ifm electronic

CE

Operating instructions
Temperature transmitter

efector600   UK

TADx81
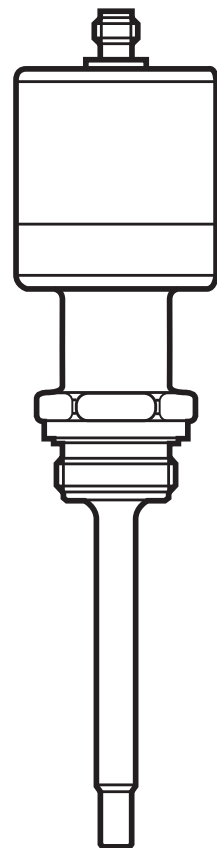
Contents

1 Preliminary note

1.1 Symbols used

▶   Instruction

\>   Reaction, result

[…]   Designation of pushbuttons, buttons or indications

→   Cross-reference

[!] Important note
Non-compliance can result in malfunctions or interference.

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.

- Check the compatibility of the product materials (→ chapter 10 Technical data) with the media to be monitored in all applications.

3 Functions and features

The unit detects the system temperature in installations.

3.1 Application

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

Minimum installation depth of the measuring probe: 25 mm

▶ The following limit values must be observed:

Measuring range	-25 ... +150 °C	-13 ... 302 °F
Operating temperature process connection	-32 ... +170 °C	-25.6 ... 338 °F
Operating temperature electronics	-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 (135 K / 7 s)	< 3000	

4 Function

4.1 Communication, parameter setting and evaluation

- The unit generates output signals according to the parameter settings.
- It moreover provides the process data via IO-Link.
- The unit is laid out for fully bidirectional communication. So, the following options are possible:
  - Remote display: reading and display of the current system temperature.
  - Remote parameter setting: reading and changing current parameter settings.
  - Using the FDT service program ifm Container, the current parameter settings can be stored and transferred to other units of the same type.

  The program library of the available DTM objects can be found at www.ifm.com → Service → Download.

  Device-specific parameter lists for IO-Link parameter setting are available at: www.ifm.com

4.2 Operating modes

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, → 4.4 Analogue function. In addition, the analogue output can be used for diagnosis following 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 unit is laid out for bidirectional communication with PC or controller via IO-Link. For communication with the PC, the FDT service program ifm Container (order no. E30110) 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.	

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4.3 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.
- 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.

4.3.1 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 difference with the set warning / alarm thresholds (drW, drA → 7.4.1, 7.4.2). 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. This is based on the corresponding specific response dynamics of the measuring elements. To prevent a drift warning or alarm in these cases, a delay time can be set by means of the parameter ddr.

4.3.2 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 characteristics of the unit if one measuring element fails is defined by means of the parameter drEd.

