GÜNTHER

ATEX

Assembly and operating instructions

Product group R0 - T6 overall

Ex i – Intrinsic safety

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Temperature Measurement Technology

Reliable . Precise . Certified

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1. General remarks

1.1 Introduction

These operating instructions contain fundamental information obligatory for installation, operation and maintenance of resistance thermometers series R0 to R6 and thermocouples series T0 to T6.

- The document should be read thoroughly before installation and commissioning of the equipment by the installer, as well as by the personnel responsible for the unit.
- These operating instructions must be available and accessible at the site at all times.
- It must also be ensured that the temperature sensors are operated exclusively in the undamaged and clean condition.

The following sections contain important safety instructions, whose non-observance may lead to risks for humans and animals, things and objects.

1.2 Staff qualifications

The equipment may be operated only by qualified personnel that has been familiarised with installation, commissioning and operation of this product which was assembled and put into operation.

Qualified persons are those that due to their specialised training, know-how and experience and their knowledge of the relevant standards assess the work assigned to them and recognise possible dangers and hazards.

In the case of explosion-proof equipment, the staff must have appropriate education or training, or authorisation to work on explosion-protected equipment in explosion-hazard areas.

Dangers related to the failure to comply with safety instructions

Failure to comply with these safety instructions, foreseen applications or limiting values provided in the technical data of the unit may lead to dangers and damages of persons, environment or the installation.
In such a case damages claims against GÜNTHER GmbH Temperaturmesstechnik shall be excluded.

1.3 General

Temperature sensors are used to transform temperature at a measuring point into electric value (voltage, resistance). They are used, in conjunction with appropriate data processing instrumentation, for measuring, registration and control of temperatures in the range from -196 °C to +600 °C (thermocouples -40 °C to +1700 °C).

Resistance thermometers and thermocouples R0 and T0 to T6 and R6 are used as intrinsically safe equipment for temperature measurement in liquid and gaseous media. Various series of the sensor groups mentioned above may also be applied in areas at risk of dust explosion.

Temperature sensors consist of a protective fitting with various process connections, a connection head or connecting cables, and - depending on the type - additionally also a replaceable measuring insert. All fittings (parts that come in contact with process procedures) are subjected to a tightness test.
Resistance thermometers are equipped with Pt100 temperature sensors compliant with EN 60751 in the tolerance classes A or B in two-, three-, or four-wire variants. Versions with two measuring circuits are also possible.

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On request, thermocouple sensors may be equipped with A, B, C, D, E, J, K, N, R, S or T thermocouple according to DIN EN 60584-1 in tolerance classes 1 or 2, as a single or double measuring circuit. They meet the requirements for explosion group II of the categories 1/2G and / or 2G, while various series also of categories 1/2D and / or 2D.
They are therefore suitable for use in areas at risk of explosion of zone 1 for gas environments and Zone 21 for dust environments. Protection tube may therefore have the thickness lying within the range of > = 1 mm in Zone 0 or 20 (zone separation).

Depending on application needs and measurement application, temperature sensor may be equipped with different connection heads. Units may only be operated with the specially provided protective sleeve.

These temperature sensors with Ex i explosion protection are certified for the connection to intrinsically safe circuits of category ia. When connecting to intrinsically safe circuits, the user must limit the power introduced in such a way, that the maximum surface heating according to the temperature class minus the safety margin is not exceeded!

1.4 Installation and operation

During installation relevant standards must be complied with, e.g. EN 60079-14
“Electrical equipment for potentially explosive atmospheres”.

- If the temperature sensor is mounted on parts of the unit that constitute a zone separator, the installation must be appropriately tight.
- Defective temperature sensors must not be used.
- Repairs must be performed only by appropriately authorised persons.
- Repairs may be done only using original spare parts from the original supplier, otherwise the requirements of the approval are not guaranteed.
- If a component of electrical unit which is of vital importance for the protection against explosion has been repaired, the unit may be put into operation again only after an expert has determined that its features vital for explosion protection comply with the requirements.

