable for industrial applications and temperature measurement in solid or liquid media.

The large screw-in thermometers with DIN connection head type A or B are mainly used in chemical industry and plant engineering. These are deliverable in various configurations, e.g. with an exchangeable measuring insert or with mineral-insulated protection tubes. Spring-loaded thermometers with connection head B are installed and tested in gears of wind power plants.

They are equipped with a stainless steel protection sheath (ø 8 mm) and cable outlet with PG16 flange. Thread sizes range from M10 to G1". The thermometer can be equipped with 1 or 2 permanent connected measurement circuits or with changeable measuring insert in 2-, 3- or 4-wire circuit. Temperature range extends up to +600°C. Depending on the application other connection heads are available e.g. made of stainless steel or plastics or with two process connections. Single or double thermometers can be manufactured.

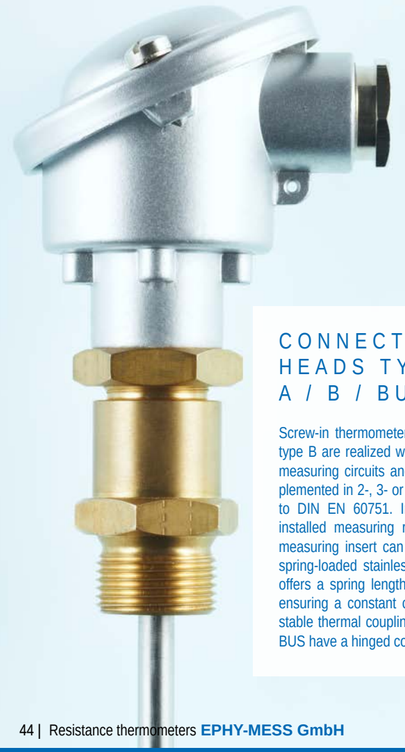
Versions of screw-in thermometers with DIN connection heads acc. DIN EN 50446

LTH-xyz
screw-in thermometers with standard connection heads type A, B, BUS, BUZ

LTH-MA
screw-in thermometers with smaller connection heads type MA

Suitable screw connections with metric or conical threads are available for all protective sheath diameters. On request, supply lines can also be installed in the connection head. Corrugated tubings made of plastic or metal function as a mechanical protection of the connecting cable and are optional available.

The respective technical versions and special features are described in detail in the following sections.



CONNECTION HEADS TYPE A / B / BUS / BUZ

Screw-in thermometer with connection head type B are realized with one or two platinum measuring circuits and can optionally be implemented in 2-, 3- or 4-wire circuit according to DIN EN 60751. Instead of permanently installed measuring resistors a replaceable measuring insert can also be provided. The spring-loaded stainless steel protection tube offers a spring length of more than 15 mm, ensuring a constant contact pressure and a stable thermal coupling. The heads BUZ and BUS have a hinged cover.

Features

- robust construction for the use in rough industrial environment
- resistant to oils, resistant hydraulic fluids, aliphatic hydrocarbons
- O-ring provides reliable sealing
- optional with head transmitter (4 - 20 mA)
- with fixed or shiftable screw connection
- optional with hinged cover and replaceable measuring insert
- also available with thermocouple type J or K

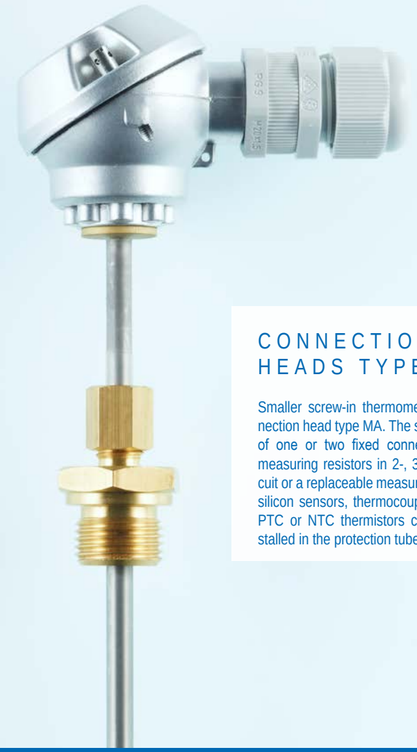
General technical data

measuring range
-60°C ... +400°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit
tolerance class
AA, A, B (acc. DIN EN 60751)
Connection heads
A, B, BUS, BUZ (others upon request)
interior construction
ceramic clamp socket 2 - 8 pole
protection tube
1) with measuring resistor insulated by shrinking tube
2) with mineral-insulated measuring resistor
3) with exchangeable measuring insert and fixed connected clamp socket

dielectric strength
0.5 kV to 2.5 kV / AC 50 Hz / 1 min.
supply line
Sx hose line with x single litzes
Gx screened hose line with x single litzes
optional with head transmitter 0 - 10 V or 4 - 20 mA
material
PTFE / FEP, peek, or silicone connection line
dimensions
protection tube diameter: ø 5 mm ... 12 mm
protection tube length: 40 mm ... 1500 mm
assembly
1) stainless steel screw connection, fixed or shiftable, with PTFE clamp ring, steel or brass cutting ring
2) stainless steel screw-in adapter, fixed
threads
M10x1 / G1/4" / G3/8" / G1/2" / G3/4" / G1" / NPT