4.3.3 Response of the outputs in case of a fault

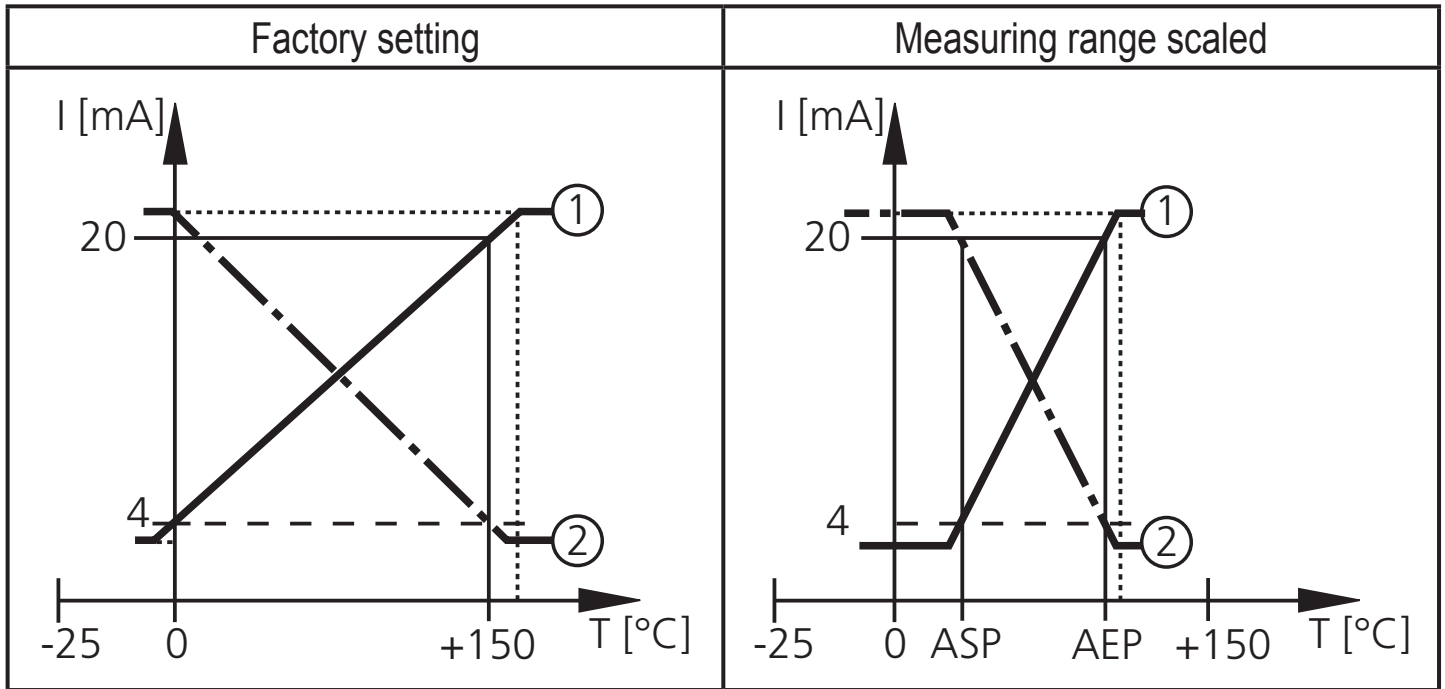| Fnr	Type of fault	drEd = OFF		drEd = On		drEd = Ondr	
		DA	AA	DA	AA	DA	AA
0	No fault, no anomaly occurred.	N	T	N	T	N	T
10	Fault during power-on self test.	A	F	A	F	A	F
20	Internal malfunction in the sensor electronics.	A	F	A	F	A	F
21	Partial malfunction in the sensor electronics, measurement with one channel still possible.	A	F	W	T/B	W	T/B
30	Short circuit in switching output Out1 (diagnostic output).	X	T	X	T	X	T
40	Malfunction on the analogue output.	A	X	A	X	A	X
41	Load for analogue output of too high impedance.	A	X	A	X	A	X
42	Analogue signal at the lower limit value, no linear transmission of the measured value possible any more. Measured temperature is below ASP value.	W	T	W	T	W	T
43	Analogue output at the upper limit value, no linear transmission of the measured value possible any more. Measured temperature has exceeded AEP value.	W	T	W	T	W	T

Fnr	Type of fault	drEd = OFF		drEd = On		drEd = Ondr	
		DA	AA	DA	AA	DA	AA
51	Interruption measuring element 1 (NTC).	A	F	W	T/B	W	T/B
52	Short circuit measuring element 1 (NTC).	A	F	W	T/B	W	T/B
53	Temperature of the probe above the operating temperature range (170 °C).	A	F	A	F	A	F
54	Temperature of the probe below the operating temperature range (-32 °C).	A	F	A	F	A	F
59	Both sensor elements faulty.	A	F	A	F	A	F
61	Interruption measuring element 2 (Pt 1000).	A	F	W	T/B	W	T/B
62	Short circuit measuring element 2 (Pt 1000).	A	F	W	T/B	W	T/B
71	Detected sensor drift exceeds warning level.	W	T	W	T	W	T
72	Detected sensor drift exceeds alarm level.	A	X	A	X	A	F
91	Supply voltage outside the operating voltage range.	W	T	W	T	W	T
92	Operating temperature of the electronics outside the specified range.	W	T	W	T	W	T
100	Fault during IO-Link parameter setting.	A	F	A	F	A	F

