Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Operating Instructions

iTEMP® TMT162

Dual Input Temperature Field Transmitter with PROFIBUS PA® Protocol

BA00275R/09/EN/02.12
71192582

Device software
01.01

Endress+Hauser

People for Process Automation

Brief overview

For quick and straightforward commissioning:

Safety instructions	→ Page 4
▼	
Installation instructions	→ Page 8
▼	
Wiring	→ Page 11
▼	
Display and operating elements	→ Page 19
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 23
Commissioning using the PROFIBUS® PA interface - quick start for device configuration for standard operation	
Customer-specific configuration	→ Page 51
Complex measurement tasks require additional functions to be configured that the user can individually select, set and adapt to his process conditions by setting the appropriate parameters. A detailed description of all the functions and device parameters.	

Table of contents

1 Safety instructions

1.1 Designated use

- The unit is a universal, presettable temperature field transmitter for resistance temperature detectors (RTD), thermocouple (TC) as well as resistance and voltage sensors. The unit is constructed for mounting in field applications.
- The manufacturer cannot be held responsible for damage caused by misuse of the unit.
- Separate Ex documentation is part of this operating manual, for measurement systems in hazardous areas. The installation conditions and connection values indicated in these instructions must be followed!

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 left-hand side of the housing.

Hazardous area
When using in hazardous areas, the national safety requirements must be met. Separate Ex documentation is contained in these Operating Instructions for measurement systems that are to mounted in hazardous areas. Strict compliance with the installation instructions, ratings and safety instructions as listed in this supplementary documentation is mandatory. 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.

Repairs
Repairs that are not described in the Operating Instructions may only be carried out directly at the manufacturer's site or by the Service team.

Electromagnetic compatibility
The device meets the general safety requirements of IEC/EN 61010-1 and the EMC requirements of IEC/EN 61326-series as well as NAMUR recommendations NE 21.

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

1.4 Notes on safety conventions and icons

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

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

2 Identification

2.1 Device designation

2.1.1 Nameplate

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

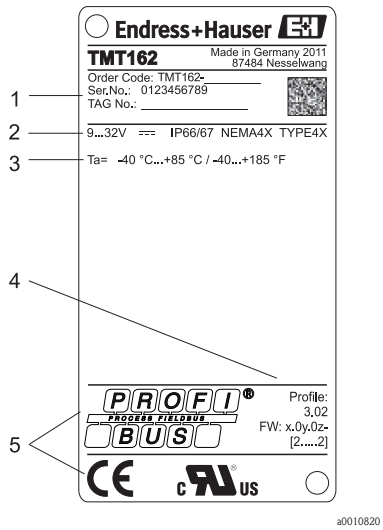


Fig. 1: Nameplate of the field transmitter (example, non-Ex version)

1 Order code, serial number and TAG of device
2 Power supply and ingress protection
3 Ambient temperature
4 PROFIBUS® profile version, firmware version and
5 device revision interoperability
Approvals with symbols

2.2 Scope of delivery

The scope of delivery of the device comprises:

- Temperature field transmitter
- Dummy plugs
- 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 ( ), such as Safety Instructions (XA...), Control or Installation Drawings (ZD...).

2.3 Certificates and approvals

The device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The device complies with the standards IEC/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-series.

2.3.1 CE mark, declaration of conformity

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

2.3.2 UL approval

UL recognized component to UL61010-1

2.3.3 CSA approval

CSA General Purpose

2.3.4 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 Quick installation guide

If the sensor is fixed then the unit can be fitted directly to the sensor. For remote mounting to a wall or stand pipe, two mounting kits are available (→ 4). The illuminated display can be mounted in four different positions (→ 2):

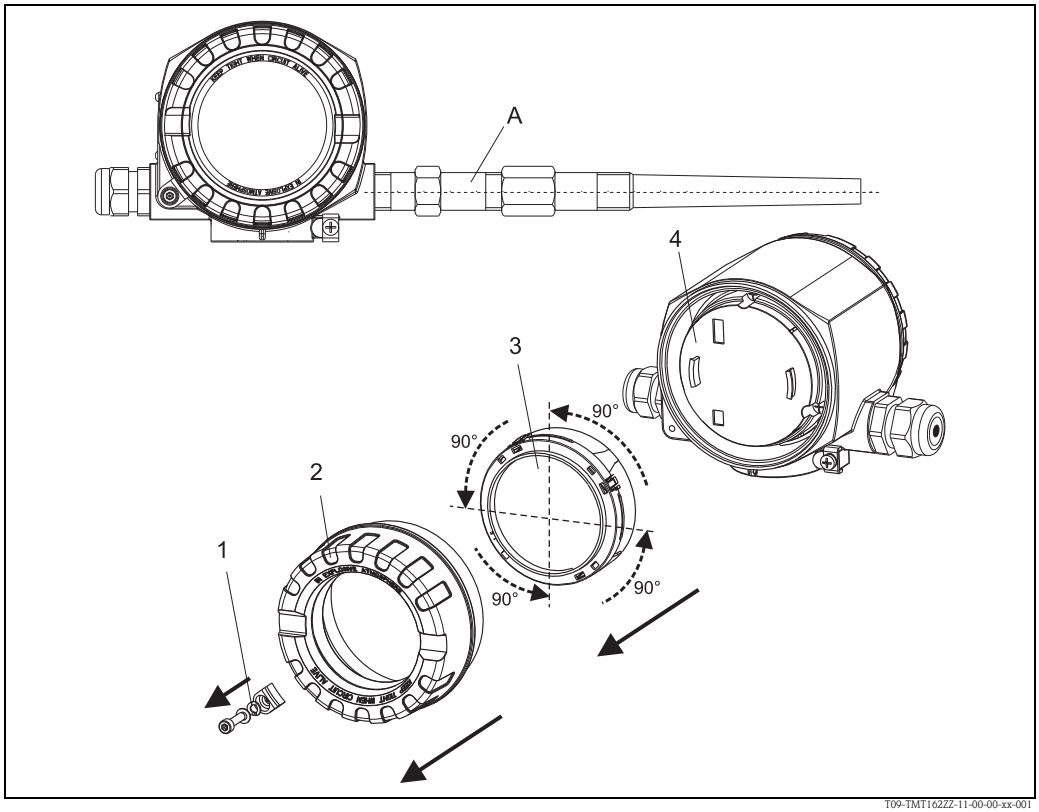


Fig. 2: Temperature field transmitter with sensor, 4 display positions, can be plugged-in in 90° steps

