



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services

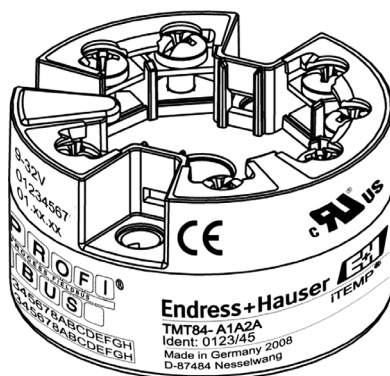


Solutions

Operating Instructions

iTEMP[®] TMT84

Temperature Head Transmitter
with PROFIBUS[®] PA Protocol



Brief overview

For quick and straightforward 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 PROFIBUS® PA communication	
▼	
Commissioning	→ Page 26
Commissioning using the PROFIBUS® PA interface - quick start for device configuration for standard operation	
Customer-specific configuration	→ Page 53
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	4	9.7	Disposal	44
1.1	Designated use	4	9.8	Firmware/software history and overview of compatibility	44
1.2	Installation, commissioning, operation	4			
1.3	Operational safety	4	10	Technical data	45
1.4	Notes on safety conventions and icons	5	11	Operation using PROFIBUS® PA	53
2	Identification	6		Index	95
2.1	Device designation	6			
2.2	Scope of delivery	6			
2.3	Certificates and approvals	6			
2.4	Registered trademarks	7			
3	Installation instructions	8			
3.1	Incoming acceptance, transport, storage	8			
3.2	Installation conditions	8			
3.3	Installation instructions	8			
3.4	Post-installation check	11			
4	Wiring	13			
4.1	Quick wiring guide	13			
4.2	Connecting the sensor cables	14			
4.3	PROFIBUS® PA cable specification	15			
4.4	Fieldbus connection	18			
4.5	Post-connection check	20			
5	Operation	21			
5.1	Quick operation guide	21			
5.2	Display and operating elements	22			
5.3	Operating options	23			
5.4	Hardware settings (optional)	24			
6	Commissioning	26			
6.1	Function check	26			
6.2	Switching on the head transmitter	26			
6.3	Commissioning the PROFIBUS® PA interface	27			
6.4	System integration	28			
6.5	Cyclical data exchange	31			
6.6	Acyclical data exchange	34			
7	Maintenance	34			
8	Accessories	35			
9	Troubleshooting	35			
9.1	Troubleshooting instructions	35			
9.2	Displaying the device status on the PROFIBUS® PA	36			
9.3	Status messages	38			
9.4	Application errors without messages	43			
9.5	Spare parts	44			
9.6	Return	44			

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 terminal 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 be mounted in hazardous areas. Strict compliance with the installation instructions, ratings and safety instructions as listed in this supplementary documentation is mandatory. Ensure you are using the correct Ex documentation for the relevant Ex-approved device. The number of the related Ex documentation (XA...) is indicated on the nameplate. You can use this Ex documentation if the two numbers (i.e. in the Ex documentation and on the nameplate) are identical.

Electromagnetic compatibility

The 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.



Warning!

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:



Caution!

This symbol draws attention to activities or procedures that can lead to defective operation or to destruction of the unit if not carried out properly.



Warning!

This symbol draws attention to activities or procedures that can lead to injuries to persons, safety risks or the destruction of the unit if not carried out properly.



Note!

This symbol draws attention to activities or procedures that have an indirect effect on operation, or can trigger an unforeseen unit reaction if not carried out properly.



ESD – Electrostatic discharge

Protect the terminals against electrostatic discharge. Failure to comply with this instruction can result in the destruction of parts or malfunction of the electronics.

2 Identification

2.1 Device designation

2.1.1 Nameplate

The right device?

Compare and check the details on the device nameplate against the measuring point requirements.

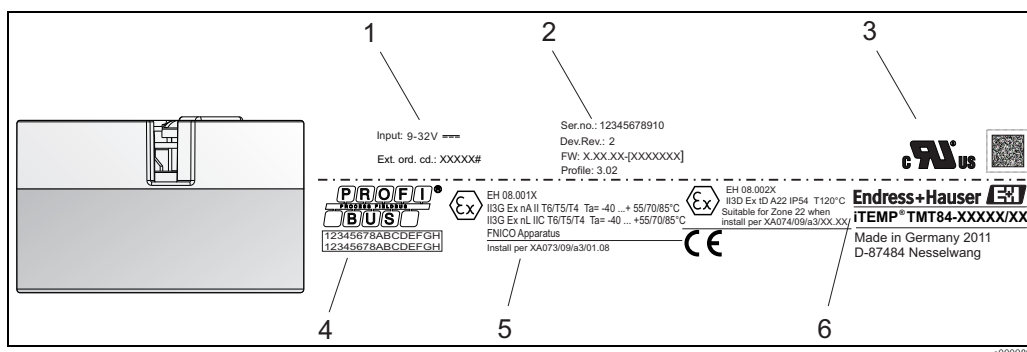


Fig. 1: Nameplate of the head transmitter (example, Ex version)

- 1 Power supply and extended order code
- 2 Serial number, device revision and firmware version
- 3 Approvals with symbols and 2D-barcode
- 4 2 lines for the TAG name
- 5 Approvals in hazardous area with number of the relevant Ex documentation (XA...)
- 6 Order code

2.2 Scope of delivery

The scope of delivery of the device comprises:

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

2.3 Certificates and approvals

On leaving the factory, the device was in perfect condition from the point of view of safety. 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 meets the legal requirements of EU Directives. The manufacturer confirms a positive completion of all tests by fitting the unit with a CE mark.

2.3.2 Certification PROFIBUS® PA

The temperature transmitter has successfully passed all test procedures and is certified and registered by the PNO (PROFIBUS® user organization e.V.). The device thus meets all the requirements of the specifications following:

- Certified according to PROFIBUS® PA Profile 3.02
- The device can also be operated with certified devices of other manufacturers (interoperability)

An overview of other approvals and certification can be found in chapter 'Technical data'.

2.4 Registered trademarks

- PROFIBUS®
Registered trademark of the PROFIBUS Nutzerorganisation e.V. (Profibus User Organization), Karlsruhe, Germany
- iTEMP®
Registered trademark of Endress+Hauser Wetzer GmbH + Co. KG, Nesselwang, Germany

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 your 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 chapter 8 'Accessories')



Note!

Mounting on a DIN rail as per EN 60715 is also possible with the DIN rail clip accessory, see chapter 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.



Caution!

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

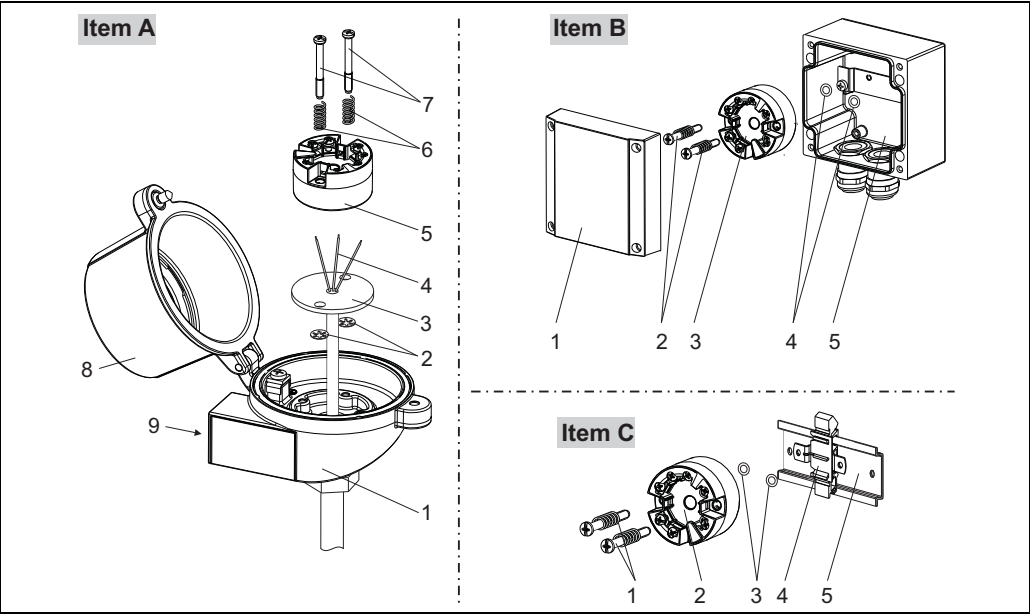


Fig. 2: Head transmitter mounting (three versions)

Item A	Mounting in a terminal head, flat face (terminal head as per DIN 43729)
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. Then screw down the head transmitter (5) to the insert (3) in the terminal head.	
6. After wiring (see chapter 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	Circlips
5	Field housing

Item B	Mounting in a field housing
Procedure:	
1. Open the cover (1) of the field housing (5).	
2. Fit the mounting springs onto the mounting screws (2) and guide them through the lateral bores of the head transmitter (3). Then fix both mounting screws in position with the circlips (4).	
3. Screw the head transmitter to the field housing.	
4. When wiring is complete (see chapter 4), screw the field housing cover (1) back on.	

Item C	Mounting on DIN rail (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 top-hat 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

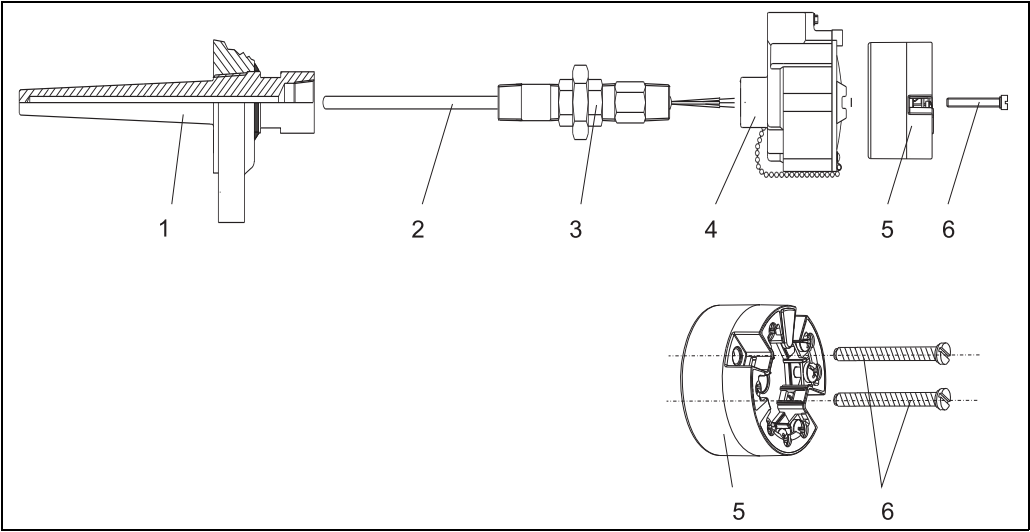


Fig. 3: Head transmitter mounting

- 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

- Fit the thermowell (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 (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 (6) through the lateral bores of the head transmitter (7).
- Position the head transmitter (5) in the terminal head (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 (5) in the terminal head (4).
- Guide the connection wires of the insert (3) through the lower cable entry of the terminal head (4) and through the middle hole in the head transmitter (5). Wire the connection wires and transmitter (see chapter 4) with one another.
- Screw the terminal head (4), with the integrated and wired head transmitter, onto the ready-mounted nipple and adapter (3).



Caution!

Once the wiring is completed, screw the terminal head cover back on. The terminal head cover must be secured properly to meet the requirements for explosion protection.

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.

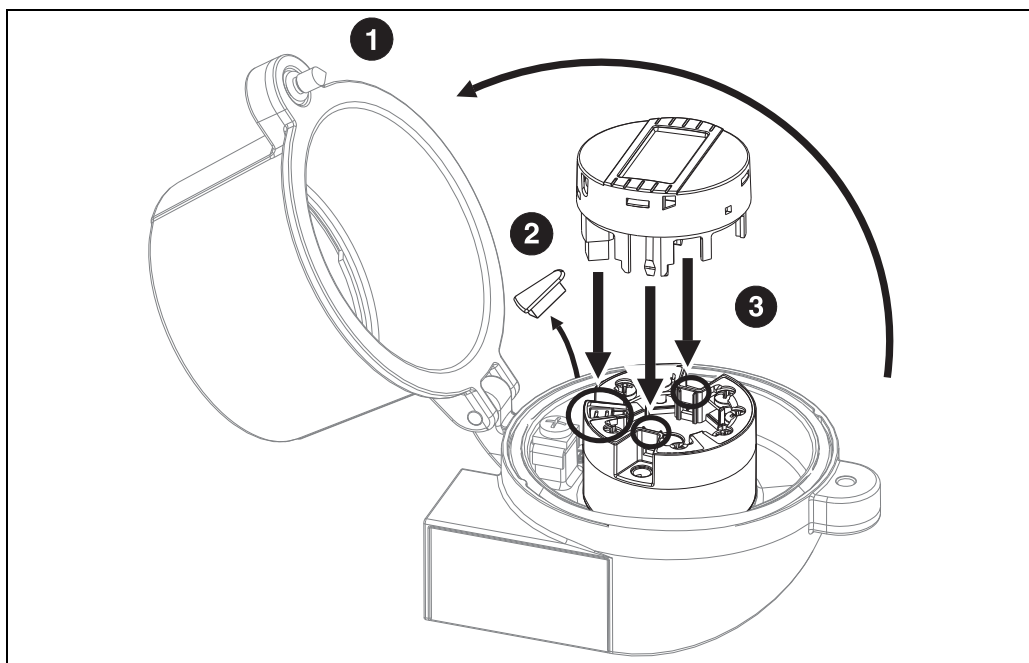


Fig. 4: Mounting the display



Note!

The display can only be used with the suitable Endress+Hauser terminal heads TA30 and caps 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 free of damage (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



Caution!

- 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. The local E+H representative is available for assistance if required.
- Do not occupy the display connection. An incorrect connection can destroy 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 chapter connection check!

4.1 Quick wiring guide

Terminal assignment

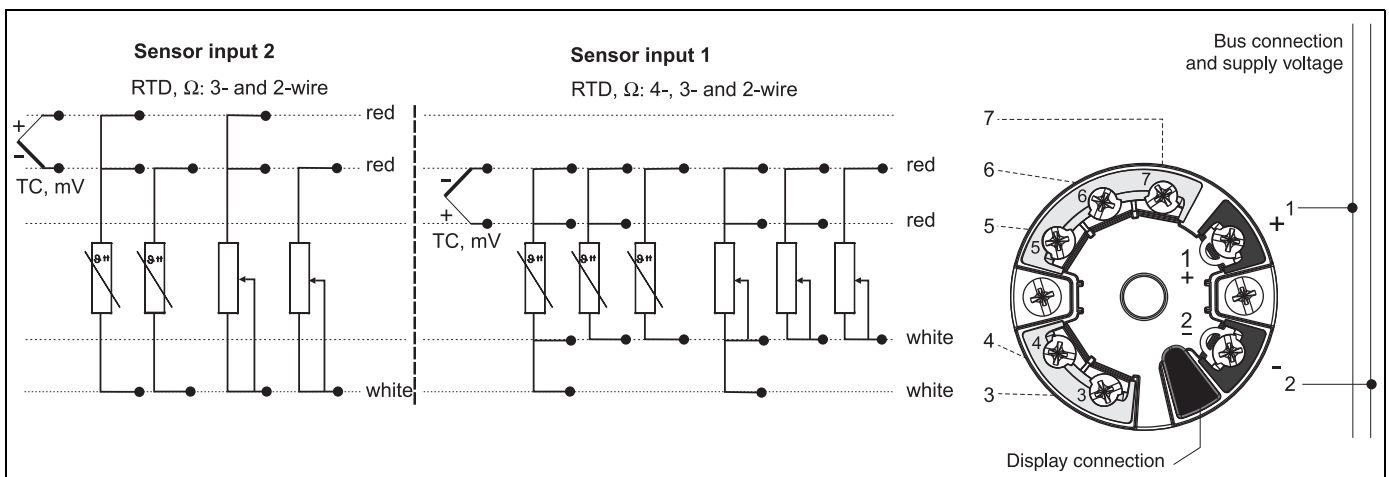


Fig. 5: Wiring the head transmitter



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

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



Caution!

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. The sensors must 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.

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

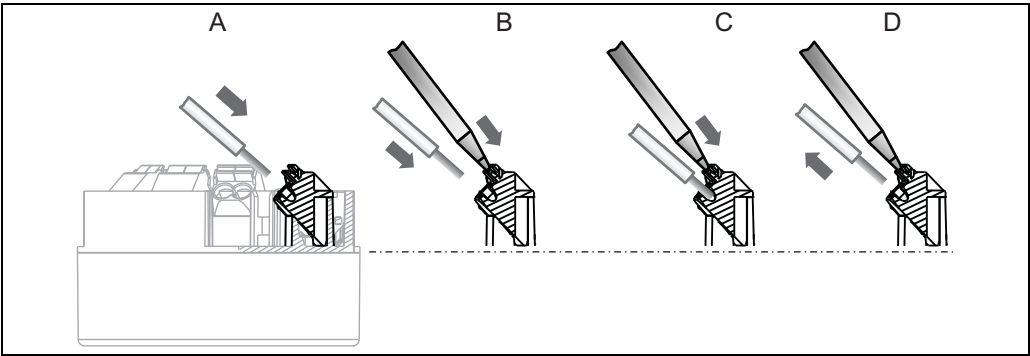


Fig. 6: Spring terminal connection

Procedure:

Item A, Solid wire:	- Strip wire end. Minimum stripping length = min. 10 mm (0.39"). - Insert the wire end into the terminal (A). - Check the connection by pulling on the wire lightly. Repeat from step 1 if necessary.
Item B Fine-strand wire without ferrule:	- Strip wire end. Minimum stripping length = min. 10 mm (0.39"). - Operate lever opener with tool (B). - Insert the wire end into the terminal (B). - Release lever opener. - 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.



Note!

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

4.3 PROFIBUS® PA cable specification

4.3.1 Cable type

Twin-core cables are required for connecting the device to the fieldbus. Following IEC 61158-2 (MBP), four different cable types (A, B, C, D) can be used with the 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 fieldbuses (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	*
Shield coverage	90%	*
Max. cable length (incl. spurs >1m/3ft)	1900 m (6233 ft)	1200 m (3937 ft)
* Not specified		

Suitable fieldbus cables from other 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 ft). Note the following points:

- The maximum permissible overall cable length depends on the cable type used.

Type A	1900m	6200ft
Type B	1200m	4000ft

- 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 ft):

Number of spurs		1 to 12	13 to 14	15 to 18	19 to 24	25 to 32
Max. length per spur	m	120	90	60	30	1
	ft	400	300	200	100	3

4.3.4 Number of field devices

The line length is limited to a maximum of 1 000m (3280ft) in systems corresponding to FISCO with Ex ia types of protection. A maximum of 32 users per segment are permitted in the non-hazardous area or 10 users in the hazardous area (Ex ia IIC). The actual number of users must be specified during configuration.

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 fieldbus system 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 on the feed side (without capacitance connection to the field device). 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 thus guaranteed. 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

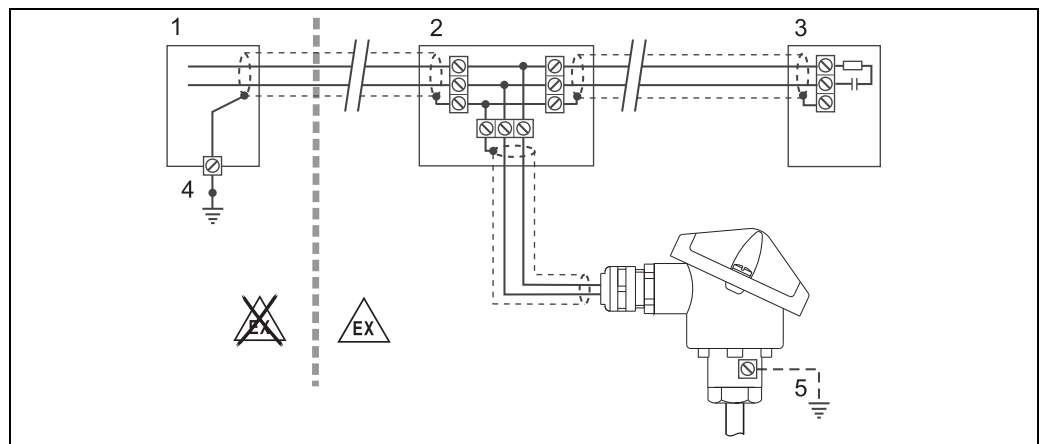


Fig. 7: Shielding and one-sided grounding of the fieldbus cable shielding

- 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.



Caution!

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 a 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 in the Operating Instructions "Guidelines for Planning and Commissioning PROFIBUS® DP/PA - Field Communication" (BA034S/04) which can also be found on the CD-ROM. (Additional sources: → www.endress.com → Download).

4.4 Fieldbus connection

Devices can be connected to the fieldbus system 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



Caution!

- 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.
- Risk of damaging the fieldbus cable!
 - 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 device, the bus communication will have to be interrupted.

4.4.1 Cable glands or entries



Note!

Please also observe the general procedure on → 13.

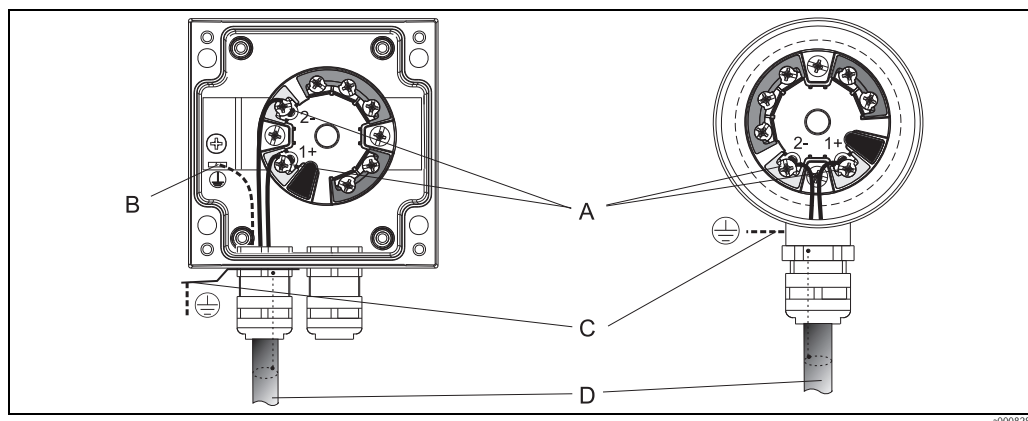


Fig. 8: Connection to the fieldbus cable - installed in the field housing on the left, and in the terminal head on the right

- A Fieldbus terminals - fieldbus communication and power supply
- B Inner ground terminal
- C Outer ground terminal
- D Shielded fieldbus cable



Note!

- The terminals for the fieldbus connection (1+ and 2-) are not polarity sensitive.
- Conductor cross-section:
 - Max. 2.5 mm² (16 AWG) for screw terminals
 - Max. 1.5 mm² (14 AWG) for spring terminals
- A shielded cable must be used for the connection.

4.4.2 Fieldbus connector

The connection technology of PROFIBUS® PA allows 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.

Therefore, the device is optionally available with a fitted fieldbus connector ex works. Fieldbus connectors for subsequent fitting can be ordered from Endress+Hauser as a spare part (see chapter 8 'Accessories').

Shielding the feed line/T-Box

Cable connections with good EMC properties must be used, preferably with wraparound cable shielding (iris spring). This requires low potential differences, possibly potential equalization.

- The PA cable shielding must not be disconnected.
- The connection of the shielding must be kept as short as possible at all times.

Ideally, cable connections with iris springs should be used for connecting the shielding. The shield is fitted on the T-box housing using the iris spring which is inside the connection. The shielding meshwork is under the iris spring. When the Pg is screwed down, the iris spring is squeezed onto the shield and thus creates a conductive connection between the shielding and the metal housing. A terminal box or connection is to be seen as part of the shielding (Faraday cage). This is particularly true for separate boxes if they are connected to a PROFIBUS® PA device with a plug-in cable. In this case, a metallic connector must be used whereby the cable shielding is fitted at the connector housing (e.g. pre-terminated cable).

