LAPP AUTOMAATIO

EPIC® SENSORS

MINERAL INSULATED TEMPERATURE SENSOR WITH CABLE
TYPE T-M-302, T-M-303 / W-M-302, W-M-303,
W-M-302-…-EX, WT-MI-302-…-EX, W-M-303-…-EX
DATA SHEET 10

INSTALLATION INSTRUCTIONS AND USER MANUAL

Table of contents

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Product description and intended use

Sensor types T-M-302 and T-M-303 (thermocouple, TC) and W-M-302 and W-M-303 (resistance, RTD) are mineral insulated temperature sensors with cable, constructed according to DIN 43721.

Sensors are intended for various industrial measuring applications, to be immersed to process/object or attached to a surface to be measured. The construction allows very versatile use cases.

Mineral insulated sensors with cable are used in applications, where wiring connection point must be further away from the measuring point, or where there is no room for traditional sensor connection head. Another reason for choosing the cable structure is possibility to easily move the sensor from measuring point to another.

Measuring elements are mineral insulated (MI) elements, which are bendable. Elements can be TC or RTD elements, standard versions are K-type thermocouple (for T-M-302/303) and 4-wire Pt100 (for W-M-302/303).

NOTE! Do not bend the sensor tip (30 mm) of RTD elements. It can destroy the sensing resistor inside!

Sensor element protection tube material can be chosen, and element / cable length can be produced according to customer needs. Sensors are available with cable (type designation -303-) or with free wires (type designation -302-). Wire and cable sheath materials can be chosen.

Tailored versions are produced on request.

Also available as protection type Ex i versions (ATEX and IECEx approved), and protection type Ex e versions (ATEX approved). Please see sections *Ex i data* and *Ex e 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 tip is:

- With Pt100 -200…+550 °C, depending on sensor element and cable material
- With TC -200…+1200 °C, depending on TC type and sensor materials.

Allowed maximum temperature for sealant tube* is:

- Max. safe temperature +100 °C

*Sealant tube is the transition point between cable and sensor element, please see *Dimensional drawing*.

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

NOTE! Max. safe temperature +100 °C for the sealant tube in cable to sensor element transition.

Make sure the process temperature is not too much for the sensor sealant tube and/or to the cable.

Temperatures, Ex i versions

For Ex i versions only (type designation -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).

Temperatures, Ex e versions

For Ex e versions only (type designation -EX), specific conditions apply according to the ATEX certificates.

For type W-M-302-…-EX, certificate EESF 18 ATEX 050X Issue 2:

Allowed maximum ambient temperature ranges for T6…T4 are:
T6: -40 °C ≤ T_{amb} ≤ +80 °C
T5: -40 °C ≤ T_{amb} ≤ +95 °C
T4: -40 °C ≤ T_{amb} ≤ +130 °C

Allowed maximum ambient temperature ranges for T60 °C…T130 °C are:
T60°C: -40 °C ≤ T_{amb} ≤ +60 °C
T130°C: -40 °C ≤ T_{amb} ≤ +130 °C
For intermediate values, the maximum surface temperature T** °C shall be equal to maximum T_{amb} value.

The sensor head may be exposed to process temperatures outside the above mentioned ranges but in no case shall the pot seal or the connection wires be exposed to temperatures beyond -40 °C…+130 °C. The permitted process temperature ranges are -200 °C…+400 °C or -200 °C…+550 °C depending on the Pt100 element and as marked on the equipment.

The connection of the sensor to external circuits shall be made within appropriate Ex eb or Ex tb enclosure as applicable. Also the pot seal shall be within the enclosure.

For type WT-MI-302-6-…-EX, certificates EESF 18 ATEX 049 Issue 1 and EESF 18 ATEX 051 Issue 1

The temperature classification of the sensor (550 °C, T1 - T6) is determined by the ambient temperature of the installation place.

Maximum ambient temperature is 550 °C for the sensor head and 125 °C for the connection terminals of the sensor cable.

