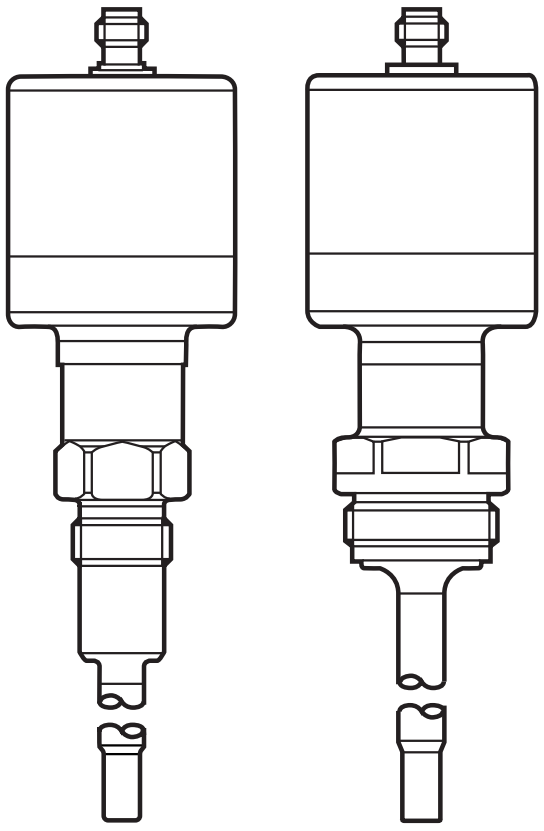
CE

Operating instructions
Temperature transmitter
TADx81
TADx91

UK



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Contents

1 Preliminary note

Technical data, approvals, accessories and further information at www.ifm.com.

1.1 Symbols used

▶ Instructions

> Reaction, result

[…] Designation of keys, buttons or indications

→ Cross-reference

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

Information
Supplementary note.

2 Safety instructions

- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ 4 Functions and features).
- Only use the product for permissible media (→ 10 Technical data).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.

3 Getting started

Detailed description under → 8 Parameter setting.

1. Connect unit to PC to set the parameters via the IO-Link interface.
2. Set the standard unit of measurement.
   - [Uni]: °C or °F
3. Set analogue signal (→ 5.1).
   - [OU2]: I = 4...20 mA or I neg = 20...4 mA
   - [ASP] and [AEP]: scaling of the measuring range.
4. Set drift monitoring.
   - [drW]: drift threshold from which the unit signals "warning".
   - [drA]: drift threshold from which the unit signals "alarm".
   - [ddr]: delay time of the drift detection.
5. Select diagnostic cases that should be signalled (→ 5.2.3).
   - [drEd]:
     ON = only diagnostic cases of category "failure"
     ONdr = diagnostic cases of categories "alarm" + "failure"
     OFF = diagnostic cases of categories "warning" + "alarm" + "failure"
6. Configure analogue signal for diagnostic case
   - [FOU2]: On = 21.5 mA or OFF = 3.5 mA
7. Configure switching signal for diagnostic case (only 3-wire operation)
   - [dOU1]: Output opens / closes / pulsates;
     according to setting Table 3 → 5.2.5.
8. Configure output logic for diagnostic output (only 3-wire operation)
   - [P-n]: pnp or npn
9. Finish parameter setting, install (→ 6), connect (→ 7) and set up unit.

4 Functions and features

The unit detects the medium temperature and converts it into an analogue output signal.

5 Function

- The unit features an IO-Link interface.
- The unit is designed for two or three-wire operation. Depending on the operating mode the following output signals are provided:

Operating mode	Output signals
2 wires	OUT: analogue signal for temperature measurement / analogue signal for diagnostics
3 wires	OUT1: switching signal for diagnostics / IO-Link OUT2: analogue signal for temperature measurement / analogue signal for diagnostics

5.1 Analogue function

The unit converts the measured temperature value into a temperature-proportional analogue signal.

In addition the analogue output is used for diagnostics (→ 5.2 Diagnostic function): The transfer of the measured temperature value is interrupted for diagnostic messages depending on the operating mode and the setting of drEd and an analogue signal according to NE43 of 3.5 mA (FOU2 = On) or 21.5 mA (FOU2 = OFF) is provided.

Depending on the parameter setting (→ 8.1) the analogue signal is within the measuring range.
4...20 mA with setting [OU2] = I or
20...4 mA with setting [OU2] = Ineg.