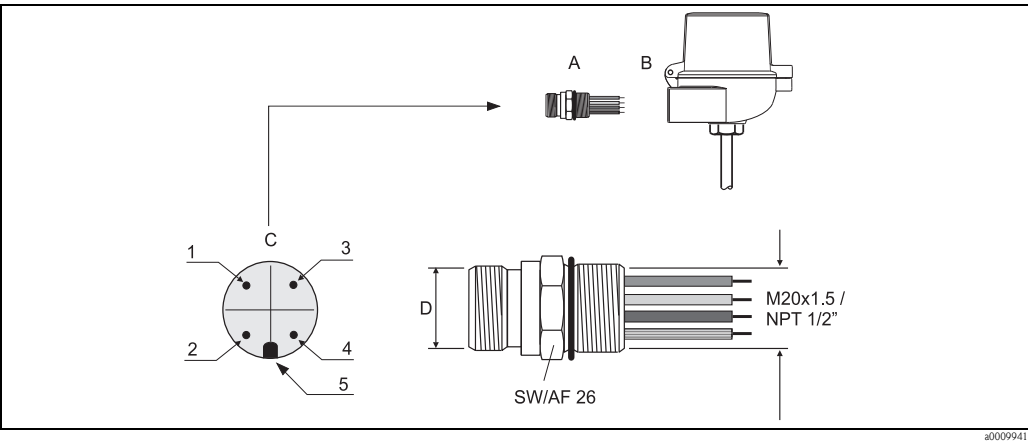


Fig. 9: Connectors for connection to the PROFIBUS® PA fieldbus

		Pin assignment / color codes	
		D Plug 7/8":	D Plug M12:
A	Fieldbus connector	1 Brown wire: PA+ (terminal 1)	1 Grey wire: shield
B	Field housing	2 Green-yellow wire: ground	2 Brown wire: PA+ (terminal 1)
C	Connector at the housing (male)	3 Blue wire: PA- (terminal 2)	3 Blue wire: PA- (terminal 2)
		4 Grey wire: shield	4 Green-yellow wire: ground
		5 Positioning tappet	5 Positioning tappet

Connector technical data:

Wire cross-section	4 x 0.8 mm
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 device or the cables free of damage (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?	
Are all the housing covers installed and tightened?	
Electrical connection of fieldbus system	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 fieldbus specifications?	→ 15
Has the max. length of the spurs been observed in accordance with the fieldbus specifications?	
Is the fieldbus cable fully shielded and correctly grounded?	

5 Operation

5.1 Quick operation guide



Note!

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 → Page 23

Both profile and device-specific parameters are configured exclusively via the fieldbus interface. You can obtain special configuration and operating programs from various manufacturers for these purposes.

2. Miniature switches (DIP switches) for diverse hardware settings, optional → Page 24

You can make the following hardware settings for the PROFIBUS® PA interface using DIP switches on the rear of the optional display:

- Entry of the device bus address
- Switching the hardware write protection on/off
- Switching (turning) the display 180 °

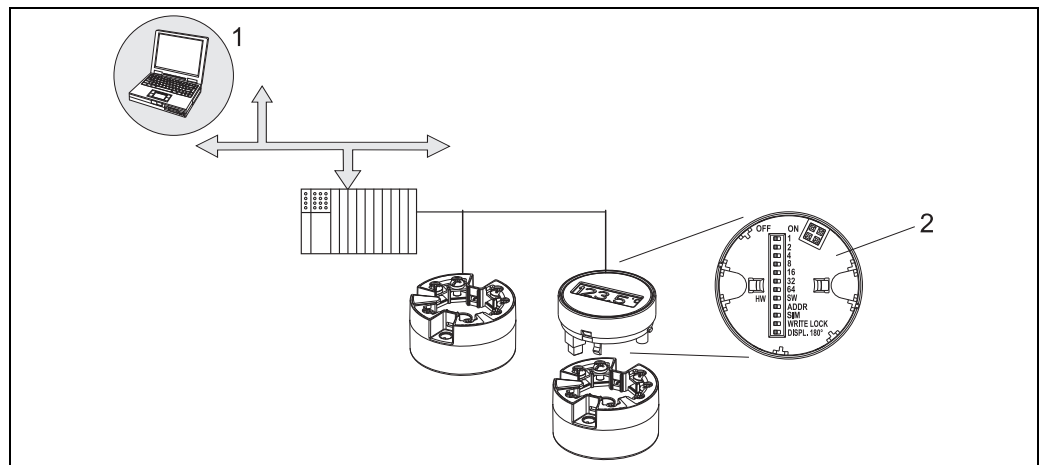


Fig. 10: Head transmitter operating options

- 1 Configuration/operating programs for operation using PROFIBUS® PA (fieldbus functions, device parameters)
- 2 DIP switches for hardware settings on the rear of the optional display (write protection, device address, turn display)

5.2 Display and operating elements

5.2.1 Display

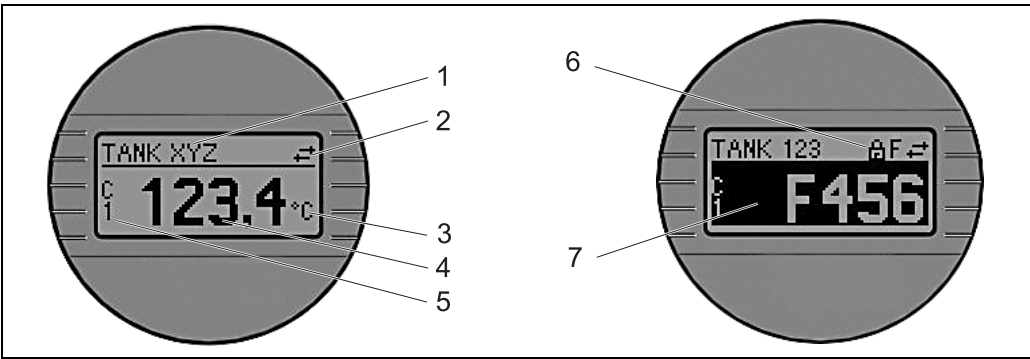


Fig. 11: Optional LC display of the head transmitter

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 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 or P2, S2, RJ	E.g. C1 for a measured value from channel 1. (S = Secondary value, P = Primary value; C = Channel, RJ = Reference junction)
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 chapter 'Status messages').

5.2.3 Local operation

You can make hardware settings for the fieldbus interface using miniature switches (DIP switches) on the rear of the optional display → Page 24.

5.3 Operating options

5.3.1 "FieldCare" operating program

FieldCare is Endress+Hauser's FDT-based Plant Asset Management Tool for the configuration and diagnosis of intelligent field devices. Using status information, FieldCare serves as a simple but effective tool for monitoring devices. Access to the iTEMP® TMT84 occurs exclusively via Profibus communication.



Note!

More information:

- to the operating structure see chapter 11.1
- on the display of diagnostic information as per NAMUR NE107 → Chap. 9.2.2

Detailed information on PROFIBUS® PA device parameterization and operation concept can be found in the BA034S/04 Operating Instructions, "Guidelines for Planning and Commissioning PROFIBUS® DP/PA - Field Communication" which can also be found on the CD-ROM. (Additional sources: → www.endress.com → Download).

5.3.2 "SIMATIC PDM" operating program (Siemens)

SIMATIC PDM is a standardized, non-proprietary tool for the operation, configuration, maintenance and diagnosis of intelligent field devices.

Further information at: www.endress.com

5.3.3 Current device description files

The following table lists the correct device description file for the relevant operating tool and the source.

PROFIBUS PA protocol (IEC 61158-2, MBP):

Valid for firmware/software:	1.00.zz	1.01.zz	See the DEVICE SOFTWARE parameter
PROFIBUS® PA device data Profile version:	3.01	3.02	See the PROFILE VERSION parameter
TMT84 device ID: Profile ID:	1551 _{hex} Depending on the profile GSD file used: 0x9703, 0x9702, 0x9701 or 0x9700		See the DEVICE ID parameter
GSD information: TMT84 GSD: Profile GSD: Bitmaps:	Extended PA139700.gsd PA139701.gsd PA139702.gsd PA139703.gsd EH1551_D.bmp EH1551_N.bmp EH1551_S.bmp		Compatibility matrix: EH3x1551.gsd EH021551.gsd 1.00.zz OK STOP* 1.01.zz OK OK *Can be used if the "C1_Read_Write_supp = 1" entry in the GSD is set to "C1_Read_Write_supp = 0".
Operating program/device driver:	Source for device descriptions/program updates, free downloads on Internet:		
GSD	■ www.endress.com (→ Download → Software → Device Drivers) ■ www.profibusb.com		
FieldCare/DTM	■ www.endress.com (→ Download → Software → Device Drivers)		
SIMATIC PDM	■ www.endress.com (→ Download → Software → Device Drivers) ■ www.fielddevices.com		

5.4 Hardware settings (optional)



Note!

The display can optionally be ordered with the transmitter, or as an accessory for subsequent mounting (see chapter 8).



ESD - Electrostatic discharge

Protect the terminals against electrostatic discharge. Failure to comply with this instruction can result in the destruction of parts or malfunction of the electronics.

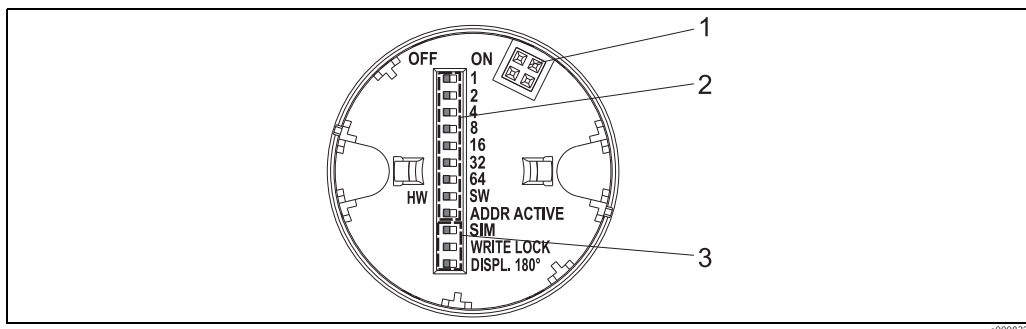


Fig. 12: Hardware settings via DIP switches

- 1 Connection to head transmitter
- 2 DIP switches (1 - 64, SW/HW and ADDR) for configuring the device address
- 3 DIP switches (SIM = simulation mode (no function); WRITE LOCK = write protection; DISPL. 180° = switch (turn) the display 180°)

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.
Generally: 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.

5.4.1 Switching write protection on/off

Write protection is switched on and off via a DIP switch on the rear of the optional attachable display. When write protection is active, parameters cannot be modified. The current write protection status is displayed in the HW WRITE PROTECT parameter (Physical Block). This is shown on the display as a key symbol when a hardware lock is activated ("WRITE LOCK" to "ON").



Note!

The TMT84 hardware lock is switched off (HW_WRITE_PROTECTION = 0) once the display is removed, when it is fitted, the configured value is updated at the DIP switch in the device.

5.4.2 Turning the display

The display can be turned 180° via DIP switch. The DIP switch setting is saved and displayed via a read-only parameter (DISP_ORIENTATION) in the display transducer block. The setting is retained when the display is removed.

5.4.3 Configuring the device address

Note the following points:

- The address must always be configured for a PROFIBUS® PA device.
Valid device addresses are in the range 0 to 125. Each address can only be assigned once in a PROFIBUS® PA network. The device is not recognized by the master if the address is not configured correctly.
Address 126 is used for initial operation and service purposes.
- All devices are delivered ex works with the address 126 and software addressing.

The hardware address is configured using DIP switches 1 (1) – 7 (64). The "SW-HW" DIP switch must be set to "HW" and the "ADDR ACTIVE" DIP switch to "ON" to use the configured hardware address.

The transmitter must be restarted so that the DIP switch settings are adopted by the TMT84 and saved.

Software address means that the saved bus address can be changed via a DDLM_SLAVE_ADD message. In contrast, if a display with a valid address is fitted, this means that the address configured on the display is used and a DDLM_SLAVE_ADD message is ignored.

Therefore, if the display is removed or a display is fitted with the "SW/HW" DIP switch set to SW ("ADDR ACTIVE" DIP switch set to ON), this means that the currently saved bus address can be changed once more via a DDLM_SLAVE_ADD message. The currently saved bus address is used until it is changed via a DDLM_SLAVE_ADD message. When this happens, the bus address is changed directly on receipt of the message and does not require the device to be restarted.

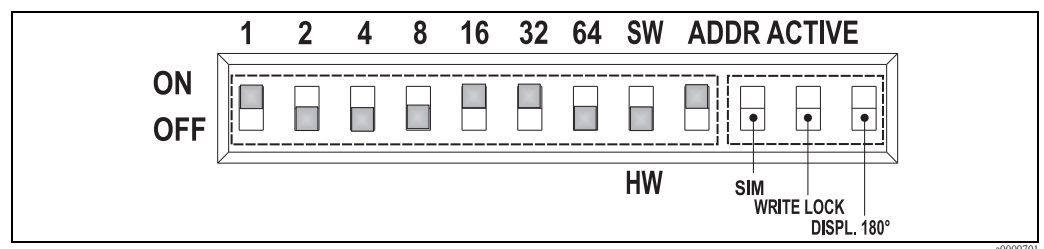


Fig. 13: Configuring the device address using the example of bus address 49.

DIP switch set to ON: $32 + 16 + 1 = 49$. Furthermore, "SW/HW" DIP switch set to "HW" and "ADDR ACTIVE" set to "ON".

■ Fitting the display during operation

The DIP switches for the bus address are checked during operation and a configured, valid bus address (DIP switches: SW/HW set to HW; ADDR ACTIVE set to ON; bus address < 126) is saved and adopted the next time the device is restarted.

The attachment of the display does not effect the bus address provided the "ADDR ACTIVE" DIP switch is set to OFF. If the switch is set to ON, and a valid bus address (DIP switches: SW/HW set to HW; ADDR ACTIVE set to ON; bus address < 126) configured, this is adopted the next time the device is started.

If the device does not start within 30 minutes of changing the bus address, this change is rejected and the device retains the last saved address.

If the "ADDR ACTIVE" DIP switch is set to ON and the "SW/HW" DIP switch set to SW, the bus address is not affected.

■ Removing the display during operation

If the display is removed during operation, the TMT84 uses the address saved in the device and operation continues without restriction.

■ Resetting the bus address to default value 126

1. Fit a display with a valid HW address (DIP switches: SW/HW set to HW; ADDR ACTIVE set to ON; bus address < 126).
2. Wait until the company logo appears on the display.
3. Remove the display and set the "SW/HW" DIP switch to SW.
4. Fit the display once more and wait until the company logo appears.
5. The bus address 126 is used when the device is restarted.

6 Commissioning

6.1 Function check

Before commissioning the measuring point make sure that all final checks have been carried out:

- “Post-installation check” checklist, → 11
- “Post-connection check” checklist, → 20



Note!

- The functional data of the PROFIBUS® PA interface as per IEC 61158-2 (MBP) must be observed.
- The bus voltage of 9 to 32 V and the current consumption of approx. 11 mA at the device can be checked using a normal multimeter.

6.2 Switching on the head transmitter

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 firmware (FW) and hardware (HW) version
2	Company logo
3a	Device name as well as the FW and HW of the head transmitter
3b	Display of device address, IDENT_NUMBER_SELECTOR mode and current IDENT_NUMBER
3c	Sensor configuration
4a	The current measured value or
4b	The current status message  Note! 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 chapter 9, 'Troubleshooting'.

The device begins normal operation after approx. 8 seconds, 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 the PROFIBUS® PA interface

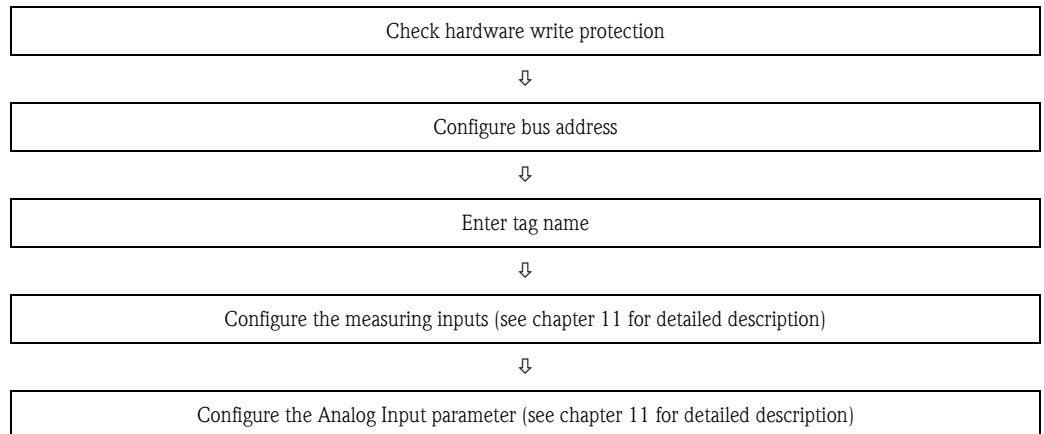


Note!

Chapter 11 "Operation using PROFIBUS® PA" provides a detailed description on all of the functions required for commissioning.

6.3.1 Commissioning PROFIBUS® PA

Procedure:



1. Check hardware write protection
 The WRITE PROTECTION parameter shows whether write access to the device is possible using PROFIBUS® (acyclical data transfer, e.g. using "FieldCare" operating program): SETUP → ADVANCED SETUP → WRITE PROTECTION
 One of the following options is displayed:
 - OFF (default value) = write access possible using PROFIBUS®
 - ON = write access not possible using PROFIBUS®
 Disable the write protection if necessary, → 24
2. Enter the tag name (optional) DIAGNOSTICS → SYSTEM INFORMATION → TAG
3. Configure the bus address
 Hardware addressing using DIP switch, → 25
4. Configure the transducer blocks
 The individual transducer blocks cover various settings such as unit, sensor type etc. The parameter groups are grouped together in blocks as follows:
 - Temperature sensor 1 → Transducer Block 1 (slot 1)
 - Temperature sensor 2 → Transducer Block 2 (slot 2)
5. Configure the Analog Input function blocks 1-4
 The device has four analog input function blocks (AI module). They are used to transmit different measured variables to the PROFIBUS® master (class 1) cyclically. The allocation of a measured variable to the analog input function block is shown below using the example of Analog Input Function Block 1 (AI module, slot 1).
 Using the CHANNEL function, you can specify the measured variables that should be transferred cyclically to the PROFIBUS® master (class 1) (e.g. Primary Value Transducer 1):
 - Call up the CHANNEL function.
 - Select the "PV Transducer 1" option
 The following settings are possible:
 CHANNEL →
 - Primary Value Transducer 1
 - Secondary Value 1 Transducer 1
 - Reference Junction Temperature
 - Primary Value Transducer 2
 - Secondary Value 1 Transducer 2

6.4 System integration

The device is ready for system integration after commissioning using the class 2 master. To integrate the field devices in the bus system, the PROFIBUS® PA system requires a description of the device parameters such as output data, input data, data format, data volume and supported transfer rate. These data are stored in a device master file (GSD file) that is made available to the PROFIBUS® PA master during commissioning of the communication system. Furthermore, device bitmaps can also be integrated. They appear as symbols in the network structure. The profile 3.02 device master file (GSD) allows you to exchange field devices from different manufacturers without reconfiguration. Generally, two different variants of the GSD are possible using the profile 3.02 (factory setting: manufacturer-specific GSD):

- **Manufacturer-specific GSD:** This GSD ensures unrestricted functioning of the field device. Device-specific process parameters and functions are therefore available.
- **Profile GSD:** varies according to the number of analog input blocks (AI). As long as a plant is configured with the profile GSD, devices can be replaced with those from other manufacturers. However, pay attention that the order of the cyclical process values is correct.

1. Manufacturer-specific GSD, EH021551.gsd or EH3x1551.gsd (→ Chap. 5.3.3 Current device description files) Ident number = 1551 (hex) Ident number selector = 1
2. Profile GSD, PA139703.gsd (4 analog inputs) Ident number = 9703 (hex) Ident number selector = 0
3. Profile GSD, PA139700.gsd (1 analog input) Ident number = 9700 (hex) Ident number selector = 129
4. Profile GSD, PA139701.gsd (2 analog inputs) Ident number = 9701 (hex) Ident number selector = 130
5. Profile GSD, PA139702.gsd (3 analog inputs) Ident number = 9702 (hex) Ident number selector = 131
6. Manufacturer-specific GSD, Eh3x1523.gsd (TMT184 compatibility mode) Ident number = 1523 (Hex) Ident number selector = 128



Note!
The GSD to be used to operate the plant should be decided before configuration. This setting can be changed with a class 2 master.

The TMT84 head transmitter supports the following GSD files (see table at → Chap. 5.3.3 Current device description files).

Each device is given an identification number (ID) from the Profibus User Organization. The name of the GSD file is derived from this. This ID number starts with the manufacturer code 15xx for Endress+Hauser. For better classification and clarity, Endress+Hauser GSD names are as follows:

EH0215xx	EH = Endress+Hauser 02 = GSD-Revision 15xx = ID number
----------	--

- The GSD files for all Endress+Hauser devices can be requested as follows:
- Internet (Endress+Hauser) → <http://www.endress.com> (Products → Process Solutions → PROFIBUS → GSD files)
 - Internet (Profibus User Organization) → <http://www.profibus.com> (GSD library)
 - On CD-ROM provided by Endress+Hauser. Contact an Endress+Hauser sales office.

6.4.1 Extended formats

There are some GSD files whose modules are transferred using an extended identification (e.g. 0x42, 0x84, 0x08, 0x05). These GSD files are in the "Extended" folder.

6.4.2 Contents of download file

- All Endress+Hauser GSD files
- Endress+Hauser bitmap files
- Useful information on the devices

6.4.3 Working with the GSD files

The GSD files must be integrated in the automation system. Depending on the firmware/software used, the GSD files can be copied into the specific program directory or read into the database using an import function within the configuration software.

Example:

The subdirectory is ... \ siemens \ step7 \ s7data \ gsd for the Siemens STEP 7 configuration software from Siemens PLC S7-300 / 400.

Bitmap files accompany the GSD files. The measuring points are illustrated using these bitmap files. They must be loaded in the ... \ siemens \ step7 \ s7data \ nsbmp directory.

For other configuration software, ask the manufacturer of your PLC for the correct directory.

6.4.4 Compatibility with the TMT184 previous model

When replacing a device, the iTEMP® TMT84 head transmitter guarantees compatibility of the cyclical data with the iTEMP® TMT184 previous model with profile version 3.0 (ID number 1523). Replacement of an iTEMP® TMT184 with an iTEMP® TMT84 is possible without adjusting the configuration of the PROFIBUS® DP/PA network in the automation system although the names and identification numbers of the devices are different.

Automatic identification

Once the head transmitter is replaced, the switch from standard operating to compatibility mode takes place automatically if the **PROFIBUS Ident Number Selector** parameter is set to 127 (default factory setting). Compatibility mode can also be activated by setting the **PROFIBUS Ident Number Selector** parameter to 128 (Manuf. specific Ident Number 1523 – TMT184). This value is transmitted and evaluated by the master when cyclical communication is being established. The iTEMP® TMT84 is configured for either standard operating or compatibility mode on the basis of this number.

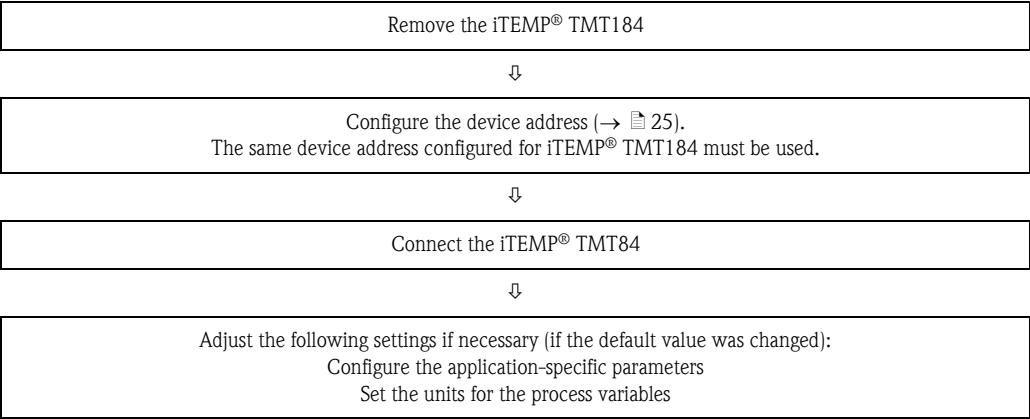
A manual switch from operation as iTEMP® TMT84 or iTEMP® TMT184 is supported.