Certificates

Rev. 20180108



CONNECTION HEADS TYPE MA

Smaller screw-in thermometers with connection head type MA. The sensors consist of one or two fixed connected platinum measuring resistors in 2-, 3- or 4-wire circuit or a replaceable measuring insert. KTY silicon sensors, thermocouples as well as PTC or NTC thermistors can also be installed in the protection tube.

Features

- small connection head type MA
- with fixed or shiftable screw connection
- optional with head transmitter (4-20 mA)
- also available with thermocouple or KTY measuring elements

General technical data

measuring range
-60°C ... +400°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit
tolerance class
AA, A, B (acc. DIN EN 60751)
Connection heads
type MA with screw cover
interior construction
ceramic clamp socket 2 - 4 pole
protection tube
with shrinking tube insulated measuring resistor
dimensions
protection tube diameter ø 6 mm ... 8 mm
protection tube length 20 mm ... 1000 mm

dielectric strength
0.5 kV to 2.5 kV / AC 50 Hz / 1 min.
supply line
Sx hose line with x single litzes
Gx screened hose line with x single litzes
optional with head transmitter 0 - 10 V or 4 - 20 mA
material
PTFE / FEP, peek, or silicone connection line
assembly
1) stainless steel screw connection, fixed or shiftable, with PTFE clamp ring, steel or brass cutting ring
2) stainless steel screw-in adapter, fixed
threads
M10x1 / G1/4" / G3/8" / G1/2" / G3/4" / G1" / NPT

Certificates

16.
CONNECTION HEADS TYPE EM12/18/24/38

These thermometers are equipped with one or two measuring resistors in a stainless steel protection tube with fixed connection head type EM12 / 18 / 24 / 38 and with an optional connection line. The heads are made of brass, nickel-plated brass or stainless steel. Fixed or shiftable screw connections are available as accessories.

In general

The group of compact screw-in thermometers with connection head consists of thermometers of the type EM12 / EM18 / EM24 / EM38 (LT12 / LT18 / LT24 / LT38). They are often used for control of the bearing temperature in electric motors and generators or in large pumps, also deliverable in a certified Ex-version (ignition protection system type Ex ia, Ex eb or Ex ta) according to IECEx, ATEX, TR or UL/CSA regulations. The code number of the thermometer (12/18/24/38) indicates the outer diameter in mm of the respective connection head without lateral cable connection port.

For screw-in thermometers with connection head type EM, one or two Pt100 measuring resistors are installed in a stainless steel protection tube and optionally equipped with an connecting line. The measuring resistor is electrically isolated against the protection tube and embedded in thermal compound for better thermal coupling. The protection tube is filled with a ceramic filler to increase the shock resistance.

The temperature measurement takes place towards the front area of the protection tube. The cable transition from the sensor to the supply line is located within the sensor head. The supply line is removed axially from the thermometer head. A version with permanent sealed supply line in the sensor head is available on request (Ex-version). The cable connection outlet can be ordered either with or without cover plate. Fixed or shiftable screw connections are available as accessories.

Versions of screw-in thermometers with connection heads type EM-xx

EM12 / EM18 (LT12 / LT18)
screw-in resistance thermometer with compact connection heads type EM12 / EM18

EM24 / EM38 (LT24 / LT38)
screw-in resistance thermometer with lager connection heads type EM24 / EM38

The respective technical versions and special features are described in detail in the following sections.

CONNECTION HEADS EM12/18

The screw-in resistance thermometers with connection head EM12 (LT12) or EM18 (LT18) are generally available with a Pt100 measurement resistor in 2-, 3- or 4-wire circuit. If two Pt100 measuring resistors are installed, a 2-wire circuit is only available because of space reasons. The connecting cable can be equipped with a permanent sealed, straight or angled cable connector. The 4-pole M8 connector (EM12 / LT12) or the M12 connector (EM18 / LT18) are in the centreline and are protected against reverse polarity according to DIN IEC 60947-5-2.

