

EPIC® SENSORS

MULTIPOINT TEMPERATURE SENSOR
TYPE T-MP, T-MPT / W-MP, W-MPT
DATA SHEET 21

INSTALLATION INSTRUCTIONS AND USER MANUAL



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Product description and intended use

Sensor types T-MP, T-MPT (thermocouple, TC) and W-MP, W-MPT (resistance, RTD) are mineral insulated multipoint temperature sensors with flange. Individual sensors can each be delivered with own weights, or all measuring points can be covered with one common armor duct and weight.

Sensors are intended for multipoint measuring applications. Sensor can be delivered with or without enclosure. Sensors can also be delivered with temperature transmitters in enclosure. Sensor element protection tube material can be chosen, and element / cable lengths can be produced according to customer needs. Wire and cable sheath materials can be chosen.

Measuring elements are mineral insulated (MI) elements, which are bendable. Elements can be TC elements, standard versions are K-type thermocouples (for T-MP), or RTD elements, standard version 4-wire, class A Pt100 (for W-MP). Tailored versions are produced on request.

Also available as ATEX and IECEx approved protection type Ex i versions. Please see section *Ex i data*.

EPIC® SENSORS temperature sensors are measuring devices intended for professional use. They should be mounted by professionally capable installer who understands the installations surroundings. The worker should understand mechanical and electrical needs and safety instructions of the object installation. Suitable safety gear for each installation task must be used.

Temperatures, measuring

Allowed measuring temperature range for sensor element part is:

- With Pt100 -200...+550 °C, depending on materials
- With TC -200...+1200 °C, depending on TC type, neck pipe length and materials

Maximum allowed temperature for flange (material AISI 316L) is +550 °C, temporarily +600 °C.

Temperatures, ambient

Allowed maximum ambient temperature for wires or cable, according to cable type, is:

- SIL = silicone, max. +180 °C
- FEP = fluoropolymer, max. +205 °C
- GGD = glass silk cable/metal braid jacket, max. +350 °C
- FDF = FEP wire insulation/braid shield/FEP jacket, max. +205 °C
- SDS = silicone wire insulation/braid shield/silicone jacket, only available as 2 wire cable, max. +180 °C
- TDT = fluoropolymer wire insulation/braid shield/ fluoropolymer jacket, max. +205 °C
- FDS = FEP wire insulation/braid shield/silicone jacket, max. +180 °C
- FS = FEP wire insulation/silicone jacket, max. +180 °C

Make sure the process temperature is not too much for the cable.

Maximum allowed temperature for flange (material AISI 316L) is +550 °C, temporarily +600 °C.

Allowed temperature range for enclosure: according to customer needs and enclosure type.

Allowed temperature range for transmitters (if delivered) according to transmitter manufacturers data.

Temperatures, Ex i versions

For Ex i versions only (type designations -EXI-), specific temperature conditions apply according to the ATEX and IECEx certificates. For more details, please see section: Ex i data (only for types with Ex i approval).

