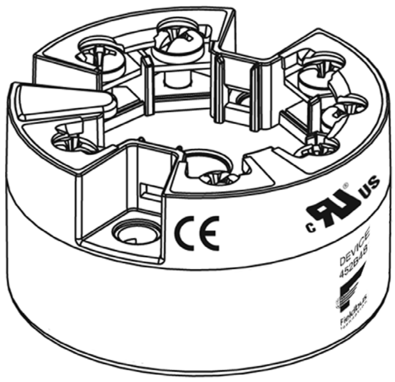
Operating instructions OTMT85

Temperature head transmitter

with FOUNDATION Fieldbus™ - protocol



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Device software
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Brief overview

For quick and easy commissioning:

Safety instructions	→ Page 4
▼	
Installation instructions	→ Page 8
▼	
Wiring	→ Page 13
▼	
Display and operating elements	→ Page 22
Information on configuration and operating programs from other manufacturers. Information about setting the hardware write protection, device address, etc. for FOUNDATION Fieldbus communication	
▼	
Commissioning	→ Page 28
Commissioning via the FOUNDATION Fieldbus interface – quick start for device configuration for standard operation	
Customer-specific configuration	
Complex measurement tasks require additional functions to be configured that the user can individually select, set and adapt to his process conditions by setting the appropriate parameters. A detailed description of all the functions and device parameters.	

Table of contents

1 Safety instructions

1.1 Designated use

- The device is a universal and configurable temperature head transmitter for resistance thermometers (RTD), thermocouples (TC) and resistance and voltage transmitters. The device is designed for installation in a connection head form B according to DIN 43729 or field housing.
- The manufacturer cannot be held responsible for damage caused by misuse of the unit.

1.2 Installation, commissioning, operation

Please note the following:

- The device may only be installed, connected, commissioned and maintained by properly qualified and authorized staff (e.g. electrical technicians) in strict compliance with these Operating Instructions, applicable standards, legal regulations and certificates (depending on the application).
- The specialist staff must have read and understood these Operating Instructions and must follow the instructions they contain.
- The installer must ensure that the measuring system is correctly connected in accordance with the electrical wiring diagrams.
- Damaged devices which could constitute a source of danger must not be put into operation and must be clearly indicated as defective.
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Please pay particular attention to the technical data on the nameplate! The nameplate is located on the side of the transmitter housing.

Hazardous area
When using in hazardous areas, the national safety requirements must be met. Separate Ex documentation is contained in these Operating Instructions for measurement systems that are to mounted in hazardous areas. Strict compliance with the installation instructions, ratings and safety instructions as listed in this supplementary documentation is mandatory. The documentation number of that document (XA...) is also indicated on the nameplate.

Electromagnetic compatibility
The measuring device meets the general safety requirements of EN 61010 and the EMC requirements of IEC/EN 61326 as well as NAMUR recommendations NE 21 and NE 89.

NOTICE

Power supply
► Power must be fed to the device from an 9 to 32 VDC power supply in accordance with NEC Class 02 (low voltage/current) with short-circuit power limit to 8 A/150 VA.

1.4 Notes on safety conventions and icons

Always refer to the safety instructions in these Operating Instructions labeled with the following symbols:

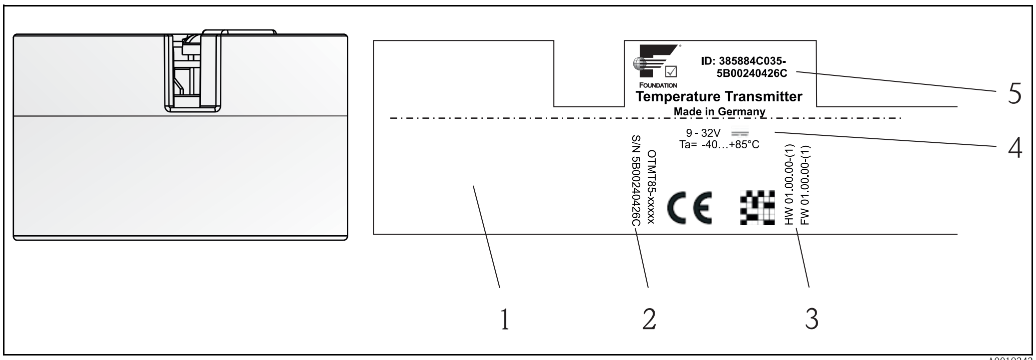
Symbol	Meaning
WARNING A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
CAUTION A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE A0011192-EN	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.
	ESD - Electrostatic discharge Protect the terminals against electrostatic discharge. Failure to comply with this instruction can result in the destruction of parts or malffunction of the electronics.
 A0011193	Indicates additional information, Tip

2 Identification

2.1 Device designation

2.1.1 Nameplate

The right device?
Compare the nameplate on the device with the following graphic:



A0019242

Fig. 1: Nameplate of the head transmitter (example, non-Ex version)

1 Approval information (optional)
2 Serial number
3 Device revision
4 Power supply and current consumption
5 Device identification number and communication symbol

2.2 Scope of delivery

The scope of delivery of the device comprises:

- Temperature head transmitter
- Securing material
- Operating Instructions
- If necessary multi-language hard copy of Brief Operating Instructions and additional documentation on CD-ROM
- Additional documentation for devices that are suitable for use in hazardous areas ( ), such as Safety Instructions (XA...), Control or Installation Drawings (ZD...).

2.3 Certificates and approvals

The device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The device complies with the standards EN 61 010-1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of IEC/EN 61326.

2.3.1 CE mark, declaration of conformity

The device described in these Operating Instructions is therefore in conformity with the statutory requirements of the EU Directives. The manufacturer confirms a positive completion of all tests by fitting the unit with a CE mark.

2.3.2 Certification Foundation Fieldbus™

The temperature transmitter has successfully passed all the tests and is certified and registered by the Fieldbus Foundation. The device meets all the requirements of the following specifications:

- Certified in accordance with FOUNDATION Fieldbus™ specification
- FOUNDATION Fieldbus™ H1
- Interoperability Test Kit (ITK), revision status 5.0.1 (device certification number available on request): the device may also be operated using certified devices from other manufacturers
- Physical Layer Conformance Test of the Fieldbus FOUNDATION™ (FF-830 FS 1.0)

An overview of additional approvals and certifications can be found on → 50.

2.4 Registered trademarks

FOUNDATION Fieldbus™
Registered trademark of the Fieldbus Foundation Austin, Texas, USA

3 Installation instructions

3.1 Incoming acceptance, transport, storage

3.1.1 Incoming acceptance

On receipt of the goods, check the following points:

- Are the contents or the packaging damaged?
- Is the delivery complete and is anything missing? Check the scope of delivery against you order.

3.1.2 Transport and storage

Note the following points:

- Pack the device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The permitted storage temperature is -40 to +100 °C (-40 to 212 °F).

3.2 Installation conditions

3.2.1 Dimensions

The dimensions of the device can be found in chapter 10 "Technical data".

3.2.2 Installation point

- In the terminal head, flat face, as per DIN 43729, direct mounting on insert with cable entry (middle hole 7 mm)
- In the field housing, separate from the process (see Section 8 'Accessories')
- Mounting on a DIN rail as per EN 60715 is also possible with the DIN rail clip accessory, see Section 8 'Accessories'.

Information on installation conditions, such as ambient temperature, protection classification, climatic class etc., can be found in chapter 10 "Technical data".
When using in the hazardous area, the limit values of the certificates and approvals must be observed (see Safety Instructions XA or CD).

3.3 Installation instructions

A screwdriver is needed to mount the head transmitter.

NOTICE

Damage of the head transmitter

► Do not overtighten the mounting screws as this could damage the head transmitter. Maximum torque = 1 Nm (¾ pound-feet).

3.3.1 Mounting typical of Europe

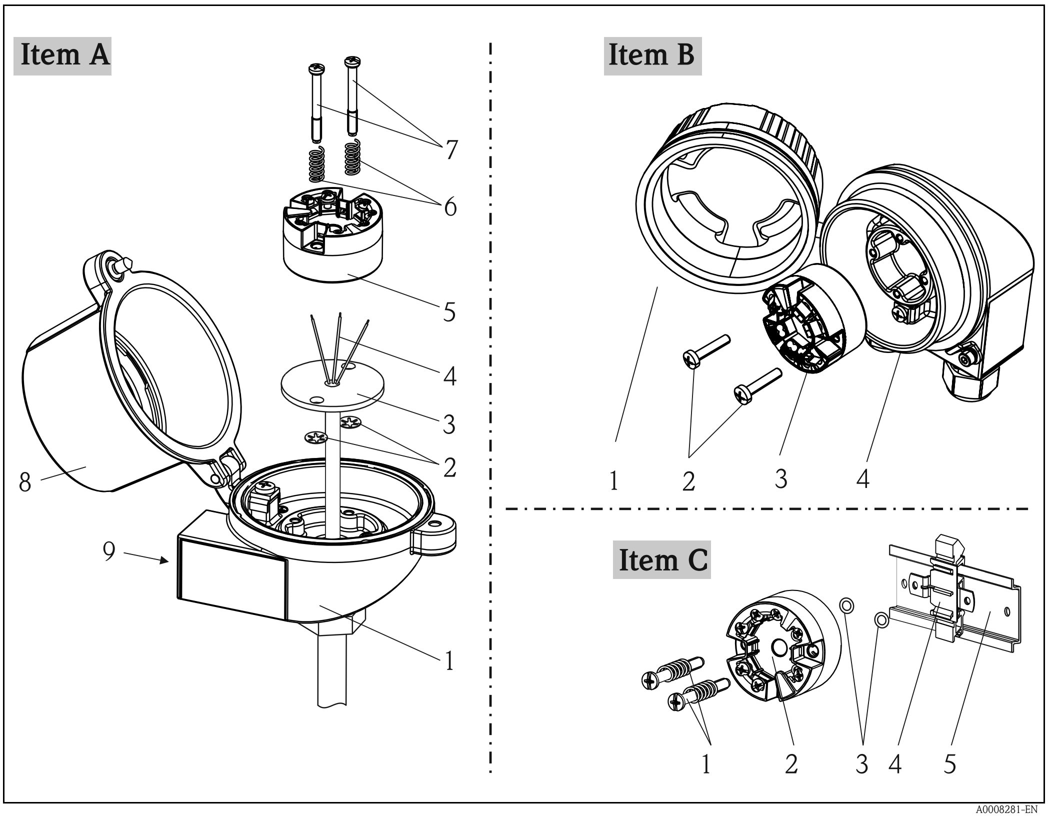


Fig. 2: Head transmitter mounting (three versions)

Item A	Mounting in a terminal head (terminal head as per DIN 43729, flat face)
1	Terminal head
2	Circlips
3	Insert
4	Connection wires
5	Head transmitter
6	Mounting springs
7	Mounting screws
8	Terminal head cover
9	Cable entry

Procedure:

1. Open the terminal head cover (8).
2. Guide the connection wires (4) of the insert (3) through the middle hole in the head transmitter (5).
3. Fit the mounting springs (6) onto the mounting screws (7).
4. Guide the mounting screws (7) through the lateral bores of the head transmitter and the insert (3). Then fix both mounting screws in position with the circlips (2).
5. Position the head transmitter in the terminal head (1) in such a way that the terminals of the bus cable (terminals 1 and 2) point to the cable entry (9).
6. Then screw down the head transmitter (5) to the insert (3) in the terminal head.
7. After wiring (see section 4), close the terminal head cover (8) back on tight.

Item B	Mounting in a field housing
1	Field housing cover
2	Mounting screws with springs
3	Head transmitter
4	Field housing
Procedure: 1. Open the cover (1) of the field housing (4). 2. Guide the mounting screws (2) through the lateral bores of the head transmitter (3). 3. Screw the head transmitter to the field housing. 4. When wiring is complete (see section 4), screw the field housing cover (1) back on.	

Item C	Mounting on DIN rail as per IEC 60715
1	Mounting screws with springs
2	Head transmitter
3	Circlips
4	DIN rail clip
5	DIN rail
Procedure: 1. Press the DIN rail clip (4) onto the DIN rail (5) until it engages. 2. Fit the mounting springs onto the mounting screws (1) and guide them through the lateral bores of the head transmitter (2). Then fix both mounting screws in position with the circlips (3). 3. Screw the head transmitter (2) to the DIN rail clip (4).	

3.3.2 Mounting typical of North America

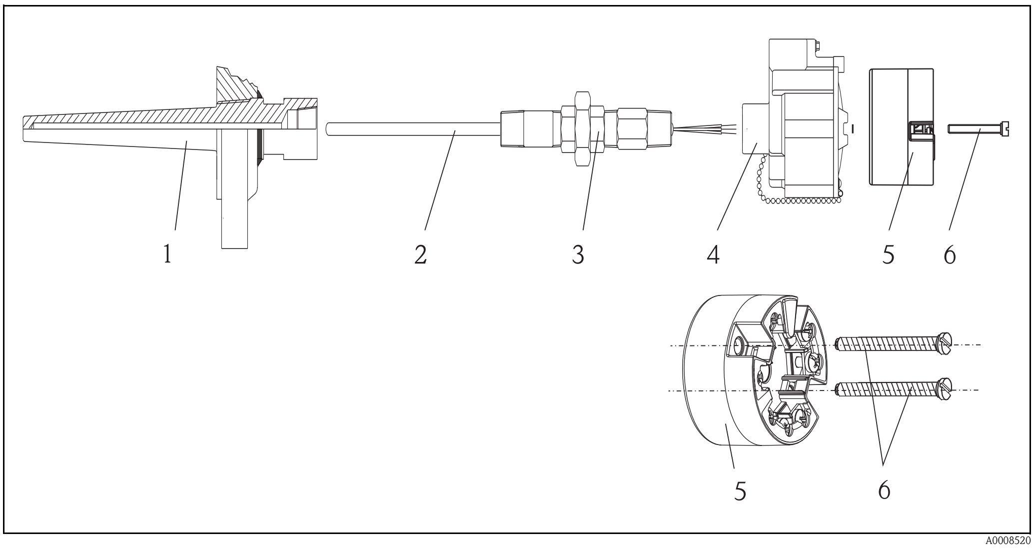


Fig. 3: Head transmitter mounting

1: Thermowell
2: Insert
3: Adapter, threaded joint
4: Terminal head
5: Head transmitter
6: Mounting screws

Thermometer design with thermocouples or RTD sensors and head transmitter (→ 3)

- Fit the thermowell (item 1) on the process pipe or the container wall. Secure the thermowell according to the instructions before the process pressure is applied.
- Fit the necessary neck tube nipples and adapter (item 3) on the thermowell.
- Make sure sealing rings are installed if such rings are needed for harsh environmental conditions or special regulations.
- Guide the mounting screws (item 6) through the lateral bores of the head transmitter (item 7).
- Position the head transmitter (item 5) in the terminal head (item 4) in such a way that the bus cable (terminals 1 and 2) point to the cable entry.
- Using a screwdriver, screw down the head transmitter (item 5) in the terminal head (item 4).
- Guide the connection wires of the insert (item 3) through the lower cable entry of the terminal head (item 4) and through the middle hole in the head transmitter (item 5). Wire the connection wires and transmitter (see Section 4) with one another.
- Screw the terminal head (item 4), with the integrated and wired head transmitter, onto the ready-mounted nipple and adapter (item 3).

NOTICE

Requirements for explosion protection

► Once the wiring is completed, screw the terminal head cover back on. The terminal head cover must be secured properly.

3.3.3 Mounting the display

1. Remove the screw from the terminal head. Open the terminal head cap (1).
2. Remove the cover of the display connection (2). Plug the display module onto the mounted and wired head transmitter. The mounting pins (3) must snap securely into the head transmitter.
3. After mounting the display, close the terminal head cap and refit the screw.

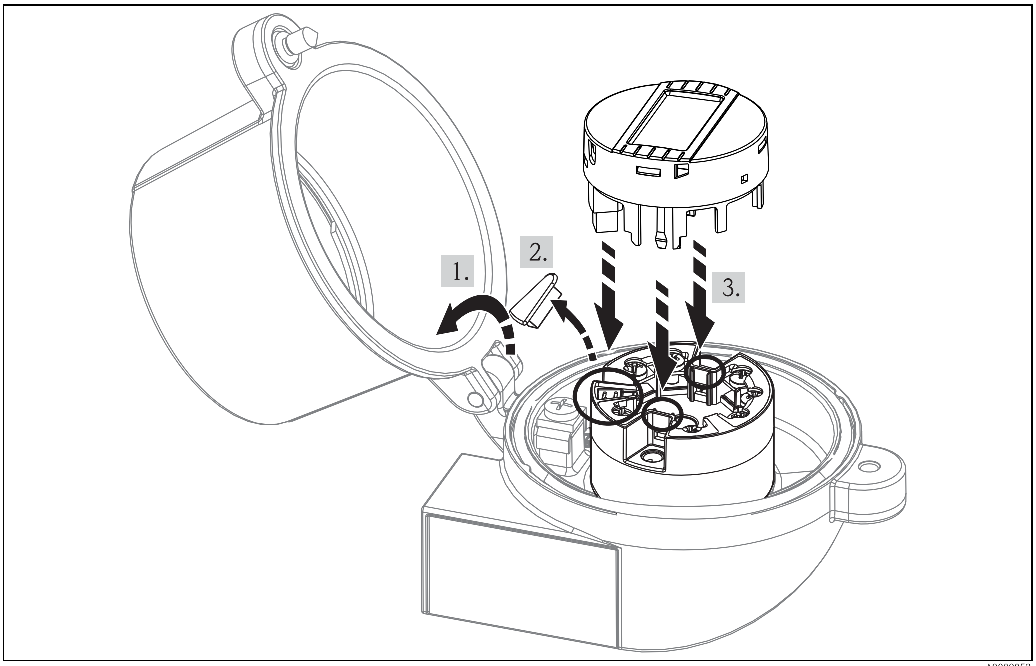


Fig. 4: Mounting the display

The display can only used with suitable terminal heads with display window.

3.4 Post-installation check

After installing the device, always run the following final checks:

Device condition and specifications	Notes
Is the device visibly damaged (visual check)?	-
Does the device comply to the measurement point specifications, such as ambient temperature, measurement range etc.?	See chapter 10 "Technical data"

4 Wiring

NOTICE

Electronic parts may be damaged

- ► Switch off power supply before installing or connecting the device. Failure to observe this may result in destruction of parts of the electronics.
- ► When installing Ex-approved devices in a hazardous area please take special note of the instructions and connection schematics in the respective Ex documentation added to these Operating Instructions. Your supplier is available for assistance if required.
- ► The 4-pin post connector is only designed for connecting the associated display. Connecting other devices can destroy parts of the electronics.

For wiring a mounted head transmitter, proceed as follows:

1. Open the cable gland and the housing cover on the terminal head or the field housing.
2. Feed the cables through the opening in the cable gland.
3. Connect the cables as shown in → 5. If the head transmitter is fitted with spring terminals, please pay particular attention to → Chap. 4.2.1.
4. Retighten the cable gland and close the housing cover.
5. In order to avoid connection errors always take note of the hints given in the section connection check!

4.1 Quick wiring guide

Terminal assignment

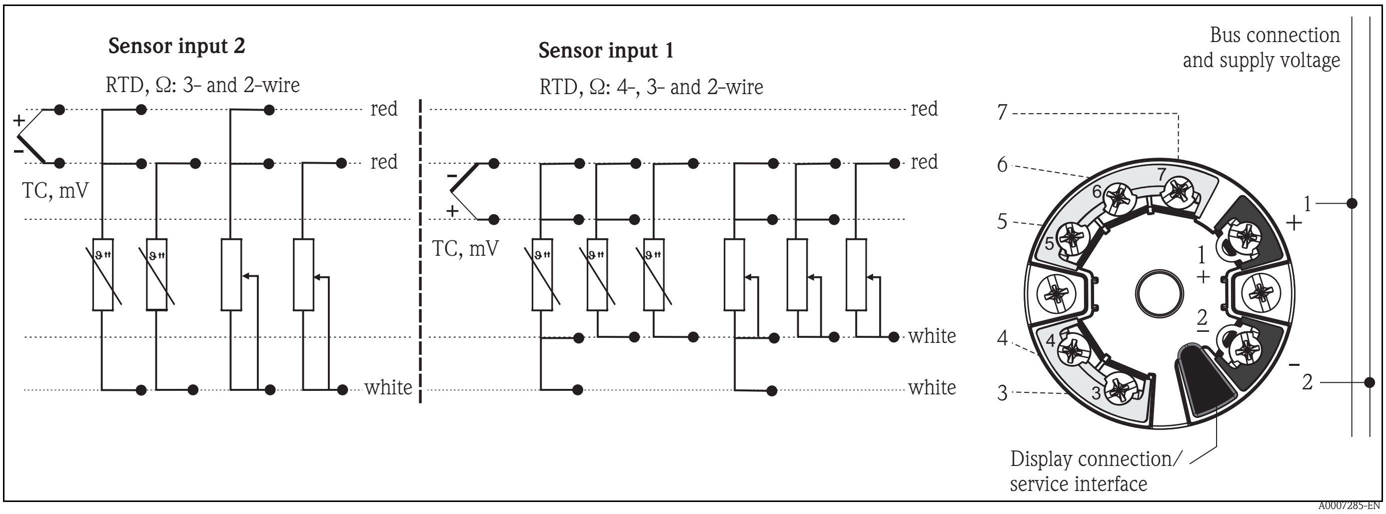


Fig. 5: Wiring the head transmitter

ESD – electrostatic discharge
Protect the terminals from electrostatic discharge. Failure to observe this may result in destruction or malfunction of parts of the electronics.

