ifm electronic

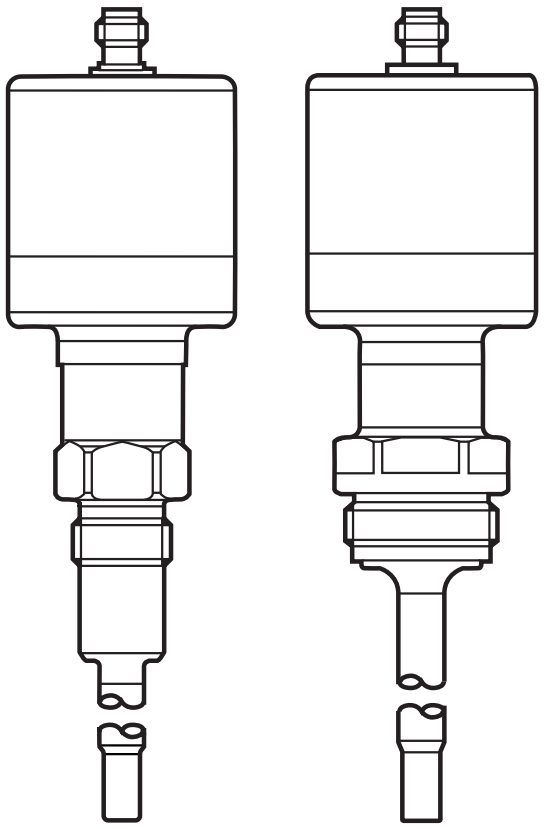
CE

Operating instructions
Temperature transmitter

efector600

UK

TADx81
TADx91
TAD710



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Contents

1 Preliminary note

1.1 Symbols used

▶ Instructions

> Reaction, result

[…] Designation of pushbuttons, buttons or indications

→ Cross-reference

Important note
Non-compliance can result in malfunction or interference.

Information
Supplementary note.

2 Safety instructions

- Please read this document prior to set-up of the unit. Ensure that the product is suitable for your application without any restrictions.
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property can occur.
- Improper or non-intended use may lead to malfunctions of the unit or to unwanted effects in your application. That is why installation, electrical connection, set-up, operation and maintenance of the unit must only be carried out by qualified personnel authorised by the machine operator.
- In order to guarantee the correct condition of the device for the operating time the device must only be used in media to which the wetted parts are sufficiently resistant (→ Technical data).
- The responsibility whether the measurement devices are suitable for the respective application lies with the operator. The manufacturer assumes no liability for consequences of misuse by the operator. Improper installation and use of the devices result in a loss of the warranty claims.

3 Functions and features

The unit detects the system temperature in installations.

3.1 Applications

To ensure long-term stability and high accuracy of the unit during operation, please note:

▶ Min. insertion depth of the measuring probe: 25 mm.

▶ The following limit values must be observed:

Measuring range	-25 ... +160°C*	-13 ... 320°F
Operating temperature of the process connection	-32 ... +170°C	-25.6 ... 338°F
Ambient temperature	-25 ... +70°C	-13 ... 158°F
Storage temperature	-40 ... +85°C	-40 ... 185°F
Operating pressure of the medium	≤ 50 bar	≤ 725 PSI
Number of temperature cycles (135K / 7s)	< 3000	

* → 10.1 Temperature resistance

4 Functionality

The unit supports IO-Link.

The following operating modes are available:

1	**2-wire temperature transmitter**
	The unit provides a temperature-proportional output signal (4...20 mA or 20...4 mA). The measuring range is scalable → 4.2 Analogue function. In addition, the analogue output for diagnostics can be used according to NAMUR NE43. Since the diagnostic output is not available in this operating mode, it is not possible to display all error states of the unit.
2	**Temperature transmitter with diagnostic output (3-wire operation)**
	In addition to the analogue signal the unit provides a diagnostic signal. Sensitivity and reaction to different error modes can be programmed. Pin 4 = output for diagnostic signal (pnp or npn).
3	**Communication mode (3-wire operation)**
	The sensor is designed for communication with the PC or PLC via IO-Link. For communication with a PC, the parameter setting software is available. For communication mode, no parameter setting is necessary. Using pin 4 (data channel), data can be read in and out at any time.