The measuring range is scalable:

- [ASP] defines at which measured temperature value the analogue signal is 4 mA (OU2 = I) or 20 mA (OU2 = Ineg).
- [AEP] defines at which measured temperature value the analogue signal is 20 mA (OU2 = I) or 4 mA (OU2 = Ineg).

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

If the measured temperature value is outside the scaled measuring range, the analogue signal is 20...20.5 mA or 3.8...4 mA (→ Figure 1). When the measured

temperature value continues to increase or decrease, case of diagnostic 5 occurs (→ 5.2.3).

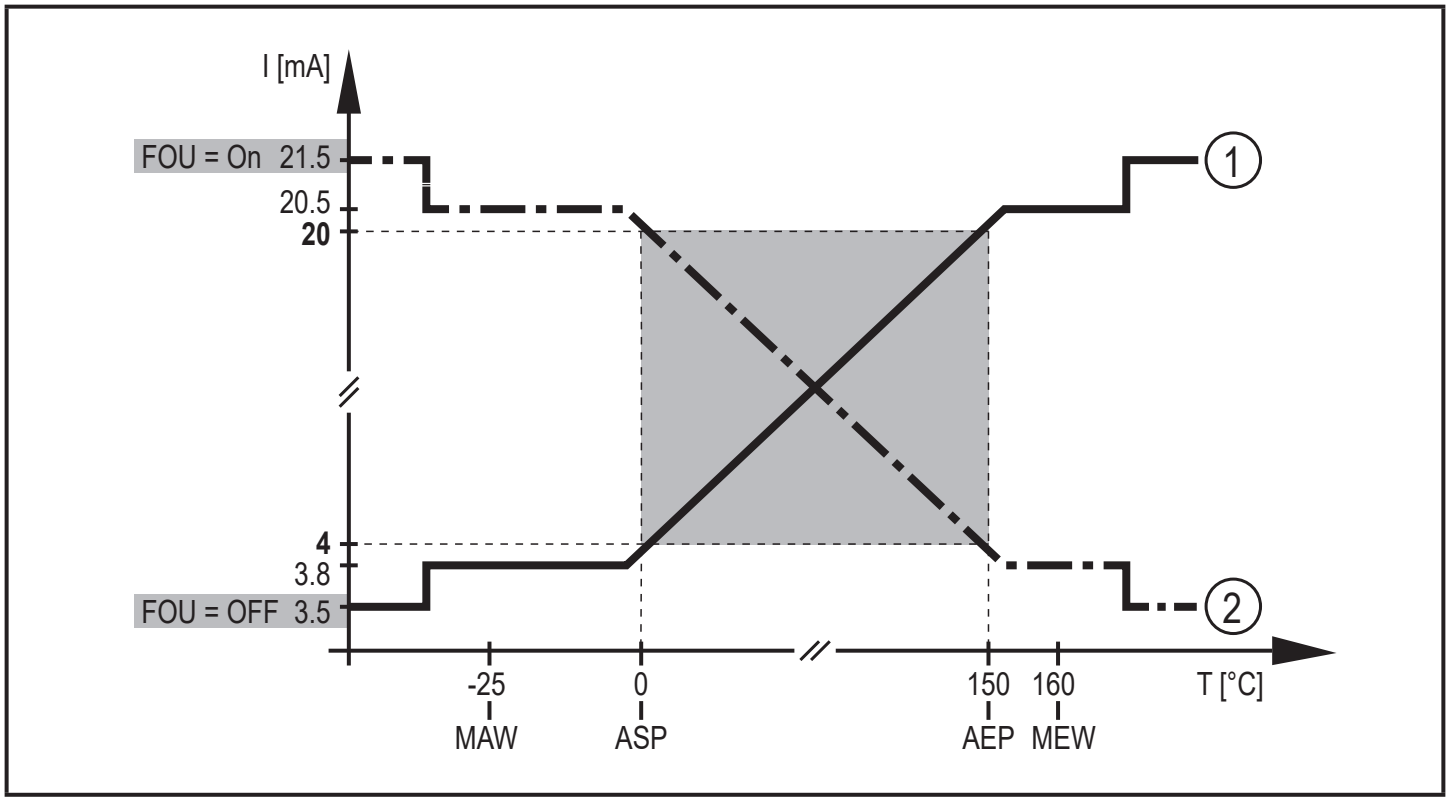


Figure 1: Output characteristics analogue output with factory setting

① Setting [OU2] = I

② Setting [OU2] = Ineg

MAW = initial value of the measuring range, MEW = final value of the measuring range, ASP = analogue start point, AEP = analogue end point

5.2 Diagnostic function

By measuring with two different, thermically coupled sensor elements (NTC, PT 1000) the unit automatically detects drifts and errors during temperature measurement.