A: Sensor
1: Cover clamp
2: Housing cover with O-ring
3: Display with retainer and twist protection
4: Electronics compartment

1. Remove the cover clamp (1).
2. Unscrew the housing cover together with the O-ring (2).
3. Remove the display with twist protection (3) from the electronics compartment (4). Adjust the display with twist protection in 90°-stages to the desired position and rearrange it on the particular slot in the electronics compartment.
4. Screw on the housing cover together with the O-ring. Mount the cover clamp.

3.2 Incoming acceptance, transport, storage

3.2.1 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.

3.2.2 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) without display.
  -40 to +80 °C (-40 to +176 °F) with display.

3.3 Installation conditions

3.3.1 Dimensions

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

3.3.2 Installation point

Information on installation conditions, such as ambient temperature, protection classification, climatic class, etc., can be found in chapter 10 "Technical data".

3.4 Installation

3.4.1 Direct installation to a sensor

If the sensor is fixed to the process installation, the transmitter can be fitted directly to the sensor.

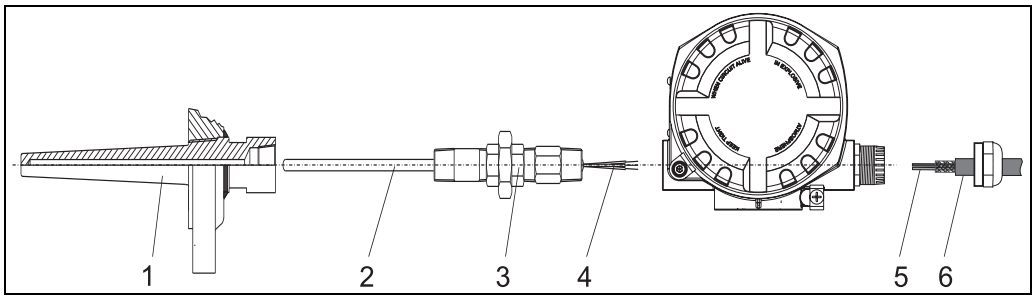


Fig. 3: Installation of the field transmitter directly to a sensor

1 Thermowell
2 Measuring insert
3 Extension nipples and adapters
4 Sensor leads
5 Fieldbus cables
6 Fieldbus shielded cable

For installation proceed as follows:

1. Install and tighten thermowell (1). Screw the measuring insert (2) into the thermowell.
2. Attach necessary extension nipples and adapters (3) to the thermowell. Seal the nipple and adapter threads with silicone tape.
3. Pull sensor leads (4) through the extensions and adapters into the terminal side of the transmitter housing.
4. Install fieldbus shielded cable (6) to the remaining transmitter conduit entry.
5. Pull fieldbus cables (5) into the terminal side of the transmitter housing.
6. Attach and tighten both transmitter covers as described in (→ Page 17). Both transmitter covers must be fully engaged to meet explosion-proof requirements.

3.4.2 Remote installation

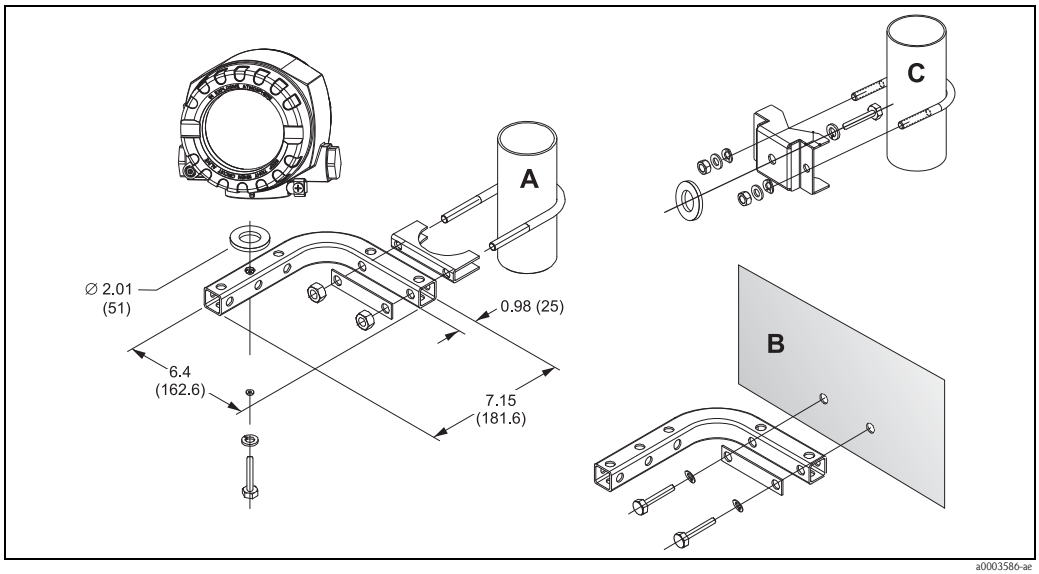


Fig. 4: Installation of the field transmitter using the mounting kit, see chapter 'Accessories' (dimensions in inches; mm)

A, B Mounting with combined wall/pipe mounting kit
C Mounting with pipe mounting kit 2"/V4A

3.5 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

NOTICE

Electronic parts may be damaged

- ► Switch off power supply before installing or connecting the device. Failure to observe this may result in destruction of parts of the electronics.
- ► When installing Ex-approved devices in a hazardous area please take special note of the instructions and connection schematics in the respective Ex documentation added to these Operating Instructions. The local E+H representative is available for assistance if required.