4.2 Connecting the sensor cables

When connecting 2 sensors ensure that there is no galvanic connection between the sensors (e.g. caused by sensor elements that are not isolated from the thermowell). The resulting equalizing currents distort the measurements considerably. In this situation, the sensors have to be galvanically isolated from one another by connecting each sensor separately to a transmitter. The device provides sufficient galvanic isolation (> 2 kV AC) between the input and output.

Please refer to → 5 for the terminal assignment of the sensor connections.

The following connection combinations are possible when both sensor inputs are assigned:

		Sensor input 1			
		RTD or resistance transmitter, two-wire	**RTD or resistance transmitter, three-wire**	**RTD or resistance transmitter, four-wire**	**Thermocouple (TC), voltage transmitter**
Sensor input 2	**RTD or resistance transmitter, two-wire**	✓	✓	-	✓
	RTD or resistance transmitter, three-wire	✓	✓	-	✓
	RTD or resistance transmitter, four-wire	-	-	-	-
	Thermocouple (TC), voltage transmitter	✓	✓	✓	✓

4.2.1 Connecting to spring terminals

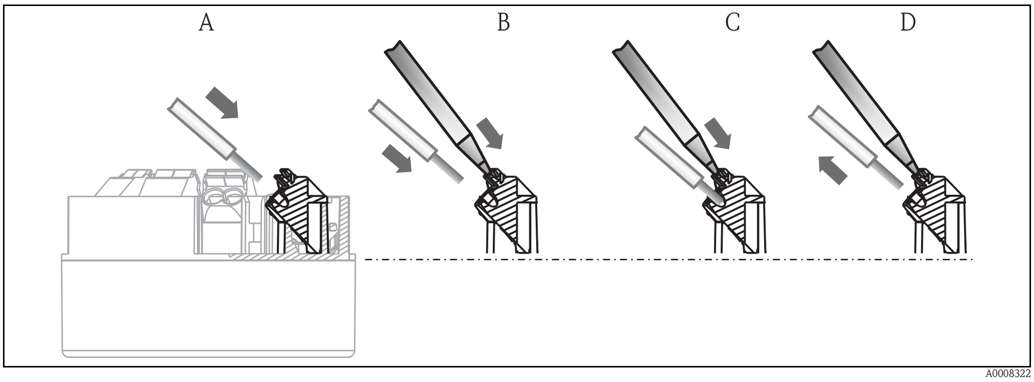


Fig. 6: Spring terminal connection

A Insert wire end (solid wire or wire with ferrule)
B Insert wire end (fine-strand wire without ferrule)
C Release wire end with tool
D Remove wire end

When connecting flexible cables and spring terminals, it is not recommended to use ferrules.

Procedure:

Item A, solid wire:	1.	Strip wire end. Minimum stripping length = 10 mm (0.39 in)
	2.	Insert the wire end into the terminal (A).
	3.	Check the connection by pulling on the wire lightly. Repeat from step 1 if necessary.

Item B, fine-strand wire without ferrule:	1.	Strip wire end. Minimum stripping length = 10 mm (0.39 in)
	2.	Operate lever opener with tool (B).
	3.	Insert the wire end into the terminal (B).
	4.	Release lever opener.
	5.	Check the connection by pulling on the wire lightly. Repeat from step 1 if necessary.

Item C and D, releasing the connection:	1.	Operate lever opener with tool (C).
	2.	Remove wire from terminal (D).
	3.	Release lever opener.

4.3 FOUNDATION Fieldbus™ cable specification

4.3.1 Cable type

Twin-core cables are required for connecting the device to the FOUNDATION Fieldbus™ H1. Following IEC 61158-2 (MBP), four different cable types (A, B, C, D) can be used with the FOUNDATION Fieldbus™, only two of which (cable types A and B) are shielded.

- Cable types A or B are particularly preferable for new installations. Only these types have cable shielding that guarantees adequate protection from electromagnetic interference and thus the most reliable data transfer. In the case of cable type B, several field buses (same degree of protection) may be operated in one cable. No other circuits are permissible in the same cable.
- Practical experience has shown that cable types C and D should not be used due to the lack of shielding, since the freedom from interference generally does not meet the requirements described in the standard.

The electrical data of the fieldbus cable have not been specified but determine important characteristics of the design of the fieldbus, such as distances bridged, number of users, electromagnetic compatibility, etc.

	Type A	Type B
Cable structure	Twisted pair, shielded	One or more twisted pairs, fully shielded
Wire size	0.8 mm^2 (AWG 18)	0.32 mm^2 (AWG 22)
Loop-resistance (direct current)	44 Ω/km	112 Ω/km
Characteristic impedance at 31.25 kHz	100 Ω ± 20%	100 Ω ± 30%
Attenuation constant at 39 kHz	3 dB/km	5 dB/km
Capacitive asymmetry	2 nF/km	2 nF/km
Envelope delay distortion (7.9 to 39 kHz)	1.7 ms/km	*

	Type A	Type B
Shield coverage	90%	*
Max. cable length (incl. spurs >1 m)	1900 m (6233 ft)	1200 m (3937 ft)
* Not specified		

Suitable fieldbus cables (type A) from various manufacturers for non-hazardous areas are listed below:
- Siemens: 6XV1 830-5BH10
- Belden: 3076F
- Kerpen: CeL-PE/OSCR/PVC/FRLA FB-02YS(ST)YFL

4.3.2 Maximum overall cable length

The maximum network expansion depends on the type of protection and the cable specifications. The overall cable length combines the length of the main cable and the length of all spurs (>1 m/ 3.28 ft). Note the following points:

- The maximum permissible overall cable length depends on the cable type used.
- If repeaters are used, the maximum permissible cable length is doubled. A maximum of three repeaters are permitted between user and master.

4.3.3 Maximum spur length

The line between the distribution box and field device is described as a spur.
In the case of non-Ex applications, the max. length of a spur depends on the number of spurs (>1 m/3.28 ft):

Number of spurs	1 to 12	13 to 14	15 to 18	19 to 24	25 to 32
Max. length per spur	120 m (393 ft)	90 m (295 ft)	60 m (196 ft)	30 m (98 ft)	1 m (3.28 ft)

4.3.4 Number of field devices

In accordance with IEC 61158-2 (MBP), a maximum of 32 field devices can be connected per fieldbus segment. However, this number is restricted under certain conditions (explosion protection, bus power option, field device current consumption). A maximum of four field devices can be connected to a spur.

4.3.5 Shielding and grounding

Optimum electromagnetic compatibility (EMC) of the fieldbus system can only be guaranteed if the system components and, in particular, the lines are shielded and the shield forms as complete a cover as possible. A shield coverage of 90% is ideal.

- To ensure an EMC protective effect, connect the shield as often as possible to the reference ground.
- For reasons of explosion protection, you should refrain from grounding however.

To comply with both requirements, the FOUNDATION Fieldbus™ basically allows three different types of shielding:
- Shielding at both ends
- Shielding at one end on the feed side with capacitance connection to the field device

- Shielding at one end on the feed side

Experience shows that the best results with regard to EMC are achieved in most cases in installations with one-sided shielding. Appropriate measures with regard to input wiring must be taken to allow unrestricted operation when EMC interference is present. These measures have been taken into account for this device. Operation in the event of disturbance variables as per NAMUR NE21 is possible with one-sided shielding.
Where applicable, national installation regulations and guidelines must be observed during the installation!
Where there are large differences in potential between the individual grounding points, only one point of the shielding is connected directly with the reference ground. In systems without potential equalization, therefore, cable shielding of fieldbus systems should only be grounded on one side, for example at the fieldbus supply unit or at safety barriers, → 7

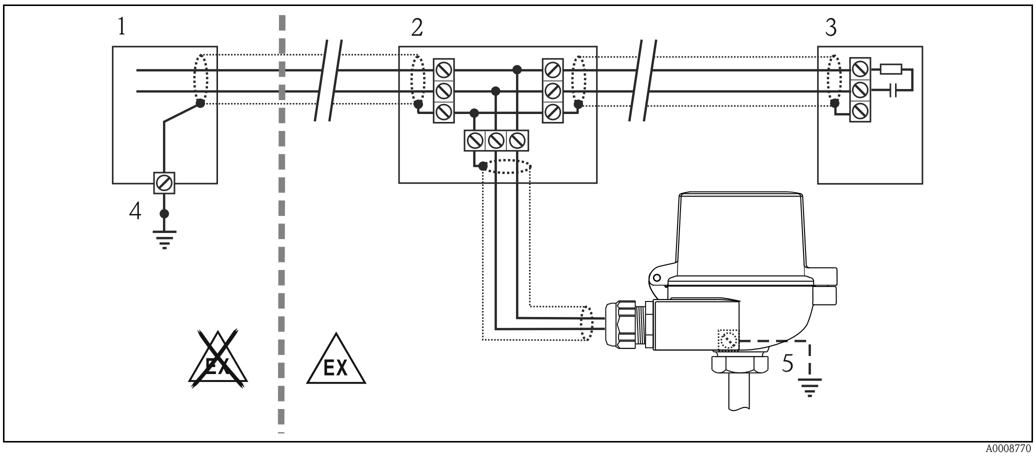


Fig. 7: Shielding and one-sided grounding of the fieldbus cable shielding

1 Supply unit
2 Distribution box (T-box)
3 Bus terminator
4 Grounding point for fieldbus cable shielding
5 Optional grounding of the field device, isolated from cable shielding.

NOTICE

If the shielding of the cable is grounded at more than one point in systems without potential matching, power supply frequency equalizing currents can occur that damage the bus cable or shielding or have serious effect on signal transmission.

► In such cases the shielding of the fieldbus cable is to be grounded on only one side, i.e. it must not be connected to the ground terminal of the housing (terminal head, field housing). The shield that is not connected should be insulated!

4.3.6 Bus termination

The start and end of each fieldbus segment are always to be terminated with a bus terminator. With various junction boxes (non-Ex), the bus termination can be activated via a switch. If this is not the case, a separate bus terminator must be installed. Note the following points in addition:
- In the case of a branched bus segment, the device furthest from the segment coupler represents the end of the bus.
- If the fieldbus is extended with a repeater, then the extension must also be terminated at both ends.

4.3.7 Further information

General information and further pointers on wiring can be found on www.fieldbus.org, the Web site of the Fieldbus Foundation.

4.4 Connecting the measuring unit

Devices can be connected to the FOUNDATION Fieldbus™ in two ways:

- Connection via conventional cable gland → Chap. 4.4.1
- Connection via fieldbus connector (optional, can be purchased as an accessory) → Chap. 4.4.2

NOTICE

Risk of damaging

- ► Switch off power supply before installing or connecting the head transmitter. Failure to observe this may result in destruction of parts of the electronics.
- ► Grounding via one of the grounding screws (terminal head, field housing) is recommended.
- ► If the shielding of the fieldbus cable is grounded at more than one point in systems without additional potential matching, power supply frequency equalizing currents can occur that damage the cable or the shielding. In such cases the shielding of the fieldbus cable is to be grounded on only one side, i.e. it must not be connected to the ground terminal of the housing (terminal head, field housing). The shield that is not connected should be insulated!
- ► We recommend that the fieldbus not be looped using conventional cable glands. If you later replace even just one measuring device, the bus communication will have to be interrupted.

4.4.1 Cable glands or entries

Please also observe the general procedure on → 13.

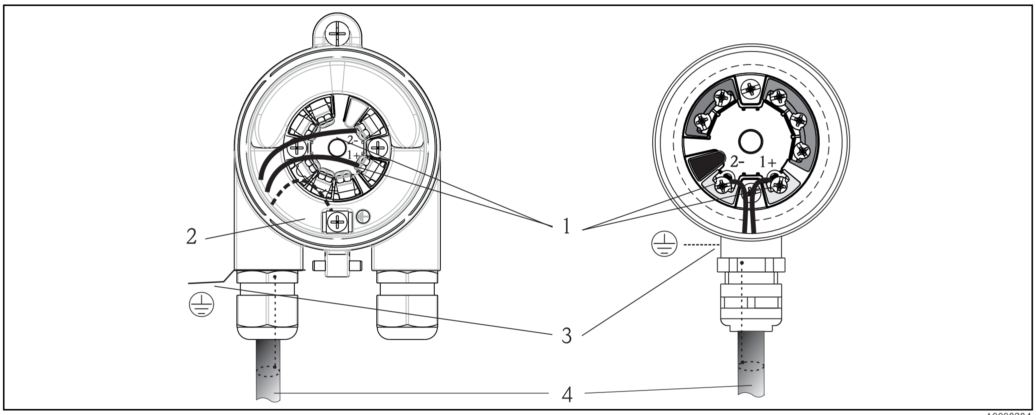


Fig. 8: Connection to the FOUNDATION Fieldbus™ fieldbus cable - installed in the field housing on the left, and in the terminal head on the right

A FF terminals - fieldbus communication and power supply
B Inner ground terminal
C Outer ground terminal
D Shielded fieldbus cable (FOUNDATION Fieldbus™)

- The terminals for the fieldbus connection (1+ and 2-) are not polarity sensitive.
- Conductor cross-section:
  max. 2.5 mm^2 for screw terminals
  max. 1.5 mm^2 for spring terminals
- A shielded cable must be used for the connection.

4.4.2 Fieldbus connector

Optionally, a fieldbus connector can be screwed into the terminal head or field housing instead of a cable gland. Fieldbus connectors can be ordered as an accessory (see Section 8 'Accessories').

The connection technology of FOUNDATION Fieldbus™ allows measuring devices to be connected to the fieldbus via uniform mechanical connections such as T-boxes, junction boxes, etc.

This connection technology using prefabricated distribution modules and plug-in connectors offers substantial advantages over conventional wiring:
- Field devices can be removed, replaced or added at any time during normal operation. Communication is not interrupted.
- Installation and maintenance are significantly easier.
- Existing cable infrastructures can be used and expanded instantly, e.g. when constructing new star distributors using 4-channel or 8-channel distribution modules.

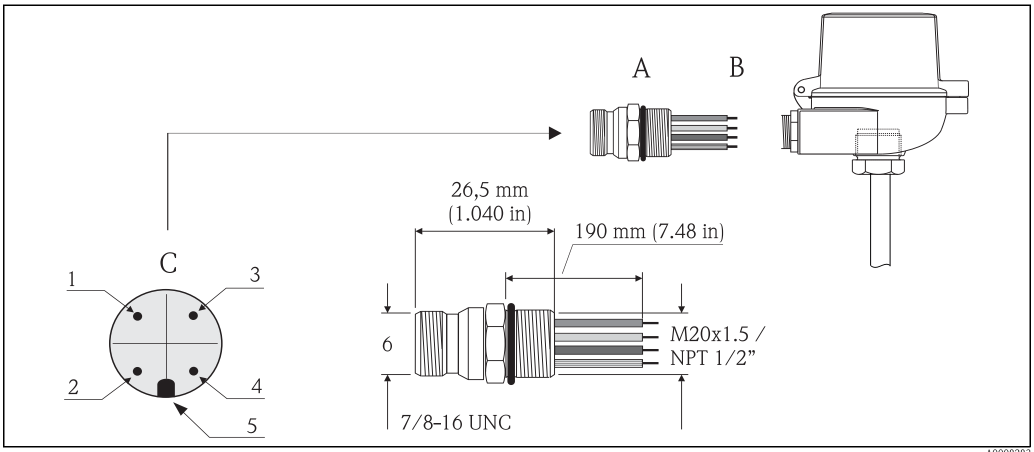


Fig. 9: Connectors for connecting to the FOUNDATION Fieldbus™

A Fieldbus connector (pin assignment/color codes)
- *1 Blue wire: FF– (terminal 2)*
- *2 Brown wire: FF+ (terminal 1)*
- *3 Gray wire: shielding*
- *4 Green/yellow wire: ground*
- *5 Positioning tappet*
- *6 7/8" UNC thread*

B Terminal head thermometer
C Connector at the housing (male)

Connector technical data:

Wire cross-section	4 x 0.8 mm^2
Connection thread	M20 x 1.5 / NPT ½"
Degree of protection	IP 67 as per DIN 40 050 IEC 529
Contact surface	CuZn, gold-plated
Housing material	1.4401 (316)
Flammability	V - 2 as per UL - 94
Ambient temperature	–40 to +105 °C (–40 to +221 °F)
Current carrying capacity	9 A
Rated voltage	max. 600 V
Contact resistance	≤ 5 mΩ
Insulation resistance	≥ 10^9 Ω

4.5 Post-connection check

After the electrical installation of the device, always perform the following final checks:

Device condition and specifications	Notes
Are the measuring device or the cables damaged (visual check)?	-
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	9 to 32 V DC
Do the cables used comply with the specifications?	Fieldbus cable, → 📄 15 Sensor cable, → 📄 14
Do the cables have adequate strain relief?	-
Are the power supply and signal cables correctly connected?	→ Chap. 4.1
Are all the screw terminals well tightened and have the connections of the spring terminals been checked?	→ 📄 14
Are all the cable entries installed, tightened and sealed? Cable run with "water trap"?	
Are all the housing covers installed and tightened?	
Electrical connection of FOUNDATION Fieldbus™	Notes
Are all the connecting components (T-boxes, junction boxes, connectors, etc.) connected with each other correctly?	-
Has each fieldbus segment been terminated at both ends with a bus terminator?	-
Has the max. length of the fieldbus cable been observed in accordance with the FOUNDATION Fieldbus™ specifications?	→ 📄 15
Has the max. length of the spurs been observed in accordance with the FOUNDATION Fieldbus™ specifications?	
Is the fieldbus cable fully shielded (90%) and correctly grounded?	

5 Operation

5.1 Quick operation guide

Display and operating elements are only available locally if the head transmitter was ordered with a display unit!

You have a number of options for configuring and commissioning the device:

1. Configuration programs
The configuration of FF functions and device-specific parameters is done via the fieldbus interface. You can obtain special configuration and operating programs from various manufacturers for these purposes.→ 26

2. Miniature switches (DIP switches) for diverse hardware settings, optional
You can make the following hardware settings for the FOUNDATION Fieldbus™ interface using miniature switches (DIP switches) on the rear of the optional display → 26:

- Enabling/disabling the simulation mode in the Analog Input function block
- Switching the hardware write protection on/off
- Switching (turning) the display 180 °

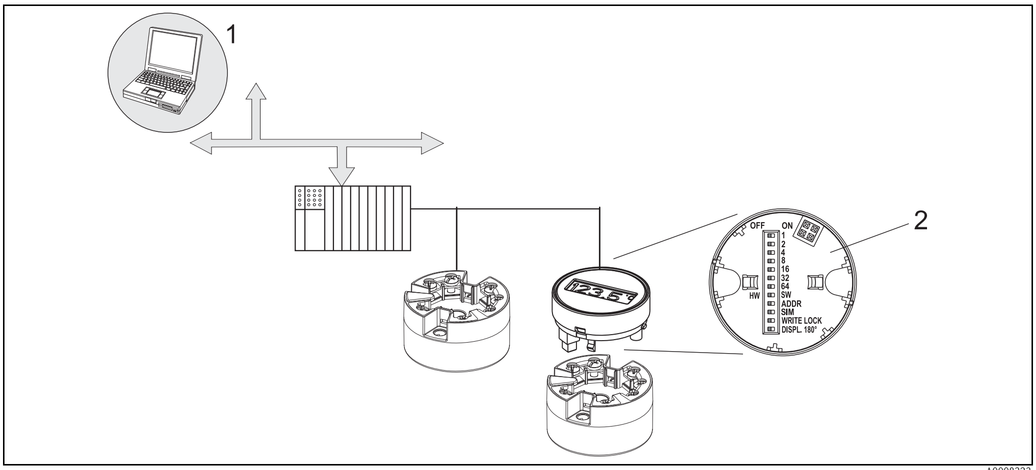


Fig. 10: Head transmitter operating options

1 Configuration/operating programs for operation via FOUNDATION Fieldbus™ (Foundation Fieldbus functions, device parameter)
2 DIP switch for hardware settings is on the rear of the optional display (write protection, simulation mode)

5.2 Display and operating elements

5.2.1 Display

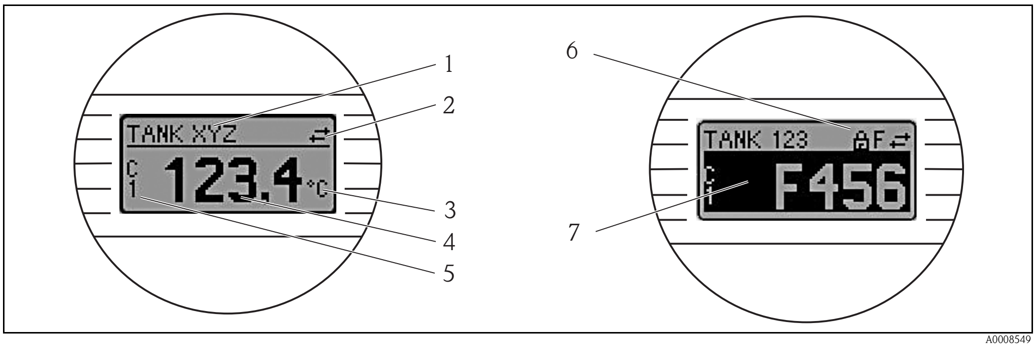


Fig. 11: Optional LC display of the head transmitter

5.2.2 Display symbols

Item No.	Function	Description
1	Displays the TAG	TAG, 32 characters long.
2	'Communication' symbol	The communication symbol appears when read and write-accessing via the FOUNDATION Fieldbus™ protocol.
3	Unit display	Unit display for the measured value displayed.
4	Measured value display	Displays the current measured value.
5	Channel display C1 or C2, P1, S1	e.g. C1 for a measured value from channel 1.
6	'Configuration locked' symbol	The 'configuration locked' symbol appears when configuration is locked via the hardware.
7	Warning or error message	If a warning occurs, the display alternates between the measured value and the warning code. If an error occurs, the display alternates between the error code and "- - - -" (no valid measured value available), (see Section 9.2 'Status messages'.