Notes on diagnosis in compatibility mode

- Access is direct using the block structure or device parameters for acyclical parameterization of the iTEMP® TMT84 using an operating program (class 2 master).
- If parameters were changed in the device to be replaced (iTEMP® TMT184), (parameter setting no longer corresponds to the original default value), these parameters must be adjusted accordingly using an operating program (class 2 master) in the new iTEMP® TMT84.
- As the iTEMP® TMT84 behaves the same as an iTEMP® TMT184 in compatibility mode with regard to diagnosis and status handling, only the PA profile 3.0 is supported with regard to the diagnosis bits and status codes during operation in this mode.

Replacing the devices

Procedure:



6.5 Cyclical data exchange

In PROFIBUS® PA, cyclical transfer of the analog values to the automation system occurs in data blocks of 5 bytes. The measured value is represented in the first 4 bytes as floating point numbers in accordance with the IEEE 754 standard (see IEEE floating point number). The 5th byte contains status information relating to the measured value, which is implemented as per the profile 3.02¹⁾-specification. The status is shown as a symbol on the device display if available. Refer to chapter 11 "Operation using PROFIBUS® PA" for a detailed description of the data types.

6.5.1 IEEE floating point number

Conversion of a hexadecimal value to an IEEE floating point number for measured value acquisition. The measured values are represented as follows in the IEEE-754 number format and transmitted to the master class 1:

Byte n			Byte n+1			Byte n+2		Byte n+3
Bit 7	Bit 6	Bit 0	Bit 7	Bit 6	Bit 0	Bit 7	Bit 0	Bit 7 Bit 0
VZ	2^7	2^6 2^5 2^4 2^3 2^2 2^1	2^0	2^{-1} 2^{-2} 2^{-3} 2^{-4} 2^{-5} 2^{-6} 2^{-7}	2^{-8} 2^{-9} 2^{-10} 2^{-11} 2^{-12} 2^{-13} 2^{-14}	2^{-15}		2^{-16} to 2^{-23}
Exponent			Mantissa			Mantissa		Mantissa

$$\text{Formula value} = (-1)^{\text{VZ}} * 2^{(\text{Exponent} - 127)} * (1 + \text{mantissa})$$

Example:

$$\begin{aligned}
 40 \text{ F0 } 00 \text{ 00 hex} &= 0100 \text{ 0000 } 1111 \text{ 0000 } 0000 \text{ 0000 } 0000 \text{ 0000 binary} \\
 \text{Value} &= (-1)^0 * 2^{(129-127)} * (1 + 2^{-1} + 2^{-2} + 2^{-3}) \\
 &= 1 * 2^2 * (1 + 0.5 + 0.25 + 0.125) \\
 &= 1 * 4 * 1.875 = 7.5
 \end{aligned}$$

6.5.2 Block model

The head transmitter supports a maximum of 5 slots for cyclical data exchange. A maximum of 4 values can be selected and transmitted.

Elements of cyclical communication:

Slot	Data block	Access
1	Analog input 1	Read access
2	Analog input 2	Read access
3	Analog input 3	Read access
4	Analog input 4	Read access
5	Display value	Write access

1) As per profile 3.01: profile GSD files used or IDENT_NUMBER_SELECTOR set to {0, 129, 130 or 131} or TMT84 GSD file used or IDENT_NUMBER_SELECTOR set to 1 and "CondensedStatus" parameter to OFF.
As per profile 3.02: TMT84 GSD file used or IDENT_NUMBER_SELECTOR set to 1 and "CondensedStatus" parameter to ON.
If IDENT_NUMBER_SELECTOR = 127, the GSD file used for establishing the cyclical data exchange determines whether diagnosis occurs according to profile 3.01 or profile 3.02.

General description of blocks:

Block name	Short description	Slot
Physical Block	General device data	0
Transducer Block 1	Sensor settings channel 1	1
Transducer Block 2	Sensor settings channel 2	2
Analog Input Block 1	Output of a measured value	1
Analog Input Block 2	Output of a measured value	2
Analog Input Block 3	Output of a measured value	3
Analog Input Block 4	Output of a measured value	4

The block model displayed (→ Page 32) shows the input and output data the head transmitter makes available for cyclical data exchange.

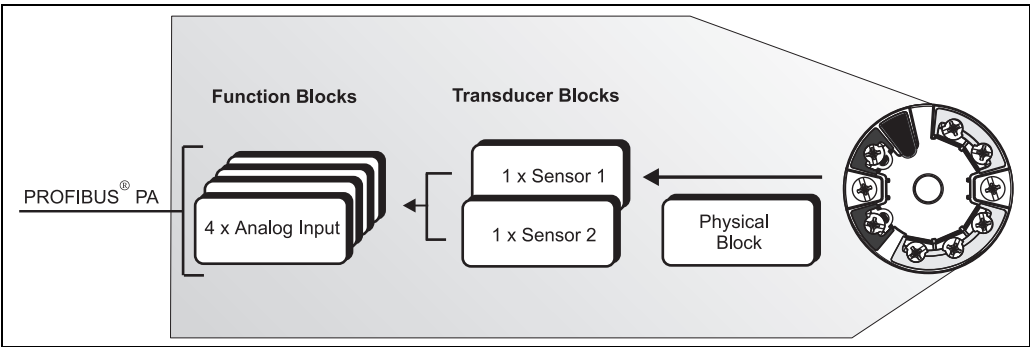


Fig. 14: Head transmitter block model, profile 3.02

6.5.3 Display value

The display value contains 4 bytes with the measured value and 1 byte with the status.

6.5.4 Input data

Input data are process temperature, internal reference temperature.

6.5.5 Data transfer from the head transmitter to the automation system

The order of the input and output bytes has a fixed structure. If addressing is done automatically using the configuration program, the numerical values of the input and output bytes can differ from the values in the following table.

Input byte	Process parameter	Access type	Comment/data format	Default value unit
0, 1, 2, 3	*Temperature	Read	32-bit floating point number (IEEE-754) representation →  31	°C
4	*Status temperature		Status code	–
* Depends on the selection of the Analog Input function block in the CHANNEL parameter →  27.				
Possible settings: –Primary value of the transducer –Measured value of sensor at sensor input –Measured value of the internal reference measuring point		→  27 → Select in the CHANNEL parameter → Primary Value TB1 → Select in the CHANNEL parameter → Secondary Value TB1 → Select in the CHANNEL parameter → Internal Temperature		

**Note!**

The system units in the table correspond to the preset scalings transferred during cyclical data exchange. However, in the case of customer-specific configuration, the units can differ from the default value.

6.5.6 Output data

The display value provides the option to transfer a measured value calculated in the automation system directly to the head transmitter. This measured value is purely a display value, displayed by PROFIBUS® PA Display RID 261 for example. The display value contains 4 bytes with the measured value and 1 byte with the status.

Input byte	Process parameter	Access type	Comment/data format
0, 1, 2, 3	Display value	Write	32-bit floating point number (IEEE-754) representation → 31
4	Status display value	Write	-

**Note!**

Only activate the data blocks that are processed in the automation system. This improves the data throughput rate of a PROFIBUS® PA network.

A flashing, double-headed arrow symbol is shown on the optional display to indicate that the device is communicating with the automation system.

6.5.7 System units

The measured values are transferred in system units, via cyclical data exchange, to the automation system as described in chapter 'Group setup' (UNIT N parameter).

6.5.8 Configuration example

Generally a PROFIBUS® DP/PA system is configured as follows:

1. The field devices to be configured (iTEMP® TMT84) are integrated in the configuration program of the automation system via the PROFIBUS® DP network using the GSD file. Required measured variables can be configured offline with the configuration software.
2. The application program of the automation system should now be programmed. The input and output data are controlled in the application program and the location of the measured variables is specified so that they can be processed further.
3. If necessary, an additional measured value conversion component must be used for an automation system that does not support the IEEE-754 floating point number format.
4. Depending on the data processing type in the automation system (little-endian or big-endian format) it may be necessary to change the byte order (byte swapping).
5. Once configuration has been completed, this is transferred to the automation system as a binary file.
6. The system can now be started. The automation system establishes a connection to the configured devices. The process-related device parameters can now be set using a class 2 master, e.g. with the help of FieldCare.

6.6 Acyclical data exchange

Acyclical data exchange is used to transfer parameters during commissioning, maintenance or for the display of further measured variables, not contained in cyclical data communication. Parameters for identification, control or adjustment can thus be changed in the various blocks (physical block, transducer block, function block) while the device is in cyclical data exchange with a PLC.

The device supports the following basic types of acyclical data transfer:

MS2AC communication with 2 available SAPs.

When observing acyclic communication, a distinction must be made between two types:

6.6.1 Class 2 master acyclic (MS2AC)

MS2AC refers to acyclical communication between a field device and a class 2 master (e.g. FieldCare, PDM etc.). The master opens a communication channel via an SAP to access the device. All parameters to be exchanged with a device using PROFIBUS® must be communicated to a master class 2. This assignment is done either in a device description (DD), a DTM (device type manager) or within a software component in the master via slot and index addressing for each individual parameter.

The slot and index, details on length (byte) and the data record are transferred in addition to the field device address when parameters are written using a master class 2. The slave acknowledges this write request on completion. The blocks can be accessed with a class 2 master.

The parameters that can be used in the E+H operating program (FieldCare) are shown in the tables in chapter 11.

Note the following for MS2AC communication:

- As already explained, a class 2 master accesses a device via special SAPs. Therefore, the number of class 2 masters that can communicate simultaneously with a device will depend on the number of SAPs made available for this communication.
- The use of a class 2 master increases the cycle time of the bus system. This must be taken into account when programming the control system used or control.

6.6.2 Class 1 master acyclic (MS1AC)

In the case of MS1AC, a cyclic master, which is already reading the cyclic data from the device or writing the data to the device, opens the communication channel via the SAP 0x33 (special service access point for MS1AC) and can then, like a Class 2 master, acyclically read or write a parameter by means of the slot and the index (if supported).

The following should be noted with MS1AC communication:

- At present, there are very few PROFIBUS masters on the market that support this kind of communication.
- Not all PROFIBUS devices support MS1AC.
- In the user program, you must be aware that constant parameter writing (e.g. with every program cycle) can drastically reduce the operating life of a device. Parameters written acyclically are written to memory modules (EEPROM, Flash, etc.). These are resistant to voltage. These memory modules are only designed for a limited number of writes. This number of writes is not even nearly reached in normal operation without MS1AC (during configuration). This maximum figure can be quickly reached as a result of incorrect programming and thus the operating time of a device can be drastically reduced.

The device supports MS2AC communication with 2 available SAPs. MS1AC communication is supported by the device. The memory module is designed for 10⁶ writes.

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. Detailed information on the order code in question can be obtained from your service organization. When ordering accessories, please specify the serial number of the device!

Type			Order number
Field housing TAF10			51005883
DIN rail clip according to IEC 60715 for head transmitter mounting			51000856
Standard - DIN mounting set (2 screws + springs, 4 securing disks and 1 display connector cover)			71044061
US – M4 mounting screws (2 screws M4 and 1 display connector cover)			71044062
Fieldbus connector (PROFIBUS® PA)	Threaded connection ■ M20x1,5 ■ NPT ½" ■ M20x1,5	Cable connecting thread ■ M12 ■ M12 ■ 7/8"	
			71090687
			71005802
			71089147
Display TID10 for Endress+Hauser head transmitters iTEMP® TMT8x, pluggable; dot-matrix display; DIP switch for hardware setting			TID10-**

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.



Note!

Due to its design, the device cannot be repaired. However, it is possible to send the device in for examination. Please refer to → 44 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, → 11
	3. If available, test the display module with other suitable E+H head transmitters
	4. Display module defective → Replace module
	5. Head transmitter defective → Replace transmitter



Onsite error messages on the display

→ Chap. 9.3



Faulty connection to the fieldbus host system

No connection can be made between the fieldbus host system and the device. Check the following points:

Fieldbus connection	Check the data cable
Fieldbus connector (optional)	Check pin assignment/wiring, → 18
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 length and number of spurs → 15

Basic current	Is there a basic current of min. 11 mA?
Terminating resistors	Has the PROFIBUS® PA segment 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 transfer.
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 PROFIBUS® PA configuration system	
→ Chap. 9.3	



Other errors (application errors without messages)	
Some other error has occurred.	Possible causes and remedial measures → Chap. 9.4

9.2 Displaying the device status on the PROFIBUS® PA

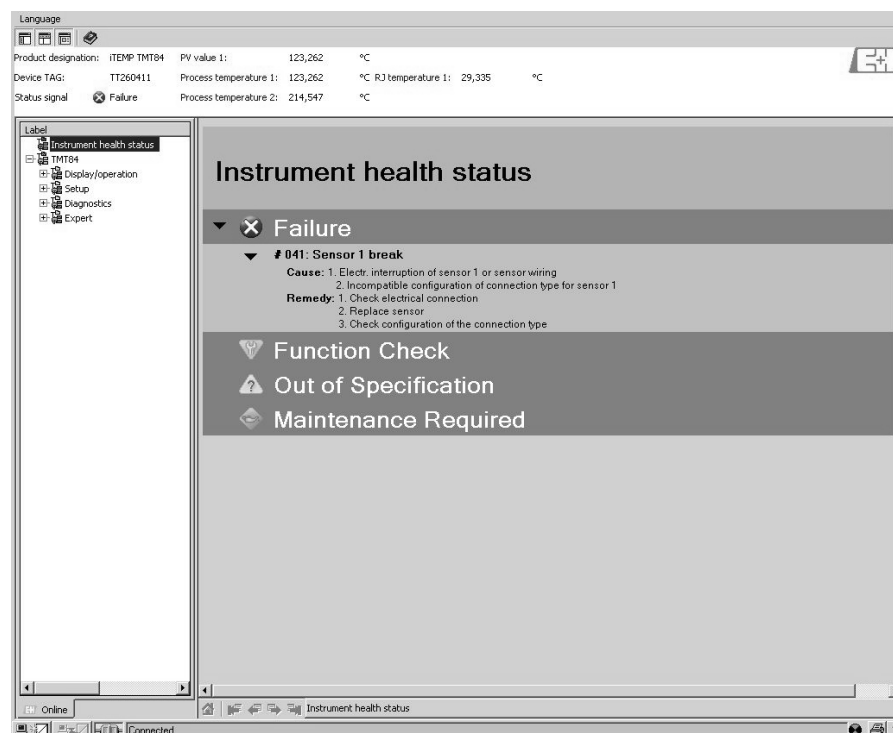
9.2.1 Display in the operating program (acyclical data transfer)

The device status can be queried using an operating program, see chapter 11.2.3: EXPERTS → DIAGNOSTICS → STATUS).

9.2.2 Display in the FieldCare diagnostic module (acyclical data transfer)

Using the startup screen of an online connection to the device, the general device status as per NAMUR NE107 can be quickly determined. All diagnostic messages for the measuring point have been classified into four categories (Failure, Function Check, Out of Specification, Maintenance Required), thereby providing the user with information on the cause and possible corrective measures. If there is no diagnostic message, the status signal "ok" appears.

The graphic shows a failure caused by a line break at sensor 1:



9.2.3 Display in the PROFIBUS® master system (cyclical data transfer)

If the AI module is configured for cyclical data transfer, the device status is coded according to PROFIBUS profile specification 3.02²⁾ and transferred, together with the measured value via the quality byte (byte 5), to the PROFIBUS master (class 1). The quality byte is divided into the segments quality status, quality substatus and limits (limit values).

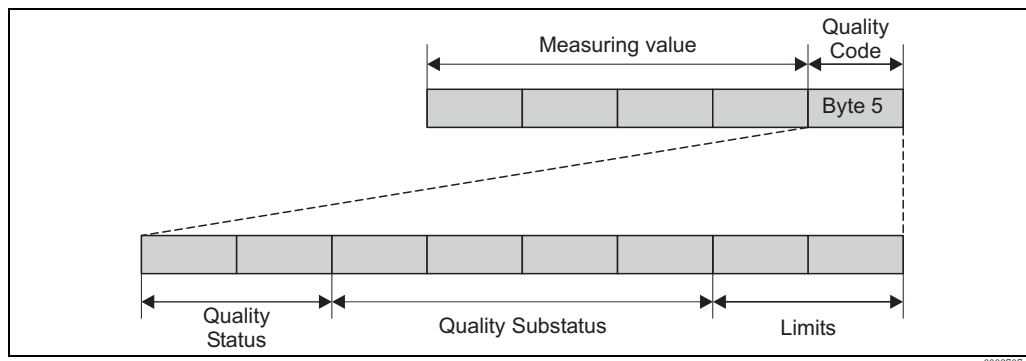


Fig. 15: Structure of the quality byte

The contents of the quality byte of an analog input function block depends on its configured failsafe mode. Depending on the failsafe mode configured in the FAILSAFE MODE function, the following status information is transferred to the PROFIBUS master (class 1) via the quality byte:

FAILSAFE MODE as per profile 3.01

When you select FAILSAFE MODE → FAILSAFE VALUE:

Quality code (HEX)	Quality status	Quality substatus	Limits
0x48 0x49 0x4A	UNCERTAIN	Substitute set	OK Low High

When you select FAILSAFE MODE → LAST GOOD VALUE (default value)

Valid output value before error				No valid output value before error			
Quality code (hex)	Quality status	Quality substatus	Limits	Quality code (hex)	Quality status	Quality substatus	Limits
0x44 0x45 0x46	UNCERTAIN	Last usable value	OK Low High	0x4C 0x4D 0x4E	UNCERTAIN	Initial value	OK Low High

When you select FAILSAFE MODE → WRONG VALUE: status messages (→ 38).



Note!

The FAILSAFE MODE function can be configured in the relevant analog input function block, i.e. 1 to 4, using an operating program (e.g. FieldCare).

2) As per profile 3.01: profile GSD files used or IDENT_NUMBER_SELECTOR set to {0, 129, 130 or 131} or TMT84 GSD file used or IDENT_NUMBER_SELECTOR set to 1 and "CondensedStatus" parameter to OFF.
As per profile 3.02: TMT84 GSD file used or IDENT_NUMBER_SELECTOR set to 1 and "CondensedStatus" parameter to ON. If IDENT_NUMBER_SELECTOR = 127, the GSD file used for establishing the cyclical data exchange determines whether diagnosis is according to profile 3.01 or profile 3.02.

FAILSAFE MODE as per profile 3.02

Input	Result		
State before Fail Safe Mechanism (FB-Input)	FSAFE_TYPE 0 (Failsafe Value)	FSAFE_TYPE 1 (Last usable value)	FSAFE_TYPE 2 (wrong calculated value)
BAD - non specific (not generated by the device)	-	-	-
BAD - passivated	BAD - passivated	BAD - passivated	BAD - passivated
BAD - maintenance alarm	UNCERTAIN - substitute set	UNCERTAIN - substitute set	BAD - maintenance alarm
BAD - process related	UNCERTAIN - process related	UNCERTAIN - process related	BAD - process related
BAD - function check	UNCERTAIN - substitute set	UNCERTAIN - substitute set	BAD - function check

9.3 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 is done in the configuration program by means of the parameter in the Physical Block or on the attached 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" or "UNCERTAIN" for the measured value. The fault state is displayed in the form of the letter "F" plus a defined number.



Note!

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 = secondary value 1 = sensor value 1 in temperature transducer block 1 = sensor value 2 in temperature transducer block 2
- SV2 = secondary value 2 = sensor value 2 in temperature transducer block 1 = sensor value 1 in temperature transducer block 2
- PV1 = Primary value 1
- PV2 = Primary value 2
- RJ1 = Reference junction 1
- RJ2 = Reference junction 2

9.3.1 Category F diagnostics code messages

Category	No.	Status messages – In physical block – Diagnostics code – Advanced diagnostics – Local display	Sensor Transducer Block measured value status 1 = Status (profile 3.01/3.02) 2 = Quality 3 = Substatus (profile 3.01/3.02) 4 = Limits	Cause of error/remedy	Output variables affected
F-	041	Device status messages (PA): Cable open circuit F-041 Local display: F041	1 = 0x10*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	Cause of error: 1. Electrical interruption of sensor or sensor wiring 2. Incorrect configuration of connection type in the CONNECTION TYPE parameter. Remedy: Re 1.) Reestablish electrical connection or replace sensor. Re 2.) Configure correct type of connection.	SV1, SV2 also PV1, PV2 depending on the configuration
F-	042	Device status messages (PA): Sensor Corrosion F-042 Local display: F042	1 = 0x10*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	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
F-	043	Device status messages (PA): Sensor Short Circuit F-043 Local display: F043	1 = 0x10*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	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
F-	103	Device status messages (PA): Sensor Drift F-103 Local display: F103	1 = 0x10*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	Cause of error: Sensor drift has been detected (according to the settings in the Transducer Blocks). Remedy: Check the sensor, depending on the application.	PV1, PV2 SV1, SV2
F-	221	Device status messages (PA): Reference Temperature Measurement F-221 Local display: F221	1 = 0x0C*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	Cause of error: Internal reference junction defective. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, RJ1, RJ2
F-	261	Device status messages (PA): Electronics Error F-261 Local display: F261	1 = 0x0C*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	Cause of error: Error in the electronics. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, RJ1, RJ2
F-	283	Device status messages (PA): Memory Error F-283 Local display: F283	1 = 0x0C*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	Cause of error: Error in memory. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, RJ1, RJ2
F-	431	Device status messages (PA): Calibration Incorrect F-431 Local display: F431	1 = 0x0C*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	Cause of error: Error in calibration parameters. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, RJ1, RJ2
*) see note on → 42					

Category	No.	Status messages – In physical block – Diagnostics code – Advanced diagnostics – Local display	Sensor Transducer Block measured value status 1 = Status (profile 3.01/3.02) 2 = Quality 3 = Substatus (profile 3.01/3.02) 4 = Limits	Cause of error/remedy	Output variables affected
F-	437	Device status messages (PA): Configuration Incorrect F-437 Local display: F437	1 = 0x0C*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	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
F-	502	Device status messages (PA): Linearization Error F-502 Local display: F502	1 = 0x0C*/0x24* 2 = BAD 3 = Sensor Failure/Maintenance alarm, more diagnostics available 4 = OK	Cause of error: Error in linearization. Remedy: Select valid type of linearization (sensor type).	SV1, SV2, PV1, PV2, RJ1, RJ2
*) see note on → 42					

9.3.2 Category M diagnostics code messages

Category	No.	Status messages – In physical block – diagnostics code – Advanced diagnostics – Local display	Sensor Transducer Block measured value status 1 = Status (profile 3.01/3.02) 2 = Quality 3 = Substatus (profile 3.01/3.02) 4 = Limits	Cause of error/remedy	Output variables affected
M-	042	Device status messages (PA): Corrosion M-042 Local display: M042	1 = 0x50*/0xA4* 2 = UNCERTAIN/GOOD 3 = Sensor conversion not accurate/ Maintenance required/demanded 4 = OK	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
M-	103	Device status messages (PA): Drift M-103 Local display: M103	1 = 0x10*/0xA4* 2 = UNCERTAIN/GOOD 3 = non specific/Maintenance required/ demanded 4 = OK	Cause of error: Sensor drift has been detected (according to the settings in the Transducer Blocks). Remedy: Check the sensor, depending on the application.	PV1, PV2 SV1, SV2
M-	262	Device status messages (PA): Display Communication Error M-262 Local display: M262	 Note! Does not affect status of measured value	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 E+H head transmitters - Display module defective → Replace module	SV1, SV2, PV1, PV2, RJ1, RJ2
*) see note on → 42					

9.3.3 Category S diagnostics code messages

Category	No.	Status messages – In physical block – diagnostics code – Advanced diagnostics – Local display	Sensor Transducer Block measured value status 1 = Status (profile 3.01/3.02) 2 = Quality 3 = Substatus (profile 3.01/3.02) 4 = Limits	Cause of error/remedy	Output variables affected
S-	101	Device status messages (PA): Sensor Measuring Range Undershot S-101 Local display: S101	1 = 0x50*/0x78* 2 = UNCERTAIN 3 = Sensor conversion not accurate/Process related, no maintenance 4 = OK	Cause of error: Physical measuring range undershot. Remedy: Select suitable sensor type.	SV1, SV2 also PV1, PV2 depending on the configuration
S-	102	Device status messages (PA): Sensor Measuring Range Overshot S-102 Local display: S102	1 = 0x50*/0x78* 2 = UNCERTAIN 3 = Sensor conversion not accurate/Process related, no maintenance 4 = OK	Cause of error: Physical measuring range overshoot. Remedy: Select suitable sensor type.	SV1, SV2 also PV1, PV2 depending on the configuration
S-	901	Device status messages (PA): Ambient Temperature too Low S-901 Local display: S901	1 = 0x40*/0x78* 2 = UNCERTAIN 3 = Non specific/Process related, no maintenance 4 = OK	Cause of error: Reference junction temperature < -40 °C (-40 °F); parameter Ambient Temperature Alarm = On. Remedy: Observe ambient temperature as per specification.	SV1, SV2, PV1, PV2, RJ1, RJ2
S-	902	Device status messages (PA): Ambient Temperature too High S-902 Local display: S902	1 = 0x40*/0x78* 2 = UNCERTAIN 3 = Non specific/Process related, no maintenance 4 = OK	Cause of error: Reference junction temperature < +85 °C (+185 °F); parameter Ambient Temperature Alarm = On. Remedy: Observe ambient temperature as per specification.	SV1, SV2, PV1, PV2, RJ1, RJ2

*) see note on → 42

9.3.4 Category C diagnostics code messages

Category	No.	Status messages – In physical block – diagnostics code – Advanced diagnostics – Local display	Sensor Transducer Block measured value status 1 = Status (profile 3.01/3.02) 2 = Quality (profile 3.01/3.02) 3 = Substatus (profile 3.01/3.02) 4 = Limits	Cause of error/remedy	Output variables affected
C-	402	Device status messages (PA): Startup Initialization C-402 Local display: C402 ↔ Measured Value	1 = 0x4C*/0x3C* 2 = UNCERTAIN/BAD 3 = Init value/function check/local override 4 = OK	Cause of error: Device starting/initializing. Remedy: Message is only displayed during power-up.	SV1, SV2, PV1, PV2, RJ1, RJ2
C-	482	Device status messages (PA): Simulation Active C-482 Local display: C482 ↔ Measured Value	1 = 0x70*/0x73(0x074) 2 = UNCERTAIN 3 = Init value/simulated value, start (end) 4 = OK	Cause of error: Simulation is active. Remedy: –	

*) see note on → 42

Category	No.	Status messages – In physical block – diagnostics code – Advanced diagnostics – Local display	Sensor Transducer Block measured value status 1 = Status (profile 3.01/3.02) 2 = Quality (profile 3.01/3.02) 3 = Substatus (profile 3.01/3.02) 4 = Limits	Cause of error/remedy	Output variables affected
C-	501	Device status messages (PA): Device Reset C-501 Local display: C501 ↔ Measured Value	1 = 0x4C*/0x4F 2 = UNCERTAIN 3 = Init value/-- 4 = OK	Cause of error: Device reset is performed. Remedy: Message is only displayed during reset.	SV1, SV2, PV1, PV2, RJ1, RJ2
*) see note on → 42					

**Note!**

The specified status can increase by the value 1 (low limit), 2 (high limit) or 3 (constant) due to a limit violation. The increase of the status value can result from a limit violation of the error directly displayed or be transferred from a low-priority error when more than one status occurs simultaneously.