Features

- small and compact connection head
- reverse polarity protected, 4-pole M8 connector (EM12 / LT12) or M12 connector (EM18 /LT18)
- with a permanent sealed, straight or angled cable coupling
- connection heads available in stainless steel or brass

General technical data

measuring range
-30°C ... +160°C
mode of connection
2-, 3,- 4-wire circuit*)
*) 3- and 4-wire circuit only with 1x Pt100
tolerance class
AA, A, B (acc. DIN EN 60751)
connection heads
type EM12 / EM18
interior construction
plastic sealing
dimensions
EM12 (LT12): ø 12 mm, height approx. 25 mm
EM18 (LT18): ø 18 mm, height approx. 25 mm
protection tube
stainless steel, bare or shrinking tube insulation

dimensions
protection tube diameter: ø 5 mm ... 12 mm
protection tube length: 20 mm ... 1000 mm
dielectric strength
0.5 to 1.5 kV / AC 50 Hz / 1 min
supply line
Sx hose line with x single litzes
Gx screened hose line with x single litzes
material
silicone or PTFE / FEP connection line
cross section
AWG30 to AWG22
plug connector
4-pole M8-connector (EM12 / LT12)
4-pole M12-connector (EM18 / LT18)
reverse polarity protection according
DIN IEC 60947-5-2

Rev. 20180108

CONNECTION HEADS EM24/38

Screw-in resistance thermometers with compact connection heads EM24 / 38 (LT24 / 38) can be easily attached at the measuring point by screw socket or by flange. One can choose between brass, nickel-plated brass or stainless steel connection heads.

Features

- 6- or 8-wire circuit for 2x Pt100 versions (only EM38 / LT38)
- clamp socket or fixed connected supply lines
- M12 round connector with screw connection (EM24 / LT24)
- connection heads available in stainless steel, brass or nickel-plated brass
- special version EM24 N (height of the head only 22 mm)

General technical data

measuring range
-60°C...260°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit*) / 6- or 8-wire circuit (EM38)
*) 3- und 4- wire circuit not with
2x Pt100 combined with EM24 head
tolerance class
AA, A, B (acc. DIN EN 60751)
connection heads
type EM24 / EM38
interior construction
platics clamp socket, sealed
dimensions head
EM24 (LT24): ø 24 mm, height approx. 36 mm
EM38 (LT38): ø 38 mm, height approx. 38 mm
protection tube
stainless steel, bare or insulated by shrinking tube

dimensions tube
protection tube diameter: ø 5 mm ... 12 mm
protection tube length: 20 mm ... 1000 mm
dielectric strength
0.5 kV to 2.5 kV / AC 50 Hz / 1 min.
supply line
Sx hose line with x single litzes
Gx screened hose line with x single litzes
material
silicone or PTFE connection line
cross section
AWG30 to AWG22
assembly
1) stainless steel screw connection,
fixed or shiftable, with PTFE clamp ring,
steel or brass cutting ring
2) stainless steel screw-in adapter, fixed
threads
M10x1 // G1/4" // G3/8" // G1/2" // G3/4" // G1"

Certificates

17.
INDUSTRIAL PLUG RESISTANCE THERMOMETERS

Screw-in resistance thermometers with industrial plug allow a very easy installation and have proven to be excellent e.g. in wind turbines or agricultural machinery.

Version with spring-loaded protection tube

Version with special immersion sheath

In general

Screw-in thermometers with plastic industrial plug connectors are an alternative to sensors with metal-based connection heads. They are also used as standard thermometers for bearing temperature measurement and for temperature measurement in liquid media.

The connection head can be released easily from the mounted sensor by loosening the central screw without disconnecting the attached cables. Industrial plug connectors are protected against reverse polarity.

In wind power plants they monitor hydraulic drives e.g. the pitch or azimuth adjustment of rotor blades and nacelles. These thermometers are also used in tractors.

Features

- temperature range from -60°C ... +260°C
- compact connection head (28 x 28 x 50 mm)
- quick release without disconnecting the cable
- reverse polarity protection
- optional with spring-loaded protection tube

General technical data

measuring range
-60°C ... +260°C // sensor head -30°C ... +90°C
mode of connection
2-, 3- wire circuit
tolerance class
AA, A, B (acc. DIN EN 60751)
sensor insulation
stainless steel sleeve
dimensions sleeve
protection tube diameter: ø 5 mm ... 12 mm
protection tube length: 20 mm ... 1000 mm
connection head
Hirschmann plug,
PG screw connection

connection line
Sx hose line with x single litzes
cross section
AWG30 to AWG20
spring-loaded version
thread G1/2"

width across flats	27 mm
nominal length	128 mm
total length	150 mm
spring load	15 mm

version special immersion sheath
thread G1/4"

width across flats	27 mm
nominal length	213 mm
total length	235 mm
pressure resistance	100 bar