4.1 Monitoring and diagnostic functions

- By measuring with two different, thermically coupled sensor elements (NTC, PT 1000) the unit automatically detects drifts and errors during temperature measurement with great reliability.
- An average value is formed from the measured individual NTC and Pt 1000 values. This average value is the basis for the provided measured value and also the basis for the drift warning threshold [drW], the drift alarm threshold [drA] and the drift failure threshold [drF] derived from the drift alarm threshold.
- If one of the two sensor elements fails, the temperature measurement can be continued with the second element (backup function).
- Very long-term stable measurement is achieved by using high-quality sensor elements.

4.1.1 Drift / fault monitoring

To monitor the drift the unit compares the temperatures of two different sensor elements that are thermically coupled in the sensor tip. Normally these temperatures are identical.

Due to the usual manufacturing tolerances a temperature difference of max. 0.1 K can also occur with new sensor elements. This does not affect the drift monitoring function.

If there is a drift in one or both sensor elements, the unit detects them due to the difference between the two measured temperatures. It compares the average value of the two temperatures with the set warning / alarm thresholds [drW], [drA] → 7.3.4; → 7.3.5.

If the thresholds are exceeded, it generates corresponding diagnostic messages and sets the corresponding status for the process value.

In case of high temperature changes in the measured medium (e.g. filling of a hot medium into a cold vessel) there may be a short-term difference between the temperatures of both measuring elements. To suppress this effect, the delay can be changed via the parameter [ddr].

4.1.2 Sensor backup / redundancy switching

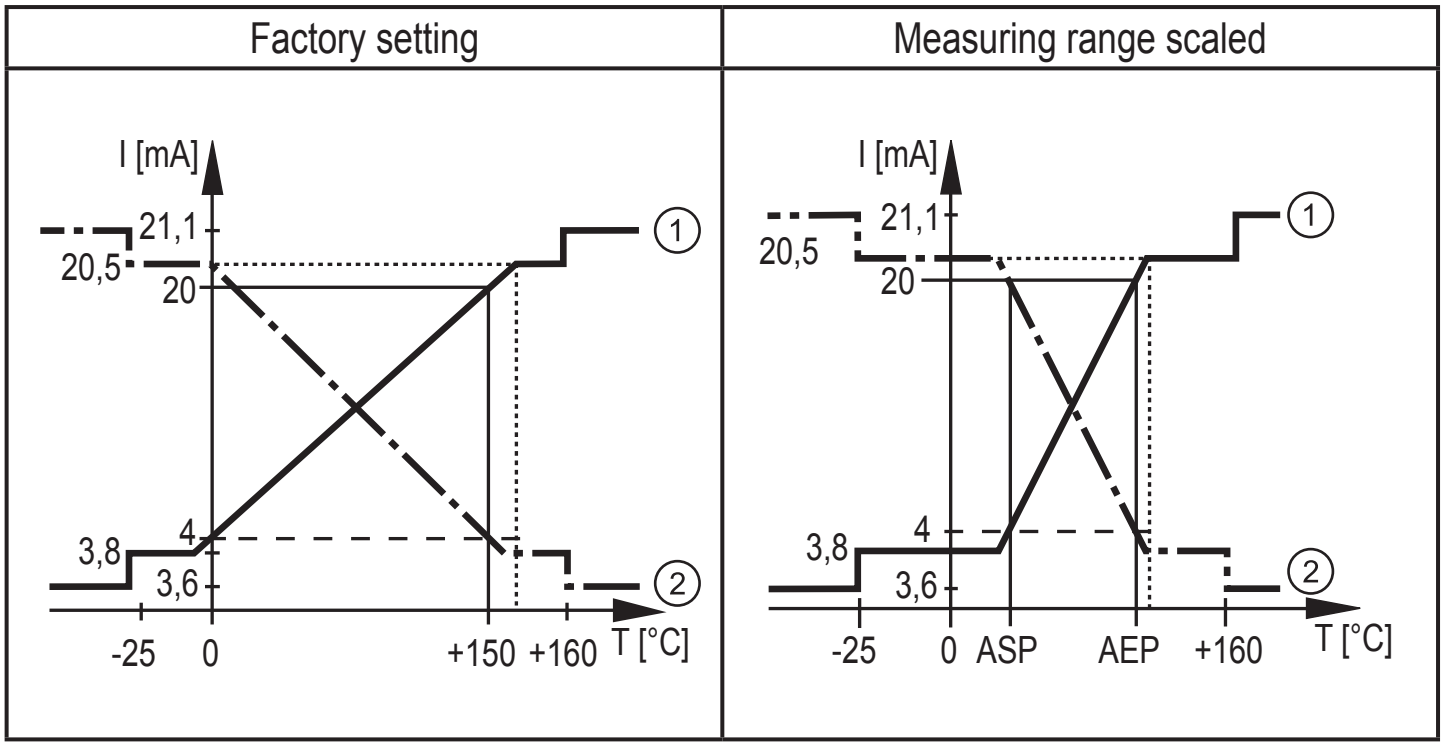
If one of the two temperature measuring channels fails (e.g. short circuit of one of the two sensor elements), the temperature can still be measured with the channel which is still operational (sensor backup). However, drift monitoring is not possible any more.