A mean average value is formed from the measured individual NTC and Pt 1000 values. This mean value is the basis for the provided measured temperature value and also the basis for the diagnostic messages with the drift monitoring (→ 5.2.1).

Besides temperature drift other errors can be detected (→ 5.2.3 Diagnostic cases). Via the parameter drEd you set which of the diagnostic cases is signalled (→ 5.2.4 / → 5.2.5).

The message of diagnostic cases is given by an analogue signal in 2-wire operation, in addition by a switching signal in 3-wire operation.

5.2.1 Drift monitoring

For drift monitoring the unit compares the temperature deviation of sensor element 1 (NTC) and sensor element 2 (Pt 1000) from the mean value. The permissible temperature deviation is defined by the parameters drW = warning threshold and drA = alarm threshold.

When values exceed these thresholds, the unit identifies it as a diagnostic case (→ 5.2.3).

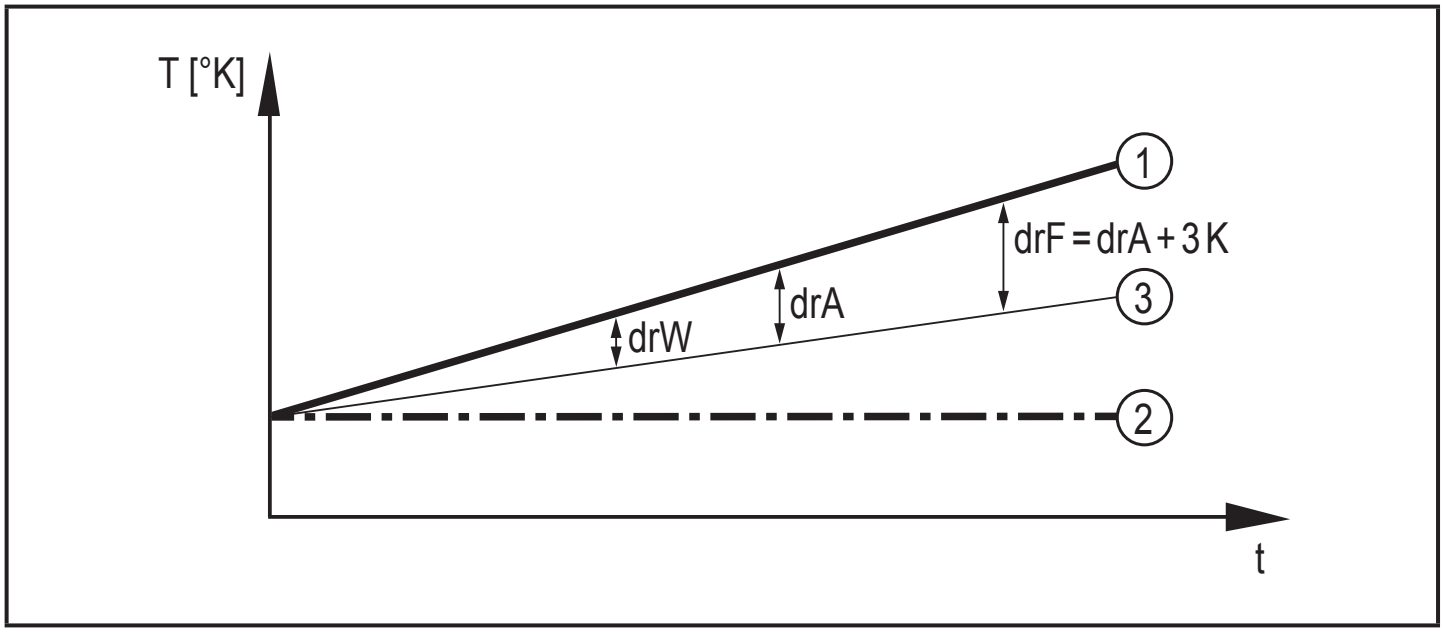


Figure 2: Drift monitoring

Example: NTC sensor element (1) measures 65 °C, Pt 1000 sensor element (2) measures 60 °C. The mean value (3) is 62.5 °C, i.e. both elements deviate by 2.5 K.
With setting drW = 2 °C and drA = 5 °C a warning message would be provided if drEd = OFF. There would not be an alarm message.