For type T- or W-M-303-…-EX, certificate EESF 18 ATEX 055X Issue 1:

Allowed maximum ambient temperature ranges for Group IIC according to T Class ranges T6...T4 are:

T6: -40 °C ≤ T_{amb} ≤ +80 °C
T5: -40 °C ≤ T_{amb} ≤ +95 °C
T4: -40 °C ≤ T_{amb} ≤ +130 °C

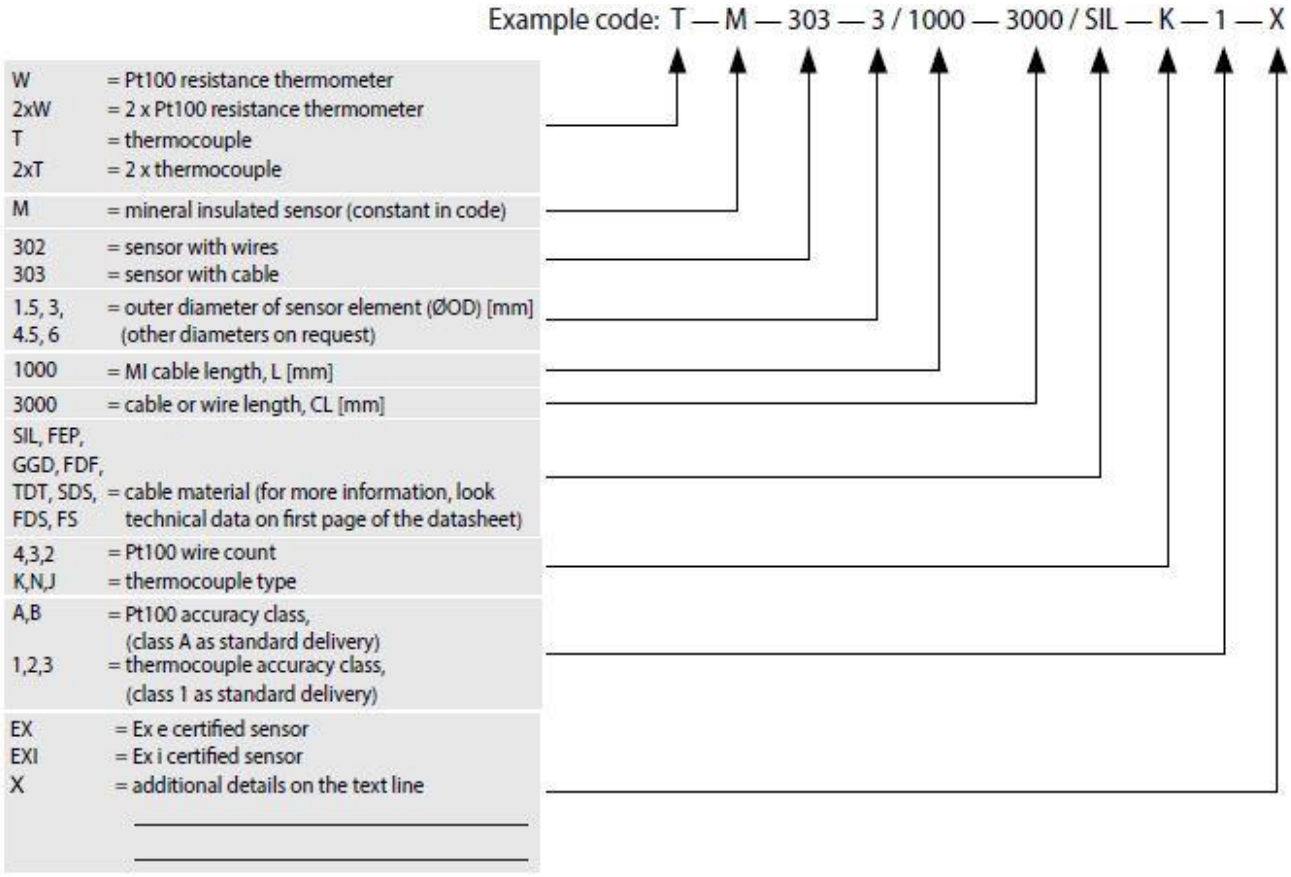
Allowed maximum ambient temperature ranges for Group IIIC according to T60 °C...T130 °C are:

T60 °C: -40 °C ≤ T_{amb} ≤ +60 °C
T130 °C: -40 °C ≤ T_{amb} ≤ +130 °C
For intermediate values, the maximum surface temperature T** °C shall be equal to maximum T_{amb} value.

The maximum service temperature of connection point to Mi-cable is +130 °C.
The maximum service temperature of end sleeve is 105 °C.
The maximum service temperature of probe end tip is given in the manufacturer's instructions.

Please see also section *Ex e data*.