- Diagnostic states of the diagnostic output (DA)
  - N: nominal operation, no faults detected.
  - W: warning: anomaly detected, operation with restricted accuracy or functionality possible.
  - A: alarm: fault detected, reliable operation not possible any more. The output signal of the diagnostic output depends on the setting of the parameter dOU1.
  - X: undefined (a defined reaction of the output cannot be guaranteed in case of a fault).
- Signals of the analogue output (AA)
  - T: temperature-proportional current signal.
  - T/B: temperature-proportional current signal during backup operation.
  - F: fault value (defined by parameter FOU2). As soon as no reliable temperature measurement is possible any more, a fault level is provided in all cases.
  - X: undefined (a defined reaction of the output cannot be guaranteed in case of a fault).

- 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.

Factory setting	Measuring range scaled
I [mA], 20, 4, -25, 0, +150, T [°C], ①, ②	I [mA], 20, 4, -25, 0, ASP, AEP, +150, T [°C], ①, ②

①: [OU2] = [I]; ②: [OU2] = [InEG]

Behaviour in case of exceeding or not reaching the limits of the measuring range
- Measured temperature above the set measuring range:
  - The output signal rises to max. 20.5 mA / falls to min. 3.8 mA.
  - With a further increase of the measured temperature the diagnostic output of the sensor provides a warning, the fault number Fnr = 43 is set.
- Measured temperature below the set measuring range:
  - The output signal falls to min. 3.8 mA / rises to max. 20.5 mA.
  - With a further decrease of the measured temperature the diagnostic output of the sensor provides a warning, the fault number Fnr = 42 is set.

5 Installation

⚠ Before installing and removing the unit: make sure that no medium is flowing through the installation. Take into account possible dangers which may arise from extreme plant/medium temperatures.

The unit can be fixed to different process connections. Options are as follows:

1	**Installation using an adapter with sealing ring (order no. E332xx / E333xx)**
	The adapter is supplied with an EPDM O-ring. More sealing rings are available as accessories: FKM O-ring (order no. E30123); PEEK sealing ring (order no. E30124). Concerning installation → Installation instructions supplied with the adapter.
2	**Installation using an adapter with metal-to-metal seal (order no. E337xx / E338xx)**
	Concerning installation → Installation instructions supplied with the adapter.
3	**Installation using a welding adapter (order no. E30122)**
	The adapter is supplied with an EPDM O-ring. More sealing rings are available as accessories: FKM O-ring, order no. E30123. Concerning installation → Installation instructions supplied with the adapter.
4	**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. ▶ Grease the sensor thread with a suitable paste. ▶ Insert the unit into the process connection. ▶ Tighten it using a spanner. Tightening torque: 35 Nm.