The behaviour of the unit, e.g., in case of failure of one of the two measuring elements is defined by the parameter [drEd] → 8 Operation.

4.2 Analogue function

- [**OU2**] defines whether the set measuring range is provided as 4...20 mA ([**OU2**] = [**I**]) or as 20...4 mA ([**OU2**] = [**InEG**]).
- The analogue start point [**ASP**] defines at which measured value the output signal is 4 mA (20 mA for [InEG]).
- The analogue end point [**AEP**] defines at which measured value the output signal is 20 mA (4 mA for [InEG]).

Minimum distance between [**ASP**] and [**AEP**] = 5 K.



①: [OU2] = [I]; ②: [OU2] = [InEG]

4.2.1 Behaviour in case of exceeding or not reaching the limits of the measuring range

- Measured temperature above the set measuring range (AEP):
  - The output signal rises to max. 20.5 mA / falls to min. 3.8 mA.
  - If the measured temperature rises any further, a message may be signalled to the controller depending on the setting of the menu item [drEd] (→ 8 Operation).
- Measured temperature below the set measuring range (ASP):
  - The output signal falls to min. 3.8 mA / rises to max. 20.5 mA.

- If the measured temperature falls any further, a message may be signalled to the controller depending on the setting of the menu item [drEd] (→ 8 Operation).

4.3 Operating mode: 2-wire temperature transmitter

4.3.1 Availability groups in 2-wire operation [drEd]

Using [drEd] it can be set which recognised diagnostics types can be passed on via the current output (setting via the parameter setting software).

Table 1: Availability groups in 2-wire operation

[drEd]	Warning	Alarm	Failure
= [ON] Maximum availability			•
= [ONdr] High operational reliability at good availability (factory setting)		•	•
= [OFF] Maximum sensor sensitivity	•	•	•

4.3.2 Setting of the analogue value in case of diagnostics [FOU2]

In 2-wire operation there is a diagnostic message when the actual process value is no longer provided but instead a defined current value to Namur NE43. Two settings are available:

Table 2: Defined analogue value for diagnostics

[FOU2]	Analogue value for diagnostics
= [ON]	21.1 mA (factory setting)
= [OFF]	3.6 mA

4.4 Operating mode: 3-wire temperature transmitter with diagnostic switching output

4.4.1 Availability groups in 3-wire operation [drEd]

Types of diagnostics to be signallled via the current or diagnostic switching output can be set using [drEd] (setting via the parameter setting software).

Since in 3-wire operation all diagnostic messages can be transferred via the switching output, the current output only leaves its process value transfer in case of a failure. This ensures maximum use of the analogue output.