Setting range for drW / drA → 10.1

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.

In case of high temperature changes in the measured medium (e.g. filling a hot medium into a cold vessel) there may be a short-term difference between the measured temperature values of both sensor elements.

To avoid short-term drift warnings:

► increase delay time ddr.

5.2.2 Sensor backup (redundancy switching)

If one of the two sensor elements fails (= diagnostic case 4 → 5.2.3), it is possible to continue to measure the temperature with the other sensor element that is still operational (sensor backup → 11 Fault correction; Fnr 21). However, drift monitoring is not possible any more.

5.2.3 Diagnostic cases

Diagnostic case		Diagnostic messages		
		Warning	Alarm	Failure
1	Drift warning threshold [drW] exceeded	●		
2	Limit temperature internal electronics exceeded (+125°C)	●		
3	Drift alarm threshold [drA] exceeded		●	
4	Failure of one of the two sensor elements		●	
5	Measured temperature value far outside the measuring range		●	
6	Supply voltage outside the operating range*		●	
7	Drift failure threshold [drF] exceeded (→ 5.2.1)			●
8	Error during parameter setting via IO-Link			●
9	Failure of both sensor elements or general electronics problems			●

*Exception: For 2-wire operation no diagnostic message is provided in case of undervoltage (→ 5.2.4).

5.2.4 Diagnostic function in 2-wire operation

In 2-wire operation the analogue output is used for temperature measurement and diagnostics.

With [drEd] the diagnostic cases to be signalled can be set via the analogue output:

	Diagnostic messages			Diagnostic cases (→ 5.2.3)
[drEd]	Warning	Alarm	Failure	
= ON			●	7...9
= ONdr		●	●	3...9
= OFF	●	●	●	1...9

Table 1: Setting of diagnostic cases to be signalled (2-wire operation)

- Setting [drEd] = ON provides maximum availability since the transmission of the measured temperature value is only interrupted for the diagnostic message in diagnostic cases of category "failure".
- Setting [drEd] = OFF provides maximum reliability of error detection since a diagnostic message is provided for every diagnostic case.

To signal a diagnostic case the transfer of the measured temperature data is interrupted and provided by the following analogue signal depending on the setting of [FOU]:
[FOU2] = ON: 21.5 mA
[FOU2] = OFF: 3.5 mA

In the event of undervoltage (diagnostic case 6 → 5.2.3) no diagnostic message is provided in 2-wire operation.

5.2.5 Diagnostic function in 3-wire operation

In 3-wire operation the analogue output is used for temperature measurement and diagnostics. In addition a switching output is used for diagnostics.

With [drEd] the diagnostic cases to be signalled can be set via the current output:

		Diagnostic messages			Diagnostic cases (→ 5.2.3)
[drEd]	Output	Warning	Alarm	Failure	
= ON	Analogue output			●	7...9
	Switching output			●	7...9
= ONdr	Analogue output			●	7...9
	Switching output		●	●	3...9
= OFF	Analogue output			●	7...9
	Switching output	●	●	●	1...9

Table 2: Setting of diagnostic cases to be signalled (3-wire operation)

Since all diagnostic cases can be signalled via the switching output in 3-wire operation, the analogue output only leaves its measured temperature value in diagnostic case of category "failure". This ensures maximum use of the analogue output.

The parameter [dOU1] is used to define how the diagnostic output reacts to diagnostic messages:

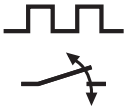
[dOU1]	Normal	Diagnostic message		
		Warning	Alarm	Failure
= nc normally closed				
= nc+ normally closed, extended		2 Hz 		
= no+ normally open, extended		2 Hz 		
= Hb heartbeat	4 Hz 	2 Hz 		

Table 3: Switching signal in diagnostic case

5.3 IO-Link

This unit has an IO-Link communication interface which enables direct access to process and diagnostic data. In addition it is possible to set the parameters of the unit during operation. Operation of the unit via IO-Link interface requires an IO-Link capable module (IO-Link master).

With a PC, suitable IO-Link software and an IO-Link adapter cable communication is possible when the system is not in operation.

The IODDs necessary for the configuration of the unit, detailed information about process data structure, diagnostic information, parameter addresses and the necessary information about the required IO-Link hardware and software can be found at www.ifm.com.