For wiring the device proceed as follows:

1. Remove the cover clamp (→ Page 8).
2. Unscrew the housing cover on the connection compartment together with the O-ring (→ Page 8).
3. Open the cable glands of the device.
4. Feed the cables through the opening in the cable glands.
5. Connect the cables as shown in → 5, chapter 4.2 (→ Page 12) and chapter 4.4 (→ Page 15).
6. On completion of the wiring, screw the screw terminals tight. Tighten the cable glands again. In doing so, also pay particular attention to chapter 4.5 (→ Page 17). Screw the housing cover down again and refit the cover clamp.
7. In order to avoid connection errors always take note of the hints given in the section connection check!

4.1 Quick wiring guide

Terminal layout

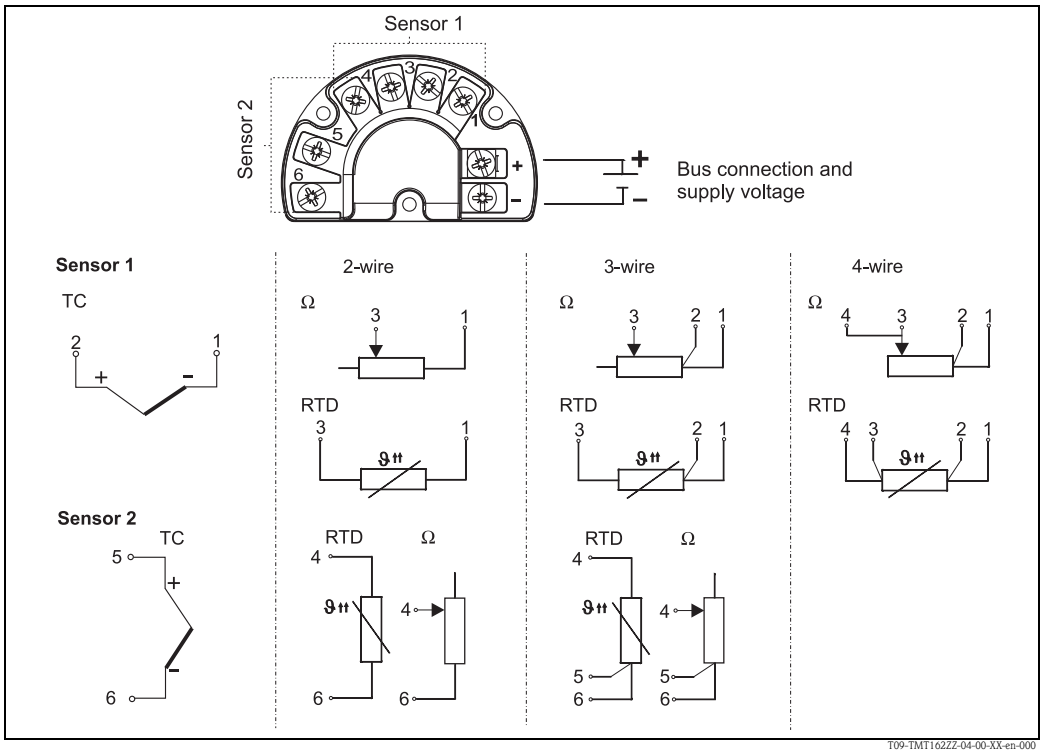


Fig. 5: Terminal layout of the field transmitter

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

4.2 Connecting the sensor cables

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

Please refer to Fig. 5 for the terminal assignment of the sensor connections.
The following connection combinations are possible when both sensor inputs are assigned:

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

There are special cable entries available as accessories when connecting 2 sensors (→ Page 30).

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 1 000 m (3280 ft) 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, → 6

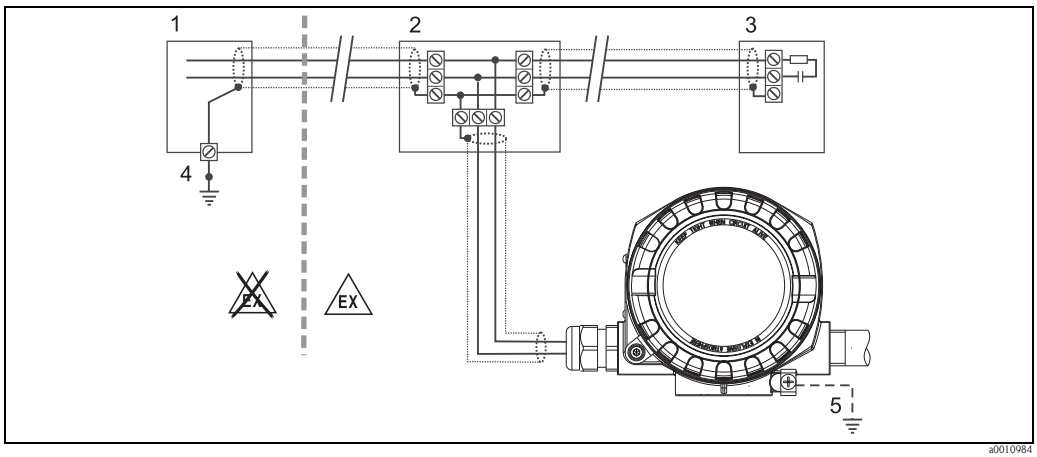


Fig. 6: Shielding and one-sided grounding of the fieldbus cable shielding

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

NOTICE

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

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

4.3.6 Bus termination

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

4.3.7 Further information

General information and further pointers on wiring can be found 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 → Page 16
- Connection via fieldbus connector (optional, can be purchased as an accessory) → Page 16

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

4.4.1 Cable glands or entries

Please also observe the general procedure on → Page 11.