Minimum installation depth: 25 mm
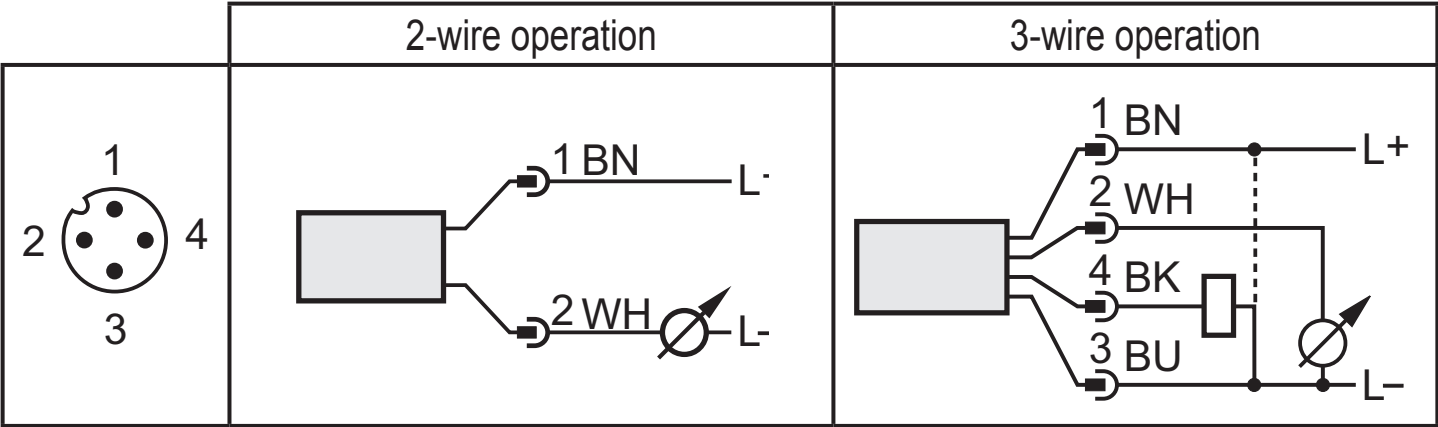
Use in hygienic areas to EHEDG
▶ Make sure that the sensors are integrated into the system in accordance with EHEDG.

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 according to EN 50178, SELV, PELV / cULus - Class 2 source required.

▶ Disconnect power.
▶ Connect the unit as follows:

	2-wire operation	3-wire operation

2-wire operation	**pin 1**	Ub+
	pin 2	Ub-
3-wire operation	**pin 1**	Ub+
	pin 3	Ub-
	pin 2 (OUT2)	• Analogue output for system temperature
	pin 4 (OUT1)	• Diagnostic output • Data channel for bidirectional communication.

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, the operating principle of the plant will be influenced.

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

- Parameter setting with FDT service program ifm Container: The program has an intuitive graphical user interface.
- The program library of the available DTM objects can be found at www.ifm.com → Service → Download.

- Device-specific parameter lists for IO-Link parameter setting are available at: www.ifm.com.

7.1 Adjustable parameters

OU2	Configuration of the analogue signal; 4...20 mA [I] or 20...4 mA [InEG].
ASP	Analogue start point for system temperature: measured value at which 4 mA is provided (20 mA if [OU2] = [InEG]).
AEP	Analogue end point for system temperature: measured value at which 20 mA is provided (4 mA if [OU2] = [InEG]).
drW	Drift warning threshold: value at which OUT1 provides a warning message according to the configuration.
drA	Drift alarm threshold: value at which OUT1 provides an alarm message according to the configuration.
EF	Extended functions / opening of menu level 2.
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.

7.2 General parameter setting

• In case of parameter setting with the user interface of the ifm Container program, the values can be directly entered in the specified fields.

• For IO-Link parameter setting → device-specific parameter lists at: www.ifm. com.

Open menu level 2	
With the user interface of the program ifm Container: ▶ Activate the [EF] button. If menu level 2 is protected by an access code, the input field for the code no. is activated. ▶ Enter valid code no. On delivery by ifm electronic: no access restriction.	*EF*

7.3 Configuration of the analogue output

7.3.1 Setting of 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

	ASP	AEP	Step increment
°C	-25...100	40...150	0.05
°F	-13...212	104...302	0.1

7.4 Configuration of the diagnostic output

7.4.1 Setting of the drift warning threshold

▶ Select [drW] and set the value at which OUT1 provides a warning message according to the configuration. 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.	*dr-W*

7.4.2 Setting of the drift alarm threshold

▶ Select [drA] and set the value at which OUT1 provides an alarm message according to the configuration. 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.	*dr-A*