Code key


Example code: T — M — 303 — 3 / 1000 — 3000 / SIL — K — 1 — X
W = Pt100 resistance thermometer
2xW = 2 x Pt100 resistance thermometer
T = thermocouple
2xT = 2 x thermocouple
M = mineral insulated sensor (constant in code)
302 = sensor with wires
303 = sensor with cable
1.5, 3, 4.5, 6 = outer diameter of sensor element (ØOD) [mm] (other diameters on request)
1000 = MI cable length, L [mm]
3000 = cable or wire length, CL [mm]
SIL, FEP, GGD, FDF, TDT, SDS, FDS, FS = cable material (for more information, look technical data on first page of the datasheet)
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)
EX = Ex e certified sensor
EXI = Ex i certified sensor
X = additional details on the text line

Technical data

Materials	AISI 316L, max. temperature +550 °C, temporarily +600 °C, INCONEL 600, max. temperature +1100 °C, temporarily +1200 °C Other materials on request (Note. max. safe temperature +100 °C for the sealant tube in cable to sensor element transition)
Wire materials	FEP wire insulation/no jacket, max. +205 °C
Cable materials	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 (Note. max. safe temperature +100 °C for the sealant tube in cable to sensor element transition)
Tolerances Pt100 (IEC 60751)	A tolerance ±0.15 + 0.002 x t, operating temperature -100...+450 °C B tolerance ±0.3 + 0.005 x t, operating temperature -196...+600 °C B 1/3 DIN, tolerance ±1/3 x (0.3 + 0.005 x t), operating temperature -196...+600 °C B 1/10 DIN, tolerance ±1/10 x (0.3 + 0.005 x t), operating temperature -196...+600 °C
Tolerances thermocouple (IEC 60584)	Type J tolerance class 1 = -40...375 °C ±1.5 °C, 375...750 °C ±0.004 x t Type K and N tolerance class 1 = -40...375 °C ±1.5 °C, 375...1000 °C ±0.004 x t
Temperature range Pt100	-200...+550 °C, depending on sensor element and cable material (Note. max. safe temperature +100 °C for the sealant tube in cable to sensor element transition)
Temperature range thermocouple	-200...+1200 °C, depending on thermocouple type and other sensor materials (Note. maximum safe temperature +100 °C for the sealant tube in cable to sensor element transition)
Approvals	ATEX, IECEx, EAC Ex, METROLOGICAL PATTERN APPROVAL
Quality certificate	ISO 9001:2015 and ISO 14001:2015 issued by DNV
IP rating	IP65, higher IP rating on request

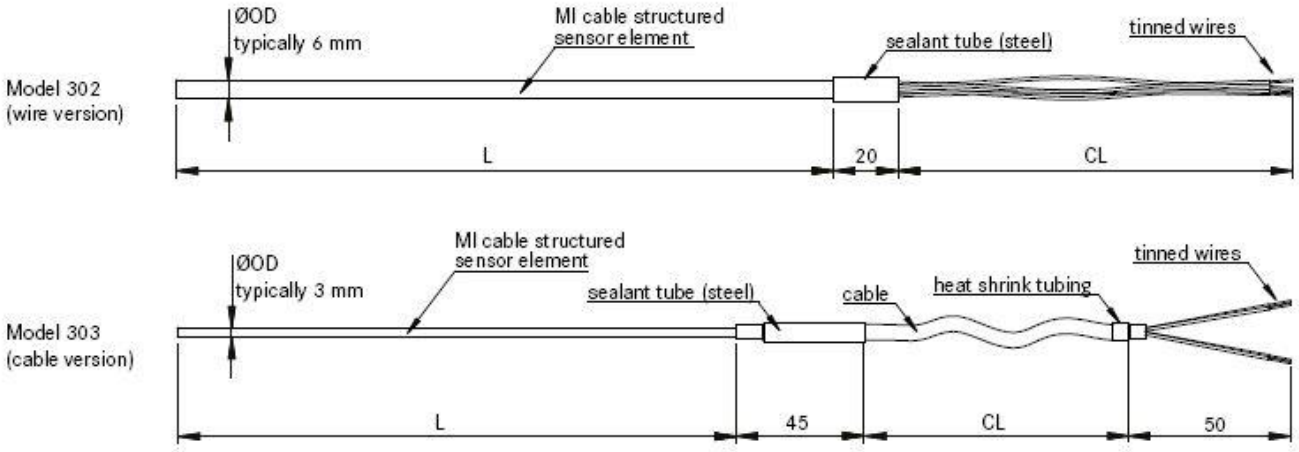
Materials

These are the standard materials of components for the sensor types T-M-302, T-M-303 / W-M-302, W-M-303.