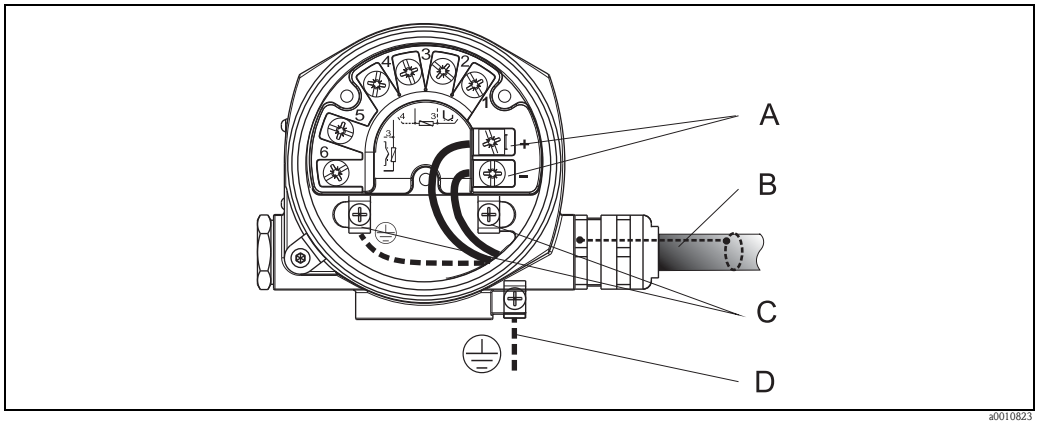


Fig. 7: Connecting the device to the fieldbus cable

A Fieldbus terminals - fieldbus communication and power supply
B Shielded fieldbus cable
C Ground terminals, internal
D Ground terminal external

- The terminals for the fieldbus connection have an integral polarity protection.
- Cable cross-section:
  max. 2.5 mm
- 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. If the transmitter has been ordered as the version with a fieldbus connector (order code → cable entry: Position A and B), the fieldbus connector is fitted and wired at the factory before being delivered. Fieldbus connectors for subsequent fitting can be ordered from Endress+Hauser as accessories (see Section 8 'Accessories').

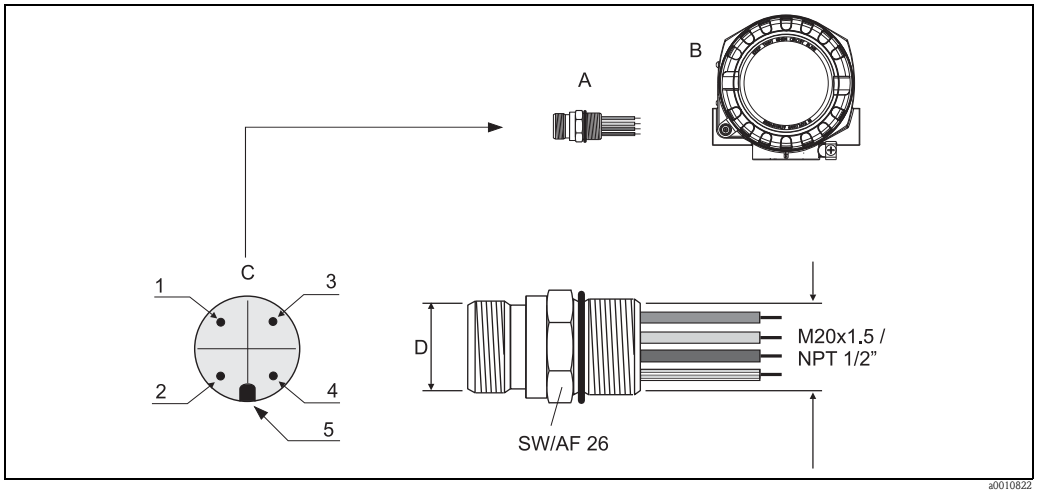
Shielding the feed line/T-Box

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).



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 Degree of protection

The device conforms to the requirements to NEMA 4X (IP 67) ingress protection. In order to fulfil an NEMA 4X (IP 67) degree of protection after installation or service, the following points must be taken into consideration, (→ 8):

- The housing seals must be clean and undamaged before they are replaced in the sealing rebate. If they are found to be too dry, they should be cleaned or even replaced.
- All housing screws and covers must be tightened.
- The cables used for connection must be of the correct specified outside diameter (e.g. M20 x 1.5, cable diameter from 0.315 to 0.47 in; 8 to 12 mm).
- Tighten cable gland or NPT fitting.
- Loop the cable or conduit before placing into the entry ("Water sack"). This means that any moisture that may form cannot enter the gland. Install the device so that the cable or conduit entries are not facing upwards.

- Entries not used are to be blanked off using the blanking plates provided.
- The protective grommet must not be removed from the NPT fitting.

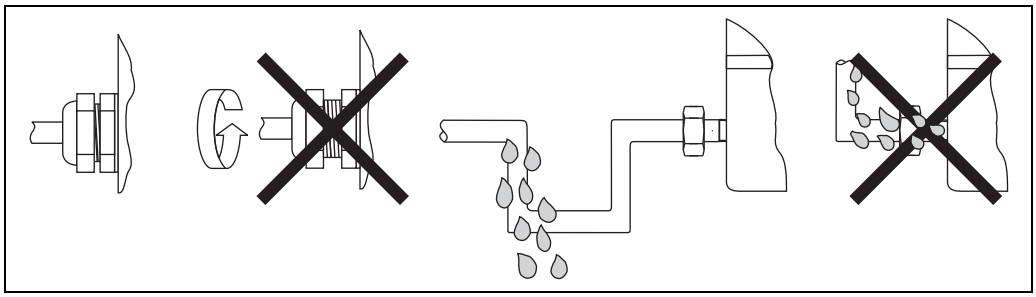


Fig. 8: Connection hints to retain NEMA 4X (IP 67) protection

4.6 Post-connection check

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

Device condition and specifications	**Notes**
Are the device and 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, see Page 12 Sensor cable, → Page 12
Do the cables have adequate strain relief?	-
Are the power supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Are all the screw terminals well tightened?	see Page 17
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?	→ Page 12
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

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

1. Configuration programs see Page 20
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 see Page 21
You can make the following hardware settings for the PROFIBUS® PA interface using DIP switches on the electronics module:

- Entry of the device bus address
- Switching the hardware write protection on/off