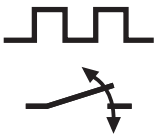
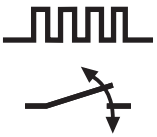
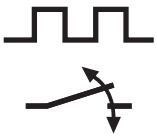
Table 3 Availability groups in 3-wire operation

[drEd]		Warning	Alarm	Failure
= [ON] Maximum availability	OU2 (current output)			•
	OU1 (switching output)			•
= [ONdr] High operational reliability at good availability (factory setting)	OU2 (current output)			•
	OU1 (switching output)		•	•
= [OFF] Maximum sensor sensitivity	OU2 (current output)			•
	OU1 (switching output)	•	•	•

4.4.2 Switching characteristics output 1 in case of diagnostics [dOU1]

The behaviour of the diagnostic output OU1 is independent of the analogue output OU2 and can be configured as below:

Table 4 Switching characteristics output 1 in case of diagnostics

[dOU1]	Normal*	Warning	Alarm or failure
= nc normally closed			
= nc+ normally closed, extended (factory setting)		2 Hz 	
= no+ normally open, extended		2 Hz 	
= Hb heartbeat	4 Hz 	2 Hz 	

* no diagnostic message

Table 5 Types of diagnostics

Case of diagnostics	Warning	Alarm	Failure
Drift warning threshold [drW] exceeded (factory setting: 0.2 °C)	•		
Limit temperature internal electronics exceeded (+90°C)	•		
Drift alarm threshold [drA] exceeded (factory setting: 0.5 °C)		•	
Failure of one of the two sensor elements (interruption / short circuit)		•	
Process value does not reach the analogue start point [ASP] or exceeds the analogue end point [AEP] → 4.2 Analogue function		•	
Supply voltage outside the operating range		•	
Failure of both sensor elements (interruption / short circuit) or general electronics problems (partial malfunction in the sensor electronics)			•
Fault during parameter setting of the IO-Link			•
Drift failure threshold [drF] > drift alarm threshold [drA] + 3 K			•

5 Installation

Before installing and removing the unit: Make sure that no pressure is applied to the system and there is no medium in the pipe. Take into account possible dangers which may arise from extreme plant/medium temperatures.

Information about the available adapters at www.ifm.com.

▶ Observe the instructions of the adapter

▶ Use a lubricating paste which is suitable and approved for the application.

5.1 Installation of units with G1 / Aseptoflex Vario process connection

The following options are possible for fitting to the process connection:

- Installation using an adapter with metal-to-metal seal
- Installation using an adapter with sealing ring
- Installation using a welding adapter
- Installation to G 1 flange:
  The sealing ring on the sensor is used as process seal. The upper sealing area on the process connection must be flush with the tapped hole and have a surface characteristic of min. Rz 6.3.

Recommended tightening torque: 35 Nm.

For use of mounting adapters with leakage port:

▶ Mount the sensor horizontally or slightly diagonally (positions 2 to 4, see figure → 5.3)

▶ Align the leakage port so that it is located at the lowest possible point.

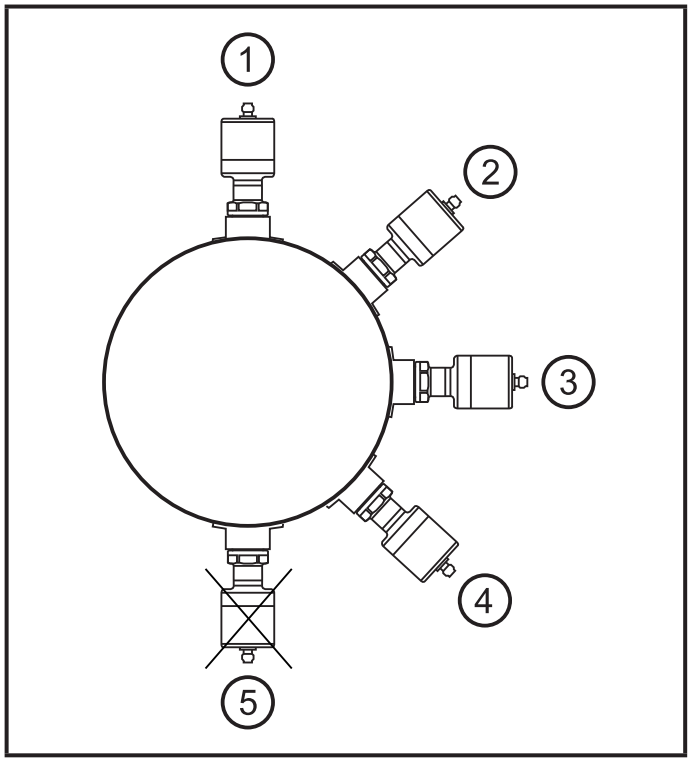
5.2 Installation of units with G½ process connection

The following options are possible for fitting to the process connection:

- Installation using an adapter with metal-to-metal seal
- Installation to G ½ flange. Use the sealing ring that can be ordered separately.