1.5 Installation and connection instructions

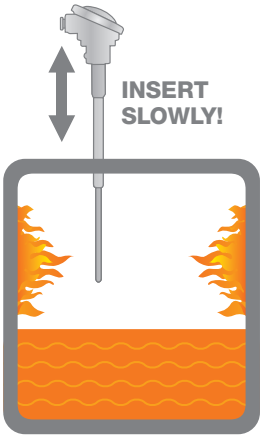
- In general, the provisions of Regulation on the installation of electrical installations in areas at risk of explosion (BetrSichV) must be observed!
- When connecting the “associated equipment”, the electrical specifications listed in the examination certificate must observed.
- It is important to ensure that the prescribed allowable ambient temperature values are not exceeded.
- When installing a connecting cable, it must be ensured that the cable insulation is not in contact with parts that have higher surface temperatures than allowed under insulation resistance.
- Moreover, it needs to be guaranteed that the required protection level (IP-rate) for the whole temperature sensor is ensured:

Necessary for explosion protection type ⟨Ex⟩ ***II 1/2G Ex ia IIC T6 Ga/Gb*** → at least IP20

Necessary for explosion protection type ⟨Ex⟩ ***II 1/2G Ex ia IIC T135***°C ***Da/Db*** → protection rate IP6X

- When inserting the new temperature probe into the hot furnace atmosphere the maximum insertion speeds must be observed. Particularly when installing ceramic protective fittings, direct flame contact must be avoided as as thermal stresses may cause the material to break.

  Therefore, observe the recommended maximum insertion speed:



Protection tubes with an external diameter ≤ 15mm	max. 200 mm / min
Protection tubes with an external diameter > 15mm	max. 20 mm / min
Mono- and polycrystalline Aluminium Oxide („Sapphire“)	max. 30 mm / min
During installation of immersing thermocouples in glass furnaces or foundries please add extra 30 min. for warming up close to the surface, then move it into end position by max. 10 mm/min.	

2. Electrical and Thermal Characteristics

2.1 Electric limiting characteristics

Temperature sensor may be connected to the following max. values.

- Maximum values: U_i = 30 V/DC
  I_i = 101 mA
  P_i = 750 mW
- Insulation test: U = 500 VAC measuring circuit/ sheath and between measurement circuits by double circuits
- Capacity C_i of the applied mineral isolated cables for measuring inserts:

  sheath-Ø 3.0 mm C_i = 160 pF/m (core/core)
  C_i = 370 pF/m (core/sheath)

  sheath-Ø 4.5 mm C_i = 145 pF/m (core/core)
  C_i = 290 pF/m (core/sheath)

  sheath-Ø 6.0 mm C_i = 130 pF/m (core/core)
  C_i = 210 pF/m (core/sheath)

  sheath-Ø >6.0 mm C_i < 130 pF/m (core/core)
  C_i < 210 pF/m (core/sheath)
- Established maximum value of capacity for flexible connection cables:

  C = 110 pF/m core/core
  C = 340 pF/m core/sheath

  Capacities may as a rule be omitted, as the length of the connecting cables is strongly limited by the construction. They can, however, be very important by larger lengths.
- Inductivity: L_i = 5 µH (measurement resistance)

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2.2 Control of electrical connection values

The intrinsically safe supply of measuring inserts can be done by:

- An auxiliary, intrinsically safe equipment that is also certified as intrinsically safe and its intrinsically safe output values do not exceed the input values of the measuring insert.

For measuring inserts with 2 measuring circuits (double measuring circuit), the following rules apply: They can be applied only in 2- or 3-wire connections. For measuring inserts with sheath diameter of 6 mm the required isolation distances between two measuring circuits in accordance with Table 5 of DIN EN 60079-11 for the 30V voltage and protection class ia must be respected. Thus, both measuring circuits can be considered as isolated. For double-measuring inserts with sheath diameter of 3.0 mm and 4.5 mm both measuring circuits must be considered as electrically connected, as due to the geometrical dimensions of the required isolation, distances according to the above table cannot be complied with. It should be noted that the voltage U_O, and current I_O must be added. The total power P_{O1} and P_{O2} may not exceed the P_i of temperature sensor.