5.2.3 Local operation

You can make hardware settings for the FOUNDATION Fieldbus™ interface using miniature switches (DIP switches) on the rear of the optional display → 26:

5.3 FOUNDATION Fieldbus™ technology

The FOUNDATION Fieldbus™ (FF) is a purely digital, serial communication system that connects fieldbus devices (sensors, actuators), automation and process control systems with each other. As a local communications network (LAN) for field devices the FF was primarily designed for the requirements of process technology. The FF thus forms the basic network throughout the hierarchy of a communication system.
Please refer to Operating Instructions BA 013S/04/en “FOUNDATION Fieldbus Overview: Installation and Commissioning Guidelines” for configuration information.

5.3.1 System architecture

The following figure shows an example of a FOUNDATION Fieldbus™ network with the associated components.

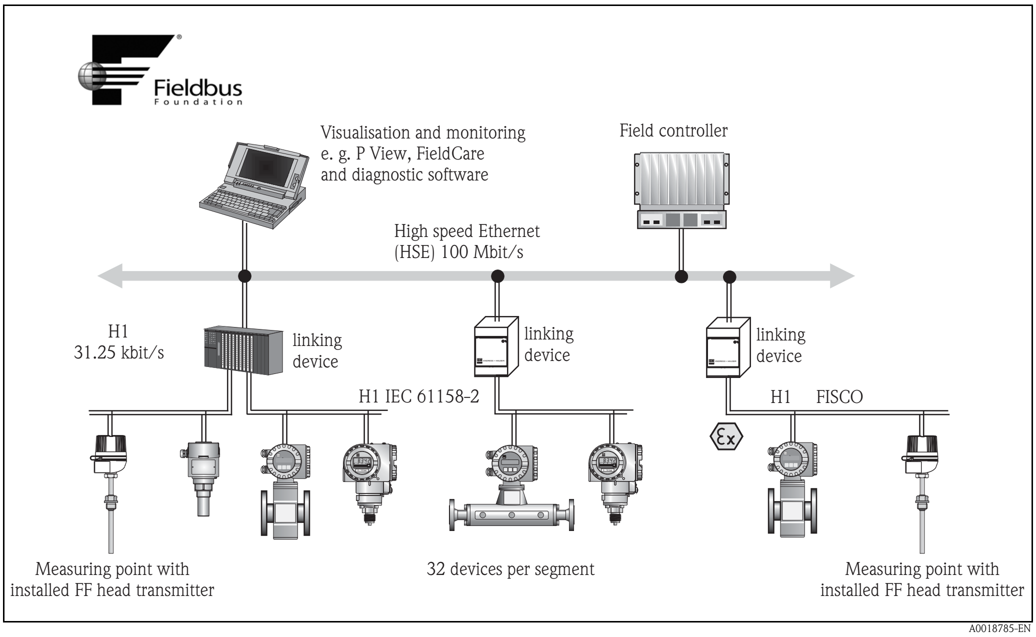


Fig. 12: System integration via FOUNDATION Fieldbus™

HSE = High Speed Ethernet, H1 = FOUNDATION Fieldbus-H1

The following system connection options are possible:
- *A linking device can be used to connect to higher ranking fieldbus protocols (e.g. to the High Speed Ethernet - HSE) (Control Net)*
- *A H1 card is required for direct connection to a process control system.*
- *System inputs are available directly for H1 (HSE).*

The system architecture of the FOUNDATION Fieldbus™ can be divided into two subnetworks:

H1 bus system:
In the field, fieldbus devices are connected only via the slower H1 bus system that is specified following IEC 61158-2. The H1 bus system allows simultaneous feed to the field devices and data transfer on the two-wire line.
The following points describe some important characteristics of the H1 bus system:

- All fieldbus devices are powered via the H1 bus. Like the fieldbus devices, the power supply is connected in parallel to the bus line. Devices requiring external power must use a separate power supply.
- One of the most common network structures is the line structure. Star, tree or mixed network structures are also possible using connecting components (junction boxes).
- The bus connection to the individual fieldbus devices is achieved by means of a T-connector or via a spur. This has the advantage that individual fieldbus devices can be connected or disconnected without interrupting the bus or the bus communication.
- The number of connected fieldbus devices depends on various factors, such as use in hazardous areas, length of spur, cable types, current consumption of field devices etc. (see → 📄 15).
- If using fieldbus devices in a hazardous area, the H1 bus must be equipped with an intrinsically safe barrier before the transition to the hazardous area.
- A bus terminator is required at each end of the bus segment.

High Speed Ethernet (HSE):
The superior bus system is realized via the High Speed Ethernet (HSE) with a transmission rate of max. 100 MBit/s. This serves as the 'backbone' (basic network) between various local sub-networks and/or where there is a large number of network users.

5.3.2 Link Active Scheduler (LAS)

The FOUNDATION Fieldbus™ works according to the 'producer-consumer' relationship.
This provides various advantages.
Data can be directly exchanged between field devices, e.g. a sensor and an actuating valve. Each bus user 'publishes' its data on the bus and all the bus users configured accordingly obtain this data. Publication of this data is carried out by a 'bus administrator' known as the 'Link Active Scheduler', which controls the sequence of bus communication centrally. The LAS organizes all the bus activities and sends appropriate commands to the individual field devices.

Other tasks of the LAS are:
- Recognition and reporting of newly connected devices.
- Reporting the removal of devices no longer communicating with the fieldbus.
- Keeping the 'Live List'. This list, in which all the fieldbus users are recorded, is checked by the LAS regularly. If devices are logged on or logged off, the "Live List" is updated and sent immediately to all the devices.
- Requesting process data from the field devices in accordance with a fixed schedule.
- Allocation of send rights (tokens) to devices between the untimed data transfer.

The LAS can be run redundantly, i.e. it exists both in the process control system and in the field device. If one LAS fails, the other LAS can accurately take over communication. Through precise timing of the bus communication via the LAS, the FF can run exact processes at regular intervals.

Fieldbus devices, such as this head transmitter, which can take over the LAS function in the event of failure of the primary master, are called 'Link Masters'. In contrast, 'Basic Devices' can only receive signals and send them to the central process control system. The LAS function is deactivated in this head transmitter when the unit is delivered.

5.3.3 Data transfer

We distinguish between two types of data transfer:
- **Scheduled data transfer (cyclic):** all time-critical process data (i.e. continuous measurement or actuating signals) are transferred and processed in accordance with a fixed schedule.
- **Unscheduled data transfer (acyclic):** device parameters that are not time-critical for the process and diagnosis information are only transferred to the fieldbus when needed. This data transfer is always carried out in the intervals between timed communication.

5.3.4 Device ID, addressing

Within the FF network, each fieldbus device is identified by a unique device ID (DEVICE_ID). The fieldbus host system (LAS) automatically gives the network address for this to the field device. The network address is the address that the fieldbus currently uses.

The FOUNDATION Fieldbus™ uses addresses between 0 and 255:
- Groups/DLL: 0 to 15
- Devices in operation: 20 to 35
- Reserve devices: 232 to 247
- Offline/substitute devices: 248 to 251

The field device tag name (PD_TAG) is given to the device in question during commissioning (see → 30). It remains stored in the device even during a supply voltage failure.

5.3.5 Function blocks

The FOUNDATION Fieldbus™ uses predefined function blocks to describe the functions of a device and to specify uniform data access. The function blocks implemented in each fieldbus device provide information on the tasks which a device can accept in the whole of the automation strategy.

In the case of sensors these are typically the following blocks:
- 'Analog Input' or
- 'Discrete Input' (digital input)

Actuating valves normally have the function blocks:
- 'Analog Output' or
- 'Discrete Output' (digital output)

For control tasks there are the blocks:
- PD controller or
- PID controller

More information on this can be found from Section 11 onwards.

5.3.6 Fieldbus based process control

With the FOUNDATION Fieldbus™ field devices can carry out simple process control functions themselves, thereby relieving pressure on the superior process control system. Here the Link Active Scheduler (LAS) coordinates data exchange between the sensor and controller and makes sure that two field devices cannot access the bus at the same time. To do this, configuration software such as the NI-FBUS Configurator from National Instruments is used to connect the various function blocks to the desired control strategy – generally graphically (→ 🗎 30).

5.3.7 Device description

For commissioning, diagnosis and configuration, make sure that process control systems or superior configuration systems can access all device data and that the operating structure is uniform.
The device-specific information required for this is stored as so-called device description data in special files (the 'Device Description'- DD). This enables the device data to be interpreted and shown via the configuration program. The DD is thus a kind of 'device driver'.
On the other hand, a CFF file (CFF = Common File Format) is required for the network configuration in the OFF-line mode.
These files can be acquired as follows:

– Via the Fieldbus Foundation Organization: www.fieldbus.org

5.4 Configuration of the transmitter and FF functions

The FF communication system will only function properly if correctly configured. You can obtain special configuration and operating programs from various manufacturers for the configuration.

Process control systems	**Asset management systems**
Endress+Hauser ControlCare	National Instruments NI-Configurator (≥ 3.1.1)
Emerson DeltaV	Emerson AMS and Handheld FC375
PACTware	
Rockwell Control Logix/FFLD	
Honeywell PKS Experion	
Yokogawa Centum CS3000	

These can be used for configuring both the FF functions and all of the device-specific parameters. The predefined function blocks allow uniform access to all the network and fieldbus device data. A detailed step-by-step description of the procedure for commissioning the FF functions is given on → 30 together with information on configuring device-specific parameters.

System files

You require the following files for commissioning and configuring the network:
- Commissioning → device description (DD: *.sym, *.ffo)
- Network configuration → CFF file (Common File Format)

5.5 Hardware settings (optional)

DIP switches on the rear of the display are used to enable and disable hardware write protection and the simulation mode (for the Analog Input Block), and to switch (turn) the display 180°. When write protection is active, parameters cannot be modified. The current write protection status is displayed in the WRITE_LOCK parameter (Resource Block, see Section 11).
The display can optionally be ordered with the transmitter, or as an accessory for subsequent mounting (see Section 8).
The simulation mode via the hardware setting must be changed before the software setting.

ESD – electrostatic discharge
Protect the terminals from electrostatic discharge. Failure to observe this may result in destruction or malfunction of parts of the electronics.

To set the DIP switches, proceed as follows:

1. Open the cover of the terminal head or field housing.
2. Remove the attached display from the head transmitter.
3. Configure the DIP switch on the rear of the display accordingly. Switch to ON = function enabled, switch to OFF = function disabled.
4. Fit the display onto the head transmitter in the correct position. The head transmitter accepts the settings within one second.
5. Secure the cover back onto the terminal head or field housing.

The DIP switch settings are no longer valid as soon as the display is removed from the head transmitter.

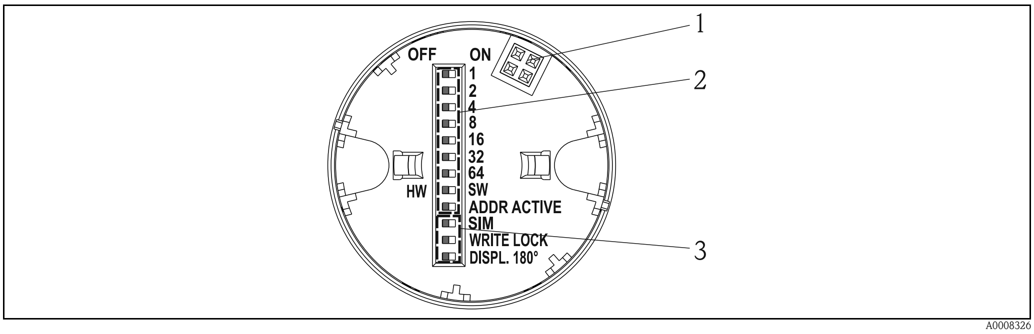


Fig. 13: Hardware settings via DIP switches

1 Connection to head transmitter
2 DIP switch (1 - 7, SW/HW and ADDR ACTIVE), no function
3 DIP switch (SIM = simulation mode; WRITE LOCK = write protection; DISPL. 180° = switch (turn) the display 180°)

6 Commissioning

6.1 Function check

Before commissioning the measurement point make sure that all final checks have been carried out:
- Checklist “Post-installation check”→ 12
- Checklist “Post-connection check”→ 20

The FOUNDATION Fieldbus interface's technical data must be maintained in accordance with IEC 61158-2 (MBP).
The bus voltage of 9 to 32 V and the current consumption of approx. 11 mA at the measuring device can be checked using a normal multimeter.

6.2 Switching on the measuring device

Once the final checks have been successfully completed, it is time to switch on the supply voltage. The head transmitter performs a number of internal test functions after power-up. As this procedure progresses, the following sequence of messages appears on the display:

Step	Display
1	Display name and software (SW) and hardware (HW) version
2	Company logo (if applicable)
3a	Device name (if applicable) as well as the SW, HW and device release of the head transmitter
3b	Displays sensor configuration
4a	Current measured value or
4b	Current status message If the switch-on procedure fails, the appropriate status message is displayed, depending on the cause. A detailed list of the status messages, as well as the measures for troubleshooting, can be found in section 9, 'Troubleshooting'.

The device is operational after approx. 8 seconds and the attached display after approx. 12 seconds! Normal measuring mode commences as soon as the switch-on procedure is completed. Various measured values and/or status values appear on the display.

6.3 Commissioning

Note the following points:

- The files required for commissioning and network configuration can be obtained as described on → 25.
- In the case of the FOUNDATION Fieldbus™, the device is identified in the host or configuration system by means of the device ID (DEVICE_ID). The DEVICE_ID is a combination of the manufacturer ID, device type and device serial number. It is unique and can never be assigned twice. The DEVICE_ID of the device is composed as follows:
  DEVICE_ID = 452B4810CE-XXXXXXXXXXX
  452B48 = manufacturer code
  10CE = device type
  XXXXXXXXXXX = device serial number (11-digit)
- For quick and reliable head transmitter configuration, a wide range of configuration wizards are available to guide the user through the configuration of the most important parameters of the Transducer Blocks. Please refer to the Operating Instructions of your operating and configuration software.

The following wizards are available:

Configuration wizards		
Name	Block	Description
Quick Setup	Sensor Transducer	Configuration of the sensor input with sensor-relevant data.
Quick Setup	Display Transducer	Menu-guided configuration of the display unit.
Set to OOS mode	Resource, Sensor Transducer, Display Transducer, AdvDiagnostic Transducer, AI, PID and ISEL	Setup to mode "Out Of Service"
Set to Auto mode	Resource, Sensor Transducer, Display Transducer, AdvDiagnostic Transducer, AI, PID and ISEL	Setup to mode "Auto"
Restart	Resource	Device restart with various options as to which parameters are to be reset to default values.
Sensor Drift Monitoring Configuration	AdvDiagnostic Transducer	Settings for drift or differential monitoring with 2 connected sensors.
Calc.- wizard for 2-wire compensation value	Sensor Transducer	Calculation of the conductor resistance for two-wire compensation.
Calibration wizards		
User Sensor Trim Configuration	Sensor Transducer	Menu guidance for linear scaling (offset + slope) to adapt the measuring point to the process (see section 11).
Factory Trim settings	Sensor Transducer	Reset scaling to the "Factory Standard Trim" (see section 11).
RTD-Platin Configuration Call.-Van Dusen	Sensor Transducer	Entry of Callendar-Van-Dusen coefficients.
RTD-Copper Configuration	Sensor Transducer	Entry of coefficients for polynom copper.
RTD-Nickel Configuration	Sensor Transducer	Entry of coefficients for polynom nickel.

6.3.1 Initial commissioning

The following description takes you step-by-step through commissioning the device and all the necessary configurations for the FOUNDATION Fieldbus™:

1. Open the configuration program.
2. Load the device description files or the CFF file into the host system or the configuration program. Make sure you are using the right system files (see Section 5.4).
3. Note the DEVICE_ID on the device nameplate for identification in the process control system (see Section 2 'Identification').
4. Switch the device on.→ 28
   The first time you establish a connection, the device reacts as follows in the configuration system:

– EH_TMT85-xxxxxxxxxxx (tag name PD-TAG)
– 452B4810CE-xxxxxxxxxxx (DEVICE_ID)
– Block structure:

Display text (xxx... = serial number)	Base index	Description
RS_xxxxxxxxxxx	400	Resource Block
TB_S1_xxxxxxxxxxx	500	Transducer Block temperature sensor 1
TB_S2_xxxxxxxxxxx	600	Transducer Block temperature sensor 2
TB_DISP_xxxxxxxxxxx	700	Transducer Block “Display”
TB_ADVDIAG_xxxxxxxxxxx	800	Transducer Block “Advanced Diagnostic”
AI1_ xxxxxxxxxxx	900	Analog Input function block 1
AI2_ xxxxxxxxxxx	1000	Analog Input function block 2
AI3_ xxxxxxxxxxx	1100	Analog Input function block 3
PID_ xxxxxxxxxxx	1200	PID function block
ISB_xxxxxxxxxxx	1300	Input Selector function block

The device is delivered from the factory with the bus address “247” and is thus in the address range between 232 and 247 reserved for readdressing field devices. A lower bus address should be assigned to the device for commissioning.

5. Using the DEVICE_ID noted, identify the field device and assign the desired tag name (PD_TAG) to the fieldbus device in question.
   Factory setting: EH_TMT85-xxxxxxxxxxx (xxx... = serial number).

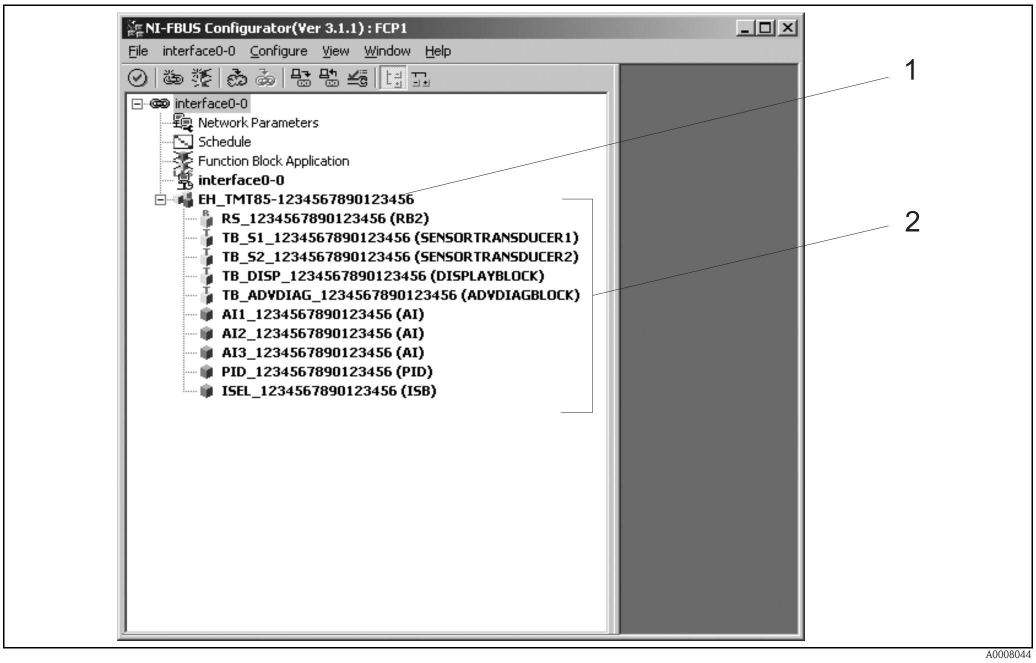


Fig. 14: Screen display in the configuration program “NI-FBUS Configurator” (National Instruments) after the connection has been established

1 Device designation in the Configurator (EH_TMT85_xxxxxxxxxxx = factory setting for tag name PD_TAG)
2 Block structure

Configuring the "Resource Block" (base index 400)

6. Open the Resource Block.
7. When the device is delivered, the hardware write protection is disabled so the write parameters can be accessed via the FF. Check the status via the WRITE_LOCK parameter:
   – Write protection enabled = LOCKED
   – Write protection disabled = NOT LOCKED
   Disable the write protection if necessary, → 🗎 26.
8. Enter the desired name for the block (optional).
   Factory setting: RS_xxxxxxxxxxx
   Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to AUTO.