Example:

Error (E)	Quality (BAD)		Quality Substatus			Limits		
	0	0	1	0	0	1	x	x
	= 0x24 0x27							

9.3.5 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.

**Note!**

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

2 different stages can be selected in the CORROSION_DETECTION parameter (see chapter 11) depending on the application requirements:

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

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	—	No alarm	No alarm
on	—	WARNING (M-042)	ALARM (F-042)

TC	< ≈ 10 kΩ	10 kΩ ≈ < x < ≈ 15 kΩ	> ≈ 15 kΩ
off	—	No alarm	No alarm
on	—	WARNING (M-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.

9.4 Application errors without messages

9.4.1 Application errors for RTD connection

Sensor types, → Page 46.

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 (→ 13)
	Programming	Incorrect sensor type set in the SENSOR_TYPE device function; change to the correct sensor type
	Device defective	Replace device

9.4.2 Application errors for TC connection

Sensor types, see page → 46.

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 measuring point set	See chapter 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, → 13)
	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

9.5 Spare parts

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

Type	Order number
Adapter for top-hat rail mounting, DIN rail clip according to IEC 60715	51000856
Standard - DIN securing set (2 screws and springs, 4 shaft lock-down rings, 1 plug for the display interface)	71044061
US - M4 securing set (2 screws and 1 plug for the display interface)	71044062

9.6 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.

9.7 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.

9.8 Firmware/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.

Date	Firmware version	Modifications	Documentation
07/2008	1.00.zz	Original firmware/software	BA257R/09/en/07.08 71076269
06/2011	1.01.zz	PROFIBUS Profile 3.02 update	BA00257R/09/en/01.11 71137264

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 ($\alpha = 0.00385$) As per JIS C1604-81 ($\alpha = 0.003916$) As per DIN 43760 ($\alpha = 0.006180$) As per Edison Copper Winding No.15 ($\alpha = 0.004274$) As per Edison Curve ($\alpha = 0.006720$) As per GOST ($\alpha = 0.003911$) As per GOST ($\alpha = 0.004278$)	Pt100	-200 to 850 °C (-328 to 1562 °F)
	Pt200	-200 to 850 °C (-328 to 1562 °F)
	Pt500	-200 to 250 °C (-328 to 482 °F)
	Pt1000	-200 to 250 °C (-238 to 482 °F)
	Pt100	-200 to 649 °C (-328 to 1200 °F)
	Ni100	-60 to 250 °C (-76 to 482 °F)
	Ni1000	-60 to 150 °C (-76 to 302 °F)
	Cu10	-100 to 260 °C (-148 to 500 °F)
	Ni120	-70 to 270 °C (-94 to 518 °F)
	Pt50 Pt100	-200 to 1100 °C (-328 to 2012 °F) -200 to 850 °C (-328 to 1562 °F)
	Cu50, Cu100	-200 to 200 °C (-328 to 392 °F)
	Pt100 (Callendar Van Dusen)	10 to 400 Ω 10 to 2000 Ω
	Nickel polynomial	10 to 400 Ω 10 to 2000 Ω
	Copper polynomial	10 to 400 Ω 10 to 2000 Ω
	■ Connection type: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA ■ With 2-wire circuit, compensation of wire resistance possible (0 to 30 Ω) ■ With 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)	0 to +1820 °C (32 to 3308 °F)
	Type E (NiCr-CuNi)	-270 to +1000 °C (-454 to 1832 °F)
	Type J (Fe-CuNi)	-210 to +1200 °C (-346 to 2192 °F)
	Type K (NiCr-Ni)	-270 to +1372 °C (-454 to 2501 °F)
As per ASTM E988	Type N (NiCrSi-NiSi)	-270 to +1300 °C (-454 to 2372 °F)
	Type R (PtRh13-Pt)	-50 to +1768 °C (-58 to 3214 °F)
	Type S (PtRh10-Pt)	-50 to +1768 °C (-58 to 3214 °F)
	Type T (Cu-CuNi)	-270 to +400 °C (-454 to 752 °F)
As per DIN 43710	Type C (W5Re-W26Re)	0 to +2315 °C (32 to 4199 °F)
	Type D (W3Re-W25Re)	0 to +2315 °C (32 to 4199 °F)
As per DIN 43710	Type L (Fe-CuNi)	-200 to +900 °C (-328 to 1652 °F)
	Type U (Cu-CuNi)	-200 to +600 °C (-328 to 1112 °F)
■ 2-wire connection ■ Internal reference junction (Pt100, class A) ■ External reference junction: value adjustable -40 to +85 °C (-40 to +185 °F) ■ Maximum sensor resistance 10kΩ (if sensor resistance is greater than 10kΩ, an error message as per NAMUR NE89 is output)		
Voltage transmitter (mV)	Millivolt transducer (mV)	-20 to 100 mV -5 to 30 mV

Input signal

Input data: The head transmitter is able to receive a cyclic value and its status sent by a master via PROFIBUS® PA. That value and status is represented and can be read acyclically.

10.0.2 Output

Output signal

- PROFIBUS® PA in accordance with EN 50170 Volume 2, IEC 61158-2 (MBP), galvanically isolated; Amendment 2 “Condensed status and diagnostic messages” Amendment 3 “Identification and Maintenance Functions”
- FDE (Fault Disconnection Electronic) = 0 mA
- Data transmission rate: supported baud rate = 31.25 kBit/s
- Signal coding = Manchester II
- Output data:
Available values via AI blocks: temperature (PV), temp sensor 1 + 2, terminal temperature
- In a control system the head transmitter always operates as a slave and, dependent on the application, can exchange data with one or more masters.
- In accordance with IEC 60079-27, FISCO/FNICO

Breakdown information

Status message in accordance with PROFIBUS® PA Profile 3.01/3.02 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, polarity-independent (max. voltage $U_b = 35$ V)

10.0.4 Performance characteristics

Response time 1 s per channel

Reference operating conditions

- Calibration temperature: $+25^{\circ}\text{C} \pm 5\text{ K}$ ($77^{\circ}\text{F} \pm 9^{\circ}\text{F}$)
- Supply voltage: 24V DC
- 4-wire connection for resistance adjustment

Resolution Resolution A/D converter = 18 bit

Maximum measured error



Note!

The accuracy data are typical values and correspond to a standard deviation of $\pm 3\sigma$ (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	$\pm 0.04\ \Omega$ $\pm 0.8\ \Omega$
Voltage transmitters (mV)	-20 to 100 mV	$\pm 10\ \mu\text{V}$

Sensor transmitter matching

RTD sensors are among the most linear temperature elements for measurement. However, the output must still be linearized. The device provides two methods to improve significantly temperature measurement accuracy:

- 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 adjust the sensor (platinum) and transducer to improve the accuracy of the measuring system. The coefficients are specified in IEC 751 for a standard sensor. If no standard sensor is available, or a higher level of accuracy is required, specific coefficients can be determined for each sensor with the aid of sensor calibration.

- Linearization for copper/nickel resistance thermometers (RTD):

The equations of the polynomial for nickel are described as:

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

The equations for copper, in conjunction with the 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)

The coefficients A, B and C are used to linearize nickel and copper resistance thermometers (RTD). The exact values of the coefficients are derived 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 the sensors		Non-repeatability
10 to 400 Ω	Cu10, Cu50, Cu100, Pt50, Pt100, Ni100, Ni120	15mΩ
10 to 2000 Ω	Pt200, Pt500, Pt1000, Ni1000	100 ppm x measured value
-20 to 100mV	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)

Effect on the accuracy when the ambient temperature changes by 1K (1.8°F):	
Input 10 to 400 Ω	0.001% of the measured value, min. 1mΩ
Input 10 to 2000 Ω	0.001% of the measured value, min. 10mΩ
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 _{nominal} /K	Cu: 0.0043 * R _{nominal} /K	Ni: 0.00617 * R _{nominal} /K

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

Typical sensitivity of thermocouples					
B: 9 μV/K at 1000 °C (1832 °F)	C: 18 μV/K at 1000 °C (1832 °F)	D: 20 μV/K at 1000 °C (1832 °F)	E: 81 μV/K at 500 °C (932 °F)	J: 56 μV/K at 500 °C (932 °F)	K: 43 μV/K at 500 °C (932 °F)
L: 60 μV/K at 500 °C (932 °F)	N: 38 μV/K at 500 °C (932 °F)	R: 13 μV/K at 1000 °C (1832 °F)	S: 11 μV/K at 1000 °C (1832 °F)	T: 46 μV/K at 100 °C (212 °F)	U: 70 μV/K at 500 °C (932 °F)

Examples for the calculation of the maximum measured error when there is a drift in ambient temperature

Example 1:

Input temperature drift Δθ = 10K (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 (s. IEC 60751) at maximum process temperature

Typical temperature drift in Ω: (0.001% of 138.5 Ω) * 10 = 0.01385 Ω

Conversion in: $0.01385\Omega / 0.385 \Omega/K = 0.04 \text{ K } (0.054^\circ\text{F})$

Example 2:

Input temperature drift $\Delta\theta = 10\text{K } (18^\circ\text{F})$, thermocouple type K

Measuring range 0 to $600^\circ\text{C } (32 \text{ to } 1112^\circ\text{F})$

Maximum process value: $600^\circ\text{C } (1112^\circ\text{F})$

Measured thermoelectric voltage: $24905 \mu\text{V}$ (s. IEC584)

Typical temperature drift in μV : $(0.001\% \text{ of } 24905 \mu\text{V}) * 10 = 2.5 \mu\text{V}$

Conversion in K: $2.5 \mu\text{V} / 43 \mu\text{V/K} = 0.06 \text{ K } (0.11^\circ\text{F})$

Total measurement uncertainty of the measuring point

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

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

Example for calculating the total measurement uncertainty of a thermometer:

Ambient temperature drift $\Delta\theta = 10\text{K } (18^\circ\text{F})$, Pt100 class A, measuring range 0 to $100^\circ\text{C } (32 \text{ to } 212^\circ\text{F})$, maximum process temperature: $100^\circ\text{C } (212^\circ\text{F})$, $k = 2$

- Basis maximum measured error: **0.1 K (0.18°F)**
- Maximum measured error through drift in ambient temperature: **0.04 K (0.072°F)**
- Maximum measured error of the sensor: $0.15 \text{ K } (0.27^\circ\text{F}) + 0.002 * 100^\circ\text{C } (212^\circ\text{F}) = \mathbf{0.35 \text{ K } (0.63^\circ\text{F})}$

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

Influence of reference junction (cold junction)	Pt100 DIN EN 60751 cl. A, accuracy $\pm 1 \text{ K } (\pm 1.8^\circ\text{F})$, internal reference junction for thermocouples TC
---	--

10.0.5 Environment

Ambient temperature range	$-40 \text{ to } +85^\circ\text{C } (-40 \text{ to } +185^\circ\text{F})$, see Ex documentation (XA, CD) for hazardous area and chapter 'Approvals'
Storage temperature	$-40 \text{ to } +100^\circ\text{C } (-40 \text{ to } 212^\circ\text{F})$
Altitude	Up to 4000m (4374.5 yards) above sea level in accordance with IEC 61010-1, CSA 1010.1-92
Climate class	As per IEC 60654-1, class C
Humidity	■ Condensation permitted as per IEC 60 068-2-33 ■ 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 at 5g as per IEC 60 068-2-6

Electromagnetic compatibility (EMC)

CE EMC compliance

The device meets all of the requirements mentioned in IEC 61326-1, 2007 and NAMUR NE 21:2006.

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

Measurement 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.

Pollution degree

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

Data in mm (in)

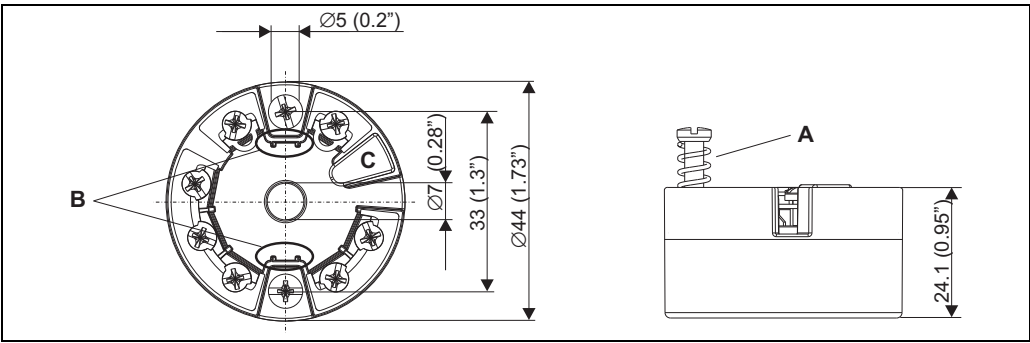


Fig. 16: Version with screw terminals

Item A: Spring travel $L \geq 5$ mm (not relevant for US - M4 securing screws)

Item B: Securing elements for attachable measured value display

Item C: Interface for measured value display contacting

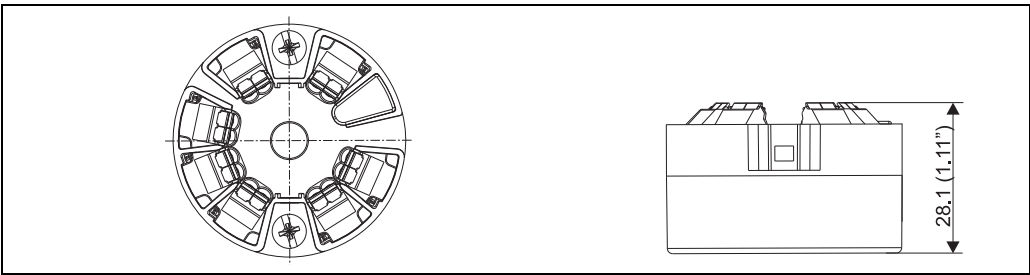


Fig. 17: Version with spring terminals. The same dimensions except for height of housing.

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 (0.39")	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)



Note!

No ferrules have to be used when connecting flexible wires to spring terminals.

10.0.7 Certificates and approvals

CE mark The device meets the legal requirements of EU Directives. Endress+Hauser confirms positive completion of all tests by fitting the device with a CE mark.

Ex approval Contact your Endress+Hauser sales office for information on Ex versions currently available (ATEX, FM, CSA, etc.). All data relating to explosion protection can be found in separate Ex documentation which you can request if required.

External standards and directives

- IEC 60529: Degrees of protection by enclosure (IP code)
- IEC 61158-2: Fieldbus standard
- IEC 61326-1:2007: Electromagnetic compatibility (EMC requirements)
- IEC 60068-2-27 and IEC 60068-2-6: Shock and vibration resistance
- NAMUR Standardization association for measurement and control in chemical industries

UL Recognized component to UL61010-1

CSA GP CSA General Purpose

Certification PROFIBUS® PA The temperature transmitter has successfully passed all test procedures and is certified and registered by the PNO (PROFIBUS® user organization e.V.). The device thus meets all the requirements of the specifications following:

- Certified according to PROFIBUS® PA Profile 3.02
- The device can also be operated with certified devices of other manufacturers (interoperability)

10.0.8 Documentation

Additional Ex documentation:

- ATEX II1G: XA069R/09/a3
- ATEX II3G: XA073R/09/a3
- ATEX II3D: XA074R/09/a3

11 Operation using PROFIBUS® PA

The operation is geared towards the user role of the operator in question and groups the operating parameters into appropriate operating menus.

Two setup modes are available in this user-oriented operating system: The "Standard" setup and the "Expert" setup.

All the basic settings that are needed to operate the device can be made in the Standard setup mode. The "Expert" setup is reserved for experienced users or service staff. All the configuration options of the "Standard" setup are available in the "Expert" setup mode. In addition, additional parameters make it possible to make special device settings in this mode. Besides these two menu items, the Display/Operation menus are available for configuring the optional display and the Diagnostics menu is available for system and diagnostics information.

The device parameters are explained in the following chapter using the user-oriented operating system. All the device parameters that are not listed in this operating structure can only be modified with the aid of appropriate tools and the information in the slot index lists (→ Chapter 11.4).

11.1 Operating structure

→ Display/operation → Page 54

→ Setup → Page 56

→ Diagnostics → Page 63

→ Expert → Page 67

→ Advanced setup → Page 60	→ Sensor 1	
	→ Sensor 2	
	→ Security settings	
→ System information → Page 63		
→ Measured value → Page 64	→ Min./max. values	
→ Device test/reset → Page 66		
→ System → Page 67	→ Display	
→ Sensory mechanism → Page 69	→ Sensor 1	→ Special linearization 1
	→ Sensor 2	→ Special linearization 2
→ Communication → Page 75	→ Analog Input 1	
	→ Analog Input 2	
	→ Analog Input 3	
	→ Analog Input 4	
→ Diagnostics → Page 85	→ System information	
	→ Measured value	→ Min./max. values
	→ Device test/reset	

11.2 Standard setup

The following parameter groups are available in the standard setup. These parameters are used for basic device configuration. The head transmitter can be put into operation with this limited parameter set.

11.2.1 Group Display/Operation

The settings for displaying the measured value on the optional TID10 plug-in display are made in the Display/Operation menu. The following parameters can be found in the **Display/Operation** group and under Expert → System → Display.



Note!

These settings do not have any effect on the output values of the transmitter. They are only used to configure how information is shown on the display.

Display/operation			
Menu item	Parameter		
"Display/operation" (Expert- → System → Display)	Name	Parameter access	Description
	Alternating time	read/ write	Entry (in s) as to how long a value should be shown on the display. Setting from 4 to 60 s. Factory settings: 6 s
	Display source n	read/ write	For selecting the value to be displayed. Possible settings: ■ Off ■ Primary Value 1 ■ Sensor Value 1 ■ Primary Value 2 ■ Sensor Value 2 ■ RJ Value Factory settings: Primary Value 1 Note! 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 'Characterization type 1'), primary value 2 is displayed.
	Display value description n	read/ write	Description of the display value displayed. Factory settings: "P1" Note! Maximum 16 letters. The value is not shown on the display.

Menu item	Display/operation		
	Parameter		
"Display/operation" (Expert- → System → Display)	Name	Parameter access	Description
	Display format n	read/ write	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: - 0 - xxxxx - 1 - xxxx.x - 2 - xxx.xx - 3 - xx.xxx - 4 - Auto Factory settings: 1 - xxxx.x

n = Number of display channels (1 to 4)

Configuration example:

The following measured values should be shown on the display:

■ Value 1:

Measured value to be displayed: Primary Value 1
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 2 (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/Operation" operating menu

Parameter	Value
Alternating time	12
Display source 1	'Primary Value 1'
Display value description 1	TEMP PIPE 11
Display format 1	'xxx.xx'
Display source 2	'RJ Value'
Display value description 2	INTERN TEMP
Display format 2	'xxxx.x'
Display source 3	'Sensor value 2'
Display value description 3	PIPE 11 BACK
Display format 3	'xxx.xx'

11.2.2 Group Setup

Information on the device mode, such as the target mode, and parameters for the basic configuration of the measuring inputs, such as the sensor type. All the settings that are needed to operate the device can be made in the Standard setup mode. The individual parameters are summarized in the Setup menu:

Standard setup	Basic settings for the measuring inputs that are needed to commission the device.
Advanced setup	Configuration of special diagnostics functions such as drift or corrosion detection.

→ Setup → Page 56

→ Advanced setup → Page 60

→ Sensor 1

→ Sensor 2

→ Security settings

Selecting the operating mode

The operating mode is set by means of the "Physical Block - target mode" parameter group (→ Page 57).

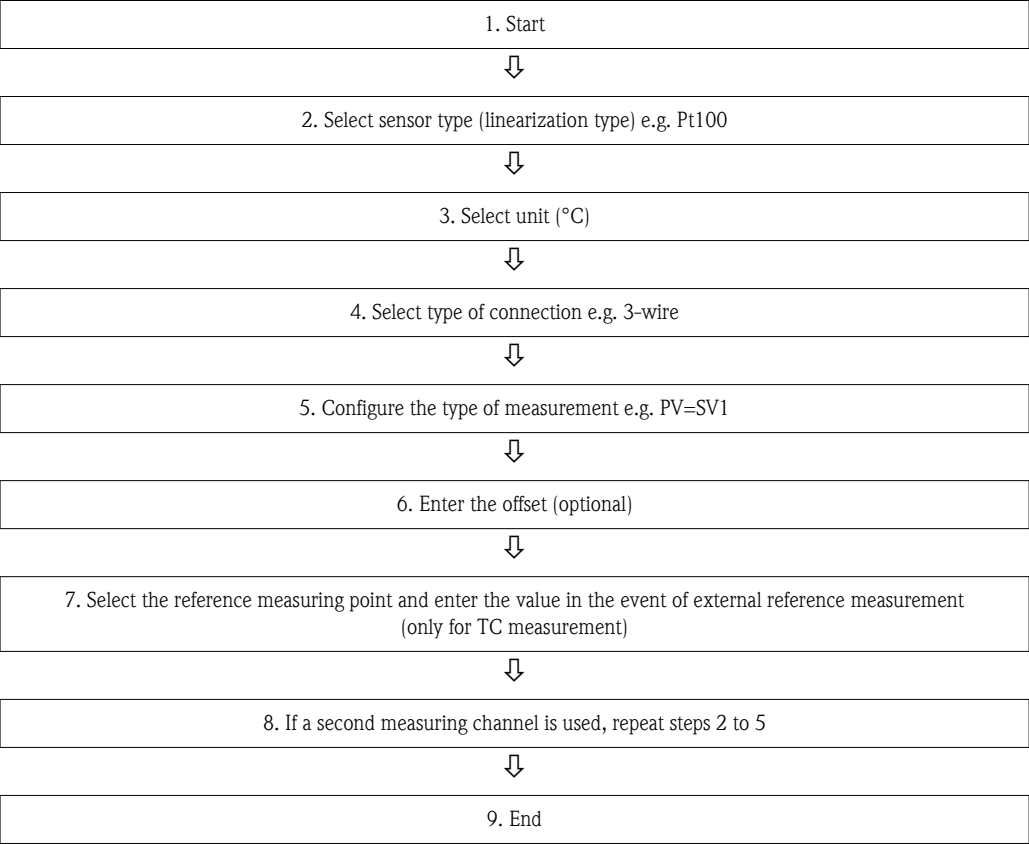
The Physical Block supports the following operating modes:

- AUTO (automatic mode)
- Out of Service (OOS)



Note!
OOS can only be configured if the Condensed Status and Diagnostics (as per Profile 3.01 Am2) are activated. Otherwise, only AUTO is supported.