The thermometer has to operate with a power-limiting circuit that limits Pmax. to 750 mW. When interconnecting intrinsically safe circuits in accordance with EN60079-14, the proof of intrinsic safety must be provided.
Two cases must be distinguished here:

- Simple intrinsically safe circuit with only one internal active and one passive, intrinsically safe unit, not requiring further care.
- More active units, which in normal operation or in the case of failure may provide energy into an intrinsically safe circuit. Simple intrinsically safe circuits can be verified by the responsible person by comparing the electrical connection from the relevant EC type-examination certificate.

The intrinsic safety of the interconnection must be observed when the following conditions are met:

Intrinsically safe measuring insert series R0 or T0		Connected unit
U_i 30 V	≥	U_O
I_i 101 mA	≥	I_O
P_i 750 mW	≥	P_O

It needs to be checked whether the capacity C and the induction L may be ignored.

It depends from the length of the measuring insert or the length of the whole sensor, as well as from the length of the connecting cable.

2.3 Thermal characteristics

In order to determine the max. permissible measuring temperature of a corresponding temperature class, the possible self-heating of a temperature sensor in case of error must be determined.
For this, the power P_O of the connected associated unit and the thermal resistance (self-heating error) R_{TH} of the sensor on the surface of the measuring tip must be known.

- P_O is shown on the type plate of the associated unit.
- R_{TH} for different measuring inserts and protection tube diameters are as follows:

  - Measuring inserts:

    sheath-Ø 3.0 mm → 165 K/W
    sheath-Ø 4.5 mm → 110 K/W
    sheath-Ø ≥ 6.0 mm → 90 K/W

  - Protection tube:

    Ø 6.0 mm, 8.0 mm and 9.0 mm → 85 K/W
    Ø 10.0 mm, 11.0 mm, 12.0 mm and 15.0 mm → 55 K/W

Sensor tube with cable connection (Series R6):

In the case of non-mineral-insulated models and directly connected cables, the thermal resistance R_{TH} of the built-in measuring resistor must be taken into consideration when deliberating on the intrinsic safety of the measuring circuit, since the connection of the cable to the sensor tube cannot be considered as a gas-tight.

- All sensor tube-Ø → 300 K/W

For the measuring inserts in built-in protection armatures, the same heat resistance or self- heating error factors can be applied because for the built-in components they are always lower.

The maximum allowable surface temperature T_{OB} depends on the introduced power P_O of the associated intrinsically safe unit and the temperature class and can be established on the basis of the following information (see below). The inner capacity and inductivity are usually negligibly small.

Determining the maximum permissible medium temperature T_M for areas where explosive mixtures of air and gases, vapours or mists may occur, and requires the electrical equipment of category 1.

This requires that the thermal resistance R_{TH}, e.g. 100 K/W of the sensor must be known.
Temperature elevation is calculated using the introduced power e.g. P_O = 50 mW:

$\Delta T = P_O \times R_{TH}$

Example: $\Delta T = 0.05\ W \times 100\ K/W = 5\ K$

Together with the permissible temperature of the respective temperature class and the existing surface temperature T_{OB} you can now determine if the sensor is permissible.

For zone 1 it is necessary to ensure a safety margin of 5 K for T3 - T6 and 10 K for T1 and T2.
T6: 85 °C - 5 K = 80 °C 80 °C - 5 K = 75 °C

The sensor may thus be applied in zone 1 and in temperature class T6 up to the medium temperature of T_M = 75 °C.

- R_{TH}: thermal resistance (self-heating) of the sensor
- T_M : max. temperature of the medium

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The following tables indicate the max. permissable media temperature for different measuring insert diameters or protection tube diameters at different levels of power supplied.