7.4.3 Setting of the function of the diagnostic output

▶ [Select [dOU1] and set the value:		dOU1
[nc]	Normally closed (DESINA characteristics, wire-break can be detected)	
	Nominal operation: Diagnostic output active* Fault warning: Diagnostic output active* Fault alarm: Diagnostic output inactive	
[nc+]	Normally closed extended (wire-break can be detected)	
	Nominal operation: Diagnostic output active* Fault warning: Diagnostic output provides 2-Hz signal* Fault alarm: Diagnostic output inactive	
[no+]	Normally open extended	
	Nominal operation: Diagnostic output inactive Fault warning: Diagnostic output provides 2-Hz signal* Fault alarm: Diagnostic output active*	
[Hb]	Heartbeat (wire-break and short circuit on the wire of the diagnostic can be detected)	
	Nominal operation: Diagnostic output provides 4-Hz signal* Fault warning: Diagnostic output provides 2-Hz signal* Fault alarm: Diagnostic output inactive	
*pnp or npn, depending on the setting of the parameter P-n		

7.5 User settings (optional)

7.5.1 Setting of the error behaviour of the analogue output

▶ Select [FOU2] and set the value: [On] = the analogue signal goes to the upper fault value (21.2 mA). [OFF] = the analogue value goes to the lower fault value (3.6 mA.)	FOU2

7.5.2 Setting of the characteristics of the redundancy switching

▶ Select [drEd] and set the value:			dr-Ed
[OFF]	Fault in the electronics:	Analogue signal at fault value*	
	Both sensor elements defective:	Analogue signal at fault value*	
	One sensor element defective:	Analogue signal at fault value*	
	[drW] and [drA] exceeded:	Analogue signal corresponds to the measured temperature.	
[On]	Fault in the electronics:	Analogue signal at fault value*	
	Both sensor elements defective:	Analogue signal at fault value*	
	One sensor element defective:	Analogue signal corresponds to the temperature of the 2nd measuring element (backup).	
	[drW] and [drA] exceeded:	Analogue signal corresponds to the measured temperature.	
[Ondr]	Fault in the electronics:	Analogue signal at fault value*	
	Both sensor elements defective:	Analogue signal at fault value*	
	One sensor element defective:	Analogue signal corresponds to the temperature of the 2nd measuring element (backup).	
	[drW] exceeded:	Analogue signal corresponds to the measured temperature.	
	[drA] exceeded:	Analogue signal at fault value*	
*corresponds to the setting of the parameter FOU2			

7.5.3 Setting of the delay of the drift detection

▶ Select [ddr] and set the value between 0 and 300 minutes.	ddr-
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.	
• If the operating voltage is interrupted during the delay time, the unit stores the remaining time. If the drift persists after re-activation of the operating voltage, the delay becomes active again until the remaining time has elapsed.	

7.5.4 Setting of the switching logic for OUT1

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

7.5.5 Setting of the standard unit of measurement for temperature

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

7.6 Service functions

7.6.1 Reading of the fault number

With the user interface of the program ifm Container: ▶ Activate the button [Fnr].	*Fnr*

7.6.2 Reset of all parameters to factory setting

▶ Select [rES]. ▶ Press [Set] and keep it pressed until [----] is displayed. ▶ Press [Mode/Enter] briefly. We recommend taking down your own settings in the table before carrying out a reset (→ 11 Factory setting).	*rES*

7.7 Setting for communication mode

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

After power on, the unit is in the Run mode (= normal operating mode). It carries out its measurement and evaluation functions and provides output signals according to the set parameters.

In case of faults / anomalies:
▶ Connect the unit to a PC.
▶ Activate [Fnr].