Procedure for configuring a measuring input:



Setup			
Menu item	Parameter		
"Setup"	Name	Parameter access	Description
	Block Mode		General information on Block Mode Block Mode contains three elements: - the block's current operating mode (Actual Mode) - the modes supported by the block (Permitted Mode): Analog Input (AI): AUTO, MAN, OOS Physical Block: AUTO, OOS Transducer Block: AUTO - normal operating mode (Normal Mode) Only the current Block Mode is displayed in the menu. Generally, you can select from several operating modes in a function block, while other block types only operate in the AUTO operating mode for example.
	Physical Block - Actual Mode	read	Displays the current operating mode of the Physical Block.
	Physical Block - Target Mode	read/write	For selecting the required operating mode. Only automatic operation can be selected in the Physical Block. The Physical Block can also be set to OOS if diagnostics is enabled as per Profile 3.01 Am2 (Physical Block parameter "COND_STATUS_DIAG" = 1). Options: 0x08 - AUTO 0x80 - Out of Service (OOS) Factory settings: AUTO
	Characterization Type n	read/write	Configuration of the sensor type. - Characterization type 1: sensor input settings - Characterization type 2: sensor input 2 settings Factory settings: Channel 1: Pt100 IEC751 Channel 2: No sensor  Note! Please observe the terminal assignment in chapter 4.1 when connecting the individual sensors. In the case of 2-channel operation, the possible connection options in chapter 4.2 also have to be observed.
	Input Range and Mode n	read/write	Configuration of the input measurement range. 0: mV, range 1: -5 to 30 mV; range: -5 to 30 mV; min. span: 1 mV 1: mV, range 2: -20 to 100 mV; min. span: 1 mV 128: Ohm, range 1: 10 to 400 Ohm; min. span: 10 Ohm 129: Ohm, range 2: 10 to 2000 Ohm; min. span: 10 Ohm Factory settings: 128: Ohm, range 1: 10 to 400 Ohm; min. span: 10 Ohm

Setup			
Menu item	Parameter		
"Setup"	Name	Parameter access	Description
	Unit n	read/write	Configuration of temperature unit for PV value n Options: ■ 1000 - K ■ 1001 - °C ■ 1002 - °F ■ 1003 - Rk ■ 1281 - Ohm ■ 1243 - mV ■ 1342 - % Factory settings: ■ °C
	Connection type n	read/write	Sensor connection mode: Sensor Transducer 1 (Connection mode 1): ■ 0 - 2 wires ■ 1 - 3 wires ■ 2 - 4 wires Factory settings: 3 wires Sensor Transducer 2 (Connection mode 2): ■ 0 - 2 wires ■ 1 - 3 wires Factory settings: 3 wires

Setup			
Menu item	Parameter		
"Setup"	Name	Parameter access	Description
	Measuring type n	read/write	Displays the calculation process for Primary Value 1. Options: Sensor Transducer 1 (Measuring mode 1): ■ PV = SV1: Secondary value 1 ■ PV = SV1-SV2: Difference ■ PV = 0.5 x (SV1+SV2): Average ■ PV = 0.5 x (SV1+SV2) redundancy: Average or Secondary Value 1 or Secondary Value 2 in the event of a sensor error in the other sensor. ■ PV = SV1 (OR SV2): Backup function: If sensor 1 fails, the value of sensor 2 automatically becomes the Primary Value. ■ PV = SV1 (OR SV2 if SV1>T): PV changes from SV1 to SV2 if SV1 > value T (Parameter: Threshold value n) ■ PV =ABS(SV1-SV2) if PV> drift value: PV is the drift value between sensor 1 and sensor 2. If PV exceeds the configured drift value (Sensor drift alert value), a drift alarm is output. ■ PV =ABS(SV1-SV2) if PV< drift value: PV is the drift value between sensor 1 and sensor 2. If PV undershoots the configured drift value (Sensor drift alert value), a drift alarm is output. Factory settings: PV = SV1 Sensor Transducer 2 (Measuring mode 2): ■ PV = SV2: Secondary value 2 ■ PV = SV2-SV1: Difference ■ PV = 0.5 x (SV2+SV1): Average ■ PV = 0.5 x (SV2+SV1) redundancy: Average or Secondary Value 1 or Secondary Value 2 in the event of a sensor error in the other sensor. ■ PV = SV2 (OR SV1): Backup function: If sensor 2 fails, the value of sensor 1 automatically becomes the Primary Value. ■ PV = SV2 (OR SV1 if SV2>T): PV changes from SV2 to SV1 if SV2 > value T (Parameter: Threshold value n) ■ PV =ABS(SV1-SV2) if PV> drift value: PV is the drift value between sensor 1 and sensor 2. If PV exceeds the configured drift value (Sensor drift alert value), a drift alarm is output. ■ PV =ABS(SV1-SV2) if PV< drift value: PV is the drift value between sensor 1 and sensor 2. If PV undershoots the configured drift value (Sensor drift alert value), a drift alarm is output. Factory settings: PV = SV1 = Sensor 2
	2-wire compensation n	read/write	Two-wire compensation for RTDs. The following values are permitted: 0 to 30 Ohm Factory settings: 0
	Offset n	read/write	Offset for Primary Value 1 The following values are permitted: ■ -10 to +10 for Celsius, Kelvin, mV and Ohm ■ -18 to +18 for Fahrenheit, Rankine Factory settings: 0.0

Setup			
Menu item	Parameter		
"Setup"	Name	Parameter access	Description
	Threshold value n	read/ write	Value for switching in PV mode for sensor switching. Entry in the range of -270°C to 2200°C (-454°F to 3992°F). Factory settings: 0
	Reference Junction Type n	read/ write	Configuration of reference junction measurement for temperature compensation in thermocouples: ■ 0 - no reference: no temperature compensation is used. ■ 1 - internally measured reference junction: internal reference junction temperature is used for temperature compensation ■ 2 - external fixed value: "Ext. Reference Junction Temperature" is used for temperature compensation. Factory settings: Internally measured reference junction
	Ext. Reference Junction Temperature n	read/ write	Value for temperature compensation (see Reference Junction Type n). Factory settings: 0.0

n: Number of the Transducer Block (1-2) or the sensor input (1 or 2)

Submenu Setup - Advanced setup

Corrosion monitoring

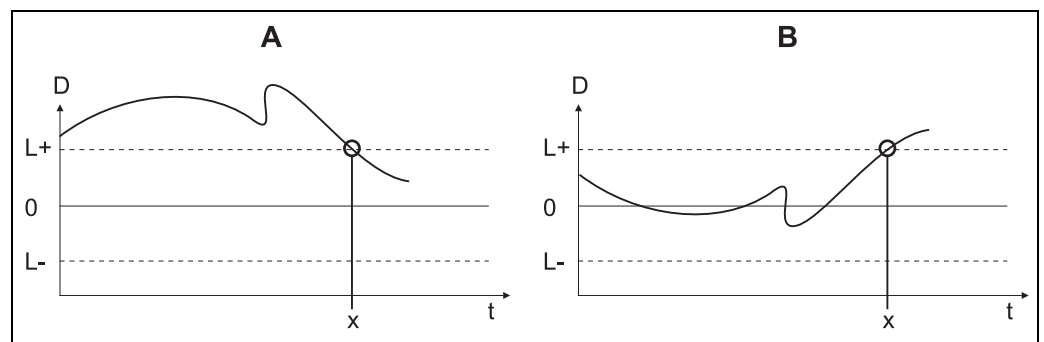
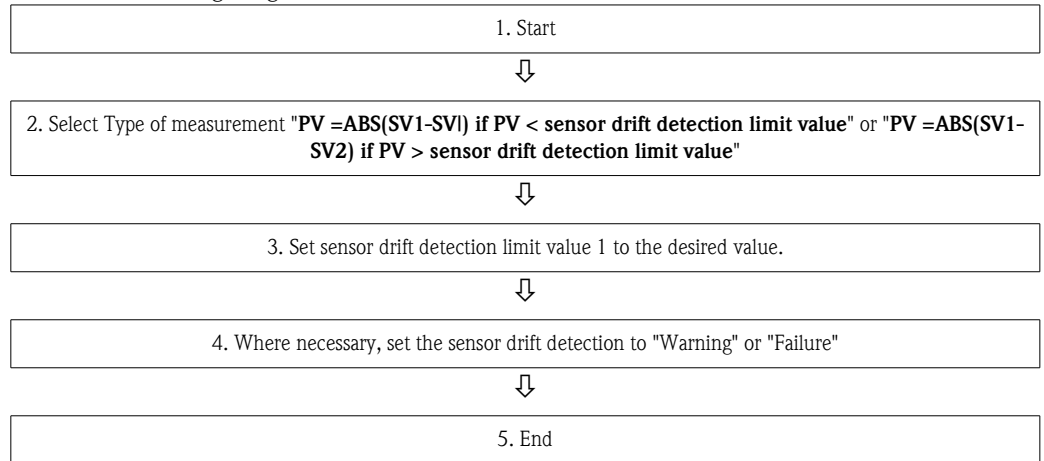
Sensor connection cable corrosion can lead to false measured value readings. Therefore the unit offers the possibility of recognizing any corrosion before a measured value is affected. Corrosion monitoring is only possible for RTDs with a 4-wire connection and thermocouples.

Sensor drift detection

If two sensors are connected and the measured values differ by a specified value, an error or a maintenance prompt (sensor drift detection) 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.

The drift detection can be activated with the Type of measurement parameter. A distinction is made between two separate modes. For the measuring mode "**PV =(ISV1-SV2I) if PV < sensor drift detection limit value**", a status message is output if the limit value is undershot or, in the case of "**PV =(ISV1-SV2I) if PV > sensor drift detection limit value**", if the limit value is overshot.

Procedure for configuring drift detection for sensor 1:



T09-TMT162FF-05-xx-xx-xx-003

Fig. 1: Drift detection

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

Write protection

Hardware write protection for the device parameters is enabled and disabled by means of a DIP switch on the rear of the optional display.

The **Hardware write protection** (→ Page 62) parameter shows the status of the hardware write protection. The following statuses are possible:

- 1 → Hardware write protection enabled, device data cannot be overwritten
- 0 → Hardware write protection disabled, device data can be overwritten



Note!

No software write protection is available to prevent all parameters being written acyclically.

n: Number of the Transducer Block (1-2) or the sensor input (1 or 2)

Advanced setup			
Menu item	Parameter		
"Setup" Submenu "Advanced setup"	Name	Parameter access	Description
	HW write protection	read	Displays the status of hardware write protection. Display: – 0 - Off → write protection disabled, parameters can be changed. – 1 - On → write protection enabled, parameters cannot be changed. Factory settings: 0
	Ambient alarm	read/ write	Status message in the event of the operating temperature of the transmitter being undershot or overshoot < -40°C (-40°F) or > +85°C (185°F): ■ 0 Maintenance: Int. temperature overshoot/undershoot results in warning. ■ 1 - Failure: Int. temperature overshoot/undershoot results in alarm. Factory settings: 0 - Maintenance
	Sensor drift monitoring	read/ write	Deviation between SV1 and SV2 is identified as an error (Failure) or as need for maintenance (Maintenance): ■ 1- FAILURE: (sensor deviation > Sensor drift alert value n) → Failure. Sensor drift is displayed as error ■ 0 - Warning: (sensor deviation > Sensor drift alert value n) → Warning. Sensor drift is displayed as warning Factory settings: Warning
	Sensor drift alert value n	read/ write	Configuration of the max. permitted measured value deviation between sensor 1 and sensor 2. This value is relevant if "PV =ABS(SV1-SV2) if PV< drift value" was selected for the measuring mode. Permitted deviation from 0.1 to 999. Factory settings: 999
	Corrosion detection n	read/ write	■ 0 - OFF: Corrosion detection off ■ 1 - ON: Corrosion detection on Factory settings: 0 - OFF  Note! Only possible for RTD 4-wire connection and thermocouples (TC).

11.2.3 Group Diagnostics

All the information that describes the device, the device status and the process conditions can be found in this group.

The individual parameters are summarized in the Diagnostics menu:

→ Diagnostics → Page 63	→ System information → Page 63	
	→ Measured value → Page 64	→ Min./max. values
	→ Device test/reset → Page 66	

System information	Standard Setup/Expert	Basic settings that are needed to operate the device.
Measured values → Min./max values	Standard Setup/Expert	Settings for the measuring input of channel 1 and channel 2.
Device test/reset	Standard Setup/Expert	Settings for special diagnostics functions such as drift or corrosion detection.

Diagnostics menu

Diagnostics			
Menu item	Parameter		
"Diagnostics" (Expert → Diagnostics)	Name	Parameter access	Description
	Current diagnostics	read	Displays the diagnostics code. The diagnostics code consists of the "Current status" and "Current error code". Example: F041 (Failure + sensor failure)
	Current diagnostics description	read	Displays the status information as description text, see chapter 9.3.
	Status channel	read	Displays where in the device the highest priority error occurs. 0: Device 1: Sensor 1 2: Sensor 2
	Status count	read	The number of status messages currently pending in the device.
	Device bus address	read	Displays the device bus address. Factory settings: 126

Submenu Diagnostics - System information

System information			
Menu item	Parameter		
"Diagnostics" Submenu "System information"	Name	Parameter access	Description
	Software Revision	read	Revision status of device firmware.
	Device serial Num	read¹	Displays the serial number of the device.
	Order code	read¹	Displays the device order code.
	Order identifier	read¹	Displays the order identification numbers as description for the device delivery status.

Menu item "Diagnostics" Submenu "System information"	System information		
	Parameter Name	Parameter access	Description
	Device TAG	read/ write	Entry of a user-specific text of max. 32 characters for unique identification and assignment of the block. Factory settings: "-----" no text
	ENP version	read	Displays the ENP (electronic name plate) version.
	Profile	read	0x4002 - PROFIBUS PA, Compact Class B
	Profile Revision	read	Displays the profile version implemented in the device.
	Manufacturer	read	Displays the manufacturer ID number. Display: 0x11(hex);17 (decimal): Endress+Hauser
	Product designation	read	Displays the manufacturer-specific device designation. Display: iTEMP TMT84
	PROFIBUS Ident Number	read	Displays the Profibus User Organization identification number of the device. – 0x1523 → TMT184 – 0x1551 → TMT84 – 0x9700 → Profile Ident Number 1x AI Block – 0x9701 → Profile Ident Number 2x AI Block – 0x9702 → Profile Ident Number 3x AI Block – 0x9703 → Profile Ident Number 4x AI Block Factory settings: 0x1551

- These parameters may be changed if the parameter **"Service locking"** in the expert menu is set correspondingly.

Submenu Diagnostics - Measured values

This menu is only visible in the online mode.

Menu item "Diagnostics" Submenu "Measured values"	Measured values		
	Parameter Name	Parameter access	Description
	PV value n	read	Displays the primary output value of the Transducer Block.  Note! The PV value n can be made available to an AI Block for further processing.
	Process temperature n	read	Displays the measured value of sensor n.
	Reference Junction Temperature	read	Internal reference temperature measurement.

n: Number of the Transducer Block (1-2) or the sensor input (1 or 2)

Submenu Diagnostics - Measured values - Min./max. value

This menu is only visible in the online mode.

In this menu, you can view the maximum indicators of the PV values, the two measuring inputs and the internal reference measurement. In addition, the PV values saved can be reset.

Menu item	Min/max value		
	Parameter		
"Diagnostics" Submenu "Measured values - Min/max value"	Name	Parameter access	Description
	Primary Value n Min.	read/ write	Min. indicator for PV is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.
	Primary Value n Max.	read/ write	Max. indicator for PV is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.
	Sensor Value n Min.	read	Displays the minimum sensor value Is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.
	Sensor Value n Max.	read	Displays the maximum sensor value Is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.
	RJ min. value	read	Indicator for the minimum value to occur at the internal reference temperature measuring point
	RJ max. value	read	Indicator for the maximum value to occur at the internal reference temperature measuring point

n: Number of the Transducer Block (1-2) or the sensor input (1 or 2)

Submenu Diagnostics - Device test/reset

This menu is only visible in the online mode.

By means of a reset, the device can be set to a defined state depending on the reset code.

Device test/reset			
Menu item	Parameter		
"Diagnostics" Submenu "Device test/reset"	Name	Parameter access	Description
	Reset	read/ write	Resets or restarts the device. User input: 0 → No function/no action 1 → Standard configuration/reset all bus-specific parameters to factory settings with the exception of the configured station address. The device displays the next cold start for 10 seconds in the corresponding bit of the DIAGNOSTICS parameter group. 2506 → Warm start/execution of a warm start. The device displays the next warm start for 10 seconds in the corresponding bit of the DIAGNOSTICS parameter group. 2712 → Resets address to '126'/resets the station address to the usual PROFIBUS default address 126. 32769 → Configuration ordered/resets to delivery status. Factory settings: 0  Caution! If you select 1, the units are reset according to the factory setting not delivery status. After resetting, check the units and configure the unit you require. Then run the "Set Unit To Bus" (→ Page 75) parameter.

11.3 Setup Expert

The parameter groups for the Expert setup contain all the parameters of the Standard setup and other parameters that are solely reserved for experts.

→ Expert → Page 67	→ System → Page 67 Settings and description of the measuring point	→ Display → Page 54	
	→ Sensory mechanism → Page 69 Settings of the two measuring inputs	→ Sensor 1	→ Special linearization 1
		→ Sensor 2	→ Special linearization 2
	→ Communication → Page 75 Settings of the Profibus address and setup of the 4 Analog Input Blocks	→ Analog Input 1	
		→ Analog Input 2	
		→ Analog Input 3	
		→ Analog Input 4	
	→ Diagnostics → Page 85 Displays device information and status for service and maintenance purposes.	→ System information → Page 63	
		→ Measured value	→ Min./max. values → Page 65
		→ Device test/reset → Page 66	

11.3.1 Group System

All the parameters that describe the measuring point in greater detail can be viewed and configured in the "System" group.

System			
Menu item	Parameter		
"Diagnostics"	Name	Parameter access	Description
	Target Mode	read/write	For selecting the required operating mode. Only automatic operation can be selected in the Physical Block. The Physical Block can also be set to OOS if diagnostics is enabled as per Profile 3.02 (Physical Block parameter "COND_STATUS_DIAG" = 1). Options: 0x08 - AUTO 0x80 - Out of Service (OOS) Factory settings: AUTO
	Block Mode		General information on Block Mode Block Mode contains three elements: - the block's current operating mode (Actual Mode) - the modes supported by the block (Permitted Mode): Analog Input (AI): AUTO, MAN, OOS Physical Block: AUTO, OOS Transducer Block: AUTO - normal operating mode (Normal Mode) Only the current Block Mode is displayed in the menu. Generally, you can select from several operating modes in a function block, while other block types only operate in the AUTO operating mode for example.
	Actual Mode	read	Displays the current operating mode. Display: AUTO

System			
Menu item	Parameter		
"Diagnostics"	Name	Parameter access	Description
	PROFIBUS Ident Number Selector	read/write	For selecting the configuration behavior.  Note! Every PROFIBUS device must check an identification number assigned by the PROFIBUS User Organization during the configuration phase. As well as these device-specific identification numbers, there are also PROFILE identification numbers that must be accepted during the configuration phase for the purpose of compatibility with products from other manufacturers. In this case, it is possible that the device restricts the functionality relating to the cyclical data to a profile-defined level. Options: – 0 → Profile-specific Ident Number 9703 (1xAI) – 1 → Manuf.-specific Ident Number 1551 (TMT84) – 127 → Automatic (0x9700, 0x9701, 0x9702, 0x9703, 0x1551, 0x1523) – 128 → Manuf.-specific Ident Number 1523 (TMT184) – 129 → Profile-specific Ident Number 9700 (1xAI) – 130 → Profile-specific Ident Number 9701 (2xAI) – 131 → Profile-specific Ident Number 9702 (3xAI) Factory settings: 127
	Descriptor	read/write	Entry of a description for the application for which the device is used. Factory settings: No description (32 space characters)
	Message	read/write	Entry of a message about the application for which the device is used. Factory settings: No message (32 space characters)
	Installation Date	read/write	Entry of the device installation date. Factory settings: No date (16 space characters)
	TAG location	read/write	I&M Parameter TAG_LOCATION
	Signature	read/write	I&M Parameter SIGNATURE
(only visible in online mode)	HW write protection	read	Displays the status of hardware write protection. Display: – 0 → write protection disabled, parameters can be changed. – 1 → write protection enabled, parameters cannot be changed. Factory settings: 0  Note! Write protection is enabled/disabled using a DIP switch (see chapter 5.4.1).

System			
Menu item	Parameter		
"Diagnostics"	Name	Parameter access	Description
	System alarm delay		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. Factory settings: 2 s  Note! This setting does not affect the display.
	Mains filter	read/write	Mains filter for the A/D converter Options: ■ 0 - 50 Hz ■ 1 - 60 Hz Factory settings: 0 - 50 Hz
	Ambient alarm	read/write	Status message in the event of the operating temperature of the transmitter being undershot or overshoot < -40°C (-40°F) or > +85°C (185°F): ■ 0 Maintenance: Int. temperature overshoot/undershoot results in warning. ■ 1 Failure: Int. temperature overshoot/undershoot results in alarm. Factory settings: 0 - Maintenance

Group Sensory mechanism

Procedure for configuring a sensor input → Chapter 11.2.2.

Submenu "Sensor 1" or "Sensor 2"

Sensor 1 / Sensor 2			
Menu item	Parameter		
"Sensor" Submenu "Sensor 1" or "Sensor 2"	Name	Parameter access	Description
	Characterization Type n	read/write	Configuration of the sensor type. Characterization Type 1: settings for sensor input 1. Characterization Type 2: settings for sensor input 2 Factory settings: Channel 1: Pt100 IEC751 Channel 2: No sensor  Note! Please observe the terminal assignment in chapter 4.1 when connecting the individual sensors. In the case of 2-channel operation, the possible connection options in chapter 4.2 also have to be observed.