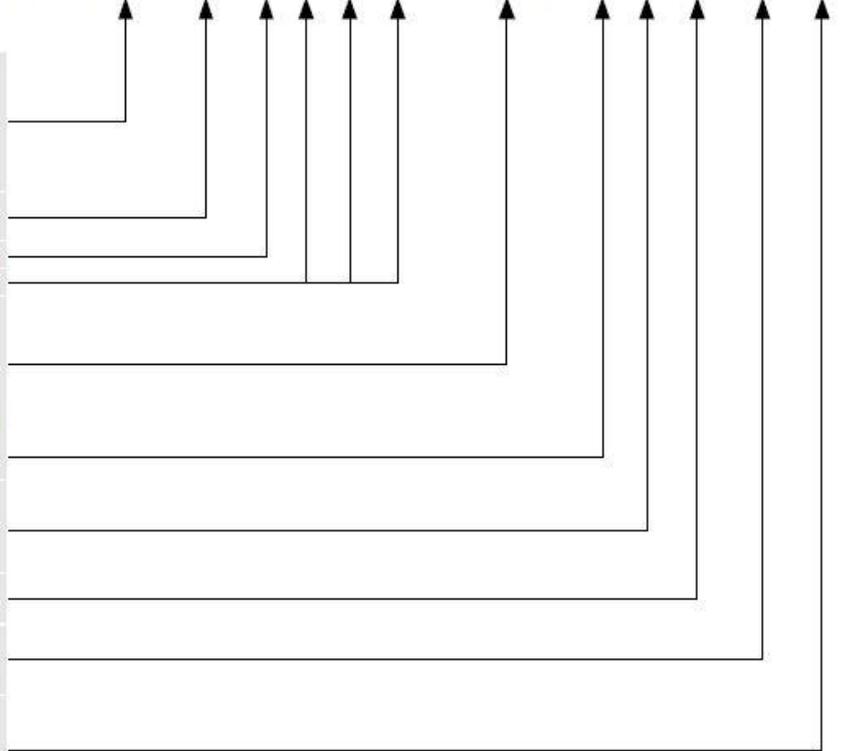
Code key

Product code key

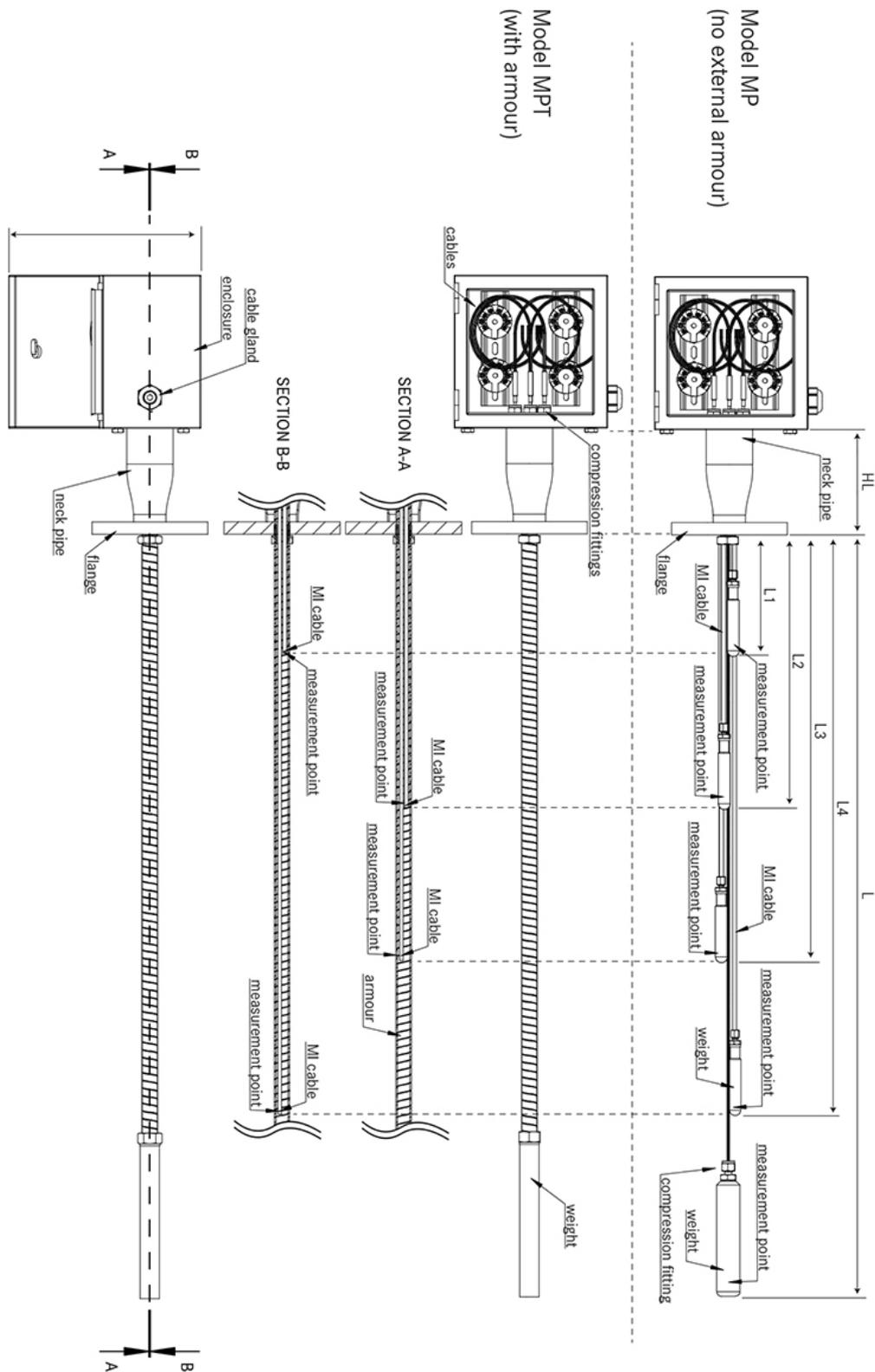
Example code: 3XW — MPT — 3 / 2500/.../7500 — DN50/PN16 — 4 — A — TR — BOX — X