Configuring the "Transducer Blocks"

The individual Transducer Blocks comprise various parameter groups arranged by device-specific functions:

Temperature sensor 1	→ Transducer Block “TB_S1_xxxxxxxxxxx” (base index: 500)
Temperature sensor 2	→ Transducer Block “TB_S2_xxxxxxxxxxx” (base index: 600)
Onsite display functions	→ Transducer Block “TB_DISP_xxxxxxxxxxx” (base index: 700)
Advanced diagnostics	→ Transducer Block “TB_ADV_DIAG_xxxxxxxxxx” (base index: 800)

9. Enter the desired name for the block (optional). For factory settings, see the table above. Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to AUTO.

Configuring the "Analog Input function blocks"

The device has 2 x three Analog Input function blocks which can be assigned to the different process variables as desired. The following section describes an example for the Analog Input function block 1 (base index 900).

10. Enter the required name for the Analog Input function block (optional).
    Factory setting: AI1_ xxxxxxxxxxx
11. Open Analog Input function block 1.
12. Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to OOS, i.e. the block is out of service.
13. Use the CHANNEL parameter to select the process variable which should be used as the input value for the function block algorithm (scaling and limit value monitoring functions). The following settings are possible:
    CHANNEL → Uninitialized
    Primary Value 1
    Primary Value 2
    Sensor Value 1
    Sensor Value 2
    RJ Value 1
    RJ Value 2
14. In the XD_SCALE parameter group, select the desired engineering unit as well as the block input range for the process variable in question.

NOTICE

Faulty parameterization

►Make sure that the engineering unit selected suits the measured variable of the process variable chosen. Otherwise, the BLOCK_ERROR parameter displays the “Block Configuration Error” error message and the operating mode of the block cannot be set to AUTO.

15. In the L_TYPE parameter, select the type of linearization for the input variable (direct, indirect, indirect sq. root), see Section 11.

NOTICE

Please note that if the “Direct” linearization type is selected, the settings in the OUT_SCALE parameter group are not taken into account. The engineering units selected in the XD_SCALE parameter group are decisive.

16. Use the following parameters to define the limit values for the alarm and warning messages:
    – HI_HI_LIM → Limit value for the upper alarm
    – HI_LIM → Limit value for the upper warning
    – LO_LIM → Limit value for the lower warning
    – LO_LO_LIM → Limit value for the lower alarm
    The limit values entered must be within the value range specified in the OUT_SCALE parameter group.
17. In addition to the actual limit values, the behavior in the event of limit value overshoot must be specified by “alarm priorities” (HI_HI_PRI, HI_PRI, LO_PRI, LO_LO_PRI parameters), see Section 11. Reporting to the fieldbus host system only occurs if the alarm priority is greater than 2.
    In addition to settings for the alarm priorities, digital outputs can also be defined for limit value monitoring. Here, these outputs (HIHI_ALM_OUT_D, HI_ALM_OUT_D, LOLO_ALM_OUT_D, LO_ALM_OUT_D parameters) are set from 0 to 1 when the limit value in question is overshot. The general alarm output (ALM_OUT_D parameter), where various alarms can be grouped together, has to be configured accordingly via the ALM_OUT_D_MODE parameter. The behavior of the output in the event of an error must be configured using the Fail Safe Type parameter (FSAFE_TYPE) and, depending on the option selected (FSAFE_TYPE = "Fail Safe Value"), the value to be output must be specified in the Fail Safe Value parameter (FSAFE_VALUE).

Alarm limit value:	HIHI_ALM_OUT_D	HI_ALM_OUT_D	LOLO_ALM_OUT_D	LO_ALM_OUT_D
PV ≥ HI_HI_LIM	1	x	x	x
PV < HI_HI_LIM	0	x	x	x
PV ≥ HI_LIM	x	1	x	x
PV < HI_LIM	x	0	x	x
PV > LO_LIM	x	x	0	x
PV ≤ LO_LIM	x	x	1	x
PV > LO_LO_LIM	x	x	x	0
PV ≤ LO_LO_LIM	x	x	x	1

System configuration / connecting function blocks (→ 15):

18. A final “overall system configuration” is necessary so that the operating mode of the Analog Input function block can be set to AUTO and the field device is integrated in the system application.
    For this purpose, configuration software, e.g. NI-FBUS Configurator from National Instruments, is used to connect the function blocks to the desired control strategy (mostly using graphic display) and then the time for processing the individual process control functions is specified.

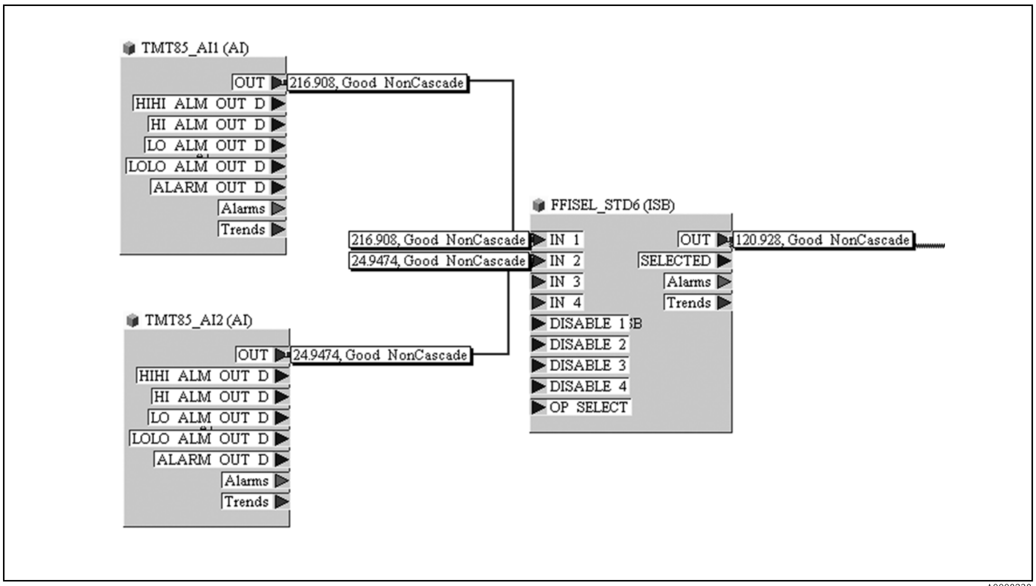


Fig. 15: Connecting function blocks with the aid of the “NI-FBUS Configurator” Example: Averaging (output OUT in the Input Selector Block) of two temperature inputs (OUT in the Analog Input Blocks 1 and 2).

19. Once you have specified the active LAS (→ 24) download all the data and parameters to the field device.
20. Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to AUTO. This is only possible, however, under two conditions:
    – The function blocks are correctly connected to one another.
    – The Resource Block is in the AUTO operating mode.

7 Maintenance

In general, no specific maintenance is required for this device.

8 Accessories

Various accessories, which can be ordered separately from your supplier, are available for the device. When ordering accessories, please specify the serial number of the device!

Type
Display for head transmitters; pluggable
Service cable for remote operation of the display for service work; length 40 cm
Field housing for head transmitter
Adapter for DIN rail mounting, DIN rail clip as per IEC 60715
Standard - DIN mounting set (2 screws + springs, 4 securing disks and 1 display connector cover)
US - M4 securing set (2 screws M4 and 1 display connector cover)
Fieldbus connector (FF): ▪ NPT1/2" → 7/8" ▪ M20 → 7/8"
Stainless steel wall mounting bracket for field housing Stainless steel pipe mounting bracket for field housing

9 Troubleshooting

9.1 Troubleshooting instructions

Always start troubleshooting with the checklists below if faults occur after start up or during operation. This takes you directly (via various queries) to the cause of the problem and the appropriate remedial measures.

NOTICE

The device cannot be repaired due to its design.

► However, it is possible to send the device in for examination. Please refer to → Chap. 9.5 in this situation.

Check display (optional, attachable LC display)	
No display visible	1. Check the supply voltage at the head transmitter → Terminals + and - 2. Check whether the retainers and the connection of the display module are correctly seated on the head transmitter, → 🗎 26 3. If available, test the display module with other suitable head transmitters 4. Display module defective → Replace module 5. Head transmitter defective → Replace transmitter

▼

Onsite error messages on the display
→ Chap. 9.2

▼

Faulty connection to the fieldbus host system	
No connection can be made between the fieldbus host system and the measuring device. Check the following points:	
Fieldbus connection	Check the data cable
Fieldbus connector (optional)	Check pin assignment / wiring, → 🗎 19
Fieldbus voltage	Check that a min. bus voltage of 9 V DC is present at the +/- terminals. Permitted range: 9 to 32 V DC
Network structure	Check permissible fieldbus cable length and number of spurs, → 🗎 15
Basic current	Is there a basic current of min. 11 mA?
Terminating resistors	Has the FOUNDATION Fieldbus H1 been terminated correctly? Each bus segment must always be terminated with a bus terminator at both ends (start and finish). Otherwise there may be interference in data transmission.
Current consumption Permissible feed current	Check the current consumption of the bus segment: The current consumption of the bus segment in question (= total of basic currents of all bus users) must not exceed the max. permissible feed current of the bus power supply unit.
Error messages in the FF configuration system	
→ Chap. 9.2	

▼

Problems when configuring function blocks	
Transducer Blocks: The operating mode cannot be set to AUTO.	Check whether the operating mode of the Resource Block is set to AUTO → MODE_BLK parameter group / TARGET parameter. **NOTICE** **Faulty parameterization** ► Make sure that the unit selected suits the process variable chosen in the SENSOR_TYPE parameter. Otherwise the BLOCK_ERROR parameter displays the “Block Configuration Error” error message. In this state, the operating mode cannot be set to AUTO.

Analog Input function block: The operating mode cannot be set to AUTO.	There can be several reasons for this. Check the following points one after another: 1. Check whether the operating mode of the Analog Input function block is set to AUTO: MODE_BLK parameter group / TARGET parameter. If not and the mode cannot be changed to AUTO, first check the following points. 2. Make sure that the CHANNEL parameter (select process variable) has already been configured in the Analog Input function block (→ 30). The option CHANNEL = 0 (uninitialized) is not valid. 3. Make sure that the XD_SCALE parameter group (input range, unit) has already been configured in the Analog Input function block. 4. Make sure that the L_TYPE parameter (linearization type) has already been configured in the Analog Input function block (→ 30). 5. Check whether the operating mode of the Resource Block is set to AUTO. MODE_BLK parameter group / TARGET parameter. 6. Make sure that the function blocks are correctly connected together and that this system configuration has been sent to the fieldbus users, → 30.
Analog Input function block: Although the operating mode is set to AUTO, the status of the AI output value OUT is "BAD" or "UNCERTAIN".	Check whether an error is pending in the Transducer Block "Advanced Diagnostic": Transducer Block "Adv. Diagnostic", "Actual Status Category" and "Actual Status Number" parameters.→ 37
▪ Parameters cannot be changed or ▪ No write access to parameters.	1. Parameters that only show values or settings cannot be changed! 2. Hardware write protection is enabled → Disable the write protection, → 26. **NOTICE** **Write protection** ►You can check whether the hardware write protection is enabled or disabled via the WRITE_LOCK parameter in the Resource Block: LOCKED = write protection enabled UNLOCKED = write protection disabled. 3. The block operating mode is set to the wrong mode. Certain parameters can only be changed in the OOS (out of service) mode or the MAN (manual) mode → Set the operating mode of the block to the desired mode → MODE_BLK parameter group. 4. The value entered is outside the specified input range for the parameter in question: → Enter a suitable value → Increase input range if necessary.
Transducer Blocks: The manufacturer-specific parameters are not visible.	The device description file (Device Description, DD) has not yet been loaded to the host system or the configuration program? → Download the file to the configuration system. For information on where to obtain the DD, → 25 Make sure you are using the correct system files for integrating field devices into the host system. Relevant version information can be queried by means of the following functions/parameters: FF interface: ▪ Resource Block → DD_REV parameter Example): Display in DEV_REV parameter → 01 Display in the DD_REV parameter → 01 Device description file (DD) required → 0101.sym / 0101.ffo
Analog Input function block: The output value OUT is not updated despite a valid "GOOD" status.	Simulation is active → Deactivate simulation by means of the SIMULATE parameter group.
▼	
Other errors (application errors without messages)	
Some other error has occurred.	Possible causes and remedial measures → Chap. 9.3

9.2 Status messages

The device displays warnings or alarms as status messages. If errors occur during commissioning or measuring operation, these errors are displayed immediately. This takes place in the configuration program by means of the parameter in the Adv. Diagnostic Block or on the mounted display. A distinction is made here between the following 4 status categories:

Status category	Description	Error category
F	Fault detected ('Failure')	ALARM
M	Maintenance necessary	WARNING
C	Device is in the service mode (check)	
S	Specifications not observed ('Out of specification')	

WARNING error category:
With "M", "C" and "S" status messages, the device tries to continue measuring (uncertain measurement!). If a display unit is attached, the display alternates between the main measured value and the status in the form of the letter in question plus the defined error number.

ALARM error category:
The device does not continue measuring when the status message is "F". If a display unit is attached, the display alternates between the status message and "- - - -" (no valid measured value available). Depending on the setting of the Fail Safe Type parameter (FSAFE_TYPE), the last good measured value, the incorrect measured value or the value configured under Fail Safe Value (FSAFE_VALUE) is transmitted via the fieldbus with the status "BAD" for the measured value. The fault state is displayed in the form of the letter "F" plus a defined number.

In both instances, the system outputs the sensor that generates the status, e.g. "C1", "C2". If no sensor name is displayed, the status message does not refer to a sensor but refers to the device itself.

Abbreviations of the output variables:
- SV1 = Sensor value 1
- SV2 = Sensor value 2
- PV1 = Primary value 1
- PV2 = Primary value 2
- RJ1 = Reference junction 1
- RJ2 = Reference junction 2

Category	No.	Status messages – ACTUAL_STATUS_NUMBER in the 'Advanced Diagnostics' Transducer Block – Local display	Error messages in the Sensor Transducer Block in question	Sensor Transducer Block measured value status	Cause of error / remedy	Output variables affected
F-	041	Device status message (FF): Sensor break F-041 Local display: F-041	BLOCK_ERR = Other | Input Failure | Device needs maintenance now	QUALITY = BAD	Cause of error: 1. Electr. interruption of sensor or sensor wiring 2. Incorrect setting for type of connection in the SENSOR_ CONNECTION parameter Remedy: Re 1.) Reestablish electr. connection or replace sensor. Re 2.) Configure correct type of connection.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_error = Mechanical failure	SUBSTATUS = Sensor failure		

Categ ory	No.	Status messages – ACTUAL_STATUS_NUMBER in the 'Advanced Diagnostics' Transducer Block – Local display	Error messages in the Sensor Transducer Block in question	Sensor Transducer Block measured value status	Cause of error / remedy	Output variables affected
F-	042	Device status message (FF): Sensor corrosion F-042 Local display: F-042	BLOCK_ERR = Other | Input Failure | Device needs maintenance now	QUALITY = BAD	Cause of error: Corrosion detected on the sensor terminals. Remedy: Check wiring and replace if necessary.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_error = Mechanical failure	SUBSTATUS = Sensor failure		
M-	042	Device status message (FF): Sensor corrosion M-042 Local display: M-042 ↔ Measured value	BLOCK_ERR = Device needs maintenance now	QUALITY = UNCERTAIN	Cause of error: Corrosion detected on the sensor terminals. Remedy: Check wiring and replace if necessary.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_Error = No error	SUBSTATUS = Sensor conversion not accurate		
F-	043	Device status message (FF): Sensor shortcut F-043 Local display: F-043	BLOCK_ERR = Other | Input Failure | Device needs maintenance now	QUALITY = BAD	Cause of error: Short circuit detected at the sensor terminals. Remedy: Check sensor and sensor wiring.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_error = Mechanical failure	SUBSTATUS = Sensor failure		
F-	101	Device status message (FF): Under-usage of sensor range F-101 Local display: F-101	BLOCK_ERR = Other | Input Failure | Device needs maintenance now	QUALITY = BAD	Cause of error: Physical measuring range undershot. Remedy: Select suitable sensor type.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_Error = General error	SUBSTATUS = Sensor failure		
M-	101	Device status message (FF): Under-usage of sensor range M-101 Local display: M-101 ↔ Measured value	BLOCK_ERR = Device needs maintenance now	QUALITY = UNCERTAIN	Cause of error: Physical measuring range undershot. Remedy: Select suitable sensor type.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_Error = No error	SUBSTATUS = Sensor conversion not accurate		
F-	102	Device status message (FF): Exceedence of sensor range F-102 Local display: F-102	BLOCK_ERR = Other | Input Failure | Device needs maintenance now	QUALITY = BAD	Cause of error: Physical measuring range overshot. Remedy: Select suitable sensor type.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_Error = General error	SUBSTATUS = Sensor failure		
M-	102	Device status message (FF): Exceedence of sensor range M-102 Local display: M-102 ↔ Measured value	BLOCK_ERR = Device needs maintenance now	QUALITY = UNCERTAIN	Cause of error: Physical measuring range overshot. Remedy: Select suitable sensor type.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_Error = No error	SUBSTATUS = Sensor conversion not accurate		
F-	103	Device status message (FF): Sensor drift detected F-103 Local display: F-103	BLOCK_ERR = Other | Input Failure | Device needs maintenance now	QUALITY = BAD	Cause of error: Sensor drift has been detected (in accordance with the settings in the Advanced Diagnostics Block). Remedy: Check the sensor, depending on the application.	PV1, PV2 SV1, SV2
			Transducer_Error = General error	SUBSTATUS = Sensor failure		

Category	No.	Status messages – ACTUAL_STATUS_NUMBER in the 'Advanced Diagnostics' Transducer Block – Local display	Error messages in the Sensor Transducer Block in question	Sensor Transducer Block measured value status	Cause of error / remedy	Output variables affected
M-	103	Device status message (FF): Sensor drift detected M-103 Local display: M-103 ↔ Measured value	BLOCK_ERR = Device needs maintenance now Transducer_Error = No error	QUALITY = UNCERTAIN SUBSTATUS = Non-specific	Cause of error: Sensor drift has been detected (in accordance with the settings in the Advanced Diagnostics Block). Remedy: Check the sensor, depending on the application.	PV1, PV2 SV1, SV2
M-	104	Device status message (FF): Backup active M-104 Local display: M-104 ↔ Measured value	BLOCK_ERR = Device needs maintenance now Transducer_Error = No error	QUALITY = GOOD / BAD SUBSTATUS = Non-specific	Cause of error: Backup function activated and an error was detected at one sensor. Remedy: Rectify sensor error.	SV1, SV2 also PV1, PV2 depending on the configuration
F-	221	Device status message (FF): RJ Error F-221 Local display: F-221	BLOCK_ERR = Device needs maintenance now Transducer_Error = General error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Internal reference junction defective. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, RJ1, RJ2
F-	261	Device status message (FF): Electronic board defective F-261 Local display: F-261	BLOCK_ERR = Other | Transducer_Error = Electronic failure	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Error in the electronics. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, RJ1, RJ2
M-	262	Device status message (FF): Display communication failure M-262 Local display: M-262	BLOCK_ERR (Display transducer = Device needs maintenance now) Transducer_Error = Electronic failure	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: No communication possible with the display. Remedy: ■ Check whether the retainers and the connection of the display module are correctly seated on the head transmitter. ■ If available, test the display module with other suitable head transmitters ■ Display module defective → Replace module	SV1, SV2, PV1, PV2, RJ1, RJ2
F-	283	Device status message (FF): Memory error F-283 Local display: F-283	BLOCK_ERR = Other | Lost static data Transducer_Error = Data integrity error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Error in memory. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, RJ1, RJ2
C-	402	Device status message (FF): Startup of device C-402 Local display: C-402 ↔ Measured value	BLOCK_ERR = Power up Transducer_Error = Data integrity error	QUALITY = UNCERTAIN SUBSTATUS = Non-specific	Cause of error: Device starting/initializing. Remedy: Message is only displayed during power-up.	SV1, SV2, PV1, PV2, RJ1, RJ2
F-	431	Device status message (FF): No calibration F-431 Local display: F-431	BLOCK_ERR = Other Transducer_Error = Calibration error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Error in calibration parameters. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, RJ1, RJ2