Sensor 1 / Sensor 2			
Menu item	Parameter		
"Sensor" Submenu "Sensor 1" or "Sensor 2"	Name	Parameter access	Description
	Input Range and Mode n	read/write	Configuration of the input measurement range. 0: mV, range 1: -5 to 30 mV; range: -5 to 30 mV; min. span: 1 mV 1: mV, range 2: -20 to 100 mV; min. span: 1 mV 128: Ohm, range 1: 10 to 400 Ohm; min. span: 10 Ohm 129: Ohm, range 2: 10 to 2000 Ohm; min. span: 10 Ohm Factory settings: 128: Ohm, range 1: 10 to 400 Ohm; min. span: 10 Ohm
	Unit n	read/write	Configuration of the temperature unit for PV value n Options: 1000 - K 1001 - °C 1002 - °F 1003 - Rk 1281 - Ohm 1243 - mV 1342 - % Factory settings: °C
	Connection type n	read/write	Sensor connection mode: Sensor Transducer 1 (Connection mode 1): 0 - 2 wires 1 - 3 wires 2 - 4 wires Factory settings: 3 wires Sensor Transducer 2 (Connection mode 2): 0 - 2 wires 1 - 3 wires Factory settings: 3 wires

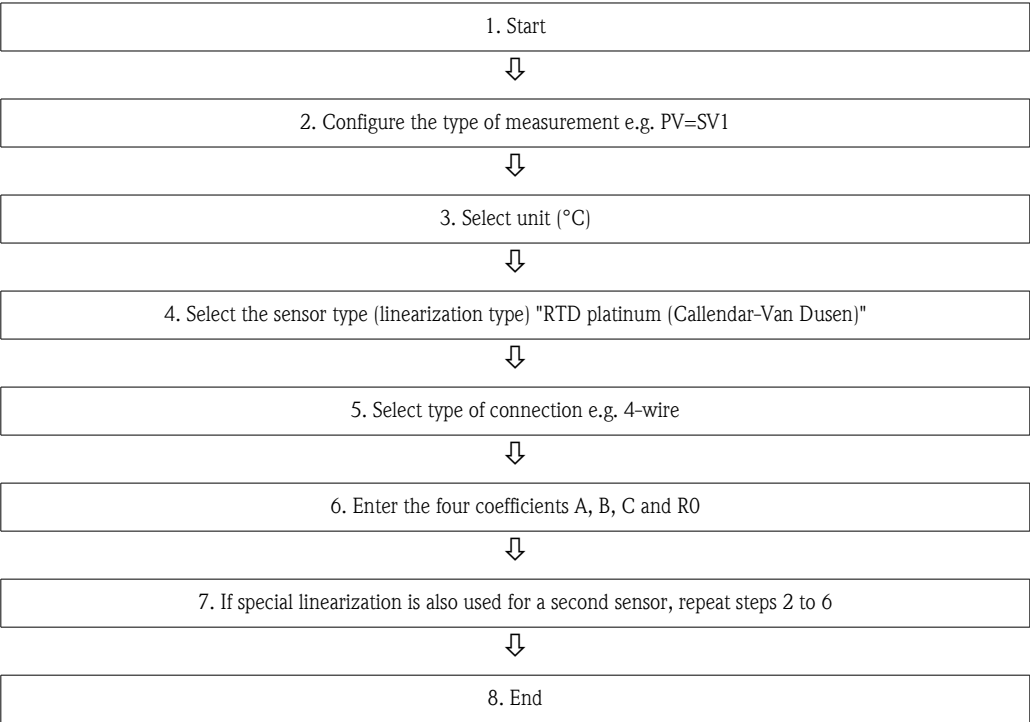
Sensor 1 / Sensor 2			
Menu item	Parameter		
"Sensor" Submenu "Sensor 1" or "Sensor 2"	Name	Parameter access	Description
	Measure type n	read/ write	Displays the calculation process for Primary Value 1, also see → Chapter 11.2.2  Note! SV1 = Secondary Value 1 = sensor value 1 in temperature Transducer Block 1 = sensor value 2 in temperature Transducer Block 2 SV2 = Secondary Value 2 = sensor value 2 in temperature Transducer Block 1 = sensor value 1 in temperature Transducer Block 2 Options: Sensor Transducer 1 (Measuring mode 1): ■ PV = SV1: Secondary value 1 ■ PV = SV1-SV2: Difference ■ PV = 0.5 x (SV1+SV2): Average ■ PV = 0.5 x (SV1+SV2) redundancy: Average or Secondary Value 1 or Secondary Value 2 in the event of a sensor error in the other sensor. ■ PV = SV1 (OR SV2): Backup function: If sensor 1 fails, the value of sensor 2 automatically becomes the Primary Value. ■ ■ PV = SV1 (OR SV2 if SV1>T): PV changes from SV1 to SV2 if SV1 > value T (Parameter: Threshold value n) ■ PV = (SV1-SV2) if PV > drift value: PV is the drift value between sensor 1 and sensor 2. If PV exceeds the configured drift value (Sensor drift alert value), a drift alarm is output. ■ PV = (SV1-SV2) if PV < drift value: PV is the drift value between sensor 1 and sensor 2. If PV undershoots the configured drift value (Sensor drift alert value), a drift alarm is output. Factory settings: PV = SV1 Sensor Transducer 2 (Measuring mode 2): ■ PV = SV2: Secondary value 2 ■ PV = SV2-SV1: Difference ■ PV = 0.5 x (SV2+SV1): Average ■ PV = 0.5 x (SV2+SV1) redundancy: Average or Secondary Value 1 or Secondary Value 2 in the event of a sensor error in the other sensor. ■ PV = SV2 (OR SV1): Backup function: If sensor 2 fails, the value of sensor 1 automatically becomes the Primary Value. ■ PV = SV2 (OR SV1 if SV2>T): PV changes from SV2 to SV1 if SV2 > value T (Parameter: Threshold value n) ■ PV = (SV1-SV2) if PV > drift value: PV is the drift value between sensor 1 and sensor 2. If PV exceeds the configured drift value (Sensor drift alert value), a drift alarm is output. ■ PV = (SV1-SV2) if PV < drift value: PV is the drift value between sensor 1 and sensor 2. If PV undershoots the configured drift value (Sensor drift alert value), a drift alarm is output. Factory settings: ■ PV = SV1 = Sensor 2
	2-wire compensation n	read/ write	Two-wire compensation for RTDs. The following values are permitted: 0 to 30 Ohm

Sensor 1 / Sensor 2			
Menu item	Parameter		
"Sensor" Submenu "Sensor 1" or "Sensor 2"	Name	Parameter access	Description
	Offset n	read/ write	Offset for Primary Value 1 The following values are permitted: ■ -10 to +10 for Celsius, Kelvin, mV and Ohm ■ -18 to +18 for Fahrenheit, Rankine Factory settings: 0.0
(only visible in online mode)	Lower sensor range n	read	Displays the lower, physical sensor range.
(only visible in online mode)	Upper sensor range n	read	Displays the upper, physical sensor range.
	Threshold value n	read/ write	Value for switching in PV mode for sensor switching. Entry in the range of -270°C to 2200°C (-454°F to 3992°F).
	Reference Junction Type n	read/ write	Configuration of reference junction measurement for temperature compensation in thermocouples: ■ 0 - no reference: no temperature compensation is used. ■ 1 - internally measured reference junction: internal reference junction temperature is used for temperature compensation ■ 2 - external fixed value: "Ext. Reference Junction Temperature" is used for temperature compensation. Factory settings: 1 - Internally measured reference junction
	Ext. Reference Junction Temperature n	read/ write	Value for temperature compensation (see parameter: "Reference Junction"). Factory settings: 0.0
	Sensor drift monitoring	read/ write	Deviation between SV1 and SV2 is identified as an error (Failure) or as need for maintenance (Warning): ■ 1 - FAILURE: (sensor deviation > Sensor drift alert value n) → Failure. Sensor drift is displayed as error. ■ 0 - Warning: (sensor deviation > Sensor drift alert value n) → Warning. Sensor drift is displayed as warning. Factory settings: Warning
	Sensor drift alert value n	read/ write	Configuration of the max. permitted measured value deviation between sensor 1 and sensor 2. This value is relevant if " PV =ABS(SV1-SV2) if PV< drift value " was selected for the measuring mode. Permitted deviation from 0.1 to 999. Factory settings: 999
	Corrosion detection n	read/ write	■ 0 - OFF: Corrosion detection off ■ 1 - ON: Corrosion detection on Factory settings: 0 - OFF  Note! Only possible for RTD 4-wire connection and thermocouples (TC).

n: Number of the Transducer Block (1-2) or the sensor input (1 or 2)

Submenu "Special linearization 1" or "Special linearization 2"

Procedure for configuring a special linearization using Callendar-Van Dusen coefficients from a calibration certificate:



Special linearization 1 / Special linearization 2			
Menu item	Parameter		
"Sensor" Submenu "Special linearization n"	Name	Parameter access	Description
	Call.-v. Dusen lower range	read/write	Lower calculation limit for Callendar-Van Dusen linearization. Factory settings: 0.0
	Call.-v. Dusen upper range	read/write	Upper calculation limit for Callendar-Van Dusen linearization. Factory settings: 100.0
	Call.-v. Dusen coeff. R0	read/write	 Note! The values for the R0 value must be in the range of 40 to 1050 Ohm. Factory settings: 100

Special linearization 1 / Special linearization 2			
Menu item	Parameter		
"Sensor" Submenu "Special lineariza- tion n"	Name	Parame- ter access	Description
	Call.-v. Dusen coeff. A	read/ write	Sensor linearization based on the Callendar-Van Dusen method.
	Call.-v. Dusen coeff. B	read/ write	
	Call.-v. Dusen coeff. C	read/ write	 Note! The Call.-v. Dusen coeff. X parameters are used for calculating the response curve if "RTD- Callendar-Van Dusen" is set in the Characterization Type n parameter. Factory settings Call.-v. Dusen coeff. A: 3.9083E-03 Factory settings Call.-v. Dusen coeff. B: -5.775E-07 Factory settings Call.-v. Dusen coeff. C: 0
(only visible in online mode)	Sensor trim	read/ write	■ Factory trim standard calibration: Sensor linearization with the factory calibration values ■ User trim standard calibration: Sensor linearization with the values "Calibration Highest Point" and "Calibration Lowest Point"  Note! The original linearization can be established by resetting this parameter to "Factory Trim Standard Calibration".
(only visible in online mode)	Sensor trimming lower value	read/ write	Lower point for linear characteristic calibration (this affects offset and slope).  Note! To write to this parameter, "Sensor trimming" must be set to "user trim standard calibration".
(only visible in online mode)	Sensor trimming upper value	read/ write	Upper point for linear characteristic calibration (this affects offset and slope).  Note! To write to this parameter, "Sensor Calibration Method" must be set to "user trim standard calibration".
(only visible in online mode)	Sensor trim min span	read	Span of the measurement range, depending on the sensor type set.
	Poly. Meas. range min	read/ write	Lower calculation limit for the RTD polynomial (nickel/copper) linearization. Factory settings: For Characterization Type = copper: 0 For Characterization Type = nickel: -60
	Poly. Meas. range max	read/ write	Upper calculation limit for the RTD polynomial (nickel/copper) linearization. Factory settings: For Characterization Type = copper: 200 For Characterization Type = nickel: 100
	Poly. coeff. R0	read/ write	 Note! The values for the R0 value must be in the range of 40 to 1050 Ohm. Factory settings: For Characterization Type = copper: 100 For Characterization Type = nickel: 100

Special linearization 1 / Special linearization 2			
Menu item	Parameter		
"Sensor" Submenu "Special lineariza- tion n"	Name	Parame- ter access	Description
	Poly. coeff. A	read/ write	Sensor linearization of copper/nickel resistance thermometers (RTD).  Note! The Poly coeff x parameters are used for calculating the response curve if "RTD polynomial nickel or RTD polynomial copper" is set in the Characterization Type n parameter. Factory settings: Polynomial coeff. A Copper = 0.00428 Nickel = 5.4963E-03 Polynomial coeff. B Copper = 6.2032E-07 Nickel = 6.7556E-06 Polynomial coeff. C Copper = 8.5154E-10 Nickel = 0
	Poly. coeff. B	read/ write	
	Poly. coeff. C	read/ write	
	Sensor serial number	read/ write	Serial number of the connected sensor.

11.3.2 Group Communication

Changing the unit

The system unit for the temperature can be changed in the Sensor 1 or Sensor 2 menu for the channel in question.

Changing the unit does not initially have any effect on the measured value transmitted to the automation system. This ensures that there are no sudden changes in the measured values that could have an effect on the subsequent control routine.

Communication			
Menu item	Parameter		
"Communication"	Name	Parame- ter access	Description
	Bus address	read	Displays the device bus address. Factory settings: 126

Communication			
Menu item	Parameter		
"Communication"	Name	Parameter access	Description
(only visible in online mode)	Set Unit To Bus	read/write	Transfers configured system units to the automation system. During the transfer, the scaling of the OUT SCALE value in the Analog Input Block is automatically overwritten with the configured PV SCALE and the unit from the Transducer Block is copied over the "Out Scale - Unit" (output unit). Options: ■ 0 - OFF ■ 1 - ON Factory settings: 0 - OFF  Caution! Activating this parameter can result in an erratic change of the output value "Out value" and thus affect subsequent control loops.

Submenus "Analog Input 1" to "Analog Input 4"

The standard parameters for the "Security settings" menu can be found on → Page 60. The expert parameters are listed in the following table.

Status of the Output value

The status of the **Output value** parameter group tells the downstream function blocks the status of the Analog Input function block and the validity of the **Output value**.

Status of the OUT output value:	Meaning of the output value:
GOOD NON CASCADE	→ OUT is valid and can be used for further processing.
UNCERTAIN	→ OUT can only be used for further processing to a limited extent.
BAD	→ OUT is not valid.
 Note! The BAD status value occurs when the Analog Input function block is switched to OOS (out-of-service) or in the event of serious errors (see status code and system/process error messages, chapter 9.3).	

Simulation of input/output

Various parameters of the Analog Input 1-4 menus allow simulation of the input and output of the function block:

Simulating the input of the Analog Input function block:

The input value (measured value and status) can be specified by means of the "AI Simulation / AI Simulation value / AI Simulation status" parameters. Since the simulation value runs through the entire function block, all the parameter settings of the block can be checked.

Simulating the output of the Analog Input function block:

Set the operating mode to MAN with the **Current mode** parameter (→ Page 57) and directly specify the desired output value in the **Output value** parameter (→ Page 76).

Failsafe mode

If an input or simulation value has the status BAD, the Analog Input function block uses the failsafe mode defined in the "**Failsafe mode**" parameter. The "**Failsafe mode**" parameter (→ Page 84) offers the following options:

Options in the FAILSAFE TYPE parameter (failsafe mode):	Failsafe mode:
FSAFE VALUE	The value specified in the "Failsafe value" parameter is used for further processing.
LAST GOOD VALUE	The last good value is used for further processing.
WRONG VALUE	The current value is used for further processing, despite the BAD status.
 Note! The factory setting is WRONG VALUE.	



Note!

Failsafe mode is also activated if the Analog Input function block is set to the "OUT OF SERVICE" operating mode.

Limit values

You can set two warning limits and two alarm limits for monitoring your process. The status of the measured value and the parameters of the limit-value alarms are indicative of the measured value's relative situation. You also have the option of defining an alarm hysteresis in order to avoid frequent changes of the limit-value flags and frequent switching between enabled and disabled alarm settings (→ Page 83).

The limit values are based on the OUT output value. If the output value OUT exceeds or under-shoots the defined limit values, an alarm is sent to the automation system via the limit value process alarms.

Process alarms provide information on certain block states and events. The following process alarms can be defined and generated in the Analog Input function block:

HI HI LIM	→ Page 82	LO LO LIM	→ Page 82
HI LIM	→ Page 82	LO LIM	→ Page 82

Limit value process alarms

If a limit value is violated, the specified priority of the limit value alarm is checked before the limit value violation is communicated to the fieldbus host system.

Rescaling the input value

In the Analog Input function block the input value or input range can be scaled in accordance with the automation requirements.

Example:

- The system unit in the Transducer Block is °C.
- The measurement range of the sensor is -200 to 850°C.
- The process relevant measurement range is 0 to 200°C.
- The output range to the process control system should be 0 to 100%.

The measured value from the Transducer Block (input value) is rescaled linearly via the input scaling PV SCALE to the desired output range OUT SCALE:

Parameter group PV SCALE (→ Page 81)		Parameter group OUT SCALE (→ Page 81)	
PV SCALE MIN	→ 0	OUT SCALE MIN	→ 0
PV SCALE MAX	→ 200	OUT SCALE MAX	→ 100
		OUT UNIT	→ %

The result is that with an input value of, for example, 100°C (212 °F), a value of 50% is output via the OUT parameter.

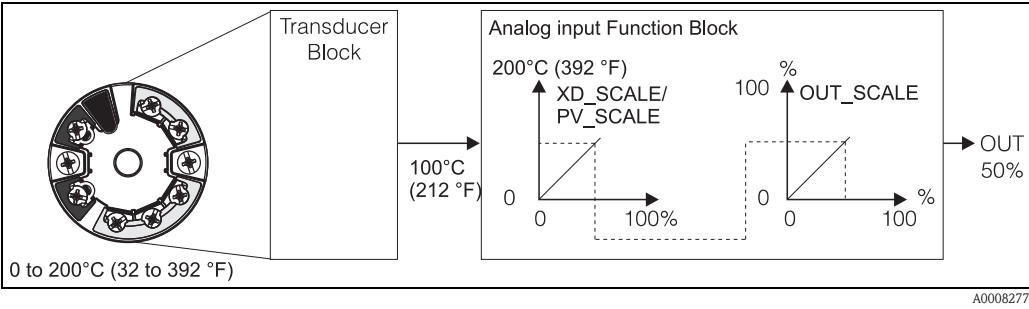
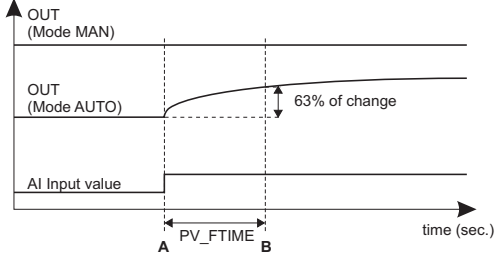


Fig. 2: Scaling procedure in the Analog Input function block

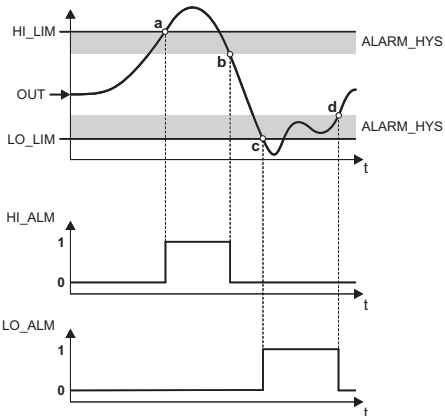
Analog Input			
Menu item	Parameter		Description
"Communication"	Name	Parameter access	
	Static Revision No.	read	A block operates static parameters (Static attribute) that are not changed by the process. Static parameters, whose values change during optimization or configuration, cause the ST REV parameter to increment by 1. This supports parameter version management. If several parameters change within the shortest possible time, e. g. due to loading of parameters from FieldCare, PDM, etc. in the device, the static revision counter can show a higher value. This counter can never be reset and is not reset to a default value after a device reset. If the counter overflows, (16 bit), it starts again at 1.
	TAG	read/write	Entry of user-specific text of max. 32 characters for unique identification and assignment of the block. User input: Text with 32 characters maximum, options: A-Z, 0-9, +, -, punctuation marks Factory settings: "-----" no text
	Target Mode	read/write	For selecting the required operating mode. Options: 0x08 AUTO 0x10 MAN 0x80 OOS Factory settings: AUTO
	BLOCK MODE		General information on the Block Mode parameter group This parameter group contains three elements: ■ the block's current operating mode (Actual Mode) ■ the modes supported by the block (Permitted Mode) ■ normal operating mode (Normal Mode) A distinction is made between "Automatic operation" (AUTO), manual intervention by the user (MAN) and "Out of service" (O/S) mode. Generally, you can select from several operating modes in a function block, while other block types only operate in the AUTO operating mode for example.

Analog Input			
Menu item	Parameter		
"Communication"	Name	Parameter access	Description
	Actual Mode	read	Displays the current operating mode. Options: 0x08 AUTO 0x10 MAN 0x80 OOS Display: AUTO
	AI n channel	read/ write	Assignment between the logical hardware channel of the Transducer Block and the input of the Analog Input function block. The Transducer Block of the TMT84 makes five different measured values available to the input channel of the Analog Input function block. Factory settings: AI1 Primary Value Transducer 1 → 1 AI2 Secondary Value Transducer 1 → 2 AI3 Primary Value Transducer 2 → 2 AI4 Secondary Value Transducer 2 → 3 Options: ■ 0x0108 (264) → Primary Value Transducer 1 ■ 0x010A (266) → Secondary Value 1 Transducer 1 ■ 0x015D (349) → Reference Junction Temperature ■ 0x0208 (520) → Primary Value Transducer 2 ■ 0x020A (522) → Secondary Value 1 Transducer 2
	Alarm Sum		General information on the "Alarm Sum" parameter group: The Active Block Alarm is supported, which indicates a change to a parameter with static parameters (Static attribute) for 10 sec. and displays that a warning or alarm limit was violated in the Analog Input function block. Display values: 0x0000 No alarm 0x0200 Upper alarm limit value 0x0400 Upper warning limit value 0x0800 Lower alarm limit value 0x1000 Lower warning limit value 0x8000 Parameter set changed
(only visible in online mode)	Current State Alarm Sum	read	Displays the device's current alarms.
(only visible in online mode)	Unacknowledged State Alarm Sum	read	Displays the device's unacknowledged alarms.
(only visible in online mode)	Unreported State Alarm Sum	read	
(only visible in online mode)	Disabled State Alarm Sum	read	Displays the device's acknowledged alarms.
	Out unit text	read/ write	Entry of ASCII text if the required unit is not available in the OUT UNIT (output unit) parameter.
(only visible in online mode)	Out value	read	Displays the (output) value OUT of the process variable selected in the CHANNEL parameter

Analog Input			
Menu item	Parameter		
"Communication"	Name	Parameter access	Description
(only visible in online mode)	Quality	read	Displays the quality (measured value status) for the "Output value". 0x80 - Good 0x84 - Good: Parameters changed 0x88 - Good: Warning limit 0x8C - Good: Alarm limit 0x90 - Good: Unacknowledged block alarm (Pr. 3.0/3.01 only) 0x94 - Good: Unacknowledged warning (Pr. 3.0/3.01 only) 0x98 - Good: Unacknowledged alarm (Pr. 3.0/3.01 only) 0xA0 - Good: Go to failsafe mode 0xA4 - Good: Maintenance required 0xA8 - Good: Request for maintenance (Pr. 3.02) 0xBC - Good: Function check/local overlap (Pr. 3.02) 0x40 - Uncertain (Pr. 3.0/3.01 only) 0x44 - Uncertain: Last usable value (Pr. 3.0/3.01 only) 0x48 - Uncertain: Substitute value (0x4B in Pr. 3.02) 0x4C - Uncertain: Initial value (0x4F in Pr. 3.02) 0x50 - Uncertain: Value incorrect (Pr. 3.0/3.01 only) 0x54 - Uncertain: Outside value range (Pr. 3.0/3.01 only) 0x58 - Uncertain: Abnormal (Pr. 3.0/3.01 only) 0x5C - Uncertain: Configuration error (Pr. 3.0/3.01 only) 0x60 - Uncertain: Simulation value (Pr. 3.0/3.01 only) 0x64 - Uncertain: Simulated value, start 0x68 - Uncertain: Request for maintenance (Pr. 3.02) 0x73 - Uncertain: Simulated value, start (Pr. 3.02) 0x74 - Uncertain: Simulated value, end (Pr. 3.02) 0x78 - Uncertain: Process fault /no maintenance required (Pr. 3.02) 0x00 - Bad: (Pr. 3.0/3.01 only) 0x04 - Bad: Configuration error (Pr. 3.0/3.01 only) 0x08 - Bad: No connection (Pr. 3.0/3.01 only) 0x0C - Bad: Device error (Pr. 3.0/3.01 only) 0x10 - Bad: Sensor error (Pr. 3.0/3.01 only) 0x14 - Bad: Last usable value (no comm., Pr. 3.0/3.01 only) 0x18 - Bad: No usable value (no comm., (Pr. 3.0/3.01) 0x1C - Bad: Out of service (Pr. 3.0/3.01 only) 0x23 - Bad: Passive (Pr. 3.02) 0x24 - Bad: Maintenance alarm (Pr. 3.02) 0x2B - Bad: Process fault/no maintenance required (Pr. 3.02) 0x3C - Bad: Function check/local overlap (Pr. 3.02)
(only visible in online mode)	Status	read	Displays the limit (measured value status) for the "Output value". 0x00 - OK 0x01 - Limit underflow 0x02 - Limit overflow 0x03 - Value constant