Recommended tightening torque: 30...50 Nm.

5.3 Use in hygienic areas to A-3



The following applies to units with 3-A qualification:

- ▶ Only use adapters with A-3 qualification for the process connection.
- ▶ Do not install the unit at the lowest point of the pipe or tank (→ position 5) in order that the medium can run off the area of the measuring element.

UK

5.4 Use in hygienic areas to EHEDG

The unit has an approval to EHEDG. It is only valid in conjunction with adapters with EHEDG approval.

- ▶ Make sure that the sensor is integrated into the system in accordance with EHEDG.

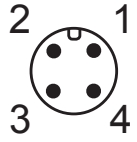
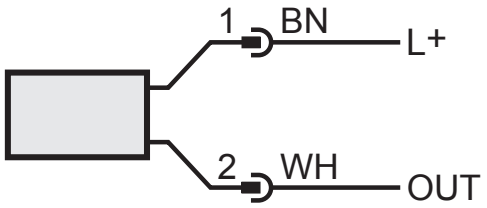
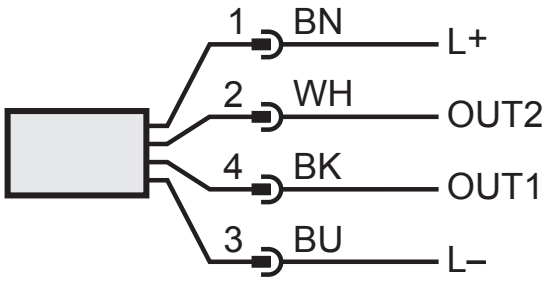
Recommended minimum insertion depth of the sensor into the medium: ≥ 25 mm.

6 Electrical connection

The unit must be connected by a qualified electrician.
The national and international regulations for the installation of electrical equipment must be adhered to.
Voltage supply to EN 50178, SELV, PELV / "supply class 2" to cULus.

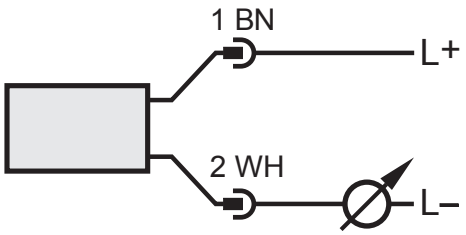
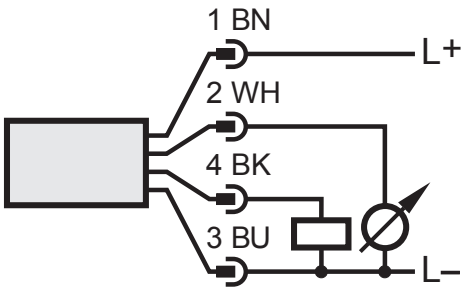
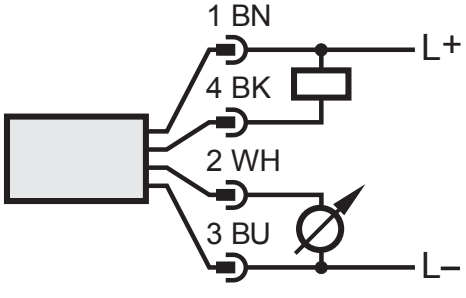
▶ Disconnect power.

▶ Connect the unit as follows:

	2-wire operation	3-wire operation
		

Colours to DIN EN 60947-5-2
BK: black, BN: brown, BU: blue, WH: white

Sample circuits:

2-wire operation	3-wire operation
	1 x positive switching / 1 x analogue 
	1 x negative switching / 1 x analogue 

2-wire operation	**Pin 1**	L+
	Pin 2	L-
3-wire operation:	**Pin 1**	L+
	Pin 3	L-
	Pin 2 (OUT2)	• Analogue output for system temperature
	Pin 4 (OUT1)	• Diagnostic output • IO-Link

Core colours of ifm sockets:
1 = BN (brown), 2 = WH (white), 3 = BU (blue), 4 = BK (black)

7 Parameter setting

Parameters can be set before installation and set-up of the unit or during operation.