Error tolerance by power reduction (e.g upplying the sensor with "ib" power)	**Temperature class**	**Max. medium temperature T_M in at the maximum power P_i on the sensor (reflects the P_o of the connected associated unit)**			
Diameter of sheath measuring insert		Zone 1			
		$P_i \leq 25$ mW	$P_i \leq 100$ mW	$P_i \leq 250$ mW	$P_i \leq 750$ mW
3.0 mm	T1; +450 °C	+436 °C	+426 °C	+406 °C	+339 °C
	T2; +300 °C	+286 °C	+276 °C	+256 °C	+189 °C
	T3; +200 °C	+191 °C	+181 °C	+161 °C	+94 °C
	T4; +135 °C	+126 °C	+116 °C	+96 °C	+29 °C
	T5; +100 °C	+91 °C	+81 °C	+61 °C	-
	T6; +85 °C	+76 °C	+66 °C	+46 °C	-
4.5 mm	T1; +450 °C	+438 °C	+432 °C	+420 °C	+380 °C
	T2; +300 °C	+288 °C	+282 °C	+270 °C	+230 °C
	T3; +200 °C	+193 °C	+187 °C	+175 °C	+135 °C
	T4; +135 °C	+128 °C	+122 °C	+110 °C	+70 °C
	T5; +100 °C	+93 °C	+87 °C	+75 °C	+35 °C
	T6; +85 °C	+78 °C	+72 °C	+60 °C	+20 °C
≥ 6.0 mm	T1; +450 °C	+438 °C	+434 °C	+426 °C	+398 °C
	T2; +300 °C	+288 °C	+284 °C	+276 °C	+148 °C
	T3; +200 °C	+193 °C	+189 °C	+181 °C	+153 °C
	T4; +135 °C	+128 °C	+124 °C	+116 °C	+88 °C
	T5; +100 °C	+93 °C	+89 °C	+81 °C	+53 °C
	T6; +85 °C	+78 °C	+74 °C	+66 °C	+38 °C

Error tolerance by power reduction (e.g upplying the sensor with "ib" power)	**Temperature class**	**Max. medium temperature T_M in at the maximum power P_i on the sensor (reflects the P_o of the connected associated unit)**			
Diameter Measuring tip, protection tube or tapering		Zone 1			
		$P_i \leq 25$ mW	$P_i \leq 100$ mW	$P_i \leq 250$ mW	$P_i \leq 750$ mW
6.0 mm, 8.0 mm und 9.0 mm	T1; +450 °C	+438 °C	+434 °C	+425 °C	+396 °C
	T2; +300 °C	+288 °C	+284 °C	+275 °C	+246 °C
	T3; +200 °C	+193 °C	+189 °C	+180 °C	+151 °C
	T4; +135 °C	+128 °C	+124 °C	+115 °C	+86 °C
	T5; +100 °C	+93 °C	+89 °C	+80 °C	+51 °C
	T6; +85 °C	+78 °C	+74 °C	+65 °C	+36 °C
10.0 mm, 11.0 mm, 12.0 mm, 15.0 mm und größer	T1; +450 °C	+439 °C	+437 °C	+434 °C	+423 °C
	T2; +300 °C	+289 °C	+287 °C	+284 °C	+273 °C
	T3; +200 °C	+194 °C	+192 °C	+189 °C	+178 °C
	T4; +135 °C	+129 °C	+127 °C	+124 °C	+113 °C
	T5; +100 °C	+94 °C	+92 °C	+89 °C	+78 °C
	T6; +85 °C	+79 °C	+77 °C	+74 °C	+63 °C

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Since each actual permissible medium temperature depends on the max. output power P_O of the associated unit, it can be determined according to the example on page 7. The specific self-heating error of the corresponding measuring insert diameter or protection tube diameter is provided on page 8 in the „Thermal Characteristics“ section.

Temperature classes / max. permissible surface temperatures

- For zone 1 temperature class minus safety margin of 5 K for T3 - T6 and 10 K for T2 and T1.
- For zone 0 temperature class minus 20% and additionally safety margin of 5 K for T3 - T6 and 10 K for T1 and T2.