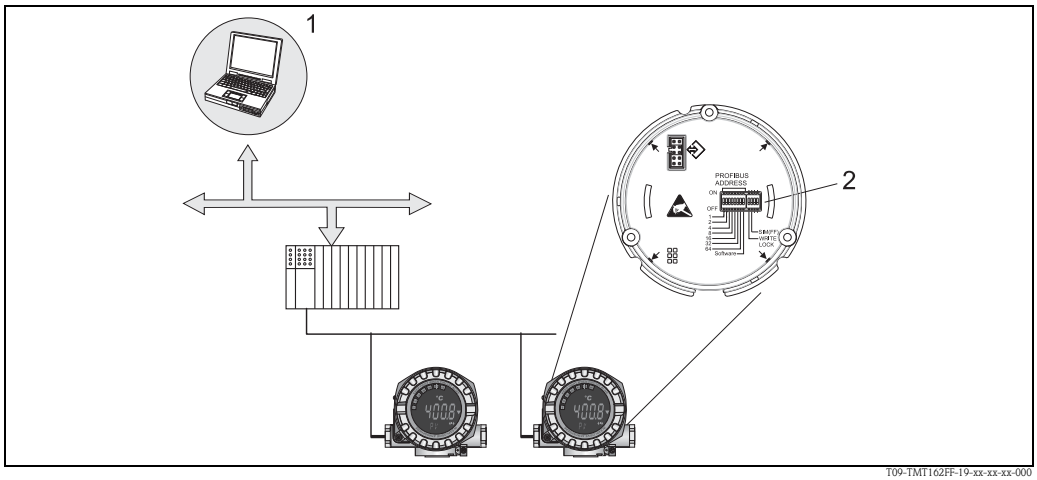


Fig. 9: Field transmitter operating options

1 Configuration/operating programs for operation using PROFIBUS® PA (fieldbus functions, device parameters)
2 DIP switches for hardware settings (write protection, device address)

5.2 Display and operating elements

5.2.1 Display

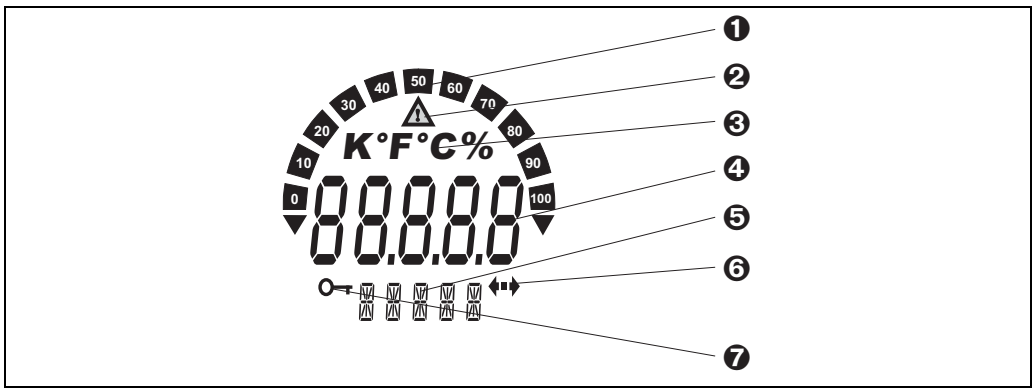


Fig. 10: LC display in the field transmitter (illuminated, can be plugged-in in 90° steps)

5.2.2 Display symbols

Item No.	Function	Description
1	Bar graph display	In 10% stages with indicators for overranging/ underranging. In the event of a fault, the display toggles between the error code and the measured value to be displayed. The bar graph is activated as long as the measured value is displayed. If the display toggles to the error code, the bar graph display is inactive.
2	'Caution' symbol	Appears in the event of a fault or warning.
3	Unit display K, °F, °C or %	Unit display for the measured value displayed.
4	Measured value display (height of digits 20.5 mm)	Displays the measured value. In the event of a warning, the display alternates between the measured value and the warning code. In the event of an error, "——" is displayed instead of the measured value.
5	Status and information display	Shows which value currently appears on the display. A specific text can be entered or each measured value to be displayed. In the event of a fault or warning, the relevant channel information, where available, is displayed. The field remains empty if the channel information is not available.
6	'Communication' symbol	The communication symbol appears when bus communication is active.
7	'Configuration locked' symbol	The 'configuration locked' symbol appears when configuration is locked via a hardware setting.

5.2.3 Local operation

Settings (bus address and configuration locking) for the PROFIBUS® PA interface can be made using DIP switches on the electronics module.

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 transmitter occurs exclusively via Profibus communication.

Detailed information on PROFIBUS® PA device parameterization and operation concept can be found in the BA034S/04/en 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/corporate → Automation → Fieldbus).

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 can be found at: **www.endress.com/corporate → Automation → Fieldbus → Fieldbus device integration**

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
TMT162 Device ID: Profile ID:	1549_{hex} Depending on the profile GSD file used: 0x9703, 0x9702, 0x9701 or 0x9700		See the DEVICE ID parameter
GSD information: **TMT162 GSD:** **Profile GSD:** **Bitmaps:**	Extended PA139700.gsd PA139701.gsd PA139702.gsd PA139703.gsd EH1549_D.bmp EH1549_N.bmp EH1549_S.bmp		Compatibility matrix: | EH3x1549.gsd | EH021549.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:	**Sources for device descriptions/program updates, free downloads on Internet:**		
GSD	■ www.endress.com/corporate (→ Automation → Fieldbus → Fieldbus device integration) ■ www.profibus.com		
FieldCare/DTM	■ www.endress.com/corporate (→ Automation → Fieldbus → Fieldbus device integration)		
SIMATIC PDM	■ www.endress.com/corporate (→ Automation → Fieldbus → Fieldbus device integration) ■ www.fielddevices.com		

5.4 Hardware configuration

ESD - electrostatic discharge
Protect the terminals against electrostatic discharge. Failure to protect the terminals may lead to the destruction or malfunction of electronic parts.