- Cable/wires — please see *Technical data*
- Heat shrink tube — Irradiated Modified Polyolefin (max. +125 °C), only on request, not used as standard
- Sealant tube (steel) — SS316/AISI 316L
- Sealant — Epoxy (max. +100 °C)
- Sensor element / MI cable sheath — AISI 316L or INCONEL 600

Other materials can be used on request.

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.

Installation phases:

- During installation, remember the MI element minimum bending radius is 2x ØOD of the element.
- Do not bend the MI element tip (30 mm length from sensing tip) of a RTD sensor element.
- Insert the measuring element into atmosphere/medium/material or on surface to be measured.
- Mount the sensor securely with application-specific mounting accessories.
- Make sure there is no excess bending or pulling force loading the cable.
- Mount extra strain relief for cable, if necessary.

Image below: this example shows a sensor installed with an adjustable coupling on a welded threaded sleeve on process piping.

Tightening torques

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

Installation of accessories

Adjustable gland couplings AISI 316:

As accessories there are adjustable gland couplings available, for occasions where the sensor should be installed to a threaded hole in process.

Gland couplings - a.k.a. compression fittings - are used with sensing inserts or sensors without wells. The immersion depth of sensing insert can be adjusted, when installing on a thread. Compression fittings have metal ferrules inside. Ferrules are made of stainless steel SS316L (other materials and sizes available upon request). Single or double ferrules are used depending on the inner diameter. By screwing the cap down, the ferrule is permanently pressed on the sensing element. This connection is pressure resistant, which is also reason for the alias name; compression fitting.

Installation phases:

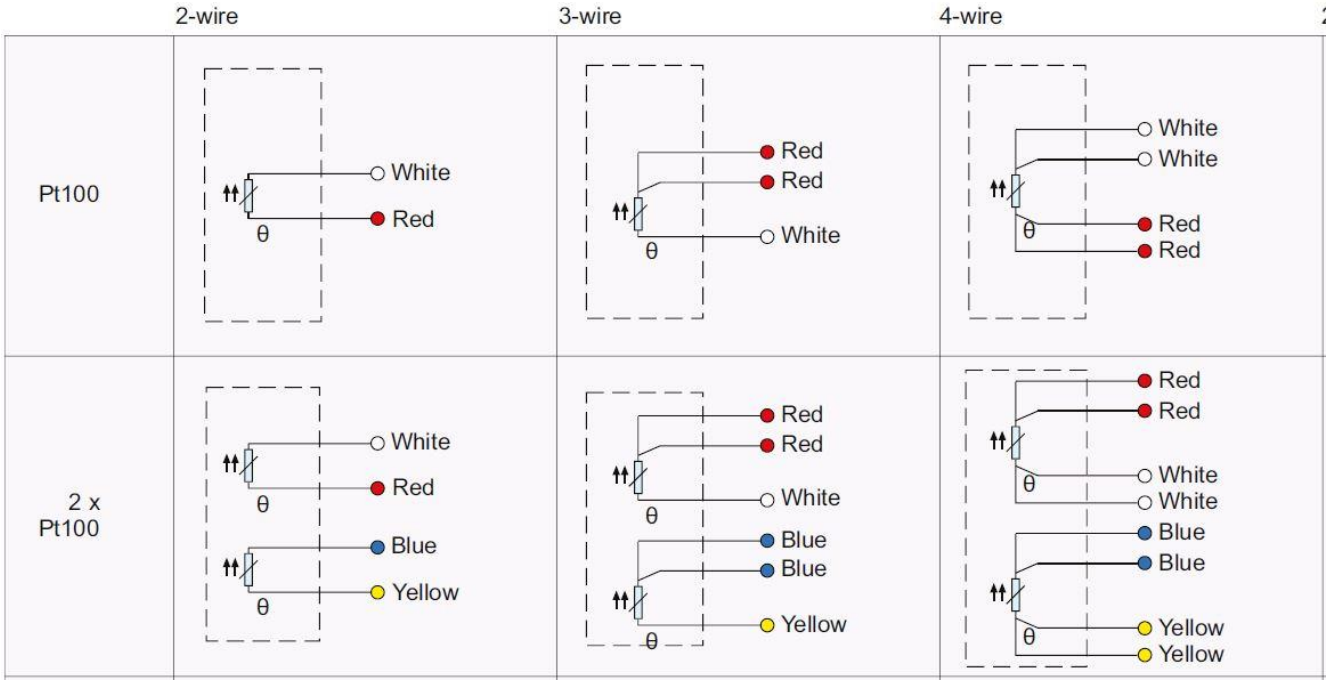
- Screw the coupling in an applicable thread hole.
- Tighten securely with the lower nut.
- Insert the sensor element as far as needed through the coupling.
- NOTE! After next phase there is no coming back, the tightened connection is permanent!
- If you are absolutely sure about the depth, screw down the cap (upper nut) to fix the depth.
- For tightening use only enough force needed. Excess force may damage the sensor element and affect the tightness of the fitting.