Temperature class	Max. surface temperature in Zone 0	Max. surface temperature In Zone 1
T1; +450 °C	+350 °C	+440 °C
T2; +300 °C	+230 °C	+290 °C
T3; +200 °C	+155 °C	+195 °C
T4; +135 °C	+103 °C	+130 °C
T5; +100 °C	+75 °C	+95 °C
T6; +85 °C	+63 °C	+80 °C

For thermocouples the maximum permissible surface temperature may be calculated as the temperature of the respective temperature class minus safety margin.

Limiting temperatures in Ex areas because of dust

- If there is no deposition of dust, the surface temperature must not exceed 2/3 of the ignition temperature in ° C of the respective dust-air mixture.
- If there is dust deposition of glow dischargeable dust with layer thickness of up to 5 mm, the maximum surface temperature must not exceed glow temperature of the respective dust minus 75 K.
- In case of layer thickness exceeding 5 mm, it is necessary to apply an additional reduction of surface temperature. Table 4 of EN 60079-11 must be applied here (Maximum allowable power dissipation at full dust overfill).

Power	350 mW	450 mW	550 mW	650 mW	750 mW
Temperature	+160 °C	+130 °C	+100 °C	+70 °C	+40 °C

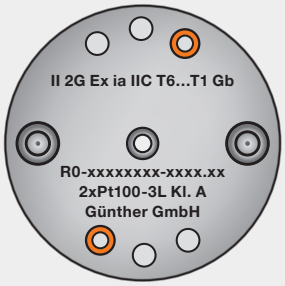
Ambient temperatures of -60 °C to +300 °C (depending on the cable insulation) are permissible on connection cables.
Ambient temperatures of -60 °C to +60 °C are permissible at the connection head.
If a transmitter is installed in the connection head for which lower ambient temperatures are permitted, these must be complied with.
In order to be able to comply with the limit temperatures, appropriate neck tube lengths must be provided.
(See below - required neck pipe lengths for corresponding media temperatures).
The neck pipe length is defined as the distance from the process connection to the end of the neck pipe in the connection head.

- Temperature range ≤ +60 °C → no neck tube required
- Temperature range ≥ +60 °C and ≤ +400 °C → Length of neck tube min. 165 mm
- Temperature range ≥ +400 °C and ≤ +600 °C → Length of neck tube min. 305 mm

For measuring temperatures up to +1000 °C (thermocouples) adherence to the max. permissable ambient temperature at the connection head must be guaranteed by extending the neck tube length or by applying other effective measures (e.g. flection plating).

3. Types of protection and coding of individual series

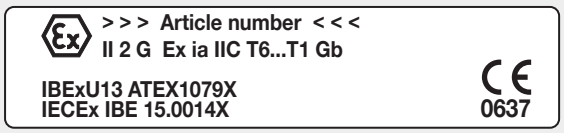
Product group: R0/T0 (Laser labelling)



Product group: R1-T3 (R1; T1; R2; T2; R3; T3) (Label)

Product group: R4/T4 (Label)

Product group: R5-T6 (R5; T5; R6; T6) (Label / Heat shrink tubing)



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Note

Measuring inserts series R0 and T0 with connection head are marked as shown above on the connection head. Optionally, the marking may be laser-inscribed on a metal plate or placed directly on the connection head.

If the measuring inserts are supplied as a separate component or spare part, they are placed at the bottom of the stainless steel flange with a limited marking according to EN60079-0 section 29.9.

In addition to the standard information, the following minimum information on explosion protection shall be included by laser inscription:

Example:

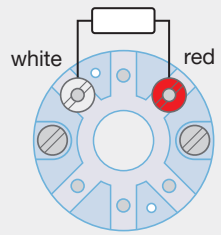
Manufacturer:	GÜNTHER GmbH
Type:	R1- . . . . .
Control centre and control number:	IBExU12ATEX ... X
CE-number and year of production:	CE 0637 2021

This limited labelling is also appropriate for sensors Series R6 and T6 as laser marking on the protection tube or optionally by means of printed shrink tubing on the cable.