18.
CABLE RESISTANCE THERMOMETERS WKF

Cable resistance thermometers are frequently used solutions for the handling of various temperature measurement tasks. Assembled with shrinking tube, metal sleeve or ceramic sleeve they are mainly used in lower temperature ranges from -40°C to 260°C. In addition, special versions with an operating temperature of up to 400°C are also part of the EPHY-MESS portfolio. Thin-film or wire-wound Pt100 platinum measuring resistors according to DIN EN 60751 are used as basic measuring elements. Other nominal values (e. g. 500 Ω, 1000 Ω) or other resistive materials (e. g. Ni, Cu) are available upon request. Also thermocouples, PTC or NTC thermistors as well as KTY silicon sensors can be used as measuring elements.

In general

EPHY-MESS offers you a wide range of cable resistance thermometers.

Applications are e. g.
- temperature control in coil or slot of electric machines
- temperature measurements in laboratories and testing facilities
- temperature measurements of air, water and solids
- temperature measurements in hazardous areas

Operating conditions for these sensors are really diverse. For the above mentioned areas of application we also offer water-resistant cable thermometers for use in liquids, as well as extra high-voltage resistant sensors (up to 7 kV) for direct use in special high-voltage machines.

EPHY-MESS manufactures tailor-made sensors according customers requirements. The following cable thermometers are available as standard version:

Versions of cable resistance thermometers

M-OK / ESH
cable resistance thermometer with single shrinking tube insulation

M-OK / DSH
cable resistance thermometer with double shrinking tube insulation

M-OK / MH
cable resistance thermometer with metal sleeve

M-OK / KH
cable resistance thermometer with ceramic sleeve

M-OK / DSH-SIT
cable resistance thermometer with electrically protective separation acc. to DIN EN 61800-5-1 and DIN EN 50178

M - O K / E S H
M - O K / D S H

Cable resistance thermometer with shrinking tube insulation. For this thermometer, one or two platinum measuring resistors are crimped, hard or soft soldered on the connection cable and insulated with a shrinking tube. Depending on the application, the thermometers are single (ESH) or double (DSH) insulated with shrinking tubes made of Kynar®, Kynarflex® or PTFE.

Features

- measuring resistors crimped, hard ord soft soldered to connection line
- universal applications
- high voltage-resistant insulation
- waterproof version available (IP66)

General technical data

measuring range
-60°C ... +260°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit
tolerance class
AA, A, B (acc. DIN EN 60751)
sensor insulation
Teflon® shrinking tube (PTFE / FEP),
Kynar® / Kynarflex® shrinking tube (PVDF)
glass fibre filament tube (LGLS)
dielectric strength
0.5 kV to 1.5 kV / AC 50 Hz / 1 min. (ESH)
0.5 kV to 5 kV / AC 50 Hz / 1 min. (DSH)

supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes
FSx flat hose line with x single litzes
VL stranded line
material
PTFE / FEP, peek or silicone connection line
cross section
AWG30 to AWG18
dimensions
diameter from approx. ø 2 mm
length from approx. 20 mm
special versions
up to 7 kV available

Certificates

Rev. 20180108

M - O K / M H

Cable resistance thermometer with metal sleeve. In this design, one or two platinum measuring resistors are connected to the supply line by soldering (hard / soft soldering). In this case, the two soldering joints are insulated against each other and the measuring resistor is insulated against the sleeve. The sensor is then assembled with heat conductive paste in a metallic protection sleeve made of brass or stainless steel. The sensor is fixed connected to the supply line by press squeeze, roll squeeze or casting.

Features

- measuring resistor protected by metal sleeve
- 1x Pt100 or 2x Pt100 measuring resistors integrated
- waterproof design available (IP66)
- versatile usability, thanks to the variable dimensions
- oil and water resistant versions available

General technical data

measuring range
-60°C ... +260°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire circuit
tolerance class
AA, A, B (acc. DIN EN 60751)
sensor insulation
stainless steel or brass*) protection sleeve
*) not available for all dimensions
dielectric strength
0.5 kV to 2.5 kV / AC 50 Hz / 1 min.

supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes
VL stranded line
material
PTFE / FEP, peek or silicone connection line
cross section
AWG30 to AWG18
cable connection
press squeeze, roll squeeze, casting
dimensions
diameter from approx. ø 2 mm
length from approx. 20 mm

Certificates

M - O K / K H

Cable resistance thermometer with ceramic sleeve (KH). In this thermometer one or two platinum measuring resistors are connected to the supply line by soldering (hard / soft soldering). The solder joints are insulated from each other by shrinking tube. The measuring resistor is casted with a part of the connection line (strain-relieved) in a ceramic sleeve. By encapsulating the sensor in a ceramic sleeve, internal components are fixed and increased mechanical protection as well as fast response time is achieved.