Some of the many available gland couplings are:

Product number	***Type - thread - inner diameter***
875823	Compression fitting G½ - 6 mm
1001171	Compression fitting G½ - 12 mm
914413	Compression fitting G½ - 15 mm
1010922	Compression fitting G¼ - 1.5 mm
911898	Compression fitting G¼ - 3 mm
911897	Compression fitting G¼ - 4.5 mm
920701	Compression fitting G¼ - 6 mm
920587	Compression fitting G⅛ - 1.5 mm
919178	Compression fitting G⅛ - 3 mm
1090957	Compression fitting G⅛ - 1 mm
1062720	Compression fitting M8x1 - 1.5 mm
911908	Compression fitting M8x1 - 3 mm
1040461	Compression fitting M18x1.5 - 6 mm
914237	Compression fitting NPT¼ - 3 mm.
1066586	Compression fitting NPT¼ - 6 mm
1001559	Compression fitting NPT⅛ - 3 mm
1066584	Compression fitting NPT⅛ - 6 mm

Pt100; connection wiring

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



Other connections on request.

Pt100; measuring current

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

Normally the recommended maximum values are:

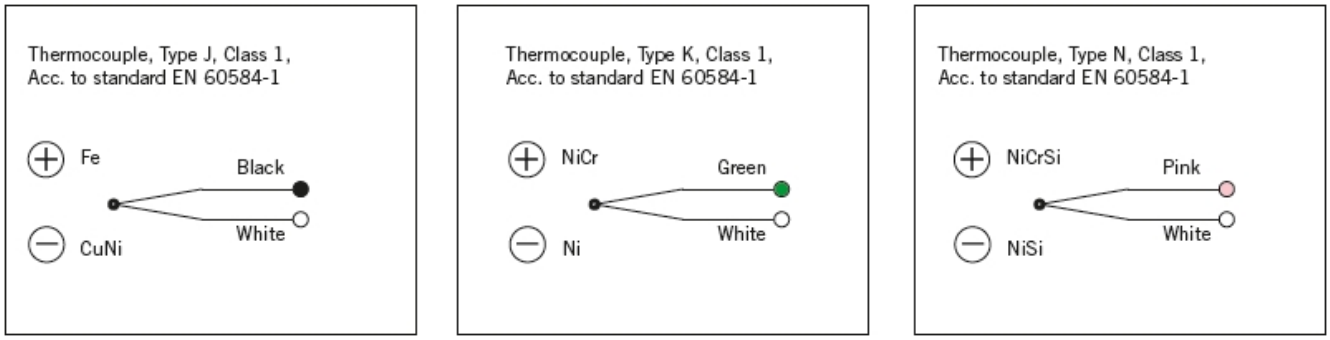
- Pt100 1 mA
- Pt500 0,5 mA
- Pt1000 0,3 mA.

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 sheath is not connected to the thermo material hot junction, where two materials are welded together.

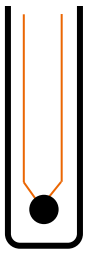
In special applications also grounded types are used.

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.

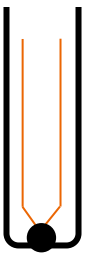
Image below: Non-grounded and grounded structures in comparison.

Non-grounded TC



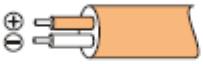
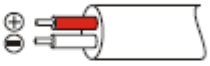
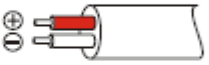
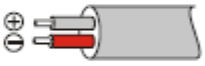
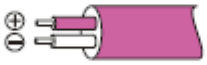
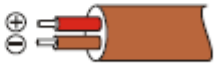
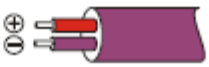
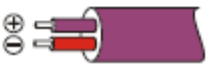
Thermo material hot junction and MI cable sheath are galvanically isolated from each other.