Analog Input			
Menu item	Parameter	Parameter access	Description
"Communication"	Name		
	Filter Time Const.	read/ write	Entry of the filter time constant (in seconds) of the digital filter of the 1st order. This time is required in order for 63% of a change in the Analog Input (input value) to have an effect on OUT (output value). The diagram shows the time-dependent signal characteristics of the Analog Input function block:  A → The Analog Input changes. B → OUT reacted 63% to the change of the Analog Input. Factory settings: 0 s A0003913-EN
	PV SCALE		In the PV SCALE parameter group, the process variable is standardized to one value by means of the "Lower Value" and "Upper Value" parameters using the unit of the connected Transducer Block. For an example on rescaling the input value, see → Page 77.
	PV scale - lower value	read/ write	This parameter is used to enter the lower value for input scaling. Factory settings: 0
	PV scale - upper value	read/ write	This parameter is used to enter the upper value for input scaling. Factory settings: 100
	OUT SCALE		In the OUT SCALE parameter group, the measurement range (lower and upper limit) and the physical unit for the output value (Out value) are defined. The following parameters are available in this parameter group: ■ Out Scale - lower value ■ Out Scale - upper value ■ Unit ■ Decimal Point  Note! Defining the measurement range in this parameter group does not represent a restriction of the output value "Out value". If the output value "Out value" is outside the measurement range, it is transferred nonetheless.
	Out scale — lower value	read/ write	Entry of the lower value for output scaling. Factory settings: 100
	Out scale - upper value	read/ write	Entry of the upper value for output scaling. Factory settings: 0

Analog Input			
Menu item "Communication"	Parameter Name	Parameter access	Description
	Unit	read/ write	For selecting the output unit. Factory settings: Analog Input function block = 0x07CD (1997)= none  Note! OUT UNIT (output unit) does not affect measured value scaling.
	Decimal Point	read/ write	Specifies the number of places after decimal point for the output value "Out value".  Note! This parameter is not supported by the device.
	Upper limit alarm	read/ write	Entry of the alarm limit value for the upper alarm (HI HI ALM). If the output value OUT exceeds this limit value, then the HI HI ALM alarm status parameter is output. User input: Unit from OUT SCALE Factory settings: max value
	Upper limit warning	read/ write	Entry of the alarm limit value for the upper warning (HI ALM). If the output value OUT exceeds this limit value, then the HI ALM alarm status parameter is output. User input: Unit from OUT SCALE Factory settings: max value
	Lower limit warning	read/ write	Entry of the alarm limit value for the lower warning (LO ALM). If the output value OUT is below this limit value then the LO ALM alarm status parameter is output. User input: Unit from OUT SCALE Factory settings: min. value
	Lower limit alarm	read/ write	Entry of the alarm limit value for the lower alarm (LO LO ALM). If the output value OUT is below this limit value then the LO LO ALM alarm status parameter is output. User input: Unit from OUT SCALE Factory settings: min. value

Analog Input			
Menu item	Parameter	Parameter access	Description
"Communication"	Name		
	Limit Hysteresis	read/ write	For entry of the hysteresis value for the upper and lower warning or alarm limit values. The alarm conditions remain active as long as the measured value is within the hysteresis. The hysteresis value affects the following warning and alarm limit values of the Analog Input function block: HI HI ALM → Upper limit alarm HI ALM → Upper limit warning LO LO ALM → Lower limit alarm LO ALM → Lower limit warning User input: 0 to 50% Factory settings: 0.5% of the measurement range  Note! ■ The hysteresis value refers is a percentage of the range specified in the OUT SCALE parameter group in the Analog Input function block: ■ If the limit values are entered in FieldCare, ensure that absolute values can be displayed and entered. Example: ■ The diagram on the top shows the defined limit values for the warnings LO LIM and HI LIM with their respective hystereses (gray background) and the signal characteristics of the output value OUT. ■ The two bottom diagrams show the behavior of the relevant alarms HI ALM and LO ALM on the changing signal characteristics (0 = no alarm, 1 = alarm is output).  a → Output value OUT exceeds limit value HI LIM, HI ALM is enabled. b → Output value OUT undershoots the hysteresis value of HI LIM, HI ALM is disabled. c → Output value OUT undershoots the limit value LO LIM, LO ALM is enabled. d → Output value OUT exceeds the hysteresis value of LO LIM, LO ALM is disabled.

A0003915

Analog Input			
Menu item	Parameter		Description
"Communication"	Name	Parameter access	
	Fail Safe Mode	read/ write	For selecting failsafe mode in the event of a device error or bad measured value. ACTUAL MODE (current operating mode of the block) remains in AUTO MODE (automatic operation).  Note! The status information only applies to diagnostics as per Profile 3.0/3.01. For Profile 3.02, see chapter 9.2.2. Options: ■ FSAFE VALUE (The substitute value is adopted in the output value). When this option is selected, the value entered in the "Fail Safe Default Value" parameter is displayed in OUT (output value). The status changes to UNCERTAIN - SUBSTITUTE VALUE. ■ LAST GOOD VALUE (The last valid output value saved is adopted in the output value) The output value valid before the failure is used. The status is set to UNCERTAIN – LAST USABLE VALUE (last valid value). If there was no valid value previously, the initial value is provided with the status UNCERTAIN – INITIAL VALUE (for values not saved during a device reset). The initial value of the TMT84 Profibus PA is "0". ■ WRONG VALUE (Incorrect measured value at the output value). The value is still used for calculation despite the bad status. Factory settings: WRONG VALUE
	Fail Safe Default Value	read/ write	This parameter is used to enter a default value to be displayed when there is an error in OUT (output value) (see Failsafe Mode). Factory settings: 0
	AI(n) simulation quality	read/ write	Simulation of Analog Input function block quality. For list of options, → Page 80. Factory settings: Bad
	AI(n) simulation status	read/ write	Simulation of Analog Input function block status. 0x00 - OK 0x01 - Limit underflow 0x02 - Limit overflow 0x03 - Value constant
	AI(n) simulation value	read/ write	Simulation of the input value. Since this value runs through the entire algorithm, the behavior of the Analog Input function block can be checked. Factory settings: 0.0
	AI(n) simulation enable	read/ write	Enable/disable simulation. Options: Disabled Enabled Factory settings: Disabled

11.3.3 Group Diagnostics

All the information that describes the device, the device status and the process conditions can be found in this group.

The individual parameters are summarized in the Diagnostics menu in this chapter:

Menu item	Diagnostics		
	Parameter		
"Diagnostics"	Name	Parameter access	Description
	Current diagnostics	read	Displays the diagnostics code. The diagnostics code consists of the "Current status" and "Last error code". Example: F041 (Failure + sensor failure)
	Current diagnostics description	read	Displays the status information as description text, see chapter 9.3.
	Status channel	read	Displays where in the device the highest priority error occurs. 0: Device 1: Sensor 1 2: Sensor 2
	Status count	read	The number of status messages currently pending in the device.
	Diagnostics	read	Diagnostics information of the device encoded in bits. Current status number: ■ 0 - Status OK ■ 0x01000000 - Hardware failure electronics. ■ 0x02000000 - Hardware failure mechanics. ■ 0x08000000 - Electronics temperature too high. ■ 0x10000000 - Memory checksum error. ■ 0x20000000 - Failure in measurement. ■ 0x80000000 - Self calibration failed. ■ 0x00040000 - Configuration not valid. ■ 0x00080000 - New start-up (warm startup) carried out. ■ 0x00100000 - Restart (cold startup) carried out. ■ 0x00200000 - Maintenance required. ■ 0x00800000 - Ident Number Violation. ■ 0x00000100 - Failure of the device ■ 0x00000200 - Maintenance demanded ■ 0x00000400 - Function check or simulation mode ■ 0x00000800 - Out of Specification ■ 0x00000080 - More information available.
	Last diagnostics	read	Displays the last diagnostics code. The diagnostics code consists of the "Current status" and "Last error code". Example: F041 (Failure + sensor failure)
	Last status channel	read	Displays where in the device the last highest priority error occurred. 0: Device 1: Sensor 1 2: Sensor 2
	Clear last diagnostics	read/write	The last diagnostics information can be deleted. 0: Show last error 1: Clear last error Factory settings: 0

Diagnostics			
Menu item	Parameter		
"Diagnostics"	Name	Parameter access	Description
	Extended diagnostics	read	Manufacturer-specific diagnostics information encoded in bits. Several messages are possible. See the "Status diagnostics bits" at the end of this manual.
	Extended diagnostics mask	read	Displays the bit mask that outputs the manufacturer-specific diagnostic messages.
(only visible in online mode)	Enabled features	read	FEATURE.Enabled: X=0 → Accumulative status and diagnostics supported/diagnostics as per Profile 3.01/3.0; X=1 → Diagnostics as per Profile 3.02/extended status/diagnostics are supported; Factory settings: X=1
(only visible in online mode)	Supported features	read	FEATURE.Enabled: X=0 → Accumulative status and diagnostics supported/diagnostics as per Profile 3.01/3.0; X=1 → Diagnostics as per Profile 3.02/extended status/diagnostics are supported; Factory settings: X=1
	Setting condensed status diagnostics	read / write	Displays whether "Condensed Status & Diagnostic Messages" is used. 0=Status and diagnostics as described in Profile 3.01 1=Support for accumulative status and diagnostics 2-255=Reserved for the Profibus User Organization (PNO) Factory settings: 1
(only visible in online mode)	Service locking	read/write	Configuration for enabling the ENP service parameters.

Submenu "System information"

In addition to the system information described from Page 63 onwards, the following parameter is also available in the Expert setup.

System information			
Menu item	Parameter		
"Diagnostics" Submenu "System informations"	Name	Parameter access	Description
	UpDown Feature Supported	read	0x00: Upload Supported 0x01: Parallel Upload Supported 0x02: Download Supported 0x03: Two Buffer Device Factory settings: Upload Supported

Submenu "Measured values"

The menu is only visible in the online mode!

All the measured values with their related status information are displayed in the "Measured values" Expert menu. Furthermore, the unscaled, unlinearized measured value of the sensor input in question can be read out by means of the "Raw value" parameter. For example, in the case of a Pt100 the actual Ohm value that can be used to calibrate and calculate Callendar-Van Dusen coefficients is displayed.

Measured values			
Menu item	Parameter		
"Diagnostics" Submenu "Measured values"	Name	Parameter access	Description
	PV value n	read	Displays the primary output value of the Transducer Block.  Note! The "PV value" can be made available to an AI Block for further processing. The quality of the measured value is displayed with the "Quality" and "Status" parameters.
	PV value n - Quality	read	Displays the quality (measured value status) for the PV value. For list of options, → Page 80
	PV value n - Status	read	Displays the limit (measured value status) for the PV value. 0x00 - OK 0x01 - Limit underflow 0x02 - Limit overflow 0x03 - Value constant
	Process temperature n	read	Displays the measured value of sensor n.
	Process temperature n - Quality	read	Displays the quality (measured value status) of the process temperature for sensor n. For value, see "PV value n - Quality"
	Process temperature n - Status	read	Displays the limit (measured value status) of the process temperature for sensor n. For value, see "PV value n - Status"
	RJ temperature n	read	Displays the internal reference temperature.

Menu item	Measured values		
	Parameter		
"Diagnostics" Submenu "Measured values"	Name	Parameter access	Description
	RJ temperature - Quality	read	Displays the quality (measured value status) of the internal reference temperature. For value, see "PV value n - Quality"
	RJ temperature - Status	read	Displays the status (measured value status) of the internal reference temperature. For value, see "PV value n - Status"
	Sensor raw value n	read	Displays the non-linearized mV/Ohm of the relevant sensor.

n: Number of the Transducer Block (1-2) or the sensor input (1 or 2).

11.4 Slot/Index lists

11.4.1 General explanatory remarks

Abbreviations used in the Slot/Index lists:

- Endress+Hauser matrix → The number of the page on which you will find the explanation of the parameter.
- Object Type:
 - Record → Contains data structures (DS)
 - Simple → Contains only single data types (e.g. float, integer, etc.)
- Parameters:
 - M → Mandatory parameter
 - O → Optional parameter
- Data Types:
 - DS → Data structure, contains data types such as Unsigned8, Octet String, etc.
 - Float → IEEE 754 format
 - Integer → 8 (range of values -128 to 127), 16 (-327678 to 327678), 32 (-2^{31} to 2^{31})
 - Octet String → Binary coded
 - Unsigned → 8 (range of values 0 to 255), 16 (0 to 65535), 32 (0 to 4294967295)
 - Visible String → ISO 646, ISO 2375
- Storage Class:
 - C → Calibration data
 - Cst → Constant parameter
 - D → Dynamic parameter
 - N → Nonvolatile parameter. Changing a parameter in this class does not affect the ST_REV parameter of the block in question
 - S → Static parameter. Changing a parameter in this class increases the ST_REV parameter of the block in question
 - V → Storage class V means that the altered parameter value is not saved in the device.

11.4.2 Device management slot 1

Parameter Name	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameter	Default value
Device Management Slot 1									
Directory Header/ Composite Directory Entries	0	X		Record	Unsigned 16	12	Cst	M	
Composite Directory Entry/ Composite Directory Entries	1	X		Record	Unsigned 16	28	Cst	M	
not used	2-15	–	–	–	–	–	–	–	

11.4.3 Physical Block slot 0

Name Parameter	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameter
Physical Block Slot 0								
not used	0 - 15	–	–	–	–	–	–	–
BLOCK_OBJECT	16	X	–	Record	DS-32	20	Cst	M
ST_REV	17	X	–	Simple	Unsigned 16	2	N	M
TAG_DESC	18	X	X	Simple	Octet String	32	S	M
STRATEGY	19	X	X	Simple	Unsigned 16	2	S	M
ALERT_KEY	20	X	X	Simple	Unsigned 8	1	S	M
TARGET_MODE	21	X	X	Simple	Unsigned 8	1	S	M
MODE_BLK	22	X	–	Record	DS-37	3	D	M
ALARM_SUM	23	X	–	Record	DS-42	8	D	M
SOFTWARE_REVISION	24	X	–	Simple	Visible String	16	Cst	M
HARDWARE_REVISION	25	X	–	Simple	Visible String	16	Cst	M
DEVICE MAN_ID	26	X	–	Simple	Unsigned 16	2	Cst	M
DEVICE_ID	27	X	–	Simple	Visible String	16	Cst	M
DEVICE SER NUM	28	X	–	Simple	Visible String	16	Cst	M
DIAGNOSIS	29	X	–	Simple	Octet String	4	D	M
DIAGNOSIS_EXTENSION	30	X	–	Simple	Octet String	6	D	O
DIAGNOSIS_MASK	31	X	–	Simple	Octet String	4	Cst	M
DIAGNOSIS_MASK_EXTENSION	32	X	–	Simple	Octet String	6	Cst	O
DEVICE CERTIFICATION	33	X	–	Simple	Visible String	32	Cst	O
not used	34	–	–	–	–	–	–	–
FACTORY_RESET	35	X	X	Simple	Unsigned 16	2	S	O
DESCRIPTOR	36	X	X	Simple	Octet String	32	S	O
DEVICE MESSAGE	37	X	X	Simple	Octet String	32	S	O
DEVICE INSTAL DATE	38	X	X	Simple	Octet String	16	S	O
not used	39	–	–	–	–	–	–	–
IDENT_NUMBER_SELECTOR	40	X	X	Simple	Unsigned 8	1	S	O
HW_WRITE_PROTECTION	41	X	–	Simple	Unsigned 8	1	D	O
FEATURE	42	X	–	Record	DS-68	8	N	M
COND_STATUS_DIAGNOSIS	43	X	X		Unsigned 8	1	S	M
not used	44 - 53	–	–	–	–	–	–	–
ACTUAL_ERROR_CODE	54	X	–	Simple	Unsigned 16	2	D	M
LAST_ERROR_CODE	55	X	–	Simple	Unsigned 16	2	D/S	M
UPDOWN_FEAT_SUPP	56	X	–	Simple	Octet String	1	Const	M
not used	57 - 58	–	–	–	–	–	–	–
DEVICE_BUS_ADDRESS	59	X	–	Simple	Unsigned 8	1	D	M

Name Parameter	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameter
not used	60	–	–	–	–	–	–	–
SET UNIT TO BUS	61	X	X	Simple	Unsigned 8	1	V	M
DISPLAY_VALUE	62	X	–	Record	LocalDispVal	6	D	O
not used	63	–	–	–	–	–	–	–
PROFILE_REVISION	64	X	–	Simple	OctetString	32	Cst(D)	M
CLEAR_LAST_ERROR	65	X	X	Simple	Unsigned 8	1	V	M
IDENT_NUMBER	66	X	–	Simple	Unsigned 16	2	D	M
CHECK_CONFIGURATION	67	X	–	Simple	Unsigned 8	1	D	O
not used	68	–	–	–	–	–	–	–
ORDER_CODE	69	X	–	Simple	Visible String	32	C	M
TAG_LOCATION	70	X	X	Simple	Visible String	22	C	O
SIGNATURE	71	X	X	Simple	OctetString	54	C	O
ENP_VERSION	72	X	–	Simple	Visible String	16	Cst	M
DEVICE_DIAGNOSIS	73	X	–	Simple	OctetString	10	D	M
EXTENDED_ORDER_CODE	74	X	–	Simple	Visible String	60	C	M
SERVICE_LOCKING	75	X	X	Simple	Unsigned 16	2	D	M
not used	76 – 94	–	–	–	–	–	–	–
STATUS	95	X	–	Simple	OctetString	16	D	O
DIAGNOSTICS_CODE	96	X	–	Simple	OctetString	4	D	O
STATUS_CHANNEL	97	X	–	Simple	Unsigned 8	1	D	O
STATUS_COUNT	98	X	–	Simple	Unsigned 8	1	D	O
LAST_STATUS	99	X	–	Simple	OctetString	16	D/S	O
LAST_DIAGNOSTICS_CODE	100	X	–	Simple	OctetString	4	D/S	O
LAST_STATUS_CHANNEL	101	X	–	Simple	Unsigned 8	1	D/S	O
not used	102 – 103	–	–	–	–	–	–	–
VERSIONINFOSWREV	104	X	–	Simple	OctetString	16	N	O
VERSIONINFOHWREV	105	X	–	Simple	OctetString	16	N	O
VERSIONINFODEVREL	106	X	–	Simple	OctetString	16	N	O
ELECTRONIC_SERIAL_NUMBER	107	X	–	Simple	Visible String	16	Cst	M
not used	108 – 112	–	–	–	–	–	–	–
DEV_BUS_ADDR_CONFIG	113	X	X	Simple	Unsigned 8	1	N	O
CAL_IDENTNUMBER	114	X	–	Simple	Unsigned 16	2	C	O
not used	115 – 118	–	–	–	–	–	–	–
SENSOR_DRIFT_MONITORING	118	X	X	Simple	Unsigned 8	1	S	MS
SYSTEM_ALARM_DELAY	119	X	X	Simple	Unsigned 8	1	S	O
MAINS_FILTER	120	X	X	Simple	Unsigned 8	1	S	O
AMBIENT_ALARM	121	X	X	Simple	Unsigned 8	1	S	O
not used	122 – 125	–	–	–	–	–	–	–
DISP_ALTERNATING_TIME	126	X	X	Simple	Unsigned 8	1	S	O
DISP_SOURCE_1	127	X	X	Simple	Unsigned 16	2	S	O
DISP_VALUE_1_DESC	128	X	X	Simple	OctetString	16	S	O
DISP_VALUE_1_FORMAT	129	X	X	Simple	Unsigned 8	1	S	O
DISP_SOURCE_2	130	X	X	Simple	Unsigned 16	2	S	O
DISP_VALUE_2_DESC	131	X	X	Simple	OctetString	16	S	O
DISP_VALUE_2_FORMAT	132	X	X	Simple	Unsigned 8	1	S	O
DISP_SOURCE_3	133	X	X	Simple	Unsigned 16	2	S	O
DISP_VALUE_3_DESC	134	X	X	Simple	OctetString	16	S	O
DISP_VALUE_3_FORMAT	135	X	X	Simple	Unsigned 8	1	S	O
not used	136 – 139	–	–	–	–	–	–	–
VIEW_PHYSICAL_BLOCK	140	X	X	Simple	Unsigned 16, DS-37, DS-42, OctetString[4]	17	D	M

11.4.4 Transducer Block slot 1

Name	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameter
BLOCK_OBJECT	70	X	–	Record	DS-32	20	C	M
ST_REV	71	X	–	Simple	Unsigned16	2	N	M
TAG_DESC	72	X	X	Simple	Octet String	32	S	M
STRATEGY	73	X	X	Simple	Unsigned 16	2	S	M
ALERT_KEY	74	X	X	Simple	Unsigned 8	1	S	M
TARGET_MODE	75	X	X	Simple	Unsigned 8	1	S	M
MODE_BLK	76	X	–	Record	DS-37	3	D	M
ALARM_SUM	77	X	–	Record	DS-42	8	D	M
PRIMARY_VALUE	78	X	–	Record	101	5	D	M
PRIMARY_VALUE_UNIT	79	X	X	Simple	Unsigned 16	2	S	M
SECONDARY_VALUE_1	80	X	–	Record	101	5	D	M
SECONDARY_VALUE_2	81	X	–	Record	101	5	D	O
SENSOR_MEAS_TYPE	82	X	X	Simple	Unsigned 8	1	S	M
INPUT_RANGE	83	X	X	Simple	Unsigned 8	1	S	M
LIN_TYPE	84	X	X	Simple	Unsigned 8	1	S	M
not used	85 - 88	–	–	–	–	–	–	–
BIAS_1	89	X	X	Simple	Float	4	S	M
not used	90	–	–	–	–	–	–	–
UPPER_SENSOR_LIMIT	91	X		Simple	Float	4	N	M
LOWER_SENSOR_LIMIT	92	X		Simple	Float	4	N	M
not used	93	–	–	–	–	–	–	–
INPUT_FAULT_GEN	94	X	–	Simple	Unsigned 8	1	D	M
INPUT_FAULT_1	95	X	–	Simple	Unsigned 8	1	D	M
not used	96 - 98	–	–	–	–	–	–	–
MAX_SENSOR_VALUE_1	99	X	X	Simple	Float	4	N	O
MIN_SENSOR_VALUE_1	100	X	X	Simple	Float	4	N	O
not used	101 - 102	–	–	–	–	–	–	–
RJ_TEMP	103	X	–	Simple	Float	4	D	O
RJ_TYPE	104	X	X	Simple	Unsigned 8	1	S	M
EXTERNAL_RJ_VALUE	105	X	X	Simple	Float	4	S	O
SENSOR_CONNECTION	106	X	X	Simple	Unsigned 8	1	S	M
COMP_WIRE1	107	X	X	Simple	Float	4	S	M
not used	108 - 131	–	–	–	–	–	–	–
MAX_PV	132	X	X	Simple	Float	4	N	M
MIN_PV	133	X	X	Simple	Float	4	N	M
CVD_COEFF_A	134	X	X	Simple	Float	4	S	M
CVD_COEFF_B	135	X	X	Simple	Float	4	S	M
CVD_COEFF_C	136	X	X	Simple	Float	4	S	M
CVD_COEFF_R0	137	X	X	Simple	Float	4	S	M
CVD_MAX	138	X	X	Simple	Float	4	S	M
CVD_MIN	139	X	X	Simple	Float	4	S	M
not used	140 - 144	–	–	–	–	–	–	–
CAL_POINT_HI	145	X	X	Simple	Float	4	S	M
CAL_POINT_LO	146	X	X	Simple	Float	4	S	M
CAL_POINT_SPAN	147	X	–	Simple	Float	4	S	M
CAL_POINT_TEMP_LO	148	X	X	Simple	Float	4	S	M
CAL_POINT_TEMP_HI	149	X	X	Simple	Float	4	S	M
CAL_METHOD	150	X	X	Simple	Unsigned 8	2	S	M
SENSOR_SERIAL_NUMBER	151	X	X	Simple	OctetString	32	S	M
POLY_COEFF_A	152	X	X	Simple	Float	4	S	M

Name	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameter
POLY_COEFF_B	153	X	X	Simple	Float	4	S	M
POLY_COEFF_C	154	X	X	Simple	Float	4	S	M
POLY_COEFF_R0	155	X	X	Simple	Float	4	S	M
POLY_MEAS_RANGE_MAX	156	X	-	Simple	Float	4	S	M
POLY_MEAS_RANGE_MIN	157	X	-	Simple	Float	4	S	M
not used	158 - 161	-	-	-	-	-	-	-
CORROSION_DETECTION	162	X	X	Simple	Unsigned 8	2	S	M
CORROSION_CYCLES	163	X	-	Simple	Unsigned 8	2	S	M
SENSOR_DRIFT_ALERT_VALUE	164	X	X	Simple	Float	4	S	M
not used	165 - 168	-	-	-	-	-	-	-
RJ_MAX_SENSOR_VALUE	169	X	-	Simple	Float	4	N	M
RJ_MIN_SENSOR_VALUE	170	X	-	Simple	Float	4	N	M
not used	171	-	-	-	-	-	-	-
TEMPERATURE_THRESHOLD	172	X	X	Simple	Float	4	S	M
RJ_OUT	173	X	-	Record	101	5	D	M
SENSOR_RAW_VALUE	174	X	-	Simple	Float	4	D	M
not used	175 - 219	-	-	-	-	-	-	-
VIEW_TRANSDUCER_BLOCK	220	X	-	Simple	Unsigned16, DS-37,DS-42, 101, Unsigned8, Unsigned8	20	D	M

11.4.5 Transducer Block slot 2

Transducer Block slot 2 contains the same parameters as Transducer Block slot 1. The settings in slot 2 affect sensor input 2.