n times the lengths, according to the amount of measurement points

| | |
|-----------|-----------------------------------------------------------------------------------|
| W | = Pt100 resistance thermometer |
| 2xW | = 2 x Pt100 resistance thermometer |
| nxW | = n x Pt100 resistance thermometer |
| T | = thermocouple |
| 2xT | = 2 x thermocouple |
| nxT | = n x thermocouple |
| MP | = multipoint sensor, no armour |
| MPT | = multipoint sensor, with armour |
| 3, 6 | = outer diameter of sensor elements (ØOD) [mm] |
| 2500/... | = sensor element lengths [mm] |
| DN25/PN40 | |
| DN40/PN40 | |
| DN50/PN16 | = flange size / flange thickness |
| DN50/PN40 | (only typical stocked values listed) |
| DN80/PN16 | (all flange sizes available) |
| DN80/PN40 | (please contact our sales for more information) |
| 4,3,2 | = Pt100 wire count |
| K,N,J | = thermocouple type |
| A,B | = Pt100 accuracy class, (class A as standard delivery) |
| 1,2,3 | = thermocouple accuracy class, (class 1 as standard delivery) |
| TR | = wires for transmitter connection |
| CB | = with ceramic terminal block |
| empty | = no junction box |
| BOX | = supplied with junction box, (add info of supplier, type, etc. to the text line) |
| EXI | = Ex i certified sensor |
| X | = additional details on the text line |



Dimensional drawing



Installation instructions and example

Before any installation, make sure the target process/machinery and site are safe to work!

Make sure the cable type matches the temperature and chemical requirements of the site.

Preparing the installation:

It is recommended to design a suitable transportation/installation support structure for the multipoint sensor set. For example, the sensor can be delivered on a cable drum or on a pallet.

a. Wound on a cable drum:

We can deliver the multipoint sensor set wound on a big enough cable drum. This way it is easier to unwind the sensor set, using a steel pipe as a horizontal axle, or a special cable drum bench if available on site.

b. On a pallet as a coil:

According to customer specification we can deliver the multipoint sensor set also on a transportation pallet. In this case there will be a center support needed, e.g. made of sawn timber pieces 2x2" or 2x4". At the installation site, there must be means of rotating the pallet to uncoil the set to the process hole. The flange bolt holes can be used as a lifting point.

Please give detailed dimension of these transportation/installation supports or ask for a suggestion from our logistics specialists.

Installation phases:

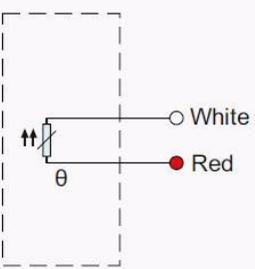
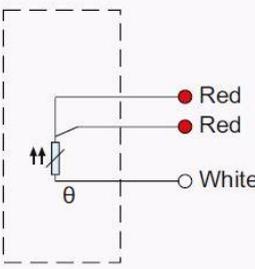
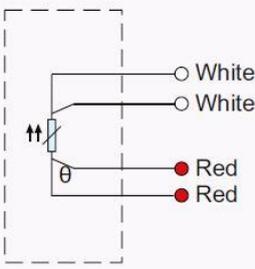
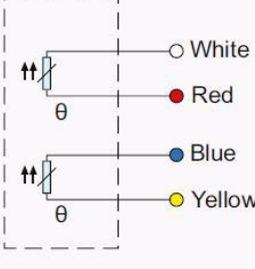
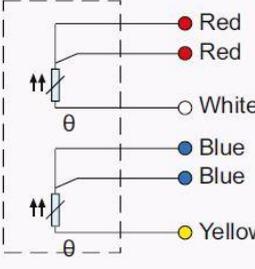
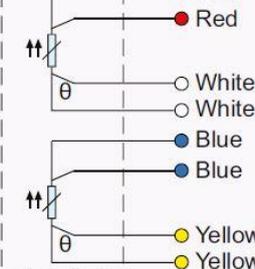
- During installation, remember the MI element minimum bending radius is $2x \text{ } \varnothing\text{OD}$ of the element.
- Do not bend the MI element tip (30 mm length from sensing tip) of a RTD sensor element.
- Use an applicable, rolling support structure for unwinding the sensor set. Please see above. If the working phases create bends on the sensor set, you can straighten them lightly by hand.
- Insert the measuring points with weights through the flanged hole to medium/material to be measured.
- Mount the sensor securely by the flange with bolts and nuts. Use applicable sealing between flange parts. Sealing, bolts, or nuts are not included in delivery.
- Make sure there is no excess bending force loading cables.