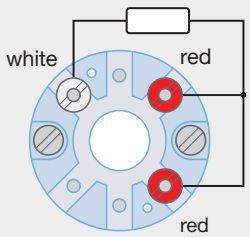
4. Connection options

4.1 Resistance thermometers (Colour coding)

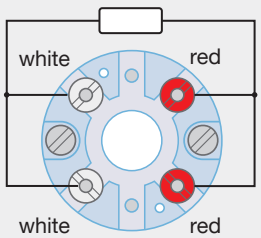
1x Pt100 2-wire connection



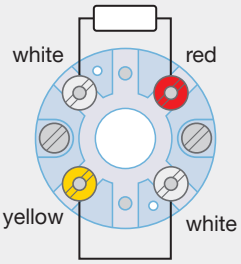
1x Pt100 3-wire connection



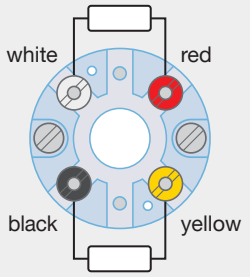
1x Pt100 4-wire connection



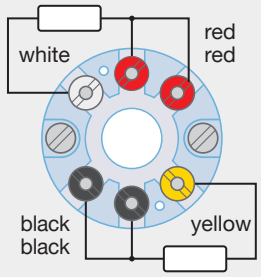
1x Pt100 with tape



2x Pt100 2-wire connection

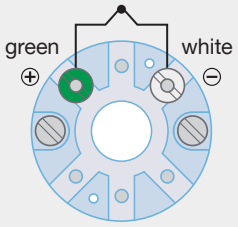


2x Pt100 3-wire connection

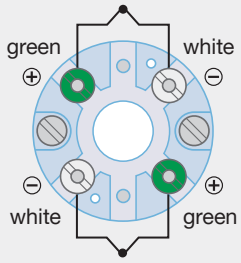


4.2 Thermocouples (Colour coding acc. to DIN EN 60584)

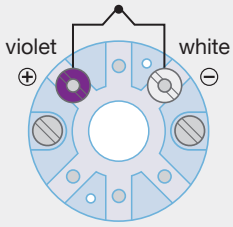
1x NiCr-Ni (Type K)



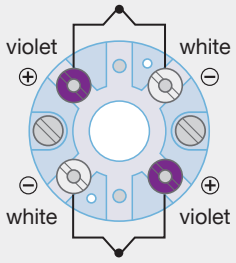
2x NiCr-Ni (Type K)



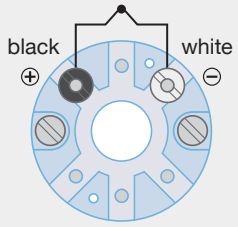
1x NiCr-CuNi (Type E)



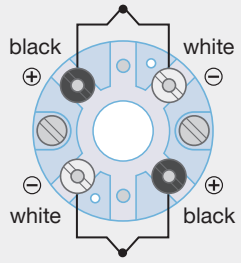
2x NiCr-CuNi (Type E)



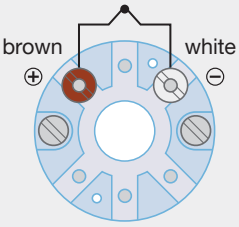
1x Fe-CuNi (Type J)



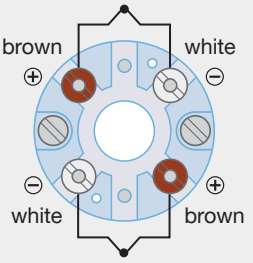
2x Fe-CuNi (Type J)



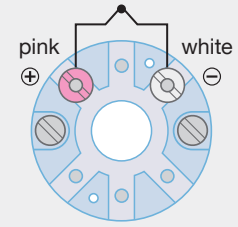
1x Cu-CuNi (Type T)



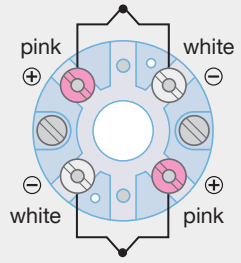
2x Cu-CuNi (Type T)