Category	No.	Status messages – ACTUAL_STATUS_NUMBER in the 'Advanced Diagnostics' Transducer Block – Local display	Error messages in the Sensor Transducer Block in question	Sensor Transducer Block measured value status	Cause of error / remedy	Output variables affected
F-	437	Device status message (FF): Configuration error F-437 Local display: F-437	BLOCK_ERR = Other | Block configuration error Transducer_Error = Configuration error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Incorrect configuration within the Transducer Blocks "Sensor 1 and 2". Remedy: Check the configuration of the sensor types used, units and the settings of PV1 and/or PV2.	SV1, SV2, PV1, PV2, RJ1, RJ2
C-	482	Device status message (FF): Simulation Mode Active C-482 Local display: C-482 ↔ Measured value	BLOCK_ERR = Simulate active Transducer_Error = No error	QUALITY = UNCERTAIN SUBSTATUS = Substitute	Cause of error: Simulation is active. Remedy: -	
C-	501	Device status message (FF): Device preset C-501 Local display: C-501 ↔ Measured value	BLOCK_ERR = Transducer_Error = No error	QUALITY = UNCERTAIN / GOOD SUBSTATUS = Non-specific/ update event	Cause of error: Device reset is performed. Remedy: Message is only displayed during reset.	SV1, SV2, PV1, PV2, RJ1, RJ2
S-	502	Device status message (FF): Linearization S-502 Local display: S-502 ↔ Measured value	BLOCK_ERR = Other | Device needs maintenance | Block Configuration Error Transducer_Error = Configuration error	QUALITY = BAD SUBSTATUS = Configuration error	Cause of error: Error in linearization. Remedy: Select valid type of linearization (sensor type).	SV1, SV2, PV1, PV2, RJ1, RJ2
S-	901	Device status message (FF): Ambient temperature too low S-901 Local display: S-901 ↔ Measured value	BLOCK_ERR = Transducer_Error = No error	QUALITY = UNCERTAIN SUBSTATUS = Non-specific	Cause of error: Reference junction temperature < -40 °C (-40 °F); **Alarm_Ambient_Temp = OFF** parameter. Remedy: Observe ambient temperature as per specification.	SV1, SV2, PV1, PV2, RJ1, RJ2
F-	901	Device status message (FF): Ambient temperature too low F-901 Local display: F-901	BLOCK_ERR = Device needs maintenance now Transducer_Error = General error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Reference junction temperature < -40 °C (-40 °F); **Alarm_Ambient_ Temp = ON** parameter Remedy: Observe ambient temperature as per specification.	SV1, SV2, PV1, PV2, RJ1, RJ2
S-	902	Device status message (FF): Ambient temperature too high S-902 Local display: S-902 ↔ Measured value	BLOCK_ERR = Transducer_Error = No error	QUALITY = UNCERTAIN SUBSTATUS = Non-specific	Cause of error: Reference junction temperature > +85 °C (+185 °F); **Alarm_Ambient_ Temp = OFF** parameter Remedy: Observe ambient temperature as per specification.	SV1, SV2, PV1, PV2, RJ1, RJ2
F-	902	Device status message (FF): Ambient temperature too high F-902 Local display: F-902	BLOCK_ERR = Device needs maintenance now Transducer_Error = General error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Reference junction temperature > +85 °C (+185 °F); **Alarm_Ambient_Temp = ON** parameter. Remedy: Observe ambient temperature as per specification.	SV1, SV2, PV1, PV2, RJ1, RJ2

9.2.1 Corrosion monitoring

Corrosion monitoring is only possible for RTD with 4-wire connection and thermocouples.

Sensor connection cable corrosion can lead to false measured value readings. Therefore the unit offers the possibility to recognize any corrosion before a measured value is affected.
2 different stages can be selected in the CORROSION_DETECTION parameter (see Section 11) depending on the application requirements:

- Off (no corrosion detection)
- On (warning output just before reaching the alarm set point. This allows for preventative maintenance/troubleshooting to be done.) An alarm message is output as of the alarm set point)

The following table describes how the device behaves when the resistance in a sensor connection cable changes depending on whether the on or off option has been selected.

RTD	**< ≈ 2 kΩ**	**2 kΩ ≈ < x< ≈ 3 kΩ**	**> ≈ 3 kΩ**
off	—	WARNING (M-042)	ALARM (F-042)
on	—	ALARM (F-042)	ALARM (F-042)

TC	**< ≈ 10 kΩ**	**10 kΩ ≈ < x< ≈ 15 kΩ**	**> ≈ 15 kΩ**
off	—	WARNING (M-042)	ALARM (F-042)
on	—	ALARM (F-042)	ALARM (F-042)

The sensor resistance can affect the resistance data in the table. If all the sensor connection cable resistances are increased at the same time, the values given in the table are halved.
The corrosion detection system presumes that this is a slow process with a continuous increase in the resistance.

9.3 Application errors without messages

9.3.1 Application errors for RTD connection

Sensor types → 🗎 44.

Symptoms	Cause	Action/cure
Measured value is incorrect/ inaccurate	Incorrect sensor orientation	Install the sensor correctly
	Heat conducted by sensor	Observe the face-to-face length of the sensor
	Device programming is incorrect (number of wires)	Change SENSOR_CONNECTION device function
	Device programming is incorrect (scaling)	Change scaling
	Incorrect RTD configured	Change SENSOR_TYPE device function
	Sensor connection (two-wire), incorrect connection configuration compared to actual connection	Check the sensor connection/ configuration of the transmitter
	The cable resistance of the sensor (two-wire) was not compensated	Compensate the cable resistance
	Offset incorrectly set	Check offset
	Sensor, sensing head defective	Check sensor, sensing head
	RTD connection incorrect	Connect the connecting cables correctly (→ 🗎 14)
	Programming	Incorrect sensor type set in the SENSOR_TYPE device function; change to the correct sensor type
	Device defective	Replace device

9.3.2 Application errors for TC connection

Sensor types → 🗎 44.

Symptoms	Cause	Action/cure
Measured value is incorrect/ inaccurate	Incorrect sensor orientation	Install the sensor correctly
	Heat conducted by sensor	Observe the face-to-face length of the sensor
	Device programming is incorrect (scaling)	Change scaling
	Incorrect thermocouple type (TC) configured	Change SENSOR_TYPE device function
	Incorrect comparison measurement point set	See Section 11
	Offset incorrectly set	Check offset
	Interference via the thermocouple wire welded in the thermowell (interference voltage coupling)	Use a sensor where the thermocouple wire is not welded
	Sensor incorrectly connected	Connect the connecting cables correctly (observe polarity, → 🗎 14)
	Sensor, sensing head defective	Check sensor, sensing head
	Programming	Incorrect sensor type set in the SENSOR_TYPE device function; set the correct thermocouple (TC)
	Device defective	Replace device

9.4 Spare parts

When ordering spare parts, please specify the serial number of the device!

Type
Adapter for top-hat rail mounting, DIN rail clip
Standard - DIN securing set (2 screws and springs, 4 shaft lock-down rings, 1 plug for the display interface)
US - M4 securing set (2 screws and 1 plug for the display interface)

9.5 Return

For later reuse or to return the device to the service organization of your supplier, the device must be packed in such a way as to protect it from impact and damage. The original packaging material offers the best protection here.
When sending the unit in to be checked, please enclose a note with a description of the error and the application.

9.6 Disposal

The device contains electronic components and must, therefore, be disposed of as electronic waste in the event of disposal. Please pay particular attention to the local regulations governing waste disposal in your country.

9.7 Software history and overview of compatibility

Release
The release number on the nameplate and in the Operating Instructions indicates the device release: XX.YY.ZZ (example 01.02.01).

XX	Change to main version. No longer compatible. The device and Operating Instructions change.
YY	Change to functions and operation. Compatible. Operating Instructions change.
ZZ	Fixes and internal changes. Operating Instructions do not change.

10 Technical Data

10.0.1 Input

Measured variable	Temperature (temperature linear transmission behavior), resistance and voltage.
Measuring range	The transmitter records different measuring ranges depending on the sensor connection and input signals (see 'Type of input').
Type of input	It is possible to connect two sensor inputs which are independent of each other. These are not galvanically isolated from each other.

Type of input	Designation	Measuring range limits
Resistance thermometer (RTD) as per IEC 60751 (α = 0.00385)	Pt100 Pt200 Pt500 Pt1000	-200 to 850 °C (-328 to 1562 °F) -200 to 850 °C (-328 to 1562 °F) -200 to 250 °C (-328 to 482 °F) -200 to 250 °C (-238 to 482 °F)
as per JIS C1604-81 (α = 0.003916)	Pt100	-200 to 649 °C (-328 to 1200 °F)
as per DIN 43760 (α = 0.006180)	Ni100 Ni1000	-60 to 250 °C (-76 to 482 °F) -60 to 150 °C (-76 to 302 °F)
as per Edison Copper Winding No.15 (α = 0.004274)	Cu10	-100 to 260 °C (-148 to 500 °F)
as per Edison Curve (α = 0.006720)	Ni120	-70 to 270 °C (-94 to 518 °F)
as per GOST (α = 0.003911)	Pt50 Pt100	-200 to 1100 °C (-328 to 2012 °F) -200 to 850 °C (-328 to 1562 °F)
as per GOST (α = 0.004280)	Cu50, Cu100	-200 to 200 °C (-328 to 392 °F)
	Pt100 (Callendar-Van Dusen)	10 to 400 Ω 10 to 2000 Ω
	Polynomial nickel	10 to 400 Ω 10 to 2000 Ω
	Polynomial copper	10 to 400 Ω 10 to 2000 Ω
	■ Connection type: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA ■ For 2-wire circuit, compensation for wire resistance possible (0 to 30 Ω) ■ For 3-wire and 4-wire connection, sensor wire resistance up to max. 50 Ω per wire	
Resistance transmitter	Resistance Ω	10 to 400 Ω 10 to 2000 Ω

Type of input	Designation	Measuring range limits
Thermocouples (TC) as per IEC 584, Part 1	Type B (PtRh30-PtRh6) Type E (NiCr-CuNi) Type J (Fe-CuNi) Type K (NiCr-Ni) Type N (NiCrSi-NiSi) Type R (PtRh13-Pt) Type S (PtRh10-Pt) Type T (Cu-CuNi)	40 to +1820 °C (104 to 3308 °F) -270 to +1000 °C (-454 to 1832 °F) -210 to +1200 °C (-346 to 2192 °F) -270 to +1372 °C (-454 to 2501 °F) -270 to +1300 °C (-454 to 2372 °F) -50 to +1768 °C (-58 to 3214 °F) -50 to +1768 °C (-58 to 3214 °F) -260 to +400 °C (-436 to 752 °F)
as per ASTM E988	Type C (W5Re-W26Re) Type D (W3Re-W25Re)	0 to +2315 °C (32 to 4199 °F) 0 to +2315 °C (32 to 4199 °F)
as per DIN 43710	Type L (Fe-CuNi) Type U (Cu-CuNi)	-200 to +900 °C (-328 to 1652 °F) -200 to +600 °C (-328 to 1112 °F)
	■ 2-wire connection ■ Internal cold junction (Pt100, Class B) ■ External cold junction: value adjustable from -40 to +85 °C (-40 to +185 °F) ■ Maximum sensor resistance 10 kΩ (if the sensor resistance is greater than 10 kΩ, an error message is output in accordance with NAMUR NE89)	
Voltage transmitter (mV)	Millivolt transmitter (mV)	-20 to 100 mV

10.0.2 Output

Output signal	■ FOUNDATION Fieldbus™ H1, IEC 61158-2 ■ FDE (Fault Disconnection Electronic) = 0 mA ■ Data transmission rate: supported baud rate = 31.25 kBit/s ■ Signal coding = Manchester II ■ Compliance with ITK 5.0.1 ■ Output data: Available values via AI blocks: temperature (PV), temp sensor 1 + 2, terminal temperature ■ LAS (link active scheduler), LM (link master) function is supported: Thus, the head transmitter can assume the function of a link active scheduler (LAS) if the current link master (LM) is no longer available. The device is supplied as a BASIC device. To use the device as an LAS, this must be defined in the distributed control system and activated by downloading the configuration to the device. ■ In accordance with IEC 60079-27, FISCO/FNICO
Signal on alarm	Status message in accordance with FOUNDATION Fieldbus™ specification.
Linearization/transmission behavior	Temperature linear, resistance linear, voltage linear
Mains voltage filter	50/60 Hz
Galvanic isolation	U = 2 kV AC (sensor input to the output)
Current consumption	≤ 11 mA
Switch-on delay	8 s

10.0.3 Power supply

Supply voltage	U = 9 to 32 V DC, reverse polarity protection (max. voltage U_b = 35 V)

10.0.4 Performance characteristics

Response time	1 s per channel
Reference operating conditions	▪ Calibration temperature: + 25 °C ± 5 K (77 °F ± 9 °F) ▪ Supply voltage: 24 V DC ▪ 4-wire circuit for resistance adjustment
Resolution	Resolution A/D converter = 18 bit

Maximum measured error

The accuracy data are typical values and correspond to a standard deviation of ± 3σ (normal distribution), i.e. 99.8% of all the measured values achieve the given values or better values.

	Designation	**Performance characteristics**
Resistance thermometers (RTD)	Cu100, Pt100, Ni100, Ni120 Pt500 Cu50, Pt50, Pt1000, Ni1000 Cu10, Pt200	0.1 °C (0.18 °F) 0.3 °C (0.54 °F) 0.2 °C (0.36 °F) 1 °C (1.8 °F)
Thermocouples (TC)	Type: K, J, T, E, L, U Type: N, C, D Type: S, B, R	typ. 0.25 °C (0.45 °F) typ. 0.5 °C (0.9 °F) typ. 1.0 °C (1.8 °F)
	Measuring range	**Performance characteristics**
Resistance transmitters (Ω)	10 to 400 Ω 10 to 2000 Ω	± 0.04 Ω ± 0.8 Ω
Voltage transmitters (mV)	-20 to 100 mV	± 10 µV

Sensor transmitter matching

RTD sensors are one of the most linear temperature measuring elements. Nevertheless, the output must be linearized. To improve temperature measurement accuracy significantly, the device enables the use of two methods:

- Callendar-Van Dusen coefficients (Pt100 resistance thermometer)
  The Callendar-Van Dusen equation is described as:

$$R_T = R_0[1+AT+BT^2+C\,(T-100)T^3]$$

  The coefficients A, B and C are used to match the sensor (platinum) and transmitter in order to improve the accuracy of the measuring system. The coefficients for a standard sensor are specified in IEC 751. If no standard sensor is available or if greater accuracy is required, the coefficients for each sensor can be determined specifically by means of sensor calibration.

- Linearization for copper/nickel resistance thermometers (RTD)
  The polynomial equations for nickel are described as:

$$R_T = R_0[1+AT+BT^2+C\,(T-100)T^3]$$

  The equations for copper, subject to temperature, are described as:

$$R_T = R_0(1+AT)$$

  T = -50 °C to 200 °C (-58 °F to 392 °F)

$$R_T = R_0[1+AT+B(T+6.7)+CT^2]$$

T = –180 °C to –50 °C (–292 °F to –58 °F)

These coefficients A, B and C are used for the linearization of nickel or copper resistance thermometers (RTD). The exact values of the coefficients derive from the calibration data and are specific to each sensor.

Sensor transmitter matching using one of the above-named methods significantly improves the temperature measurement accuracy of the entire system. This is due to the fact that to calculate the temperature measured, the transmitter uses the specific data pertaining to the connected sensor instead of using the standardized curve data of a sensor.

Non-repeatability

As per EN 61298-2

Physical input measuring range of sensors		Non-repeatability
10 to 400 Ω	Cu10, Cu50, Cu100, Pt50, Pt100, Ni100, Ni120	15 mΩ
10 to 2000 Ω	Pt200, Pt500, Pt1000, Ni1000	100 ppm x measured value
-20 to 100 mV	Thermocouples type: C, D, E, J, K, L, N, U	4 µV
-5 to 30 mV	Thermocouples type: B, R, S, T	3 µV

Long-term stability

≤ 0.1 °C/year (≤ 0.18 °F/year) in reference operating conditions

Influence of ambient temperature (temperature drift)

Impact on accuracy when ambient temperature changes by 1 K (1.8 °F):	
Input 10 to 400 Ω	0.001% of the measured value, min. 1 mΩ
Input 10 to 2000 Ω	0.001% of the measured value, min. 10 mΩ
Input -20 to 100 mV	0.001% of the measured value, min. 0.2 µV
Input -5 to 30 mV	0.001% of the measured value, min. 0.2 µV

Typical sensitivity of resistance thermometers		
Pt: 0.00385 * R_{nom}/K	Cu: 0.0043 * R_{nom}/K	Ni: 0.00617 * R_{nom}/K

Example Pt100: 0.00385 x 100 Ω/K = 0.385 Ω/K

Typical sensitivity of thermocouples					
B: 10 µV/K	C: 20 µV/K	D: 20 µV/K	E: 75 µV/K	J: 55 µV/K	K: 40 µV/K
L: 55 µV/K	N: 35 µV/K	R: 12 µV/K	S: 12 µV/K	T: 50 µV/K	U: 60 µV/K

Examples of calculating the measured error with ambient temperature drift:

Example 1:

- Input temperature drift ϑ = 10 K (18 °F), Pt100, measuring range 0 to 100 °C (32 to 212 °F)
- Maximum process temperature: 100 °C (212 °F)
- Measured resistance value: 138.5 Ω (DIN EN 60751) at maximum process temperature

Typical temperature drift in Ω: (0.001% of 138.5 Ω) * 10 = 0.01385 Ω
Conversion to Kelvin: 0.01385 Ω / 0.385 Ω/K = 0.04 K (0.054 °F)

Example 2:

- Input temperature drift $\Delta\vartheta$ = 10 K (18 °F), thermocouple type K, measuring range 0 to 600 °C (32 to 1112 °F)
- Maximum process temperature: 600 °C (1112 °F)
- Measured thermocouple voltages: 24905 µV (see IEC 584)

Typical temperature drift in µV: (0,001% of 24905 µV) * 10 = 2.5 µV
Conversion to Kelvin: 2,5 µV / 40 µV/K = 0.06 K (0.11 °F)

Total measurement inaccuracy of the measuring point

The measurement inaccuracy can be calculated according to GUM (Guide to the Expression of Uncertainty in Measurement) as follows:

$$\text{Total measurement inaccuracy} = k\sqrt{\frac{(\text{Basic measured error transmitter})^2}{3} + \frac{(\text{Measured error ambient temperature})^2}{3} + \frac{(\text{Measured error sensor})^2}{3}}$$

Example of calculting the total measurement inaccuracy of a thermometer:
Ambient temperature drift $\Delta\vartheta$ = 10 K (18 °F), Pt100 Class B, measuring range 0 to 100 °C (32 to 212 °F), maximum process temperature: 100 °C (212 °F), k = 2

- Basic measured error: **0.1 K (0.18 °F)**
- Measured error caused by ambient temperature drift: **0.04 K (0.072 °F)**
- Measured error of the sensor: 0.15 K (0.27 °F)+ 0.002 * 100 °C (212 °F) = **0.35 K (0.63 °F)**

$$\text{Total measurement inaccuracy} = 2\sqrt{\frac{(0.1\ \text{K})^2}{3} + \frac{(0.04\ \text{K})^2}{3} + \frac{(0.35\ \text{K})^2}{3}} = 0.42\ \text{K}\ (0.76\ °\text{F})$$

Influence of reference point (cold junction)	Pt100 DIN EN 60751 Cl. B, internal reference point for thermocouples TC

10.0.5 Environment

Ambient temperature	-40 to +85 °C (-40 to +185 °F), for hazardous areas see Ex documentation (XA, CD) and 'Approvals' section.
Storage temperature	-40 to +100 °C (-40 to 212 °F)
Altitude	up to 4000 m (4374.5 yd) above mean sea level in accordance with IEC 61010-1, CSA 1010.1-92
Climate class	as per IEC 60654-1, Class C
Humidity	▪ Condensation as per IEC 60 068-2-33 permitted ▪ Max. rel. humidity: 95% as per IEC 60068-2-30
Degree of protection	IP 00, in the installed state, depends on the terminal head or field housing used.
Shock and vibration resistance	10 to 2000 Hz for 5g as per IEC 60 068-2-6

Electromagnetic compatibility (EMC)

CE EMC compliance
The device meets all of the requirements mentioned in IEC 61326, Amendment 1, 1998 and NAMUR NE21.