Tightening torques

Use only tightening torques allowed in applicable standards of each thread size and material.

Pt100; connection wiring

Image below: These are the connection colors of Pt100 resistor connections, according to standard EN 60751.

| | 2-wire | 3-wire | 4-wire |
|-----------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Pt100 |  |  |  |
| 2 x Pt100 |  |  |  |

Pt100; measuring current

The highest allowed measuring current for Pt100 measuring resistors depends on resistor type and brand.

Normally the recommended maximum values are:

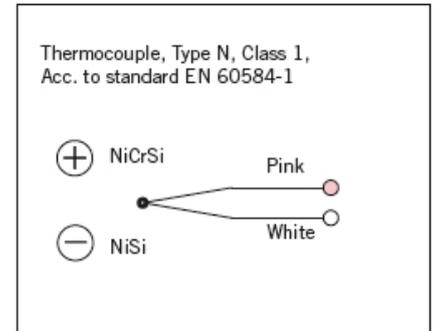
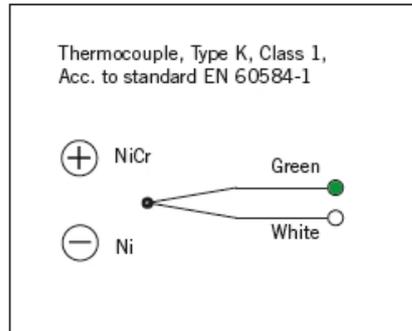
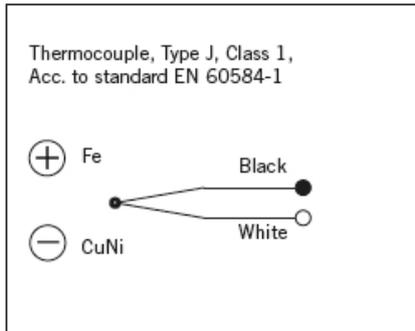
- Pt100 1 mA
- Pt500 0,5 mA
- Pt1000 0,3 mA.

Do not use higher measuring current. It will lead to false measurement values and might even destroy the resistor.

Above listed values are normal measuring current values. For Ex i certified sensor types, type designation -EXI-, higher values (worst case) are used for the self-heating calculation for safety reasons. For further details and calculation examples, please see ANNEX A.

TC; connection wiring

Image below: These are the connection colors of TC types J, K and N.



Other types on request.

TC; non-grounded or grounded types

Normally the thermocouple sensors are non-grounded, which means the MI cable sheet is not connected to the thermo material hot junction, where two materials are welded together.

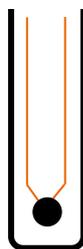
In special applications also grounded types are used.

NOTE! Non-grounded and grounded sensors cannot be connected to same circuits, make sure you are using the right type.

NOTE! Grounded TCs are not allowed for Ex i certified sensor types.

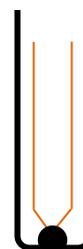
Image below: Non-grounded and grounded structures in comparison.

Non-grounded TC



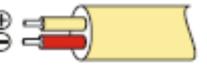
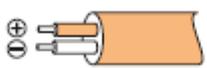
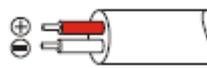
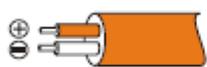
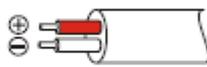
Thermo material hot junction and MI cable sheet are galvanically isolated from each other.

Grounded TC



Thermo material hot junction has galvanic connection with MI cable sheet.