Features

- high voltage resistant insulated
- increased mechanical protection
- gas-tight ceramic sleeve
- fast thermal response time

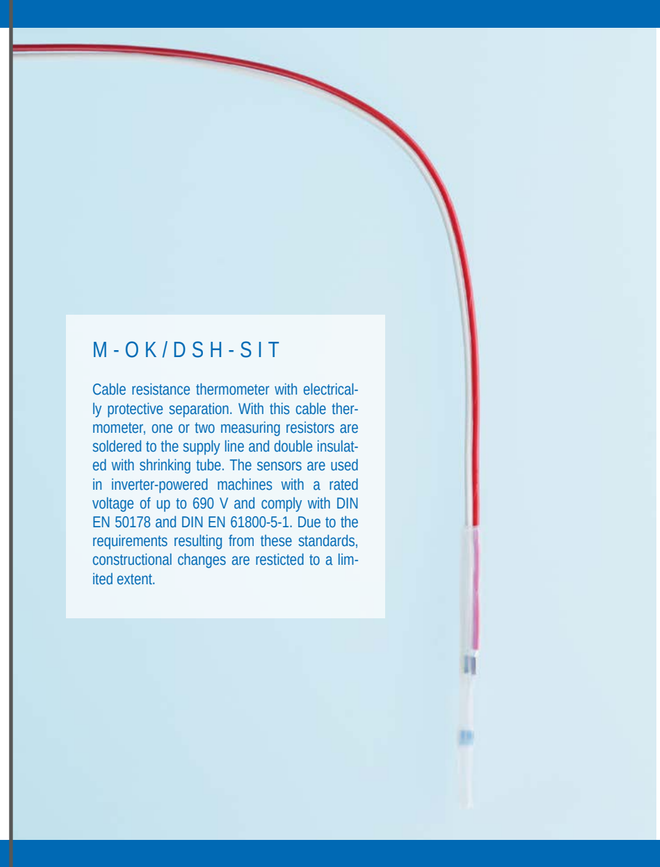
General technical data

measuring range
-60°C … +260°C // Ex: +180°C
mode of connection
2-, 3-, 4-wire circuit*)
*) depending on housing and connection line
tolerance class
AA, A, B (acc. DIN EN 60751)
sensor insulation
ceramic sleeve, Al_2O_3-ceramic
dielectric strength
0.5 kV to 4 kV / AC 50 Hz / 1 min.
supply line
E1 single litzes
Sx hose line with x single litzes
Gx screened hose line with x single litzes
FSx flat hose line with x single litzes
VL stranded line

material
PTFE / FEP, peek or glass fibre connection line
cross section
AWG30 to AWG20
dimensions
ø 3 mm x 15 mm (single side flat closed)
ø 4 mm x 25 mm (single side flat closed)
ø 4.9 mm x 16 mm (single side round closed)
ø 4.9 mm x 30 mm (single side round closed)
special versions
up to +400°C (only with glass fibre hose line)
up to 5 kV (only with Teflon® connection line)
up to 7 kV (only with Teflon® connection line combined with glass fibre filament tube (LGLS) insulation)

Certificates

Rev. 20180108



M - O K / D S H - S I T

Cable resistance thermometer with electrically protective separation. With this cable thermometer, one or two measuring resistors are soldered to the supply line and double insulated with shrinking tube. The sensors are used in inverter-powered machines with a rated voltage of up to 690 V and comply with DIN EN 50178 and DIN EN 61800-5-1. Due to the requirements resulting from these standards, constructional changes are resticted to a limited extent.

Features

- versions with Pt100 or Pt1000 resistors
- two version available with +190°C or +250°C
- according DIN EN 61800-5-1 and DIN EN 50178

General technical data

measuring range
-55°C … +190°C // -70°C ... +250°C
mode of connection
2-wire circuit
tolerance class
B (acc. DIN EN 60751)
sensor insulation
Teflon® shrinking tube (PTFE / FEP)
Kynar® / Kynarflex® shrinking tube (PVDF)
dielectric strength
3.8 kV / AC 50 Hz / 1 min.

supply line
E1 single litzes
Sx hose line with x single litzes
S4 x 24/7 on request
material
PTFE / FEP, peek connection line
cross section
AWG26/7 or AWG24/7
dimensions
max. ø 4.5 mm
length 50 mm ± 3 mm

19.