Grounded TC



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

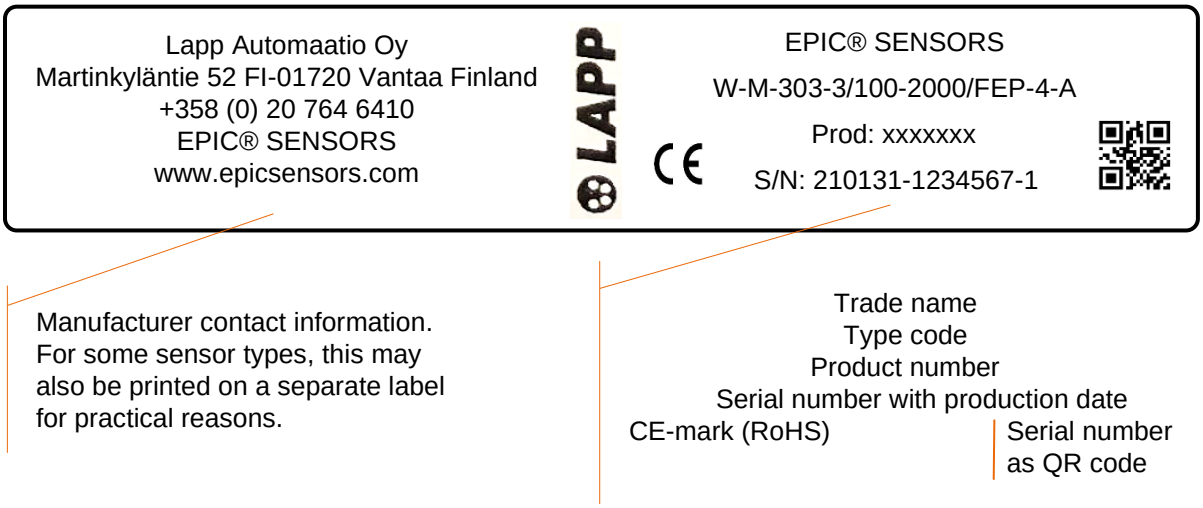
TC; thermocouple cable standards (color table)

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 is a moisture and wear proof industrial grade sticker, with black text on white label. This label has printed information as presented below.

Image below: Example of a non-Ex sensor type label.



Serial number information

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

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

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

These sensor types are available also as protection type Ex e construction, with ATEX, IECEx, KCs and EAC Ex approvals. The approved types are special versions, with type designation ending with -EX. Special data for use in Ex e applications is given in certificates.

Ex e certificates and Ex markings

Type Certificate number	Issued by	Applicable area	Marking
W-M-302-…-EX			
ATEX EESF 18 ATEX 050X	Eurofins Expert Services Oy, Finland, Notified Body Nr 0537	Europe	Ex II 2G Ex eb IIC T6…T4 Gb Ex II 2D Ex tb IIIC T60°C…T130°C Db
WT-MI-302-6-…-EX			
ATEX EESF 18 ATEX 049X, EESF 18 ATEX 051X	Eurofins Expert Services Oy, Finland, Notified Body Nr 0537	Europe	Ex II 2GD Ex e II T1-T6 Ex tD A21 IP66 T+60°C Tamb: -40…+125°C/+550°C
EAC Ex № ЕАЭС RU C-FI.AA71.B.00130-19	Lenpromexpertiza OOO, Russia	Eurasian Customs Union (Belarus, Kazakhstan, Russia)	1 Ex e IIC T6…T1 Gb X Ex tb IIIC T60°C Db X
T- or W-M-303-…-EX			
ATEX EESF 18 ATEX 055X	Eurofins Expert Services Oy, Finland, Notified Body Nr 0537	Europe	Ex II 2G Ex eb IIC T6…T4 Gb Ex II 2D Ex tb IIIC T60°C…T130°C Db
IECEx IECEx EESF 18.0027X	Eurofins Expert Services Oy, Finland, Notified Body Nr 0537	Global	Ex eb IIC T6…T4 Gb Ex tb IIIC T60°C…T130°C Db
EAC Ex № ЕАЭС RU C-FI.AA71.B.00130-19	Lenpromexpertiza OOO, Russia	Eurasian Customs Union (Belarus, Kazakhstan, Russia)	1 Ex e IIC T6…T4 Gb X Ex tb IIIC T60°…T130°C Db X
KCs 19-KA4BO-0461X (T) 19-KA4BO-0460X (W)	KTL Korea Testing Laboratory, South Korea	South Korea	Ex e IIC T6…T4