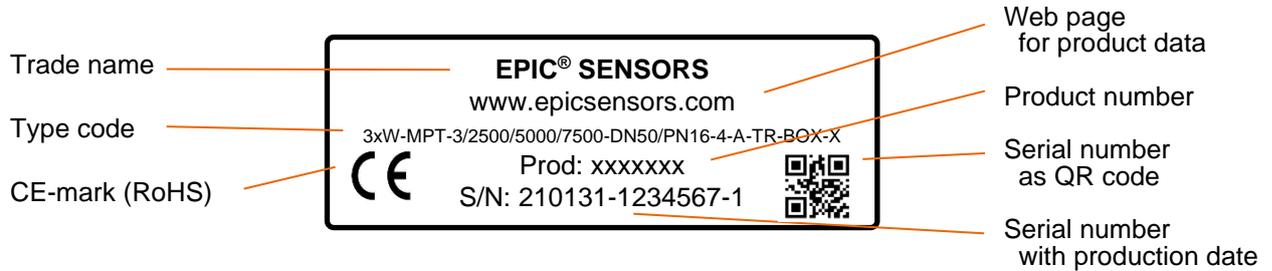
TC; thermocouple cable standards (color table)

| New standards: | IEC 60584-3 | DIN EN 60584 | ISA MC 96.1 |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Thermo Type | IEC 584 | DIN 43714 | ANSI MC 96.1 |
| NiCr-Ni / K KCA: Fe-CuNi |  + green/ - white Jacket: green |  + red/ - green Jacket: green |  + yellow/ - red Jacket: yellow |
| Fe-CuNi / L | |  + red/ - blue Jacket: blue | |
| Fe-CuNi / J |  + black/ - white Jacket: black | |  + white/ - red Jacket: black |
| Pt10Rh-Pt / S SCA: E-Cu/A-Cu |  + orange/ - white Jacket: orange |  + red/ - white Jacket: white |  + black/ - red Jacket: green |
| Pt13Rh-Pt / R RCA: E-Cu/A-Cu |  + orange/ - white Jacket: orange |  + red/ - white Jacket: white |  + black/ - red Jacket: green |
| Pt30Rh-Pt6Rh / B BC: S-Cu/E-Cu |  + grey/ - white Jacket: grey | |  + grey/ - red Jacket: grey |
| NiCrosil-Nisil / N NC: Cu-CuNi |  + pink/ - white Jacket: pink | | |
| Cu-CuNi / U | |  + red/ - brown Jacket: brown | |
| Cu-CuNi / T |  + brown/ - white Jacket: brown | | |
| NiCr-CuNi / E |  + purple/ - white Jacket: purple |  + red/ - purple Jacket: purple |  + purple/ - red Jacket: purple |

Type label of standard versions

Each sensor has a type label attached to it. It is a moisture and wear proof industrial grade sticker, with black text on white label. This label has printed information of trade name, web page, type code, CE-mark, product number and serial number, including production date. For these sensors manufacturer contact information is printed on a separate label.

Image below: Example of a standard sensor type label.



For EAC EMC-approved, sensor+transmitter combination versions, exported to Eurasian Customs Union area, there is a special type label.

Image below: Example of an EAC EMC-approved product type label, including sensor (1) and transmitter (2).



NOTE!

For some multipoint versions with many measuring points, the text space for Type code in standard label is not long enough. In such cases the label might be different, or the Type code text is shortened with special markings.

Serial number information

Serial number S/N is always printed on type label in the following form: yymmdd-xxxxxx-x:

- yymmdd production date, e.g. “210131” = 31.1.2021
- -xxxxxx production order, e.g. “1234567”
- -x sequential ID number within this production order, e.g. “1”

Ex i data (only for types with Ex i approval)

This sensor type is available also with ATEX and IECEx Ex i approvals. Assembly consists of a temperature sensor for multi-point measurement (sensor type designation -EXI-). All relevant Ex data is given below.