RESISTANCE THERMOMETERS WITH SCREW-IN HOUSING M-OK/SGH

The compact thermometers with screw-in housing M-OK/SGH also belong to the group of cable thermometers. They are often used in areas of tight space, at the end face of machine housings or are installed in e. g. switching cabinets for monitoring surface temperatures. They are also used for thermal supervison of induction coils or for temperature control of cooling water. The brass or stainless steel screw-in housings are available with or without protection tube, with permanent potted shrinking tube, with PTFE single litz wires or with a pressure mounted connector plug. Also versions with cable shoe are available.

(A) without protection tube, with sealed single litzes or hose line

(A) without protection tube, with sealed connection plug

(B) with protection tube, press squeezed or sealed hose line

(B) with cable shoe and sealed single litzes

Features

- any size of small measuring elements can be installed
- fitting at tight spaces easy assembly on housings and surfaces
- housing made of brass, aluminum or stainless steel
- with fixed connected supply line or connection plug

General technical data

measuring range
-60°C ... +260°C
mode of connection
2-, 3*)-, 4*)- wire circuit
*) depending on the size of screw-in housing
tolerance class
AA, A, B (acc. DIN EN 60751)
screw-in housing
(A) without protection tube, brass or aluminum screw-in housings, fixed connected PTFE single litzes or connection plug
(B) with protection tube, stainless steel screw-in housing, permanent sealed hose line or connection plug

dimensions
see right hand table
dielectric strength
0.5 kV to 2.5 kV / AC 50 Hz / 1 min.*)
*) not with glass fibre insulation
supply line
E1 single litz
Sx hose line with x single litzes
Gx screened hose line with x single litzes
optional with connection plug
material
silicone or PTFE glass fibre hose line*)
*) depending on the size of the housing
cross section
AWG30 to AWG20

Certificates

Overview of available screw-in housings for model (A) „without protection tube“

material	thread x installation length	SW x height
brass	M4 x 6 mm	SW 7 x 10 mm
brass	M4 x 7,5 mm	SW 7 x 10 mm
brass	M5 x 7,5 mm	SW 8 x 10 mm
brass	M6 x 7,5 mm*	SW 8 x 15 mm
brass	M6 x 7,5 mm*	SW 10 x 10 mm
brass	M8 x 7,5 mm*	SW 13 x 10 mm
brass	M8 x 8 mm*	SW 19 x 24 mm**
aluminum	M4 x 6 mm	SW 8 x 8 mm
aluminum	M5 x 6 mm	SW 8 x 12 mm

* sensor in the screw base (for better thermal conductivity)
** with permanent sealed connection plug (4-pole)

Sleeves with thread for model (B) „with protection tube“

Ø-stainless steel sleeve [mm]	installation length [mm]	threads
4 mm	from 20	M10x1
5 mm		G1/4“
6 mm (standard)		G3/8“
8 mm		G1/2“

In addition to Pt100, Pt500, Pt1000 measuring resistors, thermocouples, PTC, NTC, KTY or bimetallic switches can also be installed.

20.
BAYONET LOCK RESISTANCE THERMOMETERS

Bayonet lock resistance thermometers are ideally suited for temperature monitoring of machines and tools in manufacturing and for industrial motor protection. Resistance elements, semiconductors or thermocouples are used as basic measuring elements in the protection tube.

Bayonet lock cap with connection line and flat stainless steel sleeve

Protection tube tip in special design with 118° drilling angle

In general

EPHY-MESS thermometers with bayonet lock are assembled with one or two measuring resistors, optional with thermocouples, PTC or NTC thermistors or with KTY silicon sensors, which are located in a stainless steel sleeve and protected by a spring against bending. The thermometer operates with high mechanic reliability because of the adjustable and latching locking bayonet cap.

The tension spring is mounted on the sleeve to provide a defined and adjustable pressing for a stable thermal coupling even under mechanical vibrations or elongations caused by temperature changes. Furthermore the bayonet cap can be screwed to adjust either the immersion depth within the drill hole or to adjust the spring tension according to customized set-up.

Sensor with angled bayonet cap are the solution of choice in confined spaces.