Name	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameter
All parameters see → Chapter 11.4.4	70-220	-	-	-	-	-	-	-

11.4.6 Analog Input Block (AI 1) slot 1

Name	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameter
not used	2 - 15	–	–	–	–	–	–	–
BLOCK_OBJECT	16	X	–	Record	DS-32	20	C	M
ST_REV	17	X	–	Simple	Unsigned 16	2	N	M
TAG_DESC	18	X	X	Simple	Octet String	32	S	M
STRATEGY	19	X	X	Simple	Unsigned 16	2	S	M
ALERT_KEY	20	X	X	Simple	Unsigned 8	1	S	M
TARGET_MODE	21	X	X	Simple	Unsigned 8	1	S	M
MODE_BLK	22	X	–	Record	DS-37	3	D	M
ALARM_SUM	23	X	–	Record	DS-42	8	D	M
BATCH	24	X	X	Record	DS-67	10	S	M
not used	25	–	–	–	–	–	–	–
OUT	26	X	–	Record	101	5	D	M
PV_SCALE	27	X	X	Array	Float	8	S	M
OUT_SCALE	28	X	X	Record	DS-36	11	S	M
LIN_TYPE	29	X	X	Simple	Unsigned 8	1	S	M
CHANNEL	30	X	X	Simple	Unsigned 16	2	S	M
not used	31	–	–	–	–	–	–	–
PV_FTIME	32	X	X	Simple	Float	4	S	M
FSAFE_TYPE	33	X	X	Simple	Unsigned 8	1	S	O
FSAFE_VALUE	34	X	X	Simple	Float	4	S	O
ALARM_HYS	35	X	X	Simple	Float	4	S	M
not used	36	–	–	–	–	–	–	–
HI_HI_LIM	37	X	X	Simple	Float	4	S	M
not used	38	–	–	–	–	–	–	–
HI_LIM	39	X	X	Simple	Float	4	S	M
not used	40	–	–	–	–	–	–	–
LO_LIM	41	X	X	Simple	Float	4	S	M
not used	42	–	–	–	–	–	–	–
LO_LO_LIM	43	X	X	Simple	Float	4	S	M
not used	44 - 45	–	–	–	–	–	–	–
HI_HI_ALM	46	X	–	Record	DS-39	16	D	O
HI_ALM	47	X	–	Record	DS-39	16	D	O
LO_ALM	48	X	–	Record	DS-39	16	D	O
LO_LO_ALM	49	X	–	Record	DS-39	16	D	O
SIMULATE	50	X	X	Record	DS-50	6	S	O
OUT UNIT TEXT	51	X	X	Simple	Octet String	16	S	O
not used	52 - 64	–	–	–	–	–	–	–
VIEW_AI	65	X	–	Record	Unsigned16, DS-37, DS-42, 101	18	D	M
not used	66 - 69	–	–	–	–	–	–	–

11.4.7 Analog Input Block (AI 2) slot 2

Analog Input Block slot 2 contains the same parameters as Analog Input Block slot 1..

Name	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameters
All the parameters as in → Chapter 11.4.6	0-65	–	–	–	–	–	–	–
Not used	66 - 69	–	–	–	–	–	–	–

11.4.8 Analog Input Block (AI 3) slot 3

Analog Input Block slot 3 contains the same parameters as Analog Input Block slot 1..

Name	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameters
All the parameters as in → Chapter 11.4.6	0-65	–	–	–	–	–	–	–
Not used	66 - 255	–	–	–	–	–	–	–

11.4.9 Analog Input Block (AI 4) slot 4

Analog Input Block slot 4 contains the same parameters as Analog Input Block slot 1..

Name	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameters
All the parameters as in → Chapter 11.4.6	0-65	–	–	–	–	–	–	–
Not used	66 - 255	–	–	–	–	–	–	–

Index

C

CE EMC compliance	50
CE mark (Declaration of Conformity)	6
Certificates and approvals	51
Compatibility with previous model	
Automatic identification	29
Notes on diagnosis in compatibility mode	29
Replacing the devices	30
Configuration example	33
Configuration programs	21
Configuring the device address	25
Corrosion detection	42
Corrosion monitoring	
CORROSION_DETECTION	42

D

Declaration of Conformity (CE mark)	6
DIP switches for hardware settings	21
Display as option	24

E

Electromagnetic compatibility	4
Environment conditions	49
Error category	
Alarm	38
Warning	38
Error messages	38

F

FAILSAFE MODE as per profile 3.01	37
FAILSAFE MODE as per profile 3.01, amendment 2	38
FieldCare operating program	23

H

Hazardous area	4
----------------------	---

I

IEEE floating point number	31
Input	45
Installation instructions	
DIN rails as per IEC 60715	10
In a field housing	9
In the terminal head	9

M

Manufacturer-specific GSD	28
Master class 2 acyclical (MS2AC)	34
Mechanical construction	50
Mounting tool	8

N

NAMUR recommendations	4
-----------------------------	---

O

Output	46
Output variables	
Abbreviations of the output variables	38

P

Performance characteristics	47
Power supply	47
PROFIBUS PA protocol (IEC 61158-2 (MBP))	23
Profile GSD	28

R

Release	44
---------------	----

S

Sensor connection combinations	14
Sensor transmitter matching	47
Spring terminals	
Fine-strand wire without ferrule	14
Releasing the connection	15
Solid wires or fine-strand wires with ferrule	14
Status messages	39–41
Switching write protection on/off	24
Switch-on procedure	26

T

Technical data on the field device connector	20
Terminal assignment	13
Thermometer design	10
Thermowell	10
Turning the display	24
Two sensor inputs	14

¹ For the status of the single sensor channel observe the appendix 'PV status handling'

[illegible]

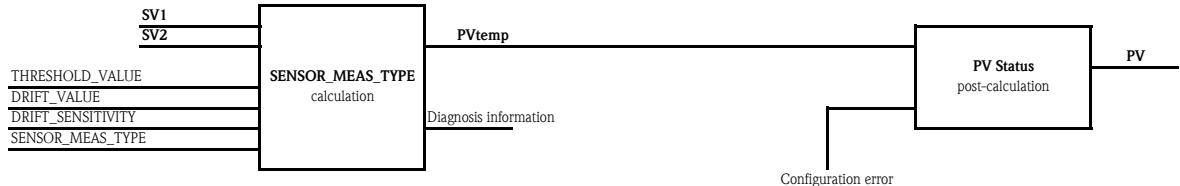
)1 For the status of the single sensor channel observe the appendix 'PV status handling'

Diagnosis Short Text	ID	Category (default)	Category (set by parameterization)	Diagnosis code	Channel	Classification	Diagnosis Extension Bit										SV1 Status	SV2 Status	R1 Status	R2 Status	PV1 Status + PV2 Status																										
							Pos.																																								
							No.	56	57	58	59-71	72	73	74	75	76						77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101-103	EXT_DIAG in Station_Status_1
							Diag Bit 56 not sup. by GSD	901: Ambient temperature undershoot	902: Ambient temperature overshoot	Diag Bit 59-71 not sup. by GSD	261: Electronic failure	431: No calibration TRD1	431: No calibration TRD2	283: Memory error	437: Configuration error TRD1	437: Configuration error TRD2						502: Linearization error TRD1	502: Linearization error TRD2	221: Reference measurement	041: Sensor 1 break	041: Sensor 2 break	043: Sensor 1 shortcut	043: Sensor 2 shortcut	042: Sensor 1 corrosion	042: Sensor 2 corrosion	103: Sensor drift detected TRD1	103: Sensor drift detected TRD2	104: Backup active TRD1	104: Backup active TRD2	101: Sensor 1 range undershoot	101: Sensor 2 range undershoot	102: Sensor 1 range overshoot	102: Sensor 2 range overshoot	482: Simulation active A11	482: Simulation active A12	482: Simulation active A13	482: Simulation active A14	501: Device Preset	262: Display communication failure	Diag Bit 101-103-71 not sup. by GSD		
Profile 3.01 without Amendment 2																																															
Electr. module	1	F		261	0	D									1																						1	0x0C	0x0C	0x0C	0x0C	0x0C					
Calibration	2	F		431	1	D									1																						1	0x0C	-	0x0C	-	) ¹					
Calibration	2	F		431	2	D																															1	-	0x0C	-	0x0C	) ¹					
Memory contents	3	F		283	0	D																															1	0x0C	0x0C	0x0C	0x0C	0x0C					
Configuration	4	F		437	1	S/P																															1	0x04	-	0x80	0x80	) ¹					
Configuration	4	F		437	2	S/P																															1	-	0x04	0x80	0x80	) ¹					
Linearization	5	F		502	1	S																															1	0x0C	-	0x80	0x80	) ¹					
Linearization	5	F		502	2	S																															1	-	0x0C	0x80	0x80	) ¹					
Ref. measurement	6	F		221	0	D																															1	0x0C	0x0C	0x0C	0x0C	0x0C					
Break	7	F		41	1	S																															1	0x10	-	0x80	0x80	) ¹					
Break	7	F		41	2	S																															1	-	0x10	0x80	0x80	) ¹					
Shortcut	8	F		43	1	S																															1	0x10	-	0x80	0x80	) ¹					
Shortcut	8	F		43	2	S																															1	-	0x10	0x80	0x80	) ¹					
Corrosion	9	M/F		42	1	S																															0/1	0x10 / (0x50)	-	0x80	0x80	) ¹					
Corrosion	9	M/F		42	2	S																															0/1	-	0x10 / (0x50)	0x80	0x80	) ¹					
Drift	10		M/F	103	1	P																															0/1	-	-	0x80	0x80	0x40 / 0x10					
Drift	10		M/F	103	2	P																															0/1	-	-	0x80	0x80	0x40 / 0x10					
Backup active	11	M		104	1	P																															0		0x80	0x80	0x80	) ¹					
Backup active	11	M		104	2	P																															0	0x80		0x80	0x80	) ¹					
Underrange	12	S/F		101	1	S																															0/1	0x50 / 0x10	-	0x80	0x80	) ¹					
Underrange	12	S/F		101	2	S																															0/1	-	0x50 / 0x10	0x80	0x80	) ¹					
Overrange	13	S/F		102	1	S																															0/1	0x50 / 0x10	-	0x80	0x80	) ¹					
Overrange	13	S/F		102	2	S																															0/1	-	0x50 / 0x10	0x80	0x80	) ¹					
Ambient temp.	14	S	F	901	0	D			1																												0/1	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C					
Ambient temp.	15	S	F	902	0	D				1																											0/1	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C					
Simulation active	16	C		482	1	P																															0	-	-	-	-	-					
Simulation active	16	C		482	2	P																															0	-	-	-	-	-					
Simulation active	16	C		482	3	P																															0	-	-	-	-	-					
Simulation active	16	C		482	4	P																															0	-	-	-	-	-					
Device Preset	17	C		501	0	D																															0	-	-	-	-	-					
Initialization	18	C		402	0	D																															0	0x4C	0x4C	0x4C	0x4C	0x4C					
Module connect.	19	M		262	0	D																															0	-	-	-	-	-					

)1 For the status of the single sensor channel observe the appendix 'PV status handling'

Diagnosis Short Text	ID	Category (default)	Category (set by parameterization)	Diagnosis code	Channel	Classification	Diagnosis Bits																			EXTENSION_AVAILABLE	SV1 Status	SV2 Status	R1 Status	R2 Status	PV1 Status + PV2 Status
							Pos	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40-54	55						
							No.	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	3.0-4.6	4.7						
							Profile 3.01 without Amendment 2																								
Electr. module	1	F		261	0	D		1								1				1	0x0C	0x0C	0x0C	0x0C	0x0C						
Calibration	2	F		431	1	D									1					1	0x0C	-	0x0C	-	) ¹						
Calibration	2	F		431	2	D									1					1	-	0x0C	-	0x0C	) ¹						
Memory contents	3	F		283	0	D		1		1										1	0x0C	0x0C	0x0C	0x0C	0x0C						
Configuration	4	F		437	1	S/P								1		1				1	0x04	-	0x80	0x80	) ¹						
Configuration	4	F		437	2	S/P								1						1	-	0x04	0x80	0x80	) ¹						
Linearization	5	F		502	1	S					1									1	0x0C	-	0x80	0x80	) ¹						
Linearization	5	F		502	2	S					1									1	-	0x0C	0x80	0x80	) ¹						
Ref. measurement	6	F		221	0	D					1									1	0x0C	0x0C	0x0C	0x0C	0x0C						
Break	7	F		41	1	S					1									1	0x10	-	0x80	0x80	) ¹						
Break	7	F		41	2	S					1									1	-	0x10	0x80	0x80	) ¹						
Shortcut	8	F		43	1	S					1									1	0x10	-	0x80	0x80	) ¹						
Shortcut	8	F		43	2	S					1									1	-	0x10	0x80	0x80	) ¹						
Corrosion	9	M/F		42	1	S					1									1	0x10 / (0x50)	-	0x80	0x80	) ¹						
Corrosion	9	M/F		42	2	S					1									1	-	0x10 / (0x50)	0x80	0x80	) ¹						
Drift	10		M/F	103	1	P					1									1	-	-	0x80	0x80	0x40 / 0x10						
Drift	10		M/F	103	2	P					1									1	-	-	0x80	0x80	0x40 / 0x10						
Backup active	11	M		104	1	P														1		0x80	0x80	0x80	) ¹						
Backup active	11	M		104	2	P														1	0x80		0x80	0x80	) ¹						
Underrange	12	S/F		101	1	S					1									1	0x50 / 0x10	-	0x80	0x80	) ¹						
Underrange	12	S/F		101	2	S					1									1	-	0x50 / 0x10	0x80	0x80	) ¹						
Overrange	13	S/F		102	1	S					1									1	0x50 / 0x10	-	0x80	0x80	) ¹						
Overrange	13	S/F		102	2	S					1									1	-	0x50 / 0x10	0x80	0x80	) ¹						
Ambient temp.	14	S	F	901	0	D					1									1	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C						
Ambient temp.	15	S	F	902	0	D					1									1	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C	0x40 / 0x0C						
Simulation active	16	C		482	1	P														1	-	-	-	-	-						
Simulation active	16	C		482	2	P														1	-	-	-	-	-						
Simulation active	16	C		482	3	P														1	-	-	-	-	-						
Simulation active	16	C		482	4	P														1	-	-	-	-	-						
Device Preset	17	C		501	0	D														1	-	-	-	-	-						
Initialization	18	C		402	0	D														0	0x4C	0x4C	0x4C	0x4C	0x4C						
Module connect.	19	M		262	0	D														1	-	-	-	-	-						

)1 For the status of the single sensor channel observe the appendix 'PV status handling'



PV = SV1			
SV2	SV1	PVtemp Val	PVtemp Stat.
good	good	PV = SV1	good
good	uncertain	PV = SV1	uncertain
good	bad	PV = SV1	bad
uncertain	good	PV = SV1	good
uncertain	uncertain	PV = SV1	uncertain
uncertain	bad	PV = SV1	bad
bad	good	PV = SV1	good
bad	uncertain	PV = SV1	uncertain
bad	bad	PV = SV1	bad

PV = SV2			
SV2	SV1	PVtemp Val	PVtemp Stat.
good	good	PV = SV2	good
good	uncertain	PV = SV2	good
good	bad	PV = SV2	good
uncertain	good	PV = SV2	uncertain
uncertain	uncertain	PV = SV2	uncertain
uncertain	bad	PV = SV2	uncertain
bad	good	PV = SV2	bad
bad	uncertain	PV = SV2	bad
bad	bad	PV = SV2	bad

PV Status post-calculation		
Configuration	PVtemp Stat.	PV Stat.
0	good	good
0	uncertain	uncertain
0	bad	bad
1	good	bad
1	uncertain	bad
1	bad	bad

PV = SV1 - SV2			
SV2	SV1	PVtemp Val	PVtemp Stat.
good	good	PV = SV1 - SV2	good
good	uncertain	PV = SV1 - SV2	uncertain
good	bad	PV = SV1 - SV2	bad
uncertain	good	PV = SV1 - SV2	uncertain
uncertain	uncertain	PV = SV1 - SV2	uncertain
uncertain	bad	PV = SV1 - SV2	bad
bad	good	PV = SV1 - SV2	bad
bad	uncertain	PV = SV1 - SV2	bad
bad	bad	PV = SV1 - SV2	bad

PV = SV2 - SV1			
SV2	SV1	PVtemp Val	PVtemp Stat.
good	good	PV = SV2 - SV1	good
good	uncertain	PV = SV2 - SV1	uncertain
good	bad	PV = SV2 - SV1	bad
uncertain	good	PV = SV2 - SV1	uncertain
uncertain	uncertain	PV = SV2 - SV1	uncertain
uncertain	bad	PV = SV2 - SV1	bad
bad	good	PV = SV2 - SV1	bad
bad	uncertain	PV = SV2 - SV1	bad
bad	bad	PV = SV2 - SV1	bad

PV = SV1 (SV2 if [SV1 > THRESHOLD_VALUE])				
SV1 > THRESH	SV2	SV1	PVtemp Val	PVtemp Stat.
0	good	good	PV = SV1	good
0	good	uncertain	PV = SV1	uncertain
0	good	bad	PV = SV1	bad
0	uncertain	good	PV = SV1	good
0	uncertain	uncertain	PV = SV1	uncertain
0	uncertain	bad	PV = SV1	bad
0	bad	good	PV = SV1	good
0	bad	uncertain	PV = SV1	uncertain
0	bad	bad	PV = SV1	bad
1	good	good	PV = SV2	good
1	good	uncertain	PV = SV2	good
1	good	bad	PV = SV2	good
1	uncertain	good	PV = SV2	uncertain
1	uncertain	uncertain	PV = SV2	uncertain
1	uncertain	bad	PV = SV2	uncertain
1	bad	good	PV = SV2	bad
1	bad	uncertain	PV = SV2	bad
1	bad	bad	PV = SV2	bad

PV = SV2 (SV1 if [SV2 > THRESHOLD_VALUE])				
SV2 > THRESHOLD_VALUE	SV2	SV1	PVtemp Val	PVtemp Stat.
0	good	good	PV = SV2	good
0	good	uncertain	PV = SV2	good
0	good	bad	PV = SV2	good
0	uncertain	good	PV = SV2	uncertain
0	uncertain	uncertain	PV = SV2	uncertain
0	uncertain	bad	PV = SV2	uncertain
0	bad	good	PV = SV2	bad
0	bad	uncertain	PV = SV2	bad
0	bad	bad	PV = SV2	bad
1	good	good	PV = SV1	good
1	good	uncertain	PV = SV1	uncertain
1	good	bad	PV = SV1	bad
1	uncertain	good	PV = SV1	good
1	uncertain	uncertain	PV = SV1	uncertain
1	uncertain	bad	PV = SV1	bad
1	bad	good	PV = SV1	good
1	bad	uncertain	PV = SV1	uncertain
1	bad	bad	PV = SV1	bad

PV = (SV1 + SV2) / 2			
SV2	SV1	PVtemp Val	PVtemp Stat.
good	good	PV = (SV1 + SV2) / 2	good
good	uncertain	PV = (SV1 + SV2) / 2	uncertain
good	bad	PV = (SV1 + SV2) / 2	bad
uncertain	good	PV = (SV1 + SV2) / 2	uncertain
uncertain	uncertain	PV = (SV1 + SV2) / 2	uncertain
uncertain	bad	PV = (SV1 + SV2) / 2	bad
bad	good	PV = (SV1 + SV2) / 2	bad
bad	uncertain	PV = (SV1 + SV2) / 2	bad
bad	bad	PV = (SV1 + SV2) / 2	bad

PV = (SV1 + SV2) / 2 Redundancy			
SV2	SV1	PVtemp Val	PVtemp Stat.
good	good	PV = (SV1 + SV2) / 2	good
good	uncertain	PV = (SV1 + SV2) / 2	uncertain
good	bad	PV = SV2	good
uncertain	good	PV = (SV1 + SV2) / 2	uncertain
uncertain	uncertain	PV = (SV1 + SV2) / 2	uncertain
uncertain	bad	PV = SV2	uncertain
bad	good	PV = SV1	good
bad	uncertain	PV = SV1	uncertain
bad	bad	PV = (SV1 + SV2) / 2	bad

PV = ((SV1 - SV2) / 2) ; Msg on PV > DRIFT_VALUE				
PV > DRIFT	SV2	SV1	PVtemp Val	PVtemp Stat.
0	good	good	PV = ((SV1 - SV2) / 2)	good
0	good	uncertain	PV = ((SV1 - SV2) / 2)	uncertain
0	good	bad	PV = ((SV1 - SV2) / 2)	bad
0	uncertain	good	PV = ((SV1 - SV2) / 2)	uncertain
0	uncertain	uncertain	PV = ((SV1 - SV2) / 2)	uncertain
0	uncertain	bad	PV = ((SV1 - SV2) / 2)	bad
0	bad	good	PV = ((SV1 - SV2) / 2)	bad
0	bad	uncertain	PV = ((SV1 - SV2) / 2)	bad
0	bad	bad	PV = ((SV1 - SV2) / 2)	bad
1	good	good	PV = ((SV1 - SV2) / 2)	bad
1	good	uncertain	PV = ((SV1 - SV2) / 2)	bad
1	good	bad	PV = ((SV1 - SV2) / 2)	bad
1	uncertain	good	PV = ((SV1 - SV2) / 2)	bad
1	uncertain	uncertain	PV = ((SV1 - SV2) / 2)	bad
1	uncertain	bad	PV = ((SV1 - SV2) / 2)	bad
1	bad	good	PV = ((SV1 - SV2) / 2)	bad
1	bad	uncertain	PV = ((SV1 - SV2) / 2)	bad
1	bad	bad	PV = ((SV1 - SV2) / 2)	bad

PV = ((SV1 - SV2) / 2) ; Msg on PV < DRIFT_VALUE				
PV < DRIFT	SV2	SV1	PVtemp Val	PVtemp Stat.
0	good	good	PV = ((SV1 - SV2) / 2)	good
0	good	uncertain	PV = ((SV1 - SV2) / 2)	uncertain
0	good	bad	PV = ((SV1 - SV2) / 2)	bad
0	uncertain	good	PV = ((SV1 - SV2) / 2)	uncertain
0	uncertain	uncertain	PV = ((SV1 - SV2) / 2)	uncertain
0	uncertain	bad	PV = ((SV1 - SV2) / 2)	bad
0	bad	good	PV = ((SV1 - SV2) / 2)	bad
0	bad	uncertain	PV = ((SV1 - SV2) / 2)	bad
0	bad	bad	PV = ((SV1 - SV2) / 2)	bad
1	good	good	PV = ((SV1 - SV2) / 2)	bad
1	good	uncertain	PV = ((SV1 - SV2) / 2)	bad
1	good	bad	PV = ((SV1 - SV2) / 2)	bad
1	uncertain	good	PV = ((SV1 - SV2) / 2)	bad
1	uncertain	uncertain	PV = ((SV1 - SV2) / 2)	bad
1	uncertain	bad	PV = ((SV1 - SV2) / 2)	bad
1	bad	good	PV = ((SV1 - SV2) / 2)	bad
1	bad	uncertain	PV = ((SV1 - SV2) / 2)	bad
1	bad	bad	PV = ((SV1 - SV2) / 2)	bad

x: can be defined to "uncertain" or "bad" by the parameter DRIFT_SENSITIVITY

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