8.1 Fault indication

Fnr	Type of fault	Remedy
0	No fault, no anomaly occurred.	-/-
10	Fault during power-on self test.	▶ Switch the supply voltage/switch off and on again. ▶ Replace the unit.
20	Internal malfunction in the sensor electronics.	▶ Replace the unit.
21	Partial malfunction in the sensor electronics, measurement with one channel still possible.	▶ Replace the unit. (Sensor backup is possible).*
30	Short circuit in switching output Out1 (diagnostic output).	▶ Check wiring and load on Out1; temperature measurement without diagnosis still possible.
40	Fault on the analogue output.	▶ Check wiring. ▶ Replace the unit.
41	Load for analogue output of too high impedance.	▶ Check wiring and load on Out2; measured temperature value available via IO-Link.
42	Analogue signal at the lower limit value, no linear transmission of the measured value possible any more. Measured temperature is below ASP value.	▶ Set ASP value (AEP value if [OU2] = [InEG]) lower if possible, or reduce medium temperature.
43	Analogue output at the upper limit value, no linear transmission of the measured value possible any more. Measured temperature has exceeded AEP value.	▶ Set AEP value (AEP value if [OU2] = [InEG]) higher if possible, or reduce medium temperature.
51	Interruption measuring element 1 (NTC).	▶ Replace the unit. (Sensor backup is possible).*

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

Fnr	Type of fault	Remedy
52	Short circuit measuring element 1 (NTC).	▶ Replace the unit. (Sensor backup is possible).*
53	Temperature of the probe above the operating temperature range (170 C°).	▶ Reduce medium temperature.
54	Temperature of the probe below the operating temperature range (-32 °C).	▶ Increase medium temperature.
59	Both sensor elements faulty.	▶ Replace the unit.
61	Interruption measuring element 2 (Pt 1000)	▶ Replace the unit. (Sensor backup is possible).*
62	Short circuit measuring element 2 (Pt 1000).	▶ Replace the unit. (Sensor backup is possible).*
71	Detected sensor drift exceeds warning level.	First indication of drift detected. ▶ Prepare replacement of the unit. ▶ Check whether the parameter [drA] is programmed correctly.
72	Detected sensor drift exceeds alarm level.	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	Fault during IO-Link parameter setting (Setting value of a parameter outside the valid range).	▶ Repeat parameter setting with admissible parameter values or reset of all parameters to factory setting (→ 7.6.2).

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

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9 Scale drawing
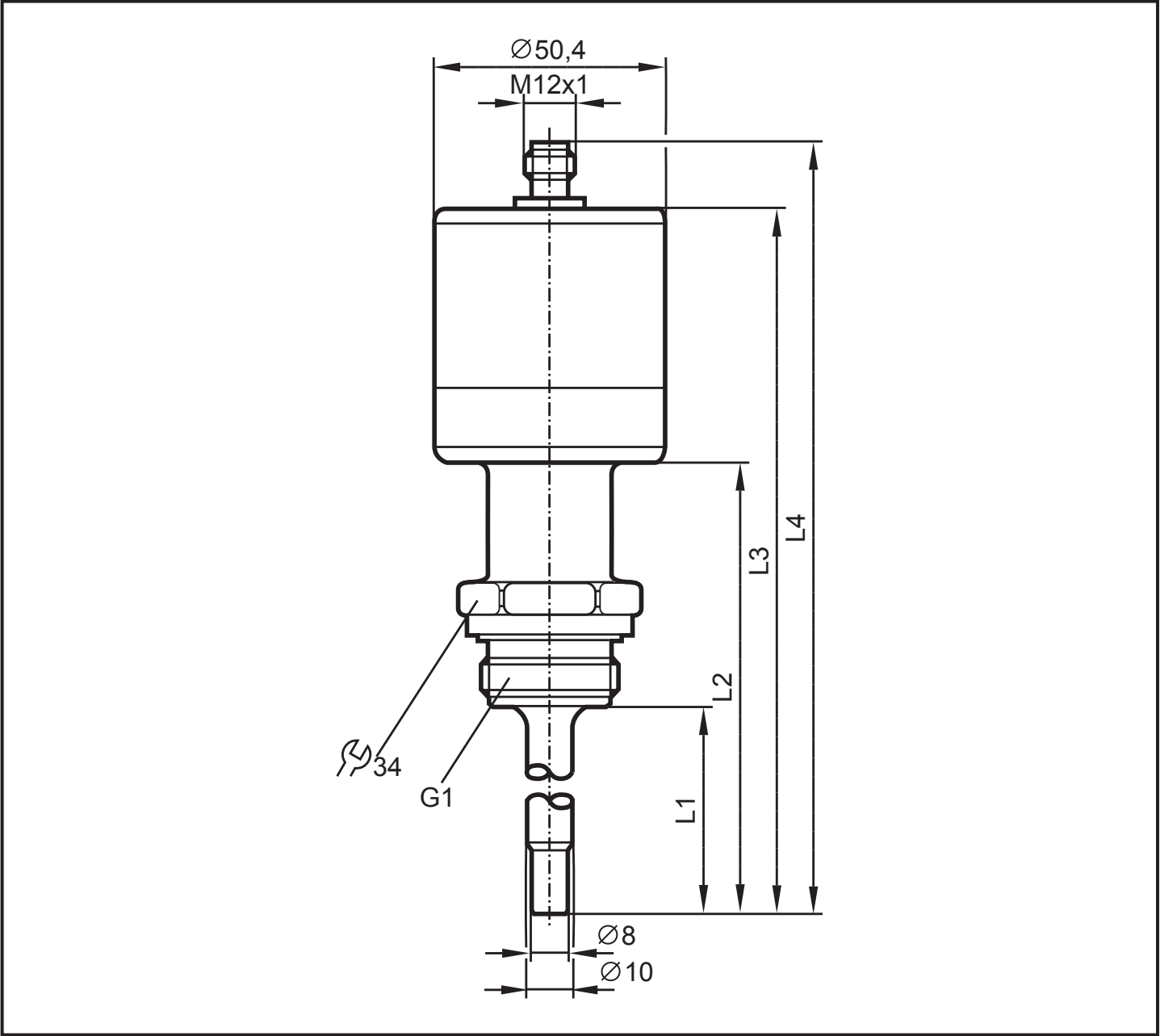
Dimensions in mm