Certificates

Features

- short response times by mechanical pressing
- with fixed or adjustable bayonet cap
- easy and quick assembly / disassembly

General technical data

measuring range
-55°C...220°C // Ex: +180°C
mode of connection
2-, 3-, 4- wire connection
tolerance class
AA, A, B (acc. DIN EN 60751)
sensor insulation
stainless steel sleeve, ø 6 - 9 mm x NL= 47, GL = 60, bevelled, front surface flat closed or drill angle 118°
spring length
175 mm / 210 mm / 250 mm
spring travel
> 12 mm
dielectric strength
0.5 kV to 3.4 kV / AC 50 Hz / 1 min.

supply line
Sx hose line with x single litzes
Gx screened hose line with x single litzes
material
PTFE / FEP, peek, or silicone connection line
cross section
AWG26 to AWG22
accessories
screw-in nipples ø 12 / 7 mm, nickel-plated brass, M10 x 1 SW 14, L = 60 mm or L = 30 mm
assembly
bayonet cap stainless steel ø = 14 mm / 12.4, L = 24 mm adjustable upon pressure spring. The assembly is always carried out with the bayonet nipple.

21.
SHEATHED RESISTANCE THERMOMETERS WT-MI

Sheathed resistance thermometers are extremely sturdy, pressure resistant, mechanically stable and vibration-resistant. Due to the small diameter these thermometers have a very short response time and are suited to be placed in areas difficult to access, in windings and in narrow openings.

In general

Sheathed resistance thermometers monitor the thermal conditions in tanks, pipes, apparatus and machinery, in laboratories or in experimental plants as well as in drives and in braking systems. Furthermore they guarantee exact temperature measuring in gaseous or liquid media, in low and high pressure environments with low flow speeds and for applications where flexibility and easy replacement are required. The bendable sheathed cable made of stainless steel or Inconel® is filled with MgO_2 powder.

EPHY-MESS offers various sensor sets for different measurement tasks on pipelines. Sensor sets consist of a thermometer, customized strip-wings, upper and lower insulation part, shrinking tube insulation and the associated spigot connection port.

The surface temperature sensors for pipes are based on Pt100 measuring resistors in a metal sleeve. Due to its flexible capillary tube the sensor can be directly embedded in the milled spigot connector and is welded on the adaptor socket by its outgoing „wings of steel“. Thus the best thermal coupling is ensured.

After embedding the sensor in the milled spigot connector the sensor is then coated with ceramic fibre leaves and insulated by a thick-walled shrinking tube, to avoid possible influences of the ambient temperature.

Versions of sheathed resistance thermometers

Sheathed resistance thermometers

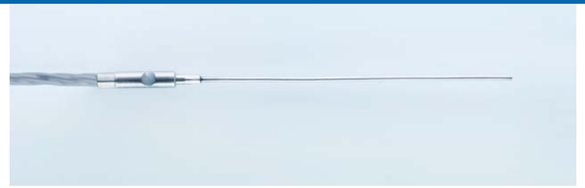
Sheathed resistance thermometers special version „Halbmondfühler“

Sheathed resistance thermometers special version „Flügelfühler“

The respective technical versions and special features are described in detail in the following sections.

SHEATHED RESISTANCE THERMOMETERS AND SHEATHED THERMOCOUPLES

Sheathed resistance sensors and thermocouples are well-suited for measuring high temperatures due to their configuration. They are generally designed moisture sealed and shock resistant. Depending on the diameter, they are quite bendable and flexible and can therefore be adapted very well to the respective installation location, especially in power plant technology.



available measuring elements: Pt100 / TE

Sheathed resistance thermometer / -thermocouples

- with bare supply line ends
- with a cable transition sleeve and a fixed connected PTFE / FEP or silicone supply line
- with a permanently connected plug (Lemosa, etc.)
- diameter starting at ø1 mm
- nominal length according to customer request
- water resistant, customized version available (IP68)

General technical data

measuring range
-60°C ... +400°C (platinum)
-200°C ... +850°C (thermocouples)
mode of connection
2-, 3-, 4- wire circuit
tolerance class
A, B (acc. DIN EN 60751)
sensor insulation
stainless steel sleeve,
capillary tube (ø 1 mm)
sheathed line
mineral insulated stainless steel line
dimensions
diameter from ø 1 mm
diameter from ø 3 mm with 2x Pt100
length from 20 mm

sheathed insulation
PVC / silicone / PTFE
dielectric strength
0.5 kV / AC 50 Hz / 1 min.
insulation resistance
$R_{(iso)}$ ≥ 200 MΩ / 500 V DC
supply line
Sx hose line with x single litzes
Gx screened hose line with x single litzes
cross section
AWG30 to AWG20
connection type
cable junction capsule with fixed connected inlet, bare connection wires, tinned cable ends
special versions
dielectric strength up to 3 kV