This recommendation is a consistent and practical way of determining whether the devices used in laboratories and in process control systems are immune to interference, thus increasing their functional safety.

ESD (electrostatic discharge)	IEC 61000-4-2	6 kV cont., 8 kV air	
Electromagnetic fields	IEC 61000-4-3	0.08 to 4 GHz	10 V/m
Burst (fast transients)	IEC 61000-4-4	1 kV	
Surge	IEC 61000-4-5	1 kV asym.	
Conducted RF	IEC 61000-4-6	0.01 to 80 MHz	10 V

Measuring category

Measuring category II as per IEC 61010-1. The measuring category is provided for measuring on power circuits that are directly connected electrically with the low-voltage network.

Degree of contamination

Degree 2 contamination as per IEC 61010-1. Normally only nonconductive contamination occurs. Temporary conductivity through condensation is possible.

10.0.6 Mechanical construction

Design, dimensions

Specifications in mm (in)

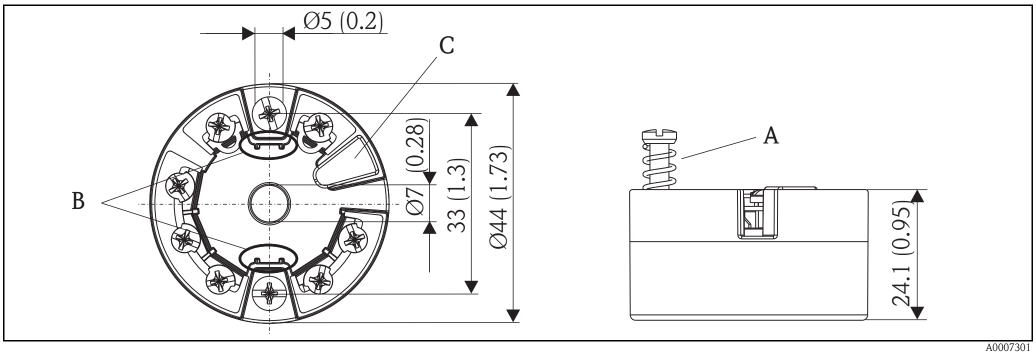


Fig. 16: Model with screw terminals

Pos. A: Spring range L ≥5 mm (not applicable to US - M4 mounting screws)
Pos. B: Fixing elements for detachable measured value display
Pos. C: Interface for contacting measured value display

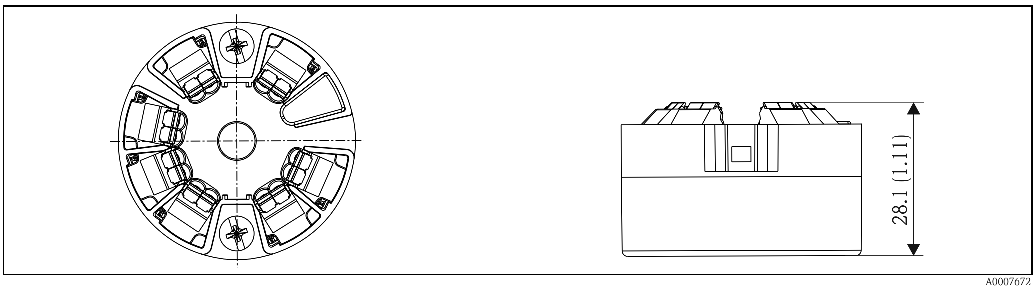


Fig. 17: Model with spring terminals. The same dimensions except for height of housing.

Weight	approx. 40 to 50 g (1.4 to 1.8 oz)
Material	All materials used are RoHS-compliant. ▪ Housing: Polycarbonate (PC), complies with UL94 HB (fire prevention characteristics) ▪ Terminals Screw terminals: Nickel-plated brass and gold-plated contact Spring terminals: Tin-plated brass, contact spring V2A ▪ Potting: PU, complies with UL94 V0 WEVO PU 403 FP / FL (fire prevention characteristics)
Terminals	Choice of screw or spring terminals (see "Design, dimensions" diagram) for sensor and fieldbus wires:

Terminals version	Wire version	Conductor cross-section
Screw terminals (with latches at the fieldbus terminals for easy connection of a handheld terminal, e.g. DXR375)	Rigid or flexible	≤ 2,5 mm^2 (14 AWG)
Spring terminals Stripped length = min. 10 mm (0.39in)	Rigid or flexible	0,2...1,5 mm^2 (24...16 AWG)
	Flexible with wire-end ferrules without plastic ferrule	0,25...1,5 mm^2 (24...16 AWG)
	Flexible with wire-end ferrules with plastic ferrule	0,25...0,75 mm^2 (24...18 AWG)

NOTICE
When connecting flexible cables and spring terminals, it is not recommended to use ferrules.

10.0.7 Certificates and approvals

CE-Mark	The device meets the legal requirements of the EC directives. The manufacturer confirms that the device has been successfully tested by applying the CE mark.
Hazardous area approvals	For further details on the available Ex versions (ATEX, CSA, FM, etc.), please contact your supplier. All relevant data for hazardous areas can be found in separate Ex documentation which can be requested, if required.
Other standards and guidelines	▪ IEC 60529: Degrees of protection through housing (IP code) ▪ IEC 61158-2: Fieldbus standard ▪ IEC 61326: Electromagnetic compatibility (EMC requirements) ▪ IEC 60068-2-27 and IEC 60068-2-6: Shock and vibration resistance ▪ NAMUR Standards working group for measurement and control technology in the chemical industry
UL	Recognized component to UL61010-1
CSA GP	CSA General Purpose Recognized component to CAN/CSA-C22.2 No. 61010-1-04

Certification FOUNDATION Fieldbus™	The temperature transmitter has successfully passed all test procedures and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the specifications following: ▪ Certified according to FOUNDATION Fieldbus™ specification ▪ The device meets all the specifications of the FOUNDATION Fieldbus™ H1 ▪ Interoperability Test Kit (ITK), revision status 5.0.1 (device certification no. available on request): the device can also be operated with certified devices of other manufacturers ▪ Physical layer conformance test of the FOUNDATION Fieldbus™ (FF-830 FS 1.0)

11 Operation via FOUNDATION Fieldbus™

11.1 Block model

In the FOUNDATION Fieldbus™ all the device parameters are categorized according to their functional properties and task and are generally assigned to three different blocks. A block may be regarded as a container in which parameters and the associated functionalities are contained. A FOUNDATION Fieldbus™ device has the following block types:

- A Resource Block (device block):
  The Resource Block contains all the device-specific features of the unit.

- One or more Transducer Blocks:
  The Transducer Blocks contain the measuring and device-specific parameters of the device.

- One or more function blocks: The function blocks contain the device's automation functions. We distinguish between different function blocks, e.g. Analog Input function block, Analog Output function block. Each of these function blocks is used to execute different application functions.

Depending on how the individual function blocks are arranged and connected, various automation tasks can be realized. In addition to these blocks, a field device may have other blocks, e.g. several Analog Input function blocks if more than one process variable is available from the field device.

The device has the following blocks:

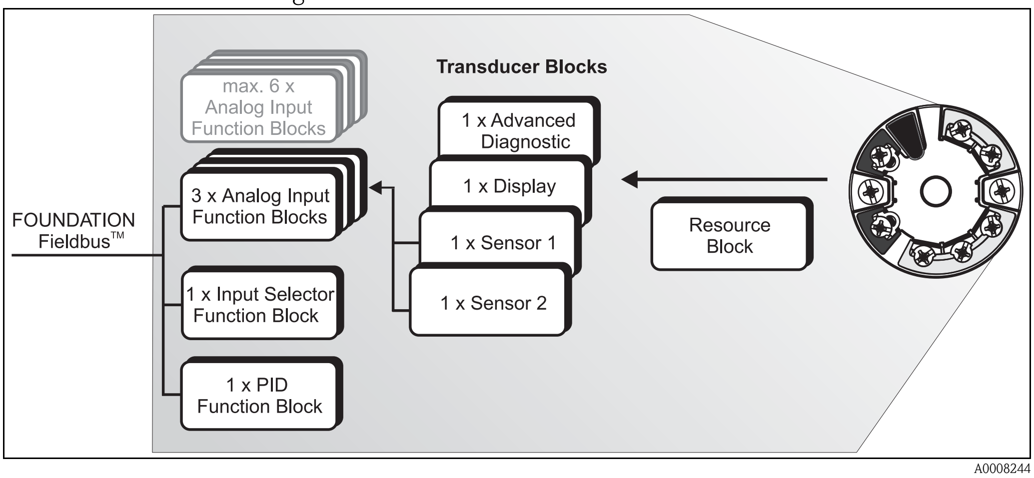


Fig. 1: Block model

11.2 Resource Block (device block)

The Resource Block contains all the data that clearly identify and characterize the field device. It is an electronic version of a nameplate on the field device. In addition to parameters that are needed to operate the device on the fieldbus, the Resource Block makes information such as the order code, device ID, hardware revision, software revision, device release etc. available.

A further task of the Resource Block is the management of overall parameters and functions that have an influence on the execution of the remaining function blocks in the field device. The Resource Block is thus a central unit that also checks the device status and thereby influences or controls the operability of the other function blocks and thus also of the device. As the Resource Block does not have any block input and block output data, it cannot be linked to other blocks.

The most important functions and parameters of the Resource Block are listed below.

11.2.1 Selecting the operating mode

The operating mode is set by means of the MODE_BLK parameter group. The Resource Block supports the following operating modes:

– AUTO (automatic mode)

– OOS (out of service)

The 'Out of Service' (OOS) operating mode is also displayed by means of the BLOCK_ERR parameter. In the OOS operating mode, all write parameters can be accessed without restriction if write protection has not been enabled.

11.2.2 Block status

The current operating status of the Resource Block is displayed in the RS_STATE parameter.

The Resource Block can assume the following states:

– STANDBY	The Resource Block is in the OOS operating mode. It is not possible to execute the remaining function blocks.
– ONLINE LINKING	The configured connections between the function blocks have not yet been established.
– ONLINE	Normal operating status, the Resource Block is in the AUTO operating mode. The configured connections between the function blocks have been established.

11.2.3 Write protection and simulation

DIP switches on the optional display allow device parameter write protection and simulation in the Analog Input function block to be disabled or enabled.

The WRITE_LOCK parameter shows the status of the hardware write protection. The following statuses are possible:

- LOCKED = The device data cannot be altered via the FOUNDATION Fieldbus interface.
- NOT LOCKED = The device data can be altered via the FOUNDATION Fieldbus interface.

The BLOCK_ERR parameter indicates whether a simulation is possible in the Analog Input function block.

- Simulation active = DIP switch for simulation mode active.

11.2.4 Alarm detection and processing

Process alarms provide information on certain block states and events.
The status of the process alarms is communicated to the fieldbus host system by means of the BLOCK_ALM parameter. The ACK_OPTION parameter allows you to specify whether an alarm has to be acknowledged by means of the fieldbus host system. The following process alarms are generated by the Resource Block:

Block process alarms
The following block process alarms of the Resource Block are displayed by means of the BLOCK_ALM parameter:

- OUT OF SERVICE
- SIMULATE ACTIVE

Write protection process alarm
If the write protection is disabled, the alarm priority specified in the WRITE_PRI parameter is checked before the status change is relayed to the fieldbus host system. The alarm priority specifies the behavior in the event of an active write protection alarm WRITE_ALM.

If the option of a process alarm was **not** activated in the ACK_OPTION parameter, this process alarm must only be acknowledged in the BLOCK_ALM parameter.

11.2.5 Resource Block FF parameters

The following table shows all the specified FOUNDATION™ Fieldbus parameters of the Resource Block.

Resource Block			
Parameter Index	**Parameter**	**Write access with operating mode (MODE_BLK)**	**Description**
38	**Acknowledge Option (ACK_OPTION)**	**AUTO - OOS**	This parameter is used to specify whether a process alarm must be acknowledged at the time of alarm recognition by the fieldbus host system. If this option is enabled, the process alarm is acknowledged automatically. **Factory default:** **The option is not enabled for any alarm, the alarms must be acknowledged.**
37	**Alarm Summary (ALARM_SUM)**	**AUTO - OOS**	Displays the current status of the process alarms in the Resource Block. In addition the process alarms can also be disabled in this parameter group.
4	**Alert Key (ALERT_KEY)**	**AUTO - OOS**	Use this function to enter the identification number of the plant unit. This information can be used by the fieldbus host system for sorting alarms and events. User input: 1 to 255 **Factory default:** **0**
36	**Block Alarm (BLOCK_ALM)**	**AUTO - OOS**	The current block status appears on the display with information on pending configuration, hardware or system errors, including information on the alarm period (date, time) when the error occurred. The block alarm is triggered in the event of the following block errors: ▪ SIMULATE ACTIVE ▪ OUT OF SERVICE IIf the option of the alarm has **not** been enabled in the ACK_OPTION parameter, the alarm can only be acknowledged via this parameter.
6	**Block Error (BLOCK_ERR)**	**Read only**	The active block errors appear on the display. Display: SIMULATE ACTIVE Simulation is possible in the Analog Input function block via the SIMULATE parameter (refer also to Hardware Write Protection Configuration in Section 5.5). OUT OF SERVICE The block is in the "Out of Service" mode.
42	**Capability Level (CAPABILITY_) LEVEL**	**Read only**	Indicates the capability level that the device supports.
30	**Clear Fault State (CLR_FSTATE)**	**AUTO - OOS**	This parameter can be used to manually disable the security behavior of the Analog Output and Discrete Output function blocks.
33	**Confirm Time (CONFIRM_TIME)**	**AUTO - OOS**	Specifies the confirmation time for the event report. If the device does not receive confirmation within this time then the event report is sent to the fieldbus host system again. **Factory default:** **640000 $^{1}/_{32}$ ms**
20	**Cycle Selection (CYCLE_SEL)**	**AUTO - OOS**	Displays the block execution method used by the fieldbus host system. The block execution method is selected by the fieldbus host system.

Resource Block			
Parameter Index	**Parameter**	**Write access with operating mode (MODE_BLK)**	**Description**
19	**Cycle Type (CYCLE_TYPE)**	**Read only**	Displays the block execution method supported by the device. Display: SCHEDULED Timed block execution method BLOCK EXECUTION Sequential block execution method MANUF SPECIFIC Manufacturer specified
9	**DD Resource (DD_RESOURCE)**	**Read only**	Displays the reference source for the device description in the device. Display: (NULL)
13	**DD Revision (DD_REV)**	**Read only**	Displays the revision number of the ITK-tested device description.
12	**Device Revision (DEV_REV)**	**Read only**	Displays the revision number of the device.
49	**Device Release (DEVICE_RELEASE)**	**Read only**	Combines the software release and hardware release in one device release.
44	**Device Tag (DEVICE_TAG)**	**Read only**	Tag name/device TAG.
11	**Device type (DEV_TYPE)**	**Read only**	Displays the device identification number in hexadecimal numerical format. Display: 0 x 10CE hex
43	**Electronic Name Plate Version (ENP_VERSION)**	**Read only**	Version of the ENP (electronic name plate).
28	**Fault State (FAULT_STATE)**	**Read only**	Current status display of the security behavior of the Analog Output and Discrete Output function blocks.
17	**Features (FEATURES)**	**Read only**	Displays the additional options supported by the device. Display: REPORTS FAULTSTATE SOFT W LOCK
18	**Feature Selection (FEATURES_SEL)**	**AUTO - OOS**	For selecting the additional functions supported by the device.
47	**Firmware Version (FIRMWARE_VERSION)**	**Read only**	Displays the version of the device software.
25	**Free Time (FREE_TIME)**	**Read only**	Displays the free system time (in percent) available for execution of further function blocks. Since the function blocks of the device are preconfigured, this parameter always displays the value 0.

Resource Block			
Parameter Index	**Parameter**	**Write access with operating mode (MODE_BLK)**	**Description**
24	**Free Space (FREE_SPACE)**	**Read only**	Displays the free system memory (in percent) available for execution of further function blocks. Since the function blocks of the device are preconfigured, this parameter always displays the value 0.
14	**Grant Deny (GRANT_DENY)**	**AUTO - OOS**	Enables or restricts the access authorization of a fieldbus host system to the field device.
15	**Hard Types (HARD_TYPES)**	**Read only**	Displays the input signal type for the Analog Input function block.
48	**Hardware Version (HARDWARE_ VERSION)**	**Read only**	Displays the version of the device hardware.
41	**ITK Version (ITK_VER)**	**Read only**	Displays the version number of the supported ITK test.
32	**Limit Notify (LIM_NOTIFY)**	**AUTO - OOS**	This parameter is used to specify the number of event reports that can exist unconfirmed at the same time. Options: 0 to 3 **Factory default: 0**
10	**Manufacturer ID (MANUFAC_ID)**	**Read only**	Displays the manufacturer's ID number. Display: 0 x 452B48
31	**Max Notify (MAX_NOTIFY)**	**Read only**	Displays the maximum number of event reports supported by the device that can exist unconfirmed at the same time. Display: 3
22	**Memory Size (MEMORY_SIZE)**	**Read only**	Displays the available configuration memory in kilobytes. This parameter is not supported.
21	**Minimum Cycle Time (MIN_CYCLE_T)**	**Read only**	Displays the minimum execution time.
5	**Block Mode (MODE_BLK)**	**AUTO - OOS**	Displays the current (Actual) and desired (Target) operating mode of the Resource Block, the permitted modes (Permitted) supported by the Resource Block and the normal operating mode (Normal). Display: AUTO - OOS The Resource Block supports the following operating modes: ▪ AUTO (automatic operation) In this mode the execution of the remaining blocks (ISEL, AI and PID function block) is permitted. ▪ OOS (out of service): The block is in the “Out of Service” mode. In this mode execution of the remaining blocks (ISEL, AI and PID function block) is blocked. These blocks cannot be set to AUTO mode. The current operating status of the Resource Block is also shown via the RS_STATE parameter.

Resource Block			
Parameter Index	**Parameter**	**Write access with operating mode (MODE_BLK)**	**Description**
50	**MS Resource Directory (MS_RESOURCE_ DIRECTORY)**	**Read only**	Displays the resource directory for the ENP.
23	**Nonvolatile Cycle Time (NV_CYCLE_T)**	**Read only**	Displays the time interval for which the dynamic device parameters are stored in the nonvolatile memory. The time interval displayed relates to storage of the following dynamic device parameters: ■ OUT ■ PV ■ FIELD_VAL Since the device does not store the dynamic device parameters in the nonvolatile memory, this parameter always displays the value 0.
46	**Order Code / Identification (ORDER_CODE)**	**Read only**	Displays the order code for the device.
16	**Restart (RESTART)**	**AUTO - OOS**	This parameter is used to reset the device in various ways. Options: ■ Restart UNINITIALIZED ■ RUN ■ Restart RESOURCE (restart the Resource Block) ■ Restart with DEFAULTS (restart with the specified default values as per FF-Spec. (only FF bus parameters)) ■ Restart PROCESSOR ■ Restart Order Configuration (all the parameters are reset to the original order configuration) ■ Restart PRODUCT DEFAULTS (resets all the device parameters to the default values)
7	**Resource State (RS_STATE)**	**Read only**	Displays the current operating status of the Resource Block. Display: STANDBY The Resource Block is in the OOS operating mode. It is not possible to execute the remaining blocks. ONLINE LINKING The configured connections between the function blocks have not yet been made. ONLINE Normal operating status, the Resource Block is in the AUTO operating mode. The configured connections between the function blocks are established.
45	**Serial Number (SERIAL_NUMBER)**	**Read only**	Displays the device serial number.
29	**Set Fault State (SET_FSTATE)**	**AUTO - OOS**	This parameter can be used to manually enable the security behavior of the device.
26	**Shed Remote Cascade (SHED_RCAS)**	**AUTO - OOS**	Specifies the monitoring time for checking the connection between the fieldbus host system and a function block in the RCAS operating mode. When the monitoring time elapses, the function block changes from the RCAS operating mode to the operating mode selected in the SHED_OPT parameter. **Factory default:** **640000 $^{1}/_{32}$ ms**

Resource Block			
Parameter Index	**Parameter**	**Write access with operating mode (MODE_BLK)**	**Description**
27	**Shed Remote Out (SHED_ROUT)**	**AUTO - OOS**	Specifies the monitoring time for checking the connection between the fieldbus host system and the PID function block in the ROUT operating mode. When the monitoring time elapses, the PID function block changes from the ROUT operating mode to the operating mode selected in the SHED_OPT parameter. A detailed description of the Analog Input (AI) function block can be found in the FOUNDATION Fieldbus™ Function Blocks manual. **Factory default:** **640000 $^{1}/_{32}$ ms**
3	**Strategy (STRATEGY)**	**AUTO - OOS**	Parameter for grouping and thus faster evaluation of blocks. Grouping is carried out by entering the same numerical value in the STRATEGY parameter of each individual block. **Factory default:** **0** This data is neither checked nor processed by the Resource Block.
1	**Static Revision (ST_REV)**	**Read only**	The revision status of the static data appears on the display. The revision status is incremented on each modification of static data.
2	**Tag Description (TAG_DESC)**	**AUTO - OOS**	Entry of a user-specific text for unique identification and assignment of the block.
8	**Test Read Write (TEST_RW)**	**AUTO - OOS**	This parameter is required only for interoperability tests and has no meaning in normal operation.
35	**Update Event (UPDATE_EVT)**	**Read only**	Indicates whether static block data have been altered, including date and time.
40	**Write Alarm (WRITE_ALM)**	**AUTO - OOS**	Displays the status of the write protected alarm. The alarm is triggered if the write protection is disabled.
34	**Write Lock (WRITE_LOCK)**	**Read only**	Able and disable write protection Display: LOCKED Device data cannot be modified NOT LOCKED Device data can be modified UNINITIALIZED
39	**Write Priority (WRITE_PRI)**	**AUTO - OOS**	Specifies the behavior of a write protected alarm ("WRITE_ALM" parameter). User input: 0 = The write protection alarm is not evaluated. 1 = No report to the fieldbus host system in the event of a write protection alarm. 2 = Reserved for block alarms. 3-7 = The write protection alarm is output with the appropriate priority (3 = low priority, 7 = high priority) to the fieldbus host system as a user notice. 8-15 = The write protection alarm is output with the appropriate priority (8 = low priority, 15 = high priority) to the fieldbus host system as a critical alarm. **Factory default:** **0**

11.3 Transducer Blocks

The Transducer Blocks contain all the measuring and device-specific parameters. All the settings directly connected with the application (temperature measurement) are made here. They form the interface between sensor-specific measured value processing and the Analog Input function blocks required for automation.