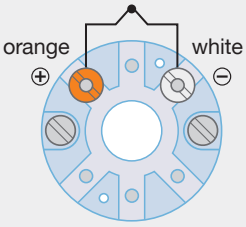
1x NiCrSi-NiSi (Type N)



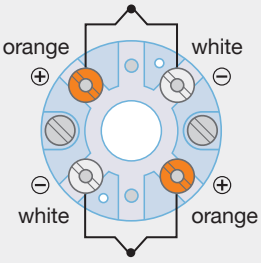
2x NiCrSi-NiSi (Type N)



1x Pt10Rh-Pt (Type S)

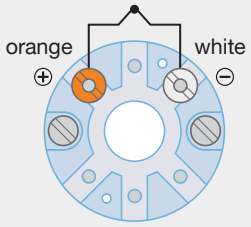


2x Pt10Rh-Pt (Type S)

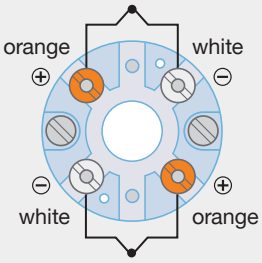


ATEX Assembly and operating instructions – Product group R0 - T6 overall

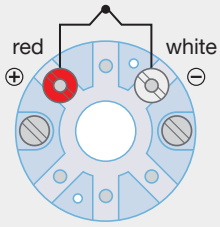
1x Pt13Rh-Pt (Type R)



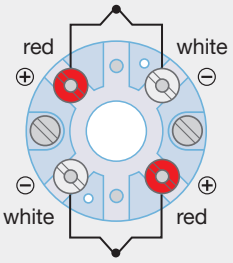
2x Pt13Rh-Pt (Type R)



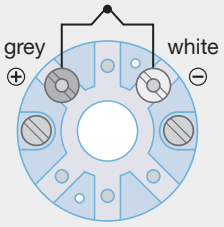
1x W5Re-W26Re (Type C)



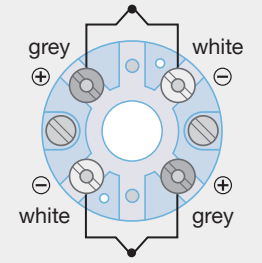
2x W5Re-W26Re (Type C)



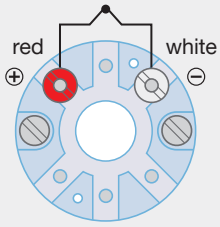
1x Pt30Rh-Pt6Rh (Type B)



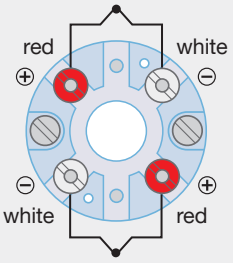
2x Pt30Rh-Pt6Rh (Type B)



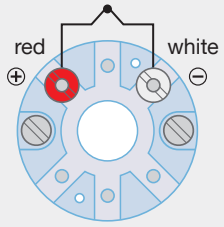
1x W3Re-W22Re (Type D)



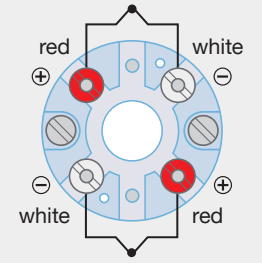
2x W3Re-W22Re (Type D)



1x W5Re-W20Re (Type A)

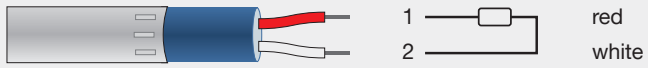


2x W5Re-W20Re (Type A)