If you change parameters during operation, this will influence the function.

▶ Ensure that there will be no malfunctions in your plant.

During parameter setting the unit remains in the operating mode. It continues to monitor with the existing parameter until the parameter setting has been completed.

7.1 IO-Link

7.1.1 General information

This unit has an IO-Link communication interface which requires an IO-Link-capable module (IO-Link master) for operation.

The IO-Link interface enables direct access to the process and diagnostic data and provides the possibility to set the parameters of the unit during operation.

In addition communication is possible via a point-to-point connection with a USB adapter cable.

You will find more detailed information about IO-Link at www.ifm.com/gb/io-link.

7.1.2 Device-specific information

You will find the IODDs necessary for the configuration of the IO-Link unit and detailed information about process data structure, diagnostic information and parameter addresses at www.ifm.com/gb/io-link.

7.1.3 Parameter setting tools

You will find all necessary information about the required IO-Link hardware and software at www.ifm.com/gb/io-link.

7.2 Adjustable parameters

Code 0 level	OU2		Configuration of the analogue signal: 4...20 mA [I] or 20...4 mA [InEG].
	ASP		Analogue start point for the system temperature: measured value at which 4 mA is provided (20 mA if [OU2] = [InEG]).
	AEP		Analogue end point for the system temperature: measured value at which 20 mA is provided (4 mA if [OU2] = [InEG]).
	drW		Drift warning threshold: When this value is exceeded, a warning is provided on the outputs depending on the basic sensor configuration [drEd].
	drA		Drift alarm threshold: When this value is exceeded, an alarm message is provided on the outputs depending on the basic sensor configuration [drEd].
	Code 1 level	HI	Maximum value memory for system temperature.
		LO	Minimum value memory for system temperature.
		dOU1	Configuration of the diagnostic output.
		FOU2	Response of the analogue output in case of a fault.
		drEd	Characteristics of the redundancy switching (backup).
		ddr	Delay of the drift detection.
		P-n	Switching logic for the diagnostic output: pnp or npn.
		Uni	Display unit.
		Fnr	Fault number.
		rES	Restore factory settings.

When the code is activated, access is locked.

7.3 General parameter setting

7.3.1 Define the analogue signal

▶ Select [OU2] and set the function: [I] = temperature-proportional current signal 4…20 mA, [InEG] = temperature-proportional current signal 20...4 mA.	OU2

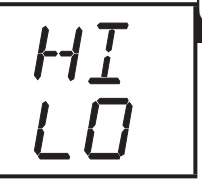
7.3.2 Scaling of the analogue value

- ▶ Select [ASP] and set the value at which 4 mA is provided.
- ▶ Select [AEP] and set the value at which 20 mA is provided.
  Minimum distance between ASP and AEP: 5 K.

	ASP	AEP	Step increment
°C	-25...155	-20...160	0.01
°F	-13...311	-4...320	0.1

7.3.3 Min. / max. values for the system temperature

- ▶ Read [HI] or [LO] values.
- ▶ Delete memory.



7.3.4 Define drift warning threshold

- ▶ Select [drW] and set the value at which the outputs are to provide a warning according to the configuration of [drEd].
- ▶ To deactivate the drift warning, select "OFF".

Setting range: 0.2...5°C / 0.4...9°F.
In case of operation in air the value should be greater than 0.35 °C / 0.6 °F.

7.3.5 Define drift alarm threshold

- ▶ Select [drA] and set the value at which the outputs are to provide an alarm message according to the configuration of [drEd].
- ▶ To deactivate the drift alarm, select "OFF".

Setting range: 0.2...5°C / 0.4...9°F.
In case of operation in air the value should be greater than 0.35 °C / 0.6 °F.

7.3.6 Drift failure threshold

The drift failure threshold [drF] is defined indirectly via the setting of [drA] according to the formula: [drF] = [drA] + 3°K.

The drift failure threshold remains active, even if the drift alarm threshold [drA] is set to [OFF].

The drift failure threshold is automatically assigned a value of 5°K when the drift alarm value [drA] is deactivated.