A Transducer Block allows you to influence the input and output variables of a function block. The parameters of a Transducer Block include information on the sensor configuration, physical units, calibration, damping, error messages, etc. as well as the device-specific parameters.
The device-specific parameters and functions are split into several Transducer Blocks, each covering different task areas (→ fig. 1).

Transducer Block "Sensor 1" / base index 500 or Transducer Block "Sensor 2" / base index 600:
This block contains all the parameters and functions that have to do with measuring the input variables (e.g. temperature).

Transducer Block "Display" / base index 700:
The parameters of this block allow the configuration of the display.

Transducer Block "Advanced Diagnostic" / base index 800:
This block comprises the parameters for automatic monitoring and diagnosis.

11.3.1 Block output variables

The following table shows which output variables (process variables) the Transducer Blocks make available. Transducer Blocks "Display" and "Advanced Diagnostic" do not have any output variables. The CHANNEL parameter in the Analog Input function block is used to assign which process variable is read in and processed in the downstream Analog Input function block.

Block	Process variable	Channel parameter (AI Block)	Channel
Transducer Block “Sensor 1”	Primary Value	Primary Value 1	1
	Sensor Value	Sensor Value 1	3
	RJ Value	RJ Value 1	5
Transducer Block “Sensor 2”	Primary Value	Primary Value 2	2
	Sensor Value	Sensor Value 2	4
	RJ Value	RJ Value 2	6

11.3.2 Selecting the operating mode

The operating mode is set by means of the MODE_BLK parameter group (page 62). The Transducer Block supports the following operating modes:
- AUTO (automatic mode)
- OOS (out of service)

The OOS block status is also displayed by means of the BLOCK_ERR parameter (page 62).

11.3.3 Alarm detection and processing

The Transducer Block does not generate any process alarms. The status of the process variables is evaluated in the downstream Analog Input function blocks. If the Analog Input function block receives no input value that can be evaluated from the Transducer Block then a process alarm is generated. This process alarm is displayed in the BLOCK_ERR parameter of the Analog Input function block (BLOCK_ERR = Input Failure).
The BLOCK_ERR parameter of the Transducer Block (→ page 62) displays the device error that produced the input value that could not be evaluated and thus triggered the process alarm in the Analog Input function block.

11.3.4 Accessing the manufacturer-specific parameters

To access the manufacturer-specific parameters, the hardware write protection must be deactivated (see Section 5.5).

11.3.5 Selecting the units

The system units selected in the Transducer Blocks do not have any effect on the desired units which should be transmitted by means of the FOUNDATION Fieldbus interface. This setting is made separately via the corresponding AI Block in the XD_SCALE parameter group. The unit selected in the Transducer Blocks is only used for the onsite display and for displaying the measured values within the Transducer Block in the configuration program in question. A detailed description of the Analog Input (AI) function block can be found in the FOUNDATION Fieldbus™ Function Blocks manual.

11.3.6 Transducer Block FF parameters

The following table lists all the specified FOUNDATION Fieldbus parameters of the Transducer Blocks. The device-specific parameters are described as of page 68 ff..

Transducer Block (FF parameters)		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Static revision (STAT_REV)	**Read only**	The revision status of the static data appears on the display. The revision status parameter is incremented on each modification of static data. This parameter is reset to 0 in all blocks in the event of a factory reset.
Tag description (TAG_DESC)	**AUTO - OOS**	Use this function to enter a user-specific text of max. 32 characters for unique identification and assignment of the block. **Factory setting:** (_____) no text

Transducer Block (FF parameters)		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Strategy (STRATEGY)	**AUTO - OOS**	Parameter for grouping and thus faster evaluation of blocks. Grouping is carried out by entering the same numerical value in the STRATEGY parameter of each individual block. **Factory setting:** 0 These data are neither checked nor processed by the Transducer Blocks.
Alert key (ALERT_KEY)	**AUTO - OOS**	Use this function to enter the identification number of the plant unit. This information can be used by the fieldbus host system for sorting alarms and events. **User input:** 1 to 255 **Factory setting:** 0
Block Mode (MODE_BLK)	**AUTO - OOS**	Displays the current (Actual) and desired (Target) operating mode of the corresponding Transducer Block, the permitted modes (Permitted) supported by the Resource Block and the normal operating mode (Normal). **Display:** AUTO OOS The Transducer Block supports the following operating modes: ▪ AUTO (automatic mode): The block is executed. ▪ OOS (out of service): The block is in the “Out of Service” mode. The process variable is updated, but the status of the process variable changes to BAD.
Block Error (BLOCK_ERR)	**Read only**	The active block errors appear on the display. **Display:** ▪ OUT OF SERVICE The block is in the "out of service" operating mode. The following block errors are only shown in the Sensor Transducer Blocks: ▪ INPUT FAILURE Error at one or the two sensor inputs ▪ MAINTENANCE NEEDED The device must be checked since an active device error is pending. The detailed cause of the error can be called up in the "Advanced Diagnostic" Transducer Block by means of the "ACTUAL_STATUS_CATEGORY" and "ACTUAL_STATUS_NUMBER" parameters. ▪ LOST STATIC DATA / LOST_NV_DATA The memory is inconsistent. ▪ POWER-UP: Status message during the startup procedure. ▪ SIMULATE ACTIVE: The DIP switch for the simulation is active. ▪ BLOCK CONFIGURATION ERROR: The block was configured incorrectly. ▪ 0x000: No active block error present. An exact error description as well as information on rectifying faults can be found in Section 9.2.

Transducer Block (FF parameters)		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Update Event (UPDATE_EVT)	**AUTO - OOS**	Indicates whether static block data have been altered, including date and time.
Block Alarm (BLOCK_ALM)	**AUTO - OOS**	The current block status appears on the display with information on pending configuration, hardware or system errors, including information on the alarm period (date, time) when the error occurred. ▪ In addition, the active block alarm can be acknowledged in this parameter group. ▪ The device does not use this parameter to display a process alarm since this is generated in the BLOCK_ALM parameter of the Analog Input function block.
Transducer Type (TRANSDUCER_ TYPE)	**Read only**	The Transducer Block type appears on the display. **Display:** ▪ Sensor Transducer Blocks: Custom Sensor Transducer ▪ Display Transducer Block: Custom Display Transducer ▪ Advanced Diagnostic Block: Custom Adv. Diag. Transducer
Transducer Error (XD_ERROR)	**Read only**	The active device error appears on the display. **Possible display:** ▪ No Error (normal status) ▪ Electronics failure ▪ Data Integrity Error ▪ Mechanical failure ▪ Configuration Error ▪ Calibration error General Error ▪ Summarized device status/condition, more precise information on the pending error(s) is available by means of the manufacturer-specific error display. This can be read via the Transducer Block "Advanced Diagnostic" in the "ACTUAL_STATUS_CATEGORY" and "ACTUAL_STATUS_NUMBER" parameters. ▪ An exact error description as well as information on rectifying faults can be found in Section 9.2.

11.3.7 Transducer Blocks "Sensor 1 and 2"

The "Sensor 1 and 2" Transducer Blocks analyze the signals of both sensors from a metrological perspective and display them as a physical variable (value and unit). Two physical measured values and an additional primary value which is mathematically calculated from the sensor values (the PRIMARY_VALUE) are available in each Sensor Transducer Block:

- The sensor value (SENSOR_VALUE) and its unit (SENSOR_RANGE -> UNITS_INDEX)
- The value of the internal temperature measurement of the device (RJ_VALUE) and its unit (RJ_UNIT)
- The primary value (PRIMARY_VALUE -> VALUE) and its unit (PRIMARY_VALUE_UNIT)

The internal temperature measurement of the reference junction is analyzed in both Transducer Blocks but both values are identical. A third value in the Block, the PRIMARY_VALUE, is formed from the sensor values.

The rule for forming the PRIMARY_VALUE can be selected in the PRIMARY_VALUE_TYPE parameter. The sensor value can be mapped unchanged in PRIMARY_VALUE but there is also the option of forming the differential value or mean value for both sensor values. In addition, various additional functions for connecting the two sensors are also available. These can help increase process safety, like the backup function or sensor drift detection.
- Backup function:
  If a sensor fails, the system automatically switches to the remaining sensor and a warning message is sent to the distributed control system. The backup function ensures that the process is not interrupted by the failure of an individual sensor and that an extremely high degree of safety and availability is achieved.
- Sensor drift detection:
  If 2 sensors are connected and the measured values differ by a specified value, a warning/alarm is sent to the distributed control system. The drift detection function can be used to verify the correctness of the measured values and for mutual monitoring of the connected sensors. Sensor drift detection is configured in the Transducer Block "Advanced Diagnostic", → chap. 11.3.8.

The electronics can be configured for various sensors and measured variables by means of the SENSOR_TYPE parameter.

If resistance thermometers or resistance transmitters are connected, the type of connection can be selected by means of the SENSOR_CONNECTION parameter. If the "two-wire" type of connection is used, the TWO_WIRE_COMPENSATION parameter is available. This parameter is used to store the resistance value of the sensor connection cables.

The resistance value can be calculated as follows:
- Total cable length: 100 m
- Conductor cross-section: 0.5 mm²
- Conductor material: copper
- Resistivity of Cu: 0.0178 mm²/m

R = 0.0178 mm²/m * (2 * 100 m)/0.5 mm² = 7.12 Ohm

Resulting measured error = 7.12 Ohm / 0.385 Ohm/K = **18.5 K**

The Transducer Blocks for sensor 1 and 2 have a Wizard (configuration assistant) for calculating the resistance of sensor cables with different material properties, cross-sections and lengths.

When measuring temperature with thermocouples, the type of reference junction compensation is specified in the RJ_TYPE parameter. For the compensation, the internal terminal temperature measurement of the device (INTERNAL) can be used or a fixed value can be specified (EXTERNAL). This value has to be entered in the RJ_EXTERNAL_VALUE parameter.

The units displayed are selected with the PRIMARY_VALUE_UNIT and SENSOR_RANGE → UNITS_INDEX parameters. It must be ensured that the units selected physically suit the measured variables.

The Sensor 1 and 2 Transducer Blocks each make the "Quick Setup" Wizard available to configure the measuring settings quickly and safely.

Sensor error adjustment can be performed with the sensor offset. Here, the difference between the reference temperature (target value) and the measured temperature (actual value) is determined and entered in the SENSOR_OFFSET parameter. This offsets the standard sensor characteristic in parallel and an adjustment between the target value and actual value is performed.

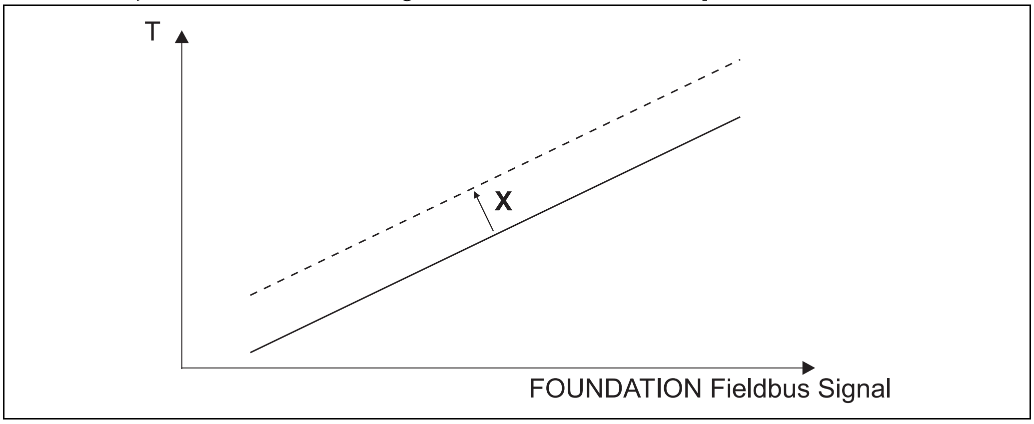


Fig. 2: Sensor offset

- *X = Offset*
- *———— = standard sensor characteristic*
- *- - - - - - - - = sensor characteristic with offset setting*

The Sensor 1 and 2 Transducer Blocks also give users the option of linearizing any sensor type by entering polynom coefficients. The design provides for three types:

- **Linear scaling of temperature-linear curve:**

With the aid of linear scaling (offset and slope), the complete measuring point (measuring device + sensor) can be adapted to the desired process. Users must run through the following procedure for this purpose:

1. Switch the setting for the SENSOR_CAL_METHOD parameter to "**user trim standard calibration**". Then apply the lowest process value to be expected (e.g. -10 °C) to the sensor of the device. This value is then entered in the CAL_POINT_LO parameter. Make sure that the status for SENSOR_VALUE is "Good".
2. Now expose the sensor to the highest process value to be expected (e.g. 120 °C), again ensure the status is "Good" and enter the value in the CAL_POINT_HI parameter. The device now precisely shows the specified process value at the two calibrated points. The curve follows a straight line between the points.
3. The SENSOR_CAL_LOC, SENSOR_CAL_DATE and SENSOR_CAL_WHO parameters are available to track sensor calibration. The place, date and time of calibration can be entered here as well as the name of the person responsible for the calibration.
4. To undo sensor input calibration, the SENSOR_CAL_METHOD parameter is set to "**Factory Trim Standard Calibration**".

Menu guidance via the "User Sensor Trim" Wizard is available for linear scaling. The "Factory Trim Settings" Wizard can be used to reset the scaling.

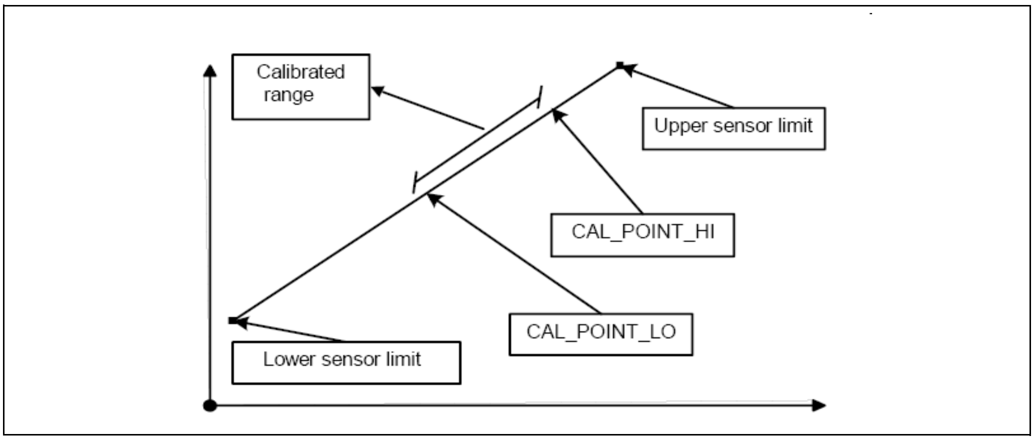


Fig. 3: Linear scaling of temperature-linear curve.

- **Linearization of platinum resistance thermometers with the aid of Callendar Van Dusen coefficients:**

The coefficients R0, A, B, C can be specified in the CVD_COEFF_R0, CVD_COEFF_A, CVD_COEFF__B, CVD_COEFF_C parameters. To activate this linearization, select the "RTD Callendar Van Dusen" setting in the SENSOR_TYPE parameter. In addition, the upper and lower calculation limits have to be entered in the CVD_COEFF_MIN and CVD_COEFF_MAX parameters.

The Callendar Van Dusen coefficients can also be entered by means of the "Callendar Van Dusen" wizard.

- **Linearization of copper/nickel resistance thermometers (RTD):**

The coefficients R0, A, B, C can be specified in the POLY_COEFF_R0, POLY_COEFF_A, POLY_COEFF_B, POLY_COEFF_C parameters. To activate this linearization, select the "RTD Polynom Nickel" or "RTD Polynom Copper" setting in the SENSOR_TYPE parameter. In addition, the upper and lower calculation limits have to be entered in the POLY_COEFF_MIN and POLY_COEFF_MAX parameters.

The coefficients for nickel and copper polynoms can be entered with the aid of a wizard in the Transducer Blocks Sensor 1 and 2.

Each of the values can be passed onto an AI function block or shown on the display. The AI and the Display Block make further options available for displaying and scaling measured values.

The following table shows all the device-specific parameters of the Sensor Transducer Blocks:

Transducer Block "Sensor 1 and 2"		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Primary value (PRIMARY_VALUE)	**AUTO - OOS**	Result of link PRIMARY_VALUE_TYPE: ▪ VALUE ▪ STATUS The PRIMARY_VALUE can be made available to the AI Block for further processing. The assigned unit is the PRIMARY_VALUE_UNIT.
Primary value unit (PRIMARY_VALUE_UNIT)	**AUTO - OOS**	Configuring the unit of the PRIMARY_VALUE The measurement range and engineering units are configured with an existing link in the relevant Analog Input function block using the XD_SCALE parameter group. A detailed description of the Analog Input (AI) function block can be found in the FOUNDATION Fieldbus™ Function Blocks manual.
Primary value type (PRIMARY_VALUE_TYPE)	**AUTO - OOS**	The calculation process for the PRIMARY_VALUE appears on the display. Display: Sensor Transducer 1: ▪ PV = SV_1: Secondary Value 1 ▪ PV = SV_1-SV_2: Difference ▪ PV = 0.5 x (SV_1+SV_2): Average ▪ PV = 0.5 x (SV_1+SV_2) redundancy: Average or Secondary Value 1 or Secondary Value 2 in the event of a sensor error in the other sensor. ▪ PV = SV_1 (OR SV_2): Backup function: If sensor 1 fails, the value of sensor 2 automatically becomes the Primary Value. ▪ PV = SV_1 (OR SV_2 if SV_1>T): PV changes from SV_1 to SV_2 if SV_1 > value T (THRESHOLD_VALUE parameter) Sensor Transducer 2: ▪ PV = SV_2: Secondary Value 2 ▪ PV = SV_2-SV_1: Difference ▪ PV = 0.5 x (SV_2+SV_1): Average ▪ PV = 0.5 x (SV_2+SV_1) redundancy: Average or Secondary Value 1 or Secondary Value 2 in the event of a sensor error in the other sensor. ▪ PV = SV_2 (OR SV_1): Backup function: If sensor 2 fails, the value of sensor 1 automatically becomes the Primary Value. ▪ PV = SV_2 (OR SV_1 if SV_2>T): PV changes from SV_2 to SV_1 if SV_2 > value T (THRESHOLD_VALUE parameter)
Threshold value (THRESHOLD_VALUE)	**AUTO - OOS**	Value for switching in the threshold PV mode. Entry in the range from -270°C to 2450°C (-454°F to 4442°F)
Primary value max. indicator (PV_MAX_INDICATOR)	**AUTO - OOS**	Max. indicator for PV is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.
Primary value min. indicator (PV_MIN_INDICATOR)	**AUTO - OOS**	Min. indicator for PV is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.