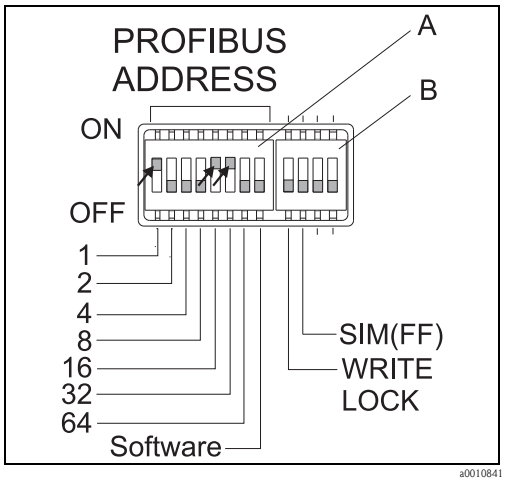


Fig. 11: Hardware configuration using a DIP switch.

A Configuring the device address using the example of bus address 49: DIP switches 32, 16, 1 to "ON" (32 + 16 + 1 = 49). 'Software' DIP switch to "OFF".

B DIP switch SIM = simulation mode (for PROFIBUS® PA communication without function); WRITE LOCK = write protection

To set the DIP switches, proceed as follows:

1. Remove the cover clamp (→ 2, 1).
2. Unscrew the housing cover together with the O-ring (→ 2, 2).
3. If necessary, remove the display with the fitting kit and twist protection (→ 2, 3) from the electronics module (→ 2, 4).
4. Configure the device address and hardware write protection accordingly using the DIP switches.
   General: Switch to "ON" = function enabled, switch to "OFF" = function disabled.
5. Assembly is the reverse of the removal procedure.

5.4.1 Switching write protection on/off

The write protection is switched on and off via a DIP switch on the electronics module. When the write protection is enabled ("WRITE LOCK" set to "ON"), no changes can be made to the parameters. The current write protection status is displayed in the 'HARDWARE WRITE PROTECTION' parameter. This is shown on the display as a key symbol when the write protection is enabled ("WRITE LOCK" to "ON").

5.4.2 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 intended for initial operation and service purposes.
- All devices are delivered from the factory with address 126 and software addressing (DIP switch set to "ON").

The bus address is configured as follows:

1. 'Software' DIP switch from "ON" to "OFF":
   The device restarts after 10 s and assumes the valid bus address configured using DIP switches 1 to 64. If the bus address is changed during ongoing operation, the device is restarted after 10 s. It then starts with the newly configured bus address. A software change to the bus address via a DDLM_SLAVE_ADD telegram is not possible.
2. 'Software' DIP switch from "OFF" to "ON":
   The device restarts after 10 s and assumes the default bus address 126. A software change to the bus address via a DDLM_SLAVE_ADD telegram is possible. A change to the bus address via DIP switches 1 to 64 is not possible.
3. 'Software' DIP switch to "OFF":
   a) Changing a valid bus address to an invalid bus address (>125) → see 2.
   b) Changing an invalid bus address (>125) to a valid bus address (<126) → Device restarts after 10 s and assumes the bus address configured in the process.

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, → Page 10
- "Post-connection check" checklist, → Page 18

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 field transmitter

Once the final checks have been successfully completed, it is time to switch on the supply voltage. The field 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	Displays
1	All segments on
2	All segments off
3	Initialization: Company logo and device name are displayed
4	Current firmware/software version
5	Current bus address in use by device
6	Current identification number in use by device
7a	Current measured value. Bar graph displays respective % value within the configured bar graph range.
7b	or: Current status message. Bar graph displays all segments. If the switch-on procedure is not successful, the relevant status message, depending on the cause, is displayed. A detailed list of status messages and the corresponding troubleshooting instructions can be found in Section 9, 'Troubleshooting'.

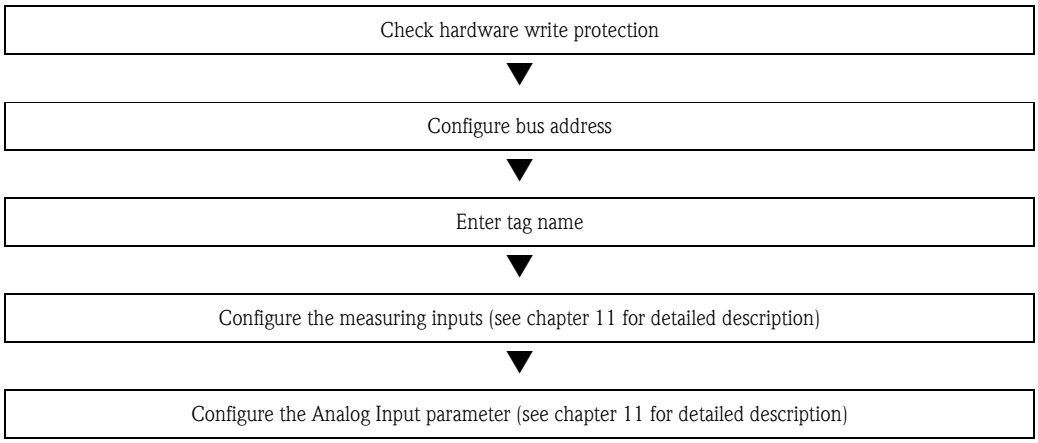
The device begins normal operation after approx. 18 seconds. Normal measuring mode commences as soon as the switch-on procedure is completed. Various measured values and/or status values appear on the display.

6.3 Commissioning the PROFIBUS® PA interface

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 HW 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 → HW 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, → Page 22
2. Enter the tag name (optional) DIAGNOSTICS → SYSTEM INFORMATION → TAG
3. Configure the bus address
   Hardware addressing using DIP switch, → Page 22
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 AI N 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 AI N CHANNEL function.
   - Select the "PV Transducer 1" option
     The following settings are possible:
     AI N 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, EH021549.gsd or EH3x1549.gsd (→ Chap. 5.3.3 Current device description files) Ident number = 1551 (hex) Ident number = 1549 (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

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 TMT162 field 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 (/corporate → Automation → Fieldbus → Fieldbus device integration
- Internet (PNO) → 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.