	TAD181	TAD981
L1	87,5	33
L2	140,5	86
L3	195,7	141,2
L4	210,5	156

10 Technical data

Measuring range [°C / °F]	-25 ...150 / -13...302

Operating voltage [V]	18 ... 32 DC [1]
Current consumption for 3-wire operation [mA]	< 6 (24 V)
Current rating [mA]	250
Short-circuit protection (pulsed); protected against reverse polarity and overload	
Integrated watchdog	
Analogue output	4...20 mA / 20...4 mA
Max. load current output [Ω]	(Ub - 15) x 50
Power-on delay time [s]	8

Accuracy	
- Drift monitoring [K]	± 0.2 (-10...100 °C); ± 0.3 (-25...-10/100...150 °C)
- Process value [K]	± 0.2 (-10...100 °C); ± 0.3 (-25...-10/100...150 °C)
Resolution	
- Drift monitoring [K]	0.05
- Process value [K]	0.05

Housing materials	stainless steel 316L / 1.4404; PEI; FPM
Materials (wetted parts)	stainless steel 316L / 1.4404; surface characteristics: Ra 0.6
Operating temperature electronics [°C]	-25 ... +70
Operating temperature process connection [°C]	-32...+170
Storage temperature [°C]	-40 ... +85
Perm. overload pressure [bar]	100
Protection	IP 68, IP 69K
Protection class	III
Shock resistance [g]	50 (DIN / IEC 68-2-27, 11 ms)
Vibration resistance [g]	20 (DIN / IEC 68-2-6, 10-2000 Hz)
EMC EN 61000-4-2 ESD:	4 kV CD / 8 kV AD
EN 61000-4-3 HF radiated:	10 V/m
EN 61000-4-4 Burst:	2 kV
EN 61000-4-6 HF conducted:	10 V

[1] Voltage supply to EN 50178, SELV, PELV.