Transducer Block “Sensor 1 and 2”		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Sensor value (SENSOR_VALUE)	**Dynamic / read only**	Sensor Transducer 1: ▪ VALUE = Value of the sensor connected to the S1 terminal group ▪ STATUS = Status of this value Sensor Transducer 2: ▪ VALUE = Value of the sensor connected to the S2 terminal group ▪ STATUS = Status of this value
Sensor type (SENSOR_TYPE)	**AUTO - OOS**	Configuration of the sensor type. Sensor Transducer 1: Settings for sensor input 1 Sensor Transducer 2: Settings for sensor input 2 Please observe the wiring diagram in Section 4.1 when connecting the individual sensors. In the case of 2-channel operation, the possible connection options in Section 4.2 also have to be observed.
Sensor connection (SENSOR_CONNECTION)	**AUTO - OOS**	Sensor connection mode: Sensor Transducer 1: ▪ 2-wire ▪ 3-wire ▪ 4-wire Sensor Transducer 2: ▪ 2-wire ▪ 3-wire
Sensor range (SENSOR_RANGE)	**Read only (EU_100, EU_0)** **AUTO - OOS (UNITS_INDEX, DECIMAL)**	Physical measuring range of the sensor: EU_100 (upper sensor range limit) EU_0 (lower sensor range limit) UNITS_INDEX (unit of the SENSOR_VALUE) DECIMAL (places after the decimal point for the SENSOR_VALUE. This does not affect the measured value display.)
Sensor offset (SENSOR_OFFSET)	**AUTO - OOS**	Offset of the SENSOR_VALUE The following values are permitted: ▪ -10 to +10 for Celsius, Kelvin, mV and Ohm ▪ -18 to +18 for Fahrenheit, Rankine
2-wire compensation (TWO_WIRE_COMPENSATION)	**AUTO - OOS**	Two-wire compensation The following values are permitted: 0 to 30 Ohm
Sensor serial number (SENSOR_SN)	**AUTO - OOS**	Serial number of the sensor
Sensor max. indicator (SENSOR_MAX_INDICATOR)	**AUTO - OOS**	Max. indicator of the SENSOR_VALUE Is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.
Sensor min. indicator SENSOR_MIN_INDICATOR	**AUTO - OOS**	Min. indicator of the SENSOR_VALUE Is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.
Mains filter (MAINS_FILTER)	**AUTO - OOS**	Mains filter for the A/D converter

Transducer Block "Sensor 1 and 2"		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Calibration highest point (CAL_POINT_HI)	**AUTO - OOS**	Upper point for linear characteristic calibration (this affects offset and slope). To write to this parameter, SENSOR_CAL_METHOD must be set to "User Trim Standard Calibration".
Calibration lowest point (CAL_POINT_LO)	**AUTO - OOS**	Lower point for linear characteristic calibration (this affects offset and slope). To write to this parameter, SENSOR_CAL_METHOD must be set to "User Trim Standard Calibration".
Calibration minimum span (CAL_MIN_SPAN)	**AUTO - OOS**	Span of the measuring range, depending on the sensor type set.
Calibration unit (CAL_UNIT)	**Read only**	Unit for sensor calibration.
Sensor calibration method (SENSOR_CAL_ METHOD)	**AUTO - OOS**	■ Factory trim standard calibration: Sensor linearization with the factory calibration values ■ User trim standard calibration: Sensor linearization with the values CAL_POINT_HI and CAL_POINT_LO The original linearization can be established by resetting this parameter to "Factory Trim Standard Calibration". For linear characteristic calibration, the Transducer Block makes a wizard available (User Sensor Trim).
Sensor calibration location (SENSOR_CAL_ LOC)	**AUTO - OOS**	Name of the location where the sensor calibration was carried out.
Sensor calibration date (SENSOR_CAL_ DATE)	**AUTO - OOS**	Date and time of the calibration.
Sensor calibration who (SENSOR_CAL_ WHO)	**AUTO - OOS**	Name of the person responsible for the calibration.
Callendar Van Dusen A (CVD_COEFF_A)	**AUTO - OOS**	Sensor linearization based on the Callendar Van Dusen method. The CVD_COEFF_XX parameters are used for calculating the response curve if "RTD Callendar Van Dusen" is set in the SENSOR_TYPE parameter. Both Transducer Blocks make a wizard available for configuring the parameters based on the "Callendar Van Dusen method".
Callendar Van Dusen B (CVD_COEFF_B)	**AUTO - OOS**	
Callendar Van Dusen C (CVD_COEFF_C)	**AUTO - OOS**	
Callendar Van Dusen R0 (CVD_COEFF_R0)	**AUTO - OOS**	
Callendar Van Dusen Measuring Range Maximum (CVD_COEFF_MAX)	**AUTO - OOS**	Upper calculation limit for Callendar Van Dusen linearization.

Transducer Block "Sensor 1 and 2"

Parameter	Write access with operating mode (MODE_BLK)	Description
Callendar Van Dusen Measuring Range Minimum (CVD_COEFF_MIN)	**AUTO - OOS**	Lower calculation limit for Callendar Van Dusen linearization.
Polynom Coeff. A (POLY_COEFF_A)	**AUTO - OOS**	Sensor linearization of copper/nickel resistance thermometers (RTD). The POLY_COEFF_XX parameters are used for calculating the response curve if "RTD Polynom Nickel or RTD Polynom Copper" is set in the SENSOR_TYPE parameter. Both Transducer Blocks make a wizard (sensor polynom) available for configuring the parameters based on the "Polynom method".
Polynom Coeff. B (POLY_COEFF_B)	**AUTO - OOS**	
Polynom Coeff. C (POLY_COEFF_C)	**AUTO - OOS**	
Polynom Coeff. R0 (POLY_COEFF_R0)	**AUTO - OOS**	
Polynom (Nickel/ Copper) Measuring Range Maximum (POLY_COEFF_MAX)	**AUTO - OOS**	Upper calculation limit for the RTD polynom (nickel/copper) linearization.
Polynom (Nickel/ Copper) Measuring Range Minimum (POLY_COEFF_MIN)	**AUTO - OOS**	Lower calculation limit for the RTD polynom (nickel/copper) linearization.
Reference junction (RJ_VALUE)	**AUTO - OOS**	Internal reference temperature measurement: ▪ VALUE ▪ STATUS
Reference junction type (RJ_TYPE)	**AUTO - OOS**	Configuration of reference junction measurement for temperature compensation: ▪ NO_REFERENCE: No temperature compensation is used. ▪ INTERNAL: Internal reference junction temperature is used for the temperature compensation. ▪ EXTERNAL: RJ_EXTERNAL_VALUE is used for the temperature compensation.
Reference junction value unit (RJ_UNIT)	**Read only**	Unit of the internal reference temperature. This always corresponds to the unit set in SENSOR_RANGE —> UNITS_INDEX.
Reference junction external value (RJ_EXTERNAL_VALUE)	**AUTO - OOS**	Value for temperature compensation (see RJ_TYPE parameter).
Reference junction max. indicator (RJ_MAX_INDICATOR)	**Read only**	Max. indicator of the internal reference temperature is stored in the nonvolatile memory in intervals of 10 minutes.
Reference junction min. indicator (RJ_MIN_INDICATOR)	**Read only**	Min. indicator of the internal reference temperature is stored in the nonvolatile memory in intervals of 10 minutes.

11.3.8 Transducer Block "Advanced Diagnostic"

The Transducer Block "Advanced Diagnostic" is used to configure all the diagnostic functions of the transmitter.

Functions such as
– Corrosion detection
– Drift detection
– Ambient temperature monitoring
can be configured here.

Corrosion monitoring
Sensor connection cable corrosion can lead to false measured value readings. Therefore the unit offers the possibility to recognize any corrosion before a measured value is affected. Corrosion monitoring is only possible for RTDs with a 4-wire connection and thermocouples (see also Section 9.2.1).

Drift detection
Drift detection can be configured with the SENSOR_DRIFT_MONITORING parameter. Drift detection can be enabled or disabled.
If drift detection is enabled and a drift occurs, an error or maintenance prompt is output. A distinction is made between 2 different modes (SENSOR_DRIFT_MODE). In the 'Overshooting' mode, a status message is output if the limit value (SENSOR_DRIFT_ALERT_VALUE) for the drift is overshot, or, as the case may be, if the limit value is undershot in the 'Undershooting' mode.

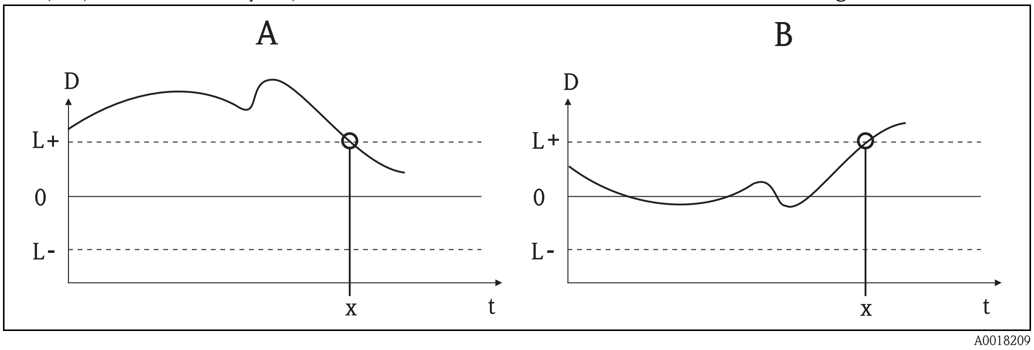


Fig. 4: Drift detection

- *A = 'Undershooting' mode*
- *B = 'Overshooting' mode*
- *D = Drift*
- *L+, L- = Upper (+) or lower (-) limit value*
- *t = Time*
- *x = Error or prompt for maintenance, depending on the configuration*

In addition, the entire status information of the device and the maximum indicators of the two sensor values and the internal temperature are available.

Transducer Block "ADVANCED DIAGNOSTIC"

Parameter	Write access with operating mode (MODE_BLK)	Description
Corrosion detection (CORROSION_ DETECTION)	**AUTO - OOS**	■ OFF: Corrosion detection off ■ ON: Corrosion detection on Only possible for RTD 4-wire connection and thermocouples (TC).
Sensor drift monitoring (SENSOR_DRIFT _MONITORING)	**AUTO - OOS**	Deviation between SV1 and SV2 as error (Failure) or as need for maintenance (Maintenance): ■ OFF: Sensor deviation monitoring off ■ FAILURE: (sensor deviation > SENSOR_DRIFT_LIMIT) => Failure ■ MAINTENANCE: (sensor deviation > SENSOR_DRIFT_LIMIT) => Maintenance
Sensor drift mode (SENSOR_DRIFT _MODE)	**AUTO - OOS**	Select whether a status is generated if the value set in the SENSOR_DRIFT_LIMIT parameter is undershot (Undershooting) or overshot (Overshooting). If "Overshooting" is selected, the corresponding status is generated if the limit value is overshot (SENSOR_DRIFT_LIMIT). In the case of "Undershooting", the status is output if the limit value is undershot.
Sensor Drift alert value (SENSOR_DRIFT _ALERT_VALUE)	**AUTO - OOS**	Limit value of the permitted deviation from 1 to 999.99.
System alarm delay (SYSTEM_ ALARM_DELAY)	**AUTO - OOS**	Alarm hysteresis: Value as to the time a device status (Failure or Maintenance) and measured value status (Bad or Uncertain) is delayed until the status is output. Can be configured between 0 and 10 seconds This setting does not affect the display.
Ambient temp. alarm (AMBIENT_ ALARM)	**AUTO - OOS**	Maintenance or Failure in the event of the operating temperature of the transmitter being undershot or overshot (< -40 °C (-40 °F) or > +85 °C (185 °F)): ■ Maintenance: Int. temperature overshoot/undershoot results in message. ■ Failure: Int. temperature overshoot/undershoot results in 'Failure' device status.
Actual status category / Previous status category (ACTUAL_ STATUS_ CATE GORY / PREVIOUS_ STATUS_ CATEGORY)	**Read only / AUTO - OOS**	Current/last status category ■ Good: No errors detected ■ F: Failure: Error detected ■ M: Maintenance: Maintenance necessary ■ C: Service mode: Device is in the service mode ■ S: Out of Spec.: Device is being operated outside the specifications

Transducer Block “ADVANCED DIAGNOSTIC”		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Actual status number / previous status number (ACTUAL_ STATUS_ NUMBER / PREVIOUS_ STATUS_ NUMBER)	**Read only / AUTO - OOS**	Current/past status number: **000 NO_ERROR:** No error is present **041 SENSOR_BREAK:** Sensor rupture **043 SENSOR_SHORTCUT:** Sensor short circuit **042 SENSOR_CORROSION:** Corrosion of connections or sensor cables **101 SENSOR_UNDERUSAGE:** Measured value of the sensor is below the linearization range **102 SENSOR_OVERUSAGE:** Measured value of the sensor is above the linearization range **104 BACKUP_ACTIVATED:** Backup function activated due to sensor failure **103 DEVIATION:** Sensor drift detected **501 DEVICE_PRESET:** Reset routine in progress **411 UP-/DOWNLOAD:** Uploading/downloading **482 SIMULATION:** Device is in the simulation mode **402 STARTUP:** Device is in the startup/initialization phase **502 LINEARIZATION:** Linearization incorrectly selected or configured **901 AMBIENT_TEMPERATURE_LOW:** Ambient temperature too low; RJ_Value < -40 °C (-40 °F) **902 AMBIENT_TEMPERATURE_HIGH:** Ambient temperature too high; RJ_Value > 85 °C (185 °F) **261 ELECTRONICBOARD:** Electronics module/hardware faulty **262 DISPLAY_COMMUNICATION_FAILURE:** No communication possible between the display and transmitter **431 NO_CALIBRATION:** Calibration values lost/modified **283 MEMORY_ERROR:** Contents of memory inconsistent **221 RJ_ERROR:** Error in reference junction measurement/internal temperature measurement
Actual status channel/previous status channel (PREVIOUS/ ACTUAL_ STATUS_ CHANNEL)	**Read only / AUTO - OOS**	ACTUAL_STATUS_CHANNEL displays the channel that currently has the error with the highest value. PREVIOUS_STATUS_CHANNEL indicates the channel where an error last occurred.
Actual Status Description / Previous Status Description (PREVIOUS/ ACTUAL_ STATUS_DESC)	**Read only / AUTO - OOS**	Displays the descriptions of the current and previous error status. The descriptions can be taken from the description for the Actual Status Number/ Previous Status Number parameter.
Actual status count (ACTUAL_ STATUS_ COUNT)	**Read only / AUTO - OOS**	The number of status messages currently pending in the device.
Primary Value 1 Max. Indicator PV1_MAX_ INDICATOR	**AUTO - OOS**	Maximum indicator for the maximum value to occur for PV1, can be reset
Primary Value 1 Min. Indicator PV1_MIN_ INDICATOR	**AUTO - OOS**	Maximum indicator for the minimum value to occur for PV1, can be reset

Transducer Block "ADVANCED DIAGNOSTIC"		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Primary Value 2 Max. Indicator PV2_MAX_ INDICATOR	**AUTO - OOS**	Maximum indicator for the maximum value to occur for PV2, can be reset
Primary Value 2 Min. Indicator PV2_MIN_ INDICATOR	**AUTO - OOS**	Maximum indicator for the minimum value to occur for PV2, can be reset
Sensor 1 Max. Indicator SV1_MAX_ INDICATOR	**AUTO - OOS**	Maximum indicator for the maximum value to occur at sensor 1, can be reset
Sensor 1 Min. Indicator SV1_MIN_ INDICATOR	**AUTO - OOS**	Maximum indicator for the minimum value to occur at sensor 1, can be reset
Sensor 2 Max. Indicator SV2_MAX_ INDICATOR	**AUTO - OOS**	Maximum indicator for the maximum value to occur at sensor 2, can be reset
Sensor 2 Min. Indicator SV2_MIN_ INDICATOR	**AUTO - OOS**	Maximum indicator for the minimum value to occur at sensor 2, can be reset
RJ Max. Indicator RJ_MAX_ INDICATOR	**Read only**	Maximum indicator for the maximum value to occur at the internal reference temperature measuring point
RJ Min. Indicator RJ_MIN_ INDICATOR	**Read only**	Maximum indicator for the minimum value to occur at the internal reference temperature measuring point

11.3.9 Transducer Block "Display"

The settings in the "Display" Transducer Block make it possible to display measured values from the two Transducer Blocks "Sensor 1 + 2" on the display which can be purchased as an option.
The selection is made by means of the DISPLAY_SOURCE_X[1] parameter. The number of decimal places displayed can be configured independently for every channel using the DISP_VALUE_X_DECIMAL_PLACES parameter. Symbols are available for the units °C, K, F, %, mV, R and Ω. These units are displayed automatically when the measured value is selected.

This text has a maximum length of 12 characters. The "Display" Transducer Block can show up to 3 values alternately on the display. The system automatically switches between the values after a configurable time interval (between 6 and 60 seconds) which can be set in the ALTERNATING_TIME parameter.

Transducer Block "DISPLAY"		
Parameter	**Write access with operating mode (MODE_BLK)**	**Description**
Alternating time ALTERNATING_ TIME	**AUTO - OOS**	Entry (in s) as to how long a value should be shown on the display. Setting from 6 to 60 s.
Display value x DISP_VALUE_X[1]	**Read only**	Selected measured value: ■ Status ■ Value
Display source x DISP_SOURCE_X	**AUTO - OOS**	For selecting the value to be displayed. Possible settings: ■ Off ■ Primary Value 1 ■ Sensor Value 1 ■ Primary Value 2 ■ Sensor Value 2 ■ RJ Value If all 3 display channels are switched off ('Off' option), the value for primary value 1 automatically appears on the display. If this value is not available (e.g. 'No Sensor' option selected in the Sensor Transducer Block 1 parameter 'SENSOR_TYPE'), primary value 2 is displayed.
Display value description x DISP_VALUE_X_ DESC	**AUTO - OOS**	Description of the display value displayed. Maximum 12 letters. The value is not shown on the display.
Decimal places x DISP_VALUE_ X_FORMAT	**AUTO - OOS**	For selecting the number of places displayed after the decimal point. Configuration option from 0 to 4. The option 4 means 'AUTO'. The maximum number of decimal places possible always appears on the display. Possible settings: – Auto – xxxxx – xxxx.x – xxx.xx – xx.xxx

1.X = number of the display channel in question (1 to 3)

Configuration example:
The following measured values should be shown on the display:

■ Value 1:

Measured value to be displayed:	Primary Value of Sensor Transducer 1 (PV1)
Measured value unit:	° C
Decimal places:	2

■ Value 2:

Measured value to be displayed:	RJ Value
Measured value unit:	° C
Decimal places:	1

- Value 3:

Measured value to be displayed:	Sensor Value (measured value) of Sensor Transducer 2 (SV2)
Unit:	° C
Decimal places:	2

Every measured value should be visible on the display for 12 seconds.

For this purpose, the following settings should be made in the "Display" Transducer Block:

Parameter	Value
DISP_SOURCE_1	'Primary Value 1'
DISP_VALUE_1_DESC	TEMP PIPE 11
DISPLAY_VALUE_1_DECIMAL_PLACES	'xxx.xx'
DISP_SOURCE_2	'RJ Value'
DISP_VALUE_2_DESC	INTERN TEMP
DISPLAY_VALUE_2_DECIMAL_PLACES	'xxxx.x'
DISP_SOURCE_3	'Sensor value 2'
DISP_VALUE_3_DESC	PIPE 11 BACK
DISPLAY_VALUE_3_DECIMAL_PLACES	'xxx.xx'
ALTERNATING_TIME	12

11.4 Analog Input function block

In the Analog Input (AI) function block, the process variables of the Transducer Blocks are prepared for subsequent automation functions (e.g. linearization, scaling and limit value processing). The automation function is defined by connecting up the outputs.
A detailed description of the Analog Input (AI) function block can be found in the FOUNDATION Fieldbus™ Function Blocks manual.

11.5 PID function block (PID controller)

A PID function block contains the input channel processing, the proportional integral-differential control (PID) and the analog output channel processing. The configuration of the PID function block depends on the automation task. The following can be realized: Basic controls, feedforward control, cascade control, cascade control with limiting.
A detailed description of the PID function block can be found in the FOUNDATION Fieldbus™ Function Blocks manual.

11.6 Input Selector function block

The signal selector block (Input Selector block = ISEL) provides selection of up to four inputs and generates an output based on the configured action.
A detailed description of the Input Selector function block can be found in the FOUNDATION Fieldbus™ Function Blocks manual.

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