6.5 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 3.02[1)]-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**

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

1) As per profile 3.01: profile GSD files used or IDENT_NUMBER_SELECTOR set to {0, 129, 130 or 131} or device GSD file used or IDENT_NUMBER_SELECTOR set to 1 and "CondensedStatus" parameter to OFF.
As per profile 3.02: Device 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.

Example:

40 F0 00 00 hex = 0100 0000 1111 0000 0000 0000 0000 0000 binary

Value = $(-1)^0 * 2^{(129-127)} * (1 + 2^{-1} + 2^{-2} + 2^{-3})$

= $1 * 2^2 * (1 + 0.5 + 0.25 + 0.125)$

= $1 * 4 * 1.875 = 7.5$

6.5.2 Block model

The field 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

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 (→ 12) shows the input and output data the field transmitter makes available for cyclical data exchange.

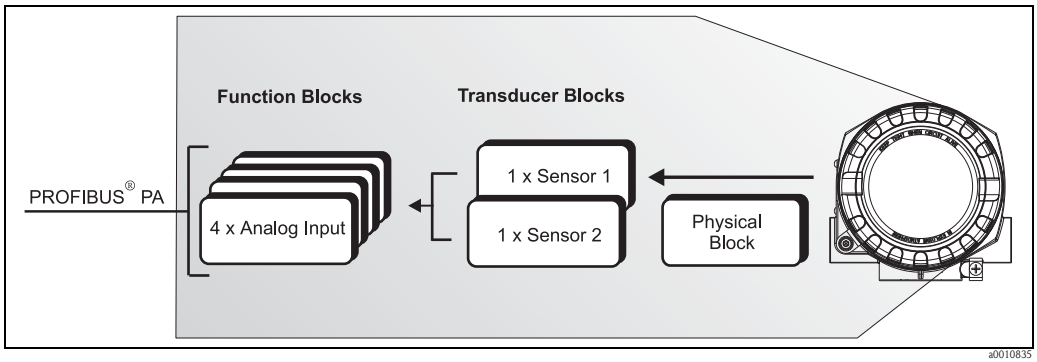


Fig. 12: Field transmitter block model, profile 3.02

6.5.3 Display value

The display value contains 4 bytes with the measured value and 1 byte with the status.
This value can only be displayed. For display on the onsite display, the relevant setting must be made in the SOURCE DISPLAY VALUE parameter.

6.5.4 Input data

Input data are process temperature, internal reference temperature.

6.5.5 Data transfer from the field 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 → Page 26	°C
4	*Status temperature		Status code	-
* Depends on the selection of the Analog Input function block in the AI N CHANNEL parameter → Page 24.				
Possible settings: –Primary value of the transducer –Measured value of sensor at sensor input –Measured value of the internal reference measuring point		→ Page 24 → Select in the AI N CHANNEL parameter → Primary Value TB1 → Select in the AI N CHANNEL parameter → Secondary Value TB1 → Select in the AI N CHANNEL parameter → Internal Temperature		

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 field transmitter. This measured value is purely a display value, displayed by the local display of the transmitter or PROFIBUS® PA Display RID261 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 → Page 26
4	Status display value	Write	-

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 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 MS2AC communication with 2 available SAPs (Service Access Point) at the acyclical data transfer.
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 10^6 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	Description		Order code
Blanks (blind)	■ M20x1.5 EEx-d/XP ■ G ½" EEx-d/XP ■ NPT ½" Aluminum ■ NPT ½" V4A		51004489 51004916 51004490 51006888
Cable glands	■ M20x1.5 cable entry for 1 sensor		51004949
	■ NPT ½" cable gland 2 x D0.5 cables for 2 sensors ■ M20x1.5 cable gland 2 x D0.5 cables for 2 sensors		51004654 51004653
Adapter	M20x1.5/NPT ½" cable entry		51004387
Wall and stand pipe mounting brackets	■ Stainless steel wall/tube 2" ■ Stainless steel tube 2" V4A		51004823 51006412
Fieldbus connector (FF)	Threaded connection ■ NPT ½" ■ M20	Cable connecting thread ■ 7/8" ■ 7/8"	 71005803 71005804
Fieldbus connector (PA)	■ M20x1.5 ■ NPT ½" ■ M20x1.5	■ M12 ■ M12 ■ 7/8"	71090687 71005802 71089147
Surge arrester HAW569	M20x1.5 threaded connection; suitable for HART®, FF and PA fieldbus connection Order code: HAW569-A11A for Non-hazardous area Order code: HAW569-B11A for hazardous area ATEX 2(1)G EEx ia IIC (More technical data see Technical Information: TI103R/09/en)		

9 Troubleshooting

9.1 Troubleshooting instructions

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

NOTICE

In the event of a serious fault, a device might have to be returned to the manufacturer for repair. Follow the instructions in → **Chap. 9.6** before returning the device to Endress+Hauser.

Check local display	
No display visible - No connection to the fieldbus host system	1. For fault elimination, see below: 'Faulty connection to the fieldbus host system' 2. Other possible causes of errors: – Electronics module defective → Test with spare electronics module → Order spare part – Housing (internal electronics) defective → Test with spare housing → Order spare part → Page 40
No display visible - However, connection established to the fieldbus host system	1. Check whether the display module brackets are correctly seated on the electronics module → Page 8 2. Display defective → Test with spare display → Order spare part → Page 40 3. Electronics module defective → Test with spare electronics module → Order spare part → Page 40

▼

Onsite error messages on the display
→ Page 34

▼

Faulty connection to the fieldbus host system	
No connection can be established 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, → Page 16
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 → Page 12
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	
→ Page 34	

▼

Other errors (application errors without messages)	
Some other error has occurred.	Possible causes and remedial measures → Page 39