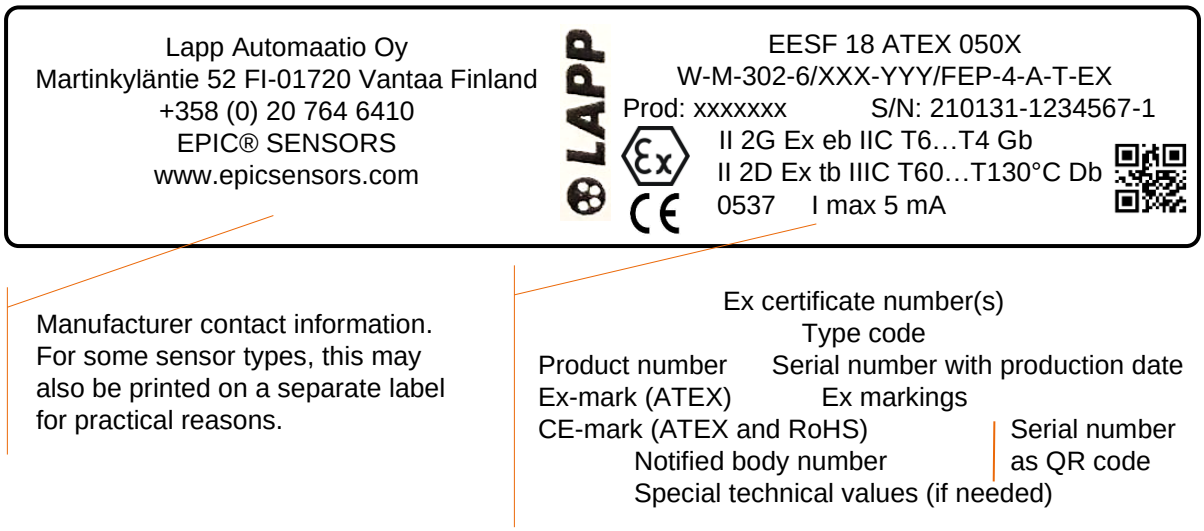
For certificate copies and special Ex e product data, please visit:

https://www.epicsensors.com/en/products/temperature-sensors/exe-extb-temperature-sensors/

Ex e type label

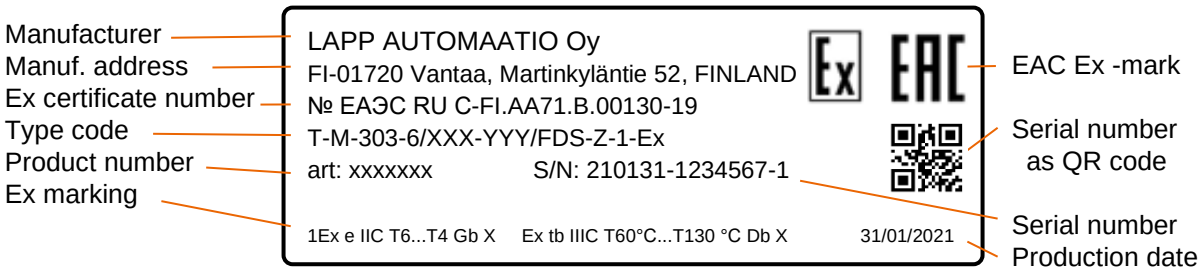
For ATEX, IECEx and KCs Ex e approved versions there is more information on the label, according to applicable standards. This label has printed information as presented below.

Image below: Example of an ATEX Ex e approved sensor type label.



For EAC Ex e approved sensor versions, exported to Eurasian Customs Union area, there is a special type label.

Image below: Example of an EAC Ex-approved sensor type label.