6 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.

▶ Note dangers related to extreme machine / 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.

6.1 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 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 adapters with leakage port:

▶ Mount the sensor horizontally or slightly diagonally (positions 2 to 4, see Figure → 6.3)

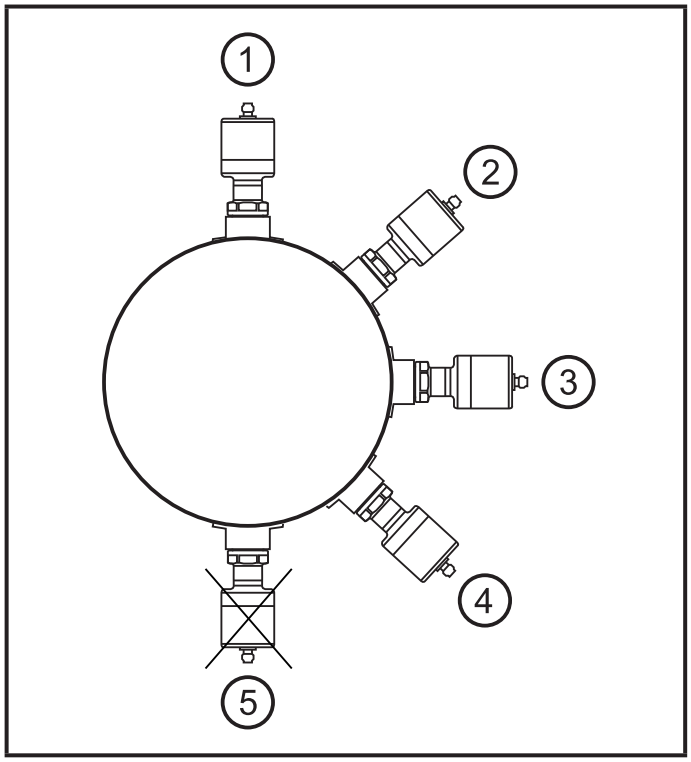
▶ Align the leakage port so that it is located at the lowest possible point.

6.2 Units with process connection G ½ sealing cone

Adaptation to the process connection: Installation using an adapter with metal-to-metal seal

Recommended tightening torque: 30...50 Nm.

6.3 Use in hygienic areas to 3-A



The following applies to units with 3-A certification:

- ▶ Only use adapters with A-3 certification 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.

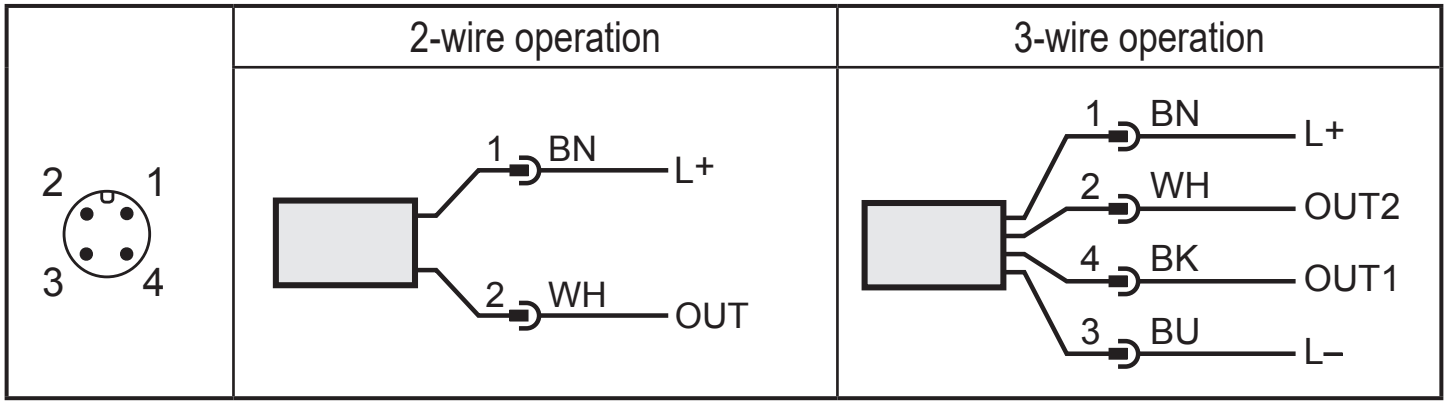
6.4 Use in hygienic areas to EHEDG

- ▶ Make sure that the sensors are integrated into the system in accordance with EHEDG.