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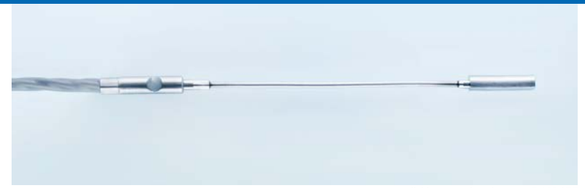

available measuring elements: Pt100 / TE

Sheathed resistance thermometers special design „Halbmondfühler“

- bendable, flexible mineral insulated wire (MI) or rigid as capillary tube version
- protection tube diameter from ø 1.5 mm
- pressure and vibration resistant
- stainless steel moulded part for special installation situations
- with bare supply line ends or with a permanently connected plug (Lemosa, etc.)
- with a cable transition sleeve and a permanently connected supply line

General technical data

measuring range
-60°C ... +180°C (capillary version)
-60°C ... +400°C (MI-Version)
mode of connection
2-, 3-, 4- wire circuit
tolerance class
A, B (acc. DIN EN 60751)
sensor insulation
stainless steel sleeve,
capillary tube (ø 1.5 mm)
sheathed line
mineral insulated stainless steel line
dimensions
diameter from ø 1.5 mm
diameter from ø 3 mm with 2x Pt100
length from 30 mm

sheathed insulation
PVC / silicone / PTFE
dielectric strength
0.5 kV / AC 50 Hz / 1 min.
insulation resistance
$R_{(iso)}$ ≥ 200 MΩ / 500 V DC
supply line
Sx hose line with x single litzes
Gx screened hose line with x single litzes
cross section
AWG30 to AWG20
special versions
dielectric strength up to 3 kV

available measuring elements: Pt100 / TE

Sheathed resistance thermometer special design „Flügelfühler“

- bendable, flexible mineral insulated wire (MI) or rigid pre-bent as capillary tube version
- protection tube diameter from ø 1.5 mm
- design with strip-wings, optional spigot connection port
- optional coated with ceramic fibre leaves (upper and lower insulation part)
- with bare supply line ends or with a permanently connected plug (Lemosa, etc.)
- with a cable transition sleeve and a permanently connected supply line

General technical data

measuring range
-60°C ... +180°C (capillary version)
-60°C ... +400°C (MI-Version)
mode of connection
2-, 3-, 4- wire circuit
tolerance class
A, B (acc. DIN EN 60751)
sensor insulation
stainless steel sleeve,
capillary tube (ø 1.5 mm)
sheathed line
mineral insulated stainless steel line
dimensions
diameter from ø 1.5 mm
diameter from ø 3 mm with 2x Pt100
length from 30 mm

sheathed insulation
PVC / silicone / PTFE
dielectric strength
0.5 kV / AC 50 Hz / 1 min.
insulation resistance
$R_{(iso)}$ ≥ 200 MΩ / 500 V DC
supply line
Sx hose line with x single litzes
Gx screened hose line with x single litzes
cross section
AWG30 to AWG20
special versions
dielectric strength up to 3 kV

22. GENERAL NOTES

General assembly and connection notes

- The installation of the thermometers should be free of tension, compression, bend and torsion.
- Avoid punctual or sharp - edged loads on the thermometer housing as that might cause damage or also lead to measured value deviations.
- The connection cable should be laid strain relieved, ideally protected, and should neither be twisted, pressed too hard nor kinked.
- When installing, prevent damage to the cable (insulation, shield, wire).
- The thermometer should only be connected to the display- and evaluation unit.
- For the versions with IECEx, ATEX, TR or UL/CSA approval, the special require ments of the type examination certificate have to be considered absolutely.

General guidelines for the cable confectioning

The cable lengths of the single sensors are usually free selectable. Regularly all cable ends are stripped and tin-coated. If required, cable ends are also deliverable with cable end sleeves, with flat or pin contacts, as well as with Harting- or Lemo-plugs / coupling in 2-, 3- or 4-pole version. Upon request, we also mount plugs from other manufacturers or plugs provided by our customers.

EPHY-MESS TECHNOLOGY

WORLDWIDE

Rev. 20180108

23. KNOW-HOW AND CREATIVITY

Our highly qualified technicians and engineers develop temperature sensors which can operate reliably under the harshest environmental conditions. With excellent technical know-how and modern equipment, we offer an environment, in which creativity and wealth of ideas will be implemented to the benefit of our customers. Moreover we maintain close contacts with renowned universities, educational institutions and accredited research institutes.

ALWAYS AT THE CUTTING EDGE

The R&D department ensures proper product design and process development. Feasibility studies and prototype assembly are coordinated. With high-quality testing methods in research laboratories customer-specific designs and applications are developed and qualified by first article inspections (e. g. compressive strength and vibration testing, tensile testing as well as temperature and climate tests). Optimizations are carried out in accordance with RoHS and REACH for instance by applying low-polluting materials.

The two ever important goals for EPHY-MESS are quality improvements to existing products as well as work process improvements to the benefit of our customer.

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EPHY MESS
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