Ex i – Special Conditions for Use

There are special specifications and conditions for use defined in certificates. These include e.g. Ex data, allowed ambient temperatures, and self-heating calculation with examples. These are presented in **Annex A: Specification and special conditions for use - Ex i approved EPIC®SENSORS temperature sensors.**

Ex i certificates and Ex markings

| Certificate - Number | Issued by | Applicable area | Marking |
|------------------------------------------|----------------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| ATEX – EESF 21 ATEX 043X | Eurofins Electric & Electronics Finland Oy, Finland, Notified Body Nr 0537 | Europe | Ex II 1G Ex ia IIC T6...T3 Ga Ex II 1/2G Ex ib IIC T6...T3 Ga/Gb Ex II 1D Ex ia IIIC T135 °C Da Ex II 1/2D Ex ib IIIC T135 °C Da/Db |
| IECEx – IECEx EESF 21.0027X | Eurofins Electric & Electronics Finland Oy, Finland, Notified Body Nr 0537 | Global | Ex ia IIC T6...T3 Ga Ex ib IIC T6...T3 Ga/Gb Ex ia IIIC T135 °C Da Ex ib IIIC T135 °C Da/Db |

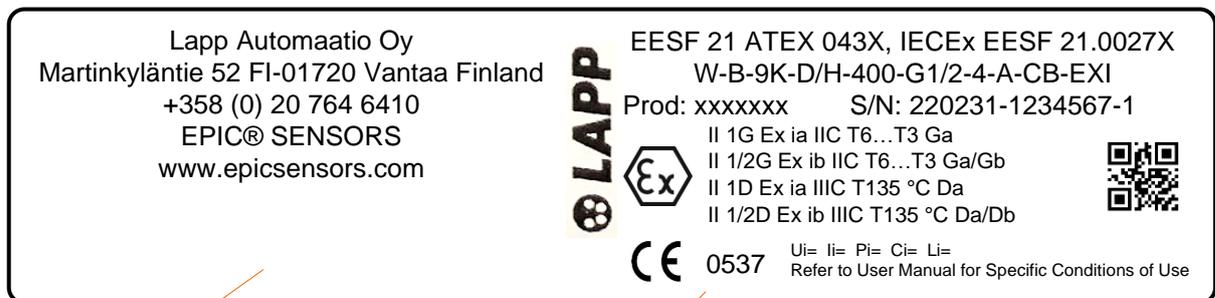
Note! Name change of the Notified Body Nr 0537:

- Until 31.3.2022, the name was: Eurofins Expert Services Oy
- As of 1.4.2022, the name is: Eurofins Electric & Electronics Finland Oy.

Ex i type label

For ATEX and IECEx Ex i approved versions there is more information on the label, according to applicable standards.

Image below: Example of an ATEX and IECEx Ex i approved sensor type label.



Manufacturer contact information.
 For some sensor types, this may also be printed on a separate label for practical reasons.

Ex certificate number(s)
 Type code
 Product number Serial number with production date
 Ex-mark (ATEX) Ex markings
 CE-mark (ATEX and RoHS) Serial number as QR code
 Notified body number
 Special technical values (if needed)

EU Declaration of Conformity

The EU Declaration of Conformity, declaring products' conformance to the European Directives, is delivered with products or sent on request.

Manufacturer contact information

Manufacturer HQ main office:

Lapp Automaatio Oy
Street address Martinkyläntie 52
Postal address FI-01720 Vantaa, Finland

Production site and logistics:

Lapp Automaatio Oy
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Postal address FI-05800 Hyvinkää, Finland

Phone (sales) +358 20 764 6410

Email epicsensors.fi.lav@lapp.com
Https www.epicsensors.com

Document history

| Version / date | Author(s) | Description |
|----------------|-----------|--------------------------------|
| 20230707 | LAPP/VeTe | Text corrections. |
| 20220822 | LAPP/JuPi | Telephone number update |
| 20220815 | LAPP/JuPi | Material name text corrections |
| 20220408 | LAPP/JuPi | Minor text corrections |
| 20220401 | LAPP/JuPi | Original version |

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We reserve the right to make changes without prior notice. © Lapp Automaatio Oy

ANNEX A - Specification and special conditions for use - Ex i approved EPIC® SENSORS temperature sensors

Annex A, page 1/4

Ex data for RTD (resistance temperature sensor) and TC (Thermocouple temperature sensor)

Sensor Ex data, maximum interface values, without transmitter or / and display.

| Electrical values | For Group IIC | For Group IIIC |
|-------------------|---------------|-------------------------------|
| Voltage U_i | 30 V | 30 V |
| Current I_i | 100 mA | 100 mA |
| Power P_i | 750 mW | 550 mW @ $T_a +100\text{ °C}$ |
| | | 650 mW @ $T_a +70\text{ °C}$ |
| | | 750 mW @ $T_a +40\text{ °C}$ |
| Capacitance C_i | Negligible, * | Negligible, * |
| Inductance L_i | Negligible, * | Negligible, * |

Table 1. Sensor Ex data.