7.3.7 Definition of the switching characteristics of the diagnostic output

- ▶ → 4.4.2 Switching characteristics output 1 in case of diagnostics [dOU1], table 4

7.3.8 Setting of the error behaviour of the analogue output

▶ → 4.3.2 Setting of the analogue value in case of diagnostics [FOU2], table 2	FOU2

7.3.9 Setting of the characteristics of the redundancy switching

▶ Select [drEd] and set the value: - For 2-wire operation (Ub- not connected): → 4.3.1 Availability groups in 2-wire operation [drEd], table 1 - For 3-wire operation (Ub- connected): → 4.4.1 Availability groups in 3-wire operation [drEd], table 3	dr-Ed

7.3.10 Setting of the delay of the drift detection

▶ Select [ddr] and set the value between 0.5 and 300 minutes. By means of this function short exceeding of the drift thresholds can be filtered out (e.g. in case of large temperature gradients). • ddr value = time for which a drift value must be above the warning/alarm threshold ([drW], [drA]) in order to activate the diagnostic output.	ddr-

7.3.11 Set switching logic for OUT1

▶ Select [P-n] and set [PnP] or [nPn].	P--n

7.3.12 Setting of the standard unit of measurement for temperature

▶ Select [Uni] and set the unit of measurement: [°C] or [°F].	Uni

7.3.13 Read error number

With the user interface of the program ifm Container: ▶ Read [Fnr].	Fnr-

7.3.14 Reset all parameters to factory setting

▶ Select [rES]. ▶ Execute the command [Reset to factory setting] We recommend making note of your own settings in the table before carrying out a reset (→ 11 Factory setting).	r-ES

7.3.15 Settings for communication operation

For communication mode, no parameter setting is necessary. Using pin 4 (data channel), data can be read in and out at any time.

8 Operation

When the supply voltage is applied the unit is in the Run mode with a power-on delay time of 8 s (= normal operating mode). It carries out its measurement and evaluation functions and provides output signals according to the set parameters.

9 Troubleshooting

In case of faults or anomalies:

▶ Connect unit with a PC.

▶ Read [Fnr].

9.1 Fault indications

Fnr	Type of fault	Corrective measures
0	No fault, no anomaly occurred.	-/-
20	Internal malfunction in the sensor electronics.	▶ Replace the unit.
21	Redundancy function of the sensor activated, e.g. a measurement channel has failed	▶ Replace the unit ▶ Sensor backup is possible: - 2-wire operation: The setting [drEd] defines at what faults a predefined current value is provided instead of the analogue value: → 4.2 and → 4.3. - 3-wire operation: The setting [drEd]* defines at what faults the diagnostic output OU1 is activated. The analogue output OU2 is provided without any changes unless there is a fault → 4.4.
42	Analogue output at the lower or upper intermediate stop lines: Linear transfer of the measured value no longer possible. The measured temperature is significantly below the ASP value or significantly above the AEP value.	▶ Adapt the ASP value and AEP value to the operating conditions or reconsider the plant parameters → 4.2.1.
71	Detected sensor drift exceeds warning level [drW]	First indication of drift detected. ▶ Prepare replacement of the unit. ▶ Check whether the parameter [drA] is programmed correctly.