7 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:



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

	Operation as 2-wire unit	Operation as 3-wire unit
Pin 1	L+	L+
Pin 2	= OUT analogue signal for temperature and diagnostics	= OUT2 analogue signal for temperature and diagnostics
Pin 3		L-
Pin 4		= OUT1 switching signal for diagnostics / IO-Link

8 Parameter setting

Using an IO-Link capable parameter setting tool, the following options are available:

- Reading current process values.
- Reading, changing and saving current parameter settings and transmitting them to other units of the same type.
- Read saved diagnostic information (→ 11).

▶ Connect the unit via the IO-Link interface to a PC or PLC with suitable parameter setting software.

IO-Link interface for connection of the sensor to a PC → www.ifm.com.

8.1 Adjustable parameters

Uni	Setting of the standard unit of measurement: °C or °F.
OU2	Configuration of the analogue signal: I = 4...20 mA or Ineg = 20...4 mA
ASP	Analogue start point for measured temperature value
AEP	Analogue end point for measured temperature value
drW	Drift warning threshold: If this value of the temperature deviation is exceeded, a diagnostic message of the category "warning" is provided with setting [drEd] = OFF. °C/°F = Maximum permitted temperature deviation of both sensor elements from the mean value. Setting range → 10.1. OFF = Drift warning deactivated.

drA	Drift alarm threshold: If this value of the temperature deviation is exceeded, a diagnostic message of the category "alarm" is provided with setting [drEd] = ONdr or OFF. °C/°F = Maximum permitted temperature deviation of both sensor elements from the mean value. Setting range → 10.1. OFF = Drift alarm deactivated.
drF	Drift failure threshold: [drF] = drA + 3 K; if this value of the temperature deviation is exceeded, a diagnostic message of the category "failure" is provided. • drF cannot be set but results from the setting of drA. • Setting drA = OFF automatically results in: drF = 8 K
ddr	Delay of the drift detection. ddr = Time span (0.5...300 min) for which a drift value must be above the warning threshold drW or alarm threshold drA so that a diagnostic signal is provided.
drEd	Setting of the diagnostic cases (→ 5.2.3) for which diagnostic messages are provided. ON = Diagnostic cases of the category "failure" are signalled. ONdr = Diagnostic cases of the categories "alarm" and "failure" are signalled. OFF = Diagnostic cases of the categories "warning", "alarm" and "failure" are signalled.
FOU2	Response of the analogue signal when a diagnostic case is signalled: > Instead of the measured temperature value a defined current value according to Namur NE43 is provided (On: 21.5 mA; OFF: 3.5 mA)
dOU1	Response of the diagnostic switching output when a diagnostic case is signalled: > Output opens / closes / pulsates depending on the category of the diagnostic case. Setting options see Table 3 → 5.2.5
P-n	Switching logic for the diagnostic output: pnp or npn.
HI	Read max. value of the temperature measured in the process.
LO	Read min. value of the temperature measured in the process.
Fnr	Read fault number → 11 Fault correction.
rES	Restoring the factory settings. It is recommended to note down your own settings before carrying out a reset (→ 12 Factory setting).