* For sensors with long cable part, the parameters C_i and L_i must be included in the calculation.
Following values per meter can be used according to EN 60079-14:
 $C_{\text{cable}} = 200\text{ pF/m}$ and $L_{\text{cable}} = 1\text{ μH/m}$.

Allowed ambient temperatures - Ex i temperature class, without transmitter and/or display.

| Marking, Gas Group IIC | Temperature class | Ambient temperature |
|-----------------------------------------------------------------|-------------------|---------------------|
| II 1G Ex ia IIC T6 Ga II 1/2G Ex ib IIC T6-T3 Ga/Gb | T6 | -40...+80 °C |
| II 1G Ex ia IIC T5 Ga II 1/2G Ex ib IIC T6-T3 Ga/Gb | T5 | -40...+95 °C |
| II 1G Ex ia IIC T4-T3 Ga II 1/2G Ex ib IIC T6-T3 Ga/Gb | T4-T3 | -40...+100 °C |
| Marking, Dust Group IIIC | Power P_i | Ambient temperature |
| II 1D Ex ia IIIC T135 °C Da II 1/2D Ex ib IIIC T135 °C Da/Db | 750 mW | -40...+40 °C |
| II 1D Ex ia IIIC T135 °C Da II 1/2D Ex ib IIIC T135 °C Da/Db | 650 mW | -40...+70 °C |
| II 1D Ex ia IIIC T135 °C Da II 1/2D Ex ib IIIC T135 °C Da/Db | 550 mW | -40...+100 °C |

Table 2. Ex i temperature classes and allowed ambient temperature ranges

Note!

The temperatures above are without cable glands.

The compatibility of cable glands must be according to the application specifications.

If the transmitter and/or display will be inside the transmitter housing, the specific Ex requirements of the transmitter and/or display installation must be noted.

The used materials must comply the needs of application, e.g., abrasion, and the temperatures above.

For EPL Ga Group IIC the aluminium parts in connection heads are subject to sparking by impacts or friction.

For Group IIIC the maximum input power P_i shall be observed.

When the sensors are mounted across boundary between different Zones, refer to standard IEC 60079-26 section 6, for ensuring the boundary wall between different hazardous areas.

ANNEX A - Specification and special conditions for use - Ex i approved EPIC® SENSORS temperature sensors

Annex A, page 2/4

Considering sensor self-heating

Self-heating of the sensor tip shall be considered in respect with Temperature Classification and associated ambient temperature range and manufacturer's instructions for calculating tip surface temperature according to thermal resistances stated in the instructions shall be observed.

Allowed ambient temperature range of sensor head or process connection for Groups IIC and IIIC with different temperature classes are listed in Table 2. For Group IIIC the maximum input power P_i shall be observed.

The process temperature shall not adversely affect ambient temperature range assigned for Temperature Classification.

Calculation for self-heating of the sensor at the tip of sensor or the thermowell tip

When the sensor-tip is located at environment where the temperature is within $T_6 \dots T_3$, it is needed to consider the self-heating of the sensor. Self-heating is of particular significance when measuring low temperatures.

The self-heating at the sensor tip or thermowell tip depends on the sensor type (RTD/TC), the diameter of sensor and structure of sensor. It is also needed to consider the Ex i values for the transmitter. The table 3. shows the R_{th} values for different type of sensors structure.

| Sensor type | Thermal resistance R_{th} [°C / W] | | | | | |
|--------------------------------------------------------------------------------------------------|--------------------------------------|-----------|----------|-------------------|-----------|----------|
| | Resistance thermometer (RTD) | | | Thermocouple (TC) | | |
| Measuring insert diameter | < 3 mm | 3...<6 mm | 6...8 mm | < 3 mm | 3...<6 mm | 6...8 mm |
| Without thermowell | 350 | 250 | 100 | 100 | 25 | 10 |
| With thermowell made from tube material (e.g. B-6k, B-9K, B-6, B-9, A-15, A-22, F-11, etc) | 185 | 140 | 55 | 50 | 13 | 5 |
| With thermowell – solid material (e.g. D-Dx, A-Ø-U) | 65 | 50 | 20 | 20 | 5 | 1 |

Table 3. Thermal resistance based on Test report 211126

Note!