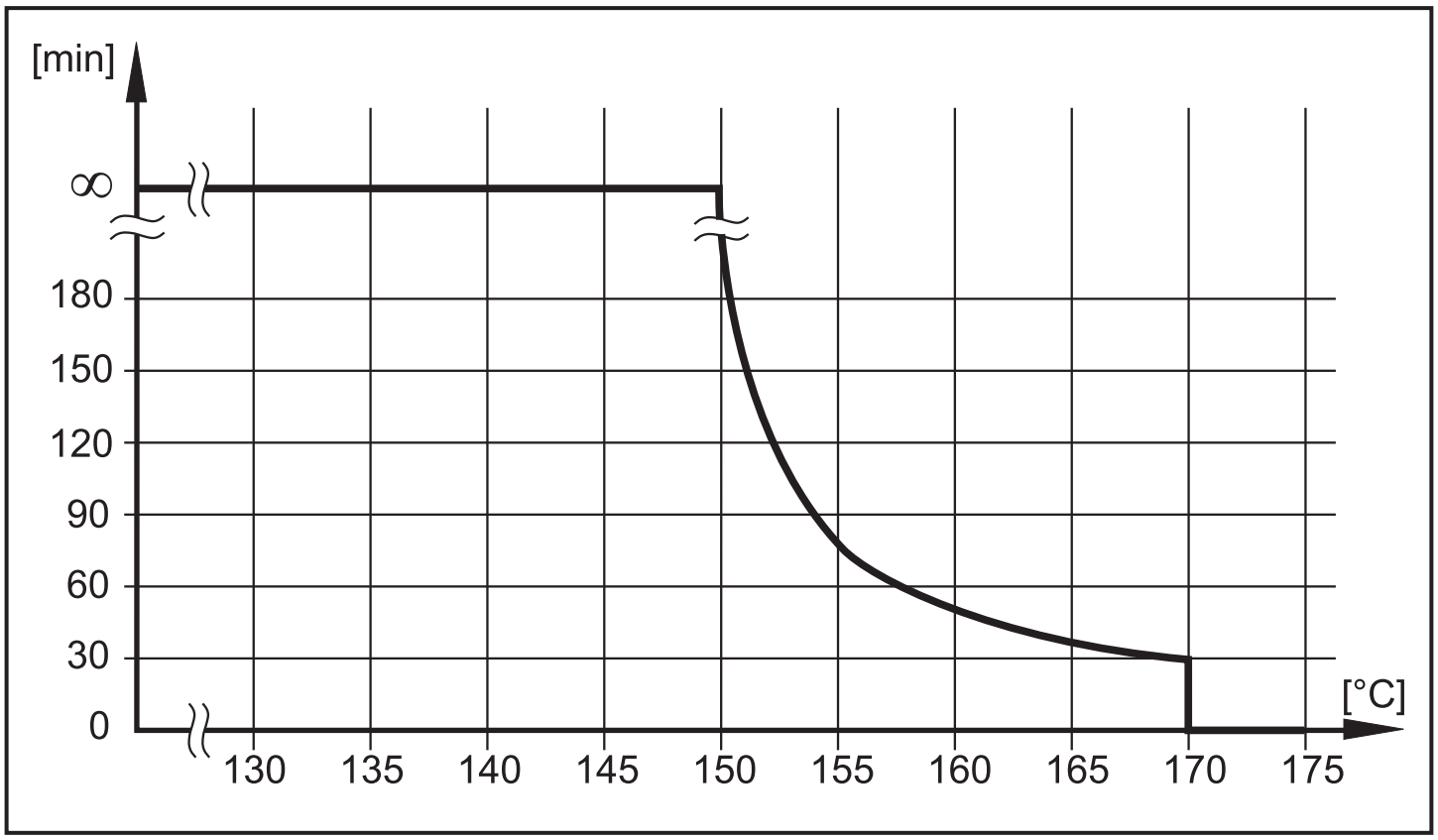
Fnr	Type of fault	Corrective measures
72	Detected sensor drift exceeds alarm level [drA].	Drift exceeds alarm threshold. Temperature measurement with reduced accuracy possible. ▶ Replace the unit. ▶ Check whether the parameter [drA] is programmed correctly.
91	Supply voltage outside the operating voltage range.	▶ Check the supply voltage; ensure a correct voltage supply.
92	Operating temperature of the electronics outside the specified range.	▶ Check the temperature of the upper part of the unit. ▶ Adhere to the specified temperature range.
100	Error during parameter setting via IO-Link (set value of a parameter outside the valid range).	▶ Repeat parameter setting with admissible parameter values or make a reset (reset all parameters to the factory setting).

*[drEd] = [On] or [Ondr].

10 Technical data and scale drawing

10.1 Temperature resistance

Maximum operation time depending on the medium temperature:



Further technical data and scale drawing at www.ifm.com.

11 Factory setting

	Factory setting	User setting
OU2	I	
ASP	0.0	
AEP	150.0	
drW	0.2	
drA	0.5	
dOU1	nc+	
FOU2	On	
drEd	Ondr	
ddr	30	
p-n	PnP	
Uni	°C	