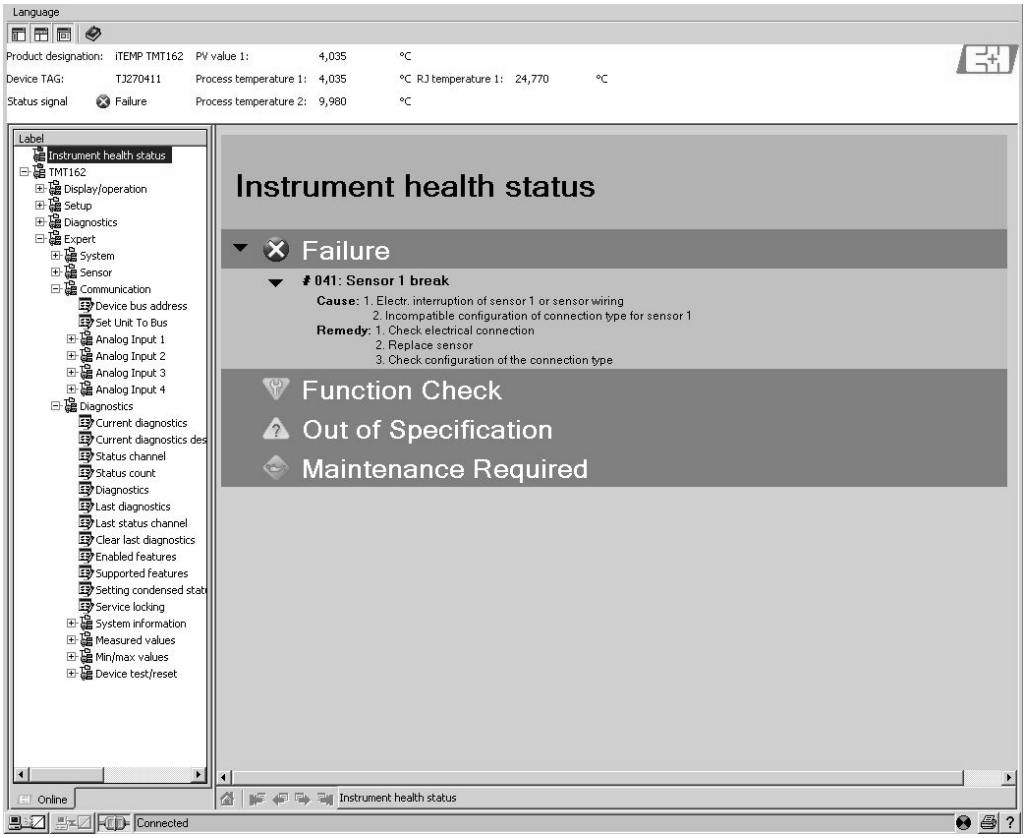
9.2 Displaying the device status on the PROFIBUS® PA

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 3.01[2)] 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).

2) As per profile 3.01: profile GSD files used or IDENT_NUMBER_SELECTOR set to {0, 129, 130 or 131} or device GSD file used or IDENT_NUMBER_SELECTOR set to 1 and "CondensedStatus" parameter to OFF.
As per profile 3.02: Device 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.

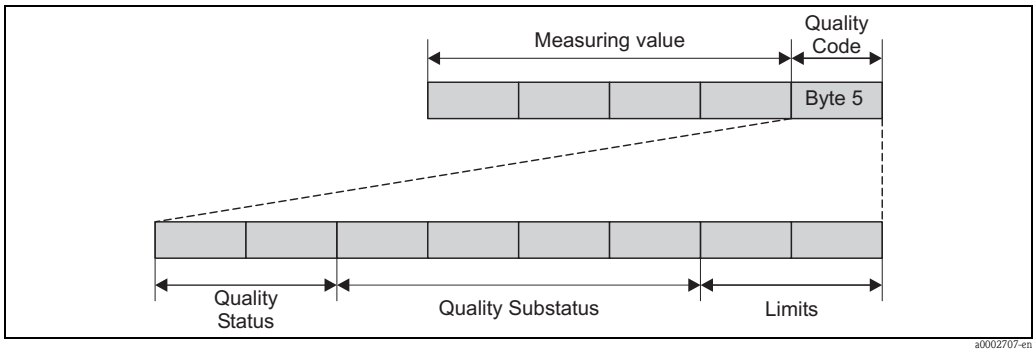


Fig. 13: Structure of the quality byte

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 0x4B	UNCERTAIN	Substitute-set	OK Low High Const

When you select FAILSAFE MODE → LAST GOOD 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 0x47	UNCERTAIN	Last usable value	OK Low High Const	0x4C 0x4D 0x4E 0x4F	UNCERTAIN	Initial value	OK Low High Const

When you select FAILSAFE MODE → WRONG VALUE (default value): status messages (→ Page 34).

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).

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	UNCERCTAIN – 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 local 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!). The display alternates between the primary measured value and the status - indicated by the appropriate letter - plus the defined error number (7-segment display) and the '⚠' symbol (→ Page 19).

ALARM error category:
The device does not continue measuring when the status message is "F". Depending on the setting of the Failsafe Type parameter (FSAFE_TYPE), the last good measured value, the incorrect measured value or the value configured under Failsafe Value (FSAFE_VALUE) is transmitted via the fieldbus with the status "BAD" or "UNCERTAIN" for the measured value. The display alternates between the last valid measured value and the status - indicated by the letter "F" - plus a defined number (7-segment display) and the '⚠' symbol (→ Page 19).

In both cases, the sensor which generates the status, e.g. "SENS1", "SENS2", is output on the 14-segment display. 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 → Page 38**					

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 → Page 38**					

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. **Corrosion detection = off** 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
***) see note on → Page 38**					

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 overshot. 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 → Page 38**					

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	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	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 → Page 38**					

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	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 → Page 38					

NOTICE

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:

	Quality (BAD)		Quality Substatus				Limits		
Error (E)	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.

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 Section 11) depending on the application requirements:

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

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

RTD	< ≈ 2 kΩ	2 kΩ ≈ < x< ≈ 3 kΩ	> ≈ 3 kΩ
off	—	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 43.

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 (→ Page 12)
	Programming	Incorrect sensor type set in the SENSOR_TYPE device function; change to the correct sensor type
	Device defective	Replace device