If the measuring device for RTD-measuring is using measuring current > 1 mA, the maximum surface temperature of the temperature sensor tip should be calculated and taken to account. Please see next page.

If sensor type has multiple sensing elements included, and those are used simultaneously, note that the maximum power for all sensing elements should not be more than the allowed total power P_i . Maximum power must be limited to 750 mW. This must be guaranteed by process owner. (Not applicable for Multi-point temperature sensor types T-MP / W-MP or T-MPT / W-MPT with segregated Exi circuits).

ANNEX A - Specification and special conditions for use - Ex i approved EPIC® SENSORS temperature sensors

Annex A, page 3/4

Calculation for maximum temperature:

The self-heating of the sensor tip can be calculated from formula:

$$T_{max} = P_o \times R_{th} + MT$$

- (T_{max}) = Maximum temperature = surface temperature at the sensor tip
- (P_o) = Maximum feeding power for the sensor (see the transmitter certificate)
- (R_{th}) = Thermal resistance (K/W, Table 3.)
- (MT) = Medium temperature.

Calculate the maximum possible temperature at the tip of sensor:

Example 1 - Calculation for RTD-sensor tip with thermowell

Sensor used at Zone 0

RTD sensor type: W-M-9K . . . (RTD-sensor with head-mounted transmitter).

Sensor with thermowell, diameter of Ø 9 mm.

Medium temperature (MT) is 120 °C

Measuring is made with PR electronics head mounted transmitter 5437D and isolated barrier PR 9106 B.

Maximum temperature (T_{max}) can be calculated by adding the temperature of the medium that you are measuring and the self-heating. The self-heating of the sensor tip can be calculated from the Maximum power (P_o) which is feeding the sensor and R_{th}-value of used sensor type. (See the Table 3.)

Supplied power by PR 5437 D is (P_o) = 23,3 mW (from the transmitter Ex-certificate)

Temperature class T4 (135 °C) must not be exceeded.

Thermal resistance (R_{th}) for the sensor is = 55 K/W (from Table 3).

Self-heating is 0.0233 W * 55 K/W = 1,28 K

Maximum temperature (T_{max}) is MT + self-heating: 120 °C + 1,28 °C = 121,28 °C

The result in this example shows that, the self-heating at the sensor tip is negligible.

The safety margin for (T₆ to T₃) is 5 °C and that must be subtracted from 135 °C; means that up to 130 °C would be acceptable. In this example the temperature of class T4 is not exceeded.

Example 2 - Calculation for RTD-sensor tip without the thermowell.

Sensor used at Zone 1

RTD sensor type: W-M-6/303 . . . (RTD-sensor with cable, without head-mounted transmitter)

Sensor without thermowell, diameter of Ø 6 mm.

Medium temperature (MT) is 40 °C

Measuring is made with rail-mounted PR electronics PR 9113D isolated transmitter/barrier.

Maximum temperature (T_{max}) can be calculated by adding the temperature of the medium that you are measuring and the self-heating. The self-heating of the sensor tip can be calculated from the Maximum power (P_o) which is feeding the sensor and R_{th}-value of used sensor type. (See the Table 3.)

Supplied power by PR 9113D is (P_o) = 40,0 mW (from the transmitter Ex-certificate)

Temperature class T3 (200 °C) must not be exceeded.

Thermal resistance (R_{th}) for the sensor is = 100 K/W (from Table 3).

Self-heating is 0.040 W * 100 K/W = 4,00 K

Maximum temperature (T_{max}) is MT + self-heating: 40 °C + 4,00 °C = 44,00 °C

The result in this example shows that, the self-heating at the sensor tip is negligible.

The safety margin for (T₆ to T₃) is 5 °C and that must be subtracted from 200 °C; means that up to 195 °C would be acceptable. In this example the temperature of class T3 is not exceeded.

ANNEX A - Specification and special conditions for use
- Ex i approved EPIC® SENSORS temperature sensors

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Additional information for Group II devices: (acc. to EN IEC 60079-0: 2019 section: 5.3.2.2 and 26.5.1)

Temperature class for T3 = 200 °C
Temperature class for T4 = 135 °C
Safety margin for T3 to T6 = 5 K
Safety margin for T1 to T2 = 10 K.

Note!

This ANNEX is an instructional document on specifications.
For original regulatory data on specific conditions for use, always refer to ATEX and IECEx certificates:

EESF 21 ATEX 043X
IECEx EESF 21.0027X