9 Operation

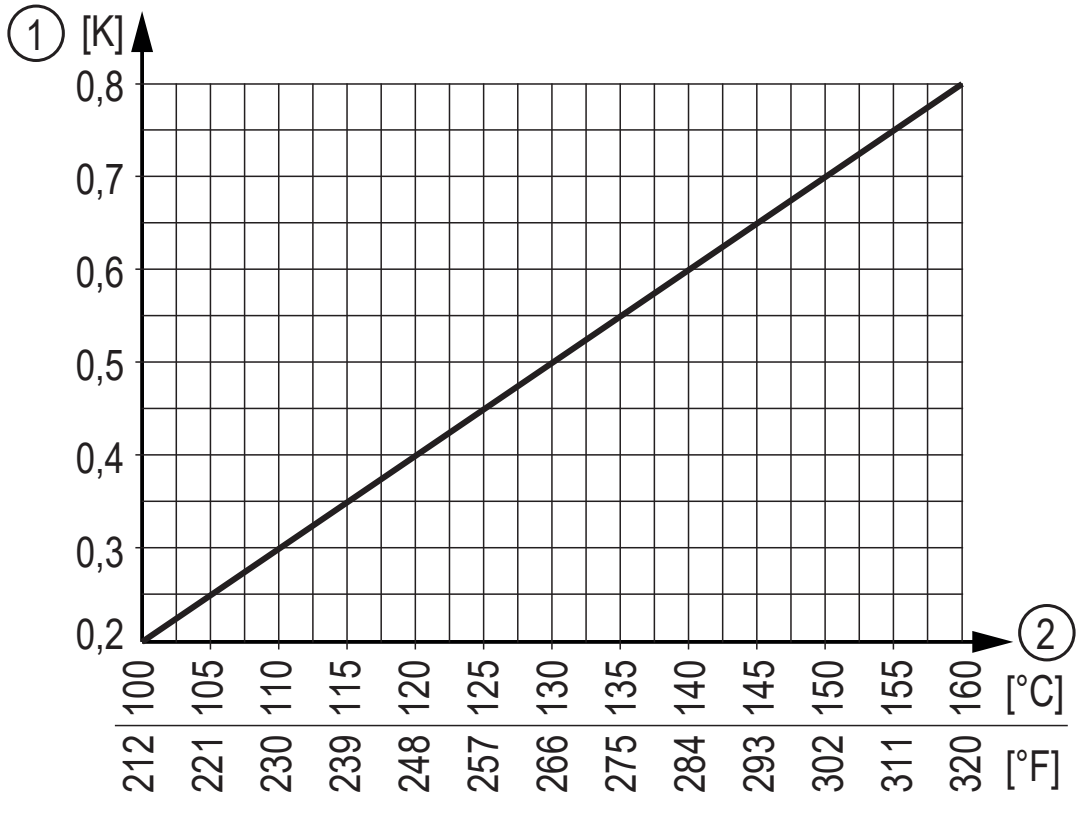
When the supply voltage is applied, the unit is in the RUN mode after a power-on delay time of 8 s (= normal operating mode). It carries out its measurement and evaluation functions and provides output signals according to the set parameters.

10 Technical data

Technical data and scale drawing at www.ifm.com.

10.1 Setting range for drW / drA

Medium temperature		Setting range
-10...100 °C	14...212 °F	0.2...5 K
-25...0 °C	-13...32 °F	0.3...5 K
> 100 °C	> 212 °F	x...5 K (→ chart)



1: x = minimum value for drW and drA
2: Medium temperature

If the value that has been set for drW or drA is lower than the value x, the sensor will change it automatically to the value x.

In case of operation in gaseous media the value should be greater than 0.35 °C / 0.6 °F.

11 Fault correction

In case of faults or anomalies:

▶ Connect unit with a PC.

▶ Read [Fnr].

Fnr	Type of fault	Corrective measures
0	No fault, no anomaly occurred.	-/-
20	Internal malfunction in the sensor electronics.	▶ Replace the unit.
21	Backup function of the sensor activated, e.g. a sensor element has failed (diagnostic case 4 → 5.2.3)	▶ Replace the unit. ▶ Continue measurement with only one sensor element (backup function): - In 2-wire operation set [drEd] = ON so that the measured temperature value can be continued to be transferred. Then the analogue output only provides diagnostic cases of the category "failure". - In 3-wire operation all diagnostic cases can be signalled via the diagnostic switching output except those used for drift monitoring (diagnostic cases 1, 3, 7 → 5.2.3).
30	Wiring fault	▶ Check wiring.
42	Analogue signal 21.5 mA (FOU2 = On) or 3.5 mA (FOU2 = OFF) > The switch point is clearly outside the measuring range.	▶ Check measuring range. ▶ Adapt [ASP] value and [AEP] vaule to the operating conditions.
71	Detected sensor drift exceeds warning level [drW]	First indication of drift detected. ▶ Check whether the parameter [drW] is programmed correctly. ▶ Prepare replacement of the unit.
72	Detected sensor drift exceeds alarm level [drA]	Drift exceeds alarm threshold. Temperature measurement with reduced accuracy possible. ▶ Check whether the parameter [drA] is programmed correctly. ▶ Replace the unit.

Fnr	Type of fault	Corrective measures
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).

SP = analogue start point; AEP = analogue end point

12 Factory setting

	Factory setting	User setting
OU2	I	
ASP	0 °C	
AEP	150 °C	
drW	0.2 °C	
drA	0.5 °C	
ddr	30 min	
drEd	Ondr	
dOU1	nc+	
FOU2	On	
p-n	PnP	
Uni	°C	