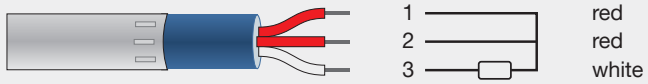


4.3 Cable sensors – Resistance thermometers (Colour coding)

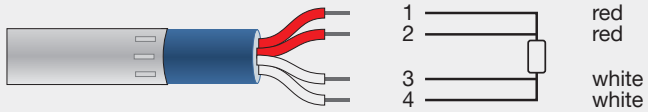
1x Pt100 2-wire connection



1x Pt100 3-wire connection



1x Pt100 4-wire connection

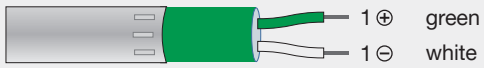


2x Pt100 2-wire connection

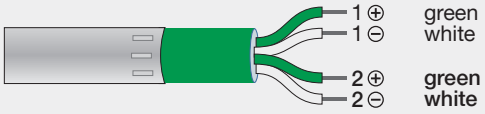
2x Pt100 3-wire connection

4.4 Cable sensors - Thermocouples (Colour coding acc. to DIN EN 60584)

1x NiCr-Ni (Type K)

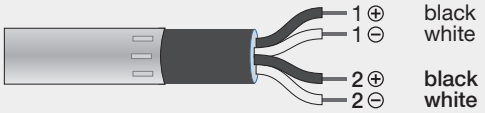


2x NiCr-Ni (Type K)

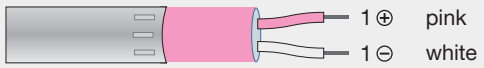


1x Fe-CuNi (Type J)

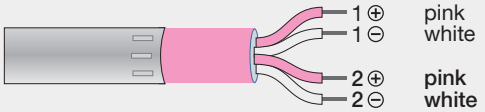
2x Fe-CuNi (Type J)



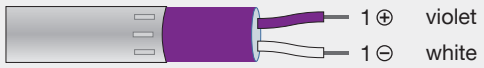
1x NiCrSi-NiSi (Type N)



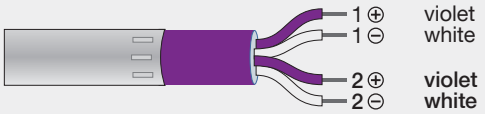
2x NiCrSi-NiSi (Type N)



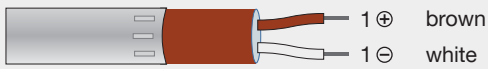
1x NiCr-CuNi (Type E)



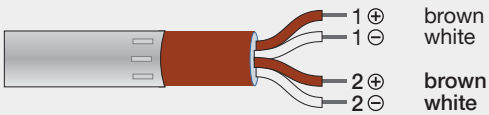
2x NiCr-CuNi (Type E)



1x Cu-CuNi (Type T)



2x Cu-CuNi (Type T)



Declaration of Conformity

CE

EC Declaration of Conformity
DIN EN ISO/IEC 17050 part 1 and 2
within the meaning of art. 4 of the regulation on the protection against explosions
in connection with the Directive no 2014/34/EU,concerning equipment and protective systems intended for use in potentially explosive atmospheres
Annex X Part B

We hereby declare that the company Günther GmbH Temperaturmesstechnik
Bauhofstrasse 12
90571 Schwaig
Germany

and the equipment listed below complies with the essential safety and health requirements of the EC Directive in terms of their design and type, as brought into circulation.

Description:	Temperature sensors
Series:	Resistance thermometers R0 to R6 Thermocouples T0 to T6
EC Directives:	**Directive concerning equipment and protective systems intended for use in potentially explosive atmospheres (**2014/34/EU**)**
Applied harmonised standards:	**EN 60079-0:2014** **EN 60079-11:2012** **EN 60079-26:2015**
EC Certificate number: IECEx Certificate number:	IBExU13ATEX1079 X IECEx IBE 15.0014X
Type of protection:	**II 2 G Ex ia IIC T6…1 Gb** **II 1/2 G Ex ia IIC T6 …1 Ga/Gb** **II 1/2 D Ex ia IIIC TX Da/Db**

ATEX certifying institution
IBExU (Notified Body Nummer: 0637)
Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7
09599 Freiberg
Germany

20-04-2016; Schwaig
Date, place

Bernhard Oelmayer, Executive Director

GÜNTHER

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