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 with cable or wires for connection (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

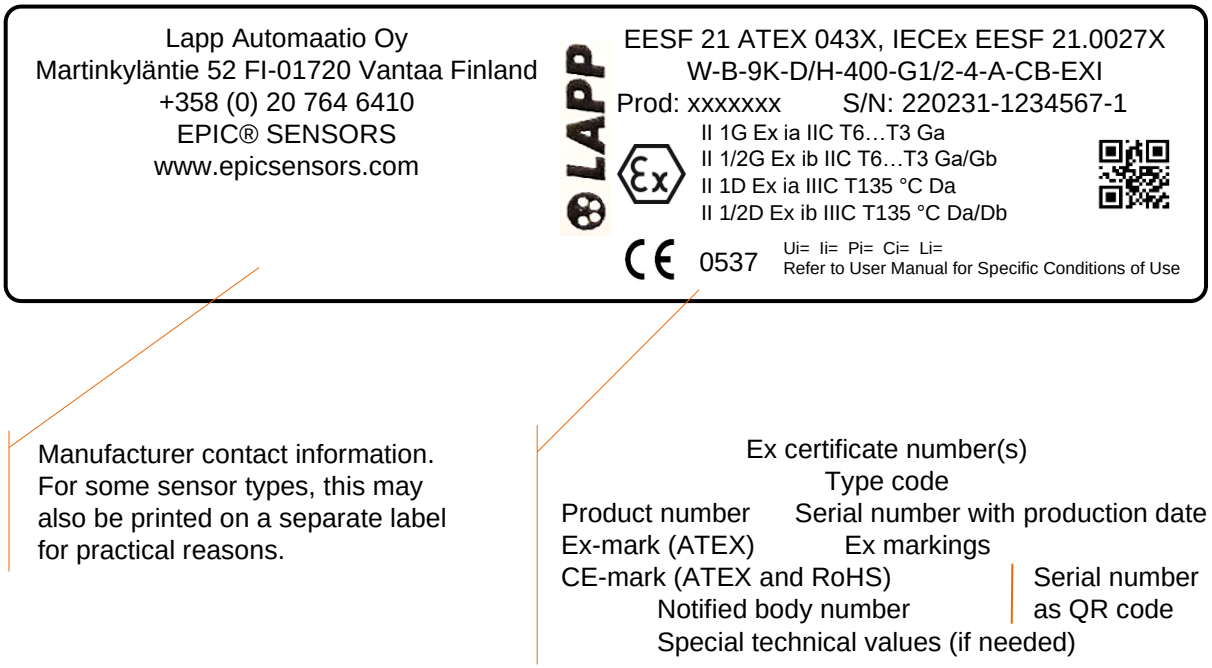
Note! Name change of the Notified Body Nr 0537:

- 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.



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

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Document history

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20230707	LAPP/VeTe	Additional info for sensor cable installation.
20220822	LAPP/JuPi	Telephone number update
20220815	LAPP/JuPi	Material name text corrections
20220408	LAPP/JuPi	Minor text corrections
20220401	LAPP/JuPi	Original version

Although every reasonable effort is made to ensure the accuracy of the content of the operating instructions, Lapp Automaatio Oy is not responsible for the way the publications are used or for possible misinterpretations by end users. The user must ensure that she or he has the latest edition of this publication.

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

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 Ui	30 V	30 V
Current Ii	100 mA	100 mA
Power Pi	750 mW	550 mW @ Ta +100 °C
		650 mW @ Ta +70 °C
		750 mW @ Ta +40 °C
Capacitance Ci	Negligible, *	Negligible, *
Inductance Li	Negligible, *	Negligible, *

Table 1. Sensor Ex data.

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

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 Pi 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 T6…T3, 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 Rth values for different type of sensors structure.

	Thermal resistance Rth [°C / W]					
Sensor type	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 Pi.
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

Calculation for maximum temperature:

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

Tmax= Po × Rth + MT

(Tmax) = Maximum temperature = surface temperature at the sensor tip
(Po) = Maximum feeding power for the sensor (see the transmitter certificate)
(Rth) = 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 (Tmax) 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 (Po) which is feeding the sensor and Rth-value of used sensor type. (See the Table 3.)

Supplied power by PR 5437 D is (Po) = 23,3 mW (from the transmitter Ex-certificate)
Temperature class T4 (135 °C) must not be exceeded.
Thermal resistance (Rth) for the sensor is = 55 K/W (from Table 3).
Self-heating is 0.0233 W * 55 K/W = 1,28 K
Maximum temperature (Tmax) 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 (Tmax) 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 (Po) which is feeding the sensor and Rth-value of used sensor type. (See the Table 3.)

Supplied power by PR 9113D is (Po) = 40,0 mW (from the transmitter Ex-certificate)
Temperature class T3 (200 °C) must not be exceeded.
Thermal resistance (Rth) for the sensor is = 100 K/W (from Table 3).
Self-heating is 0.040 W * 100 K/W = 4,00 K
Maximum temperature (Tmax) 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

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