10.1 Temperature resistance
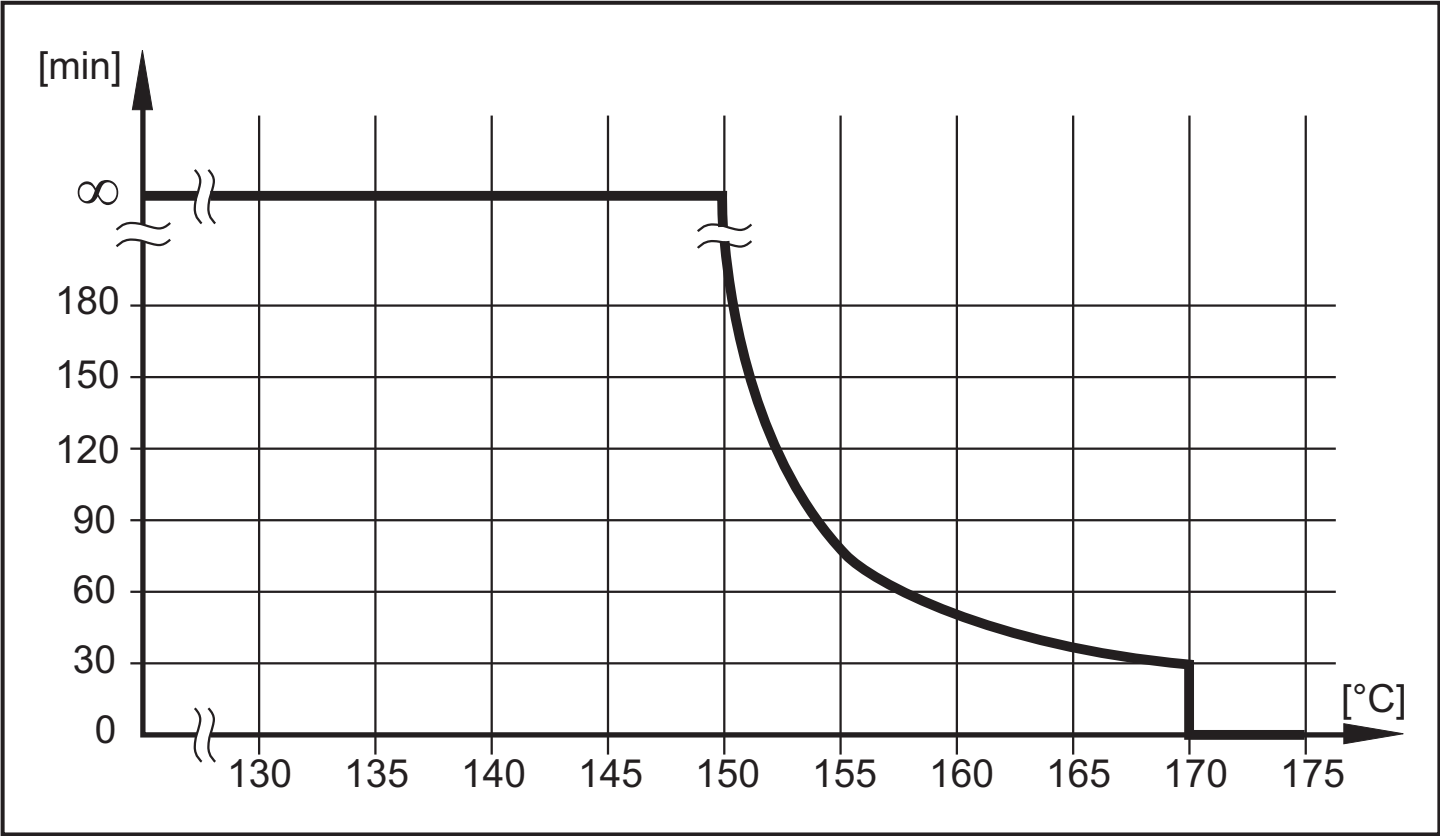
Maximum operation time depending on the medium temperature

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	

More information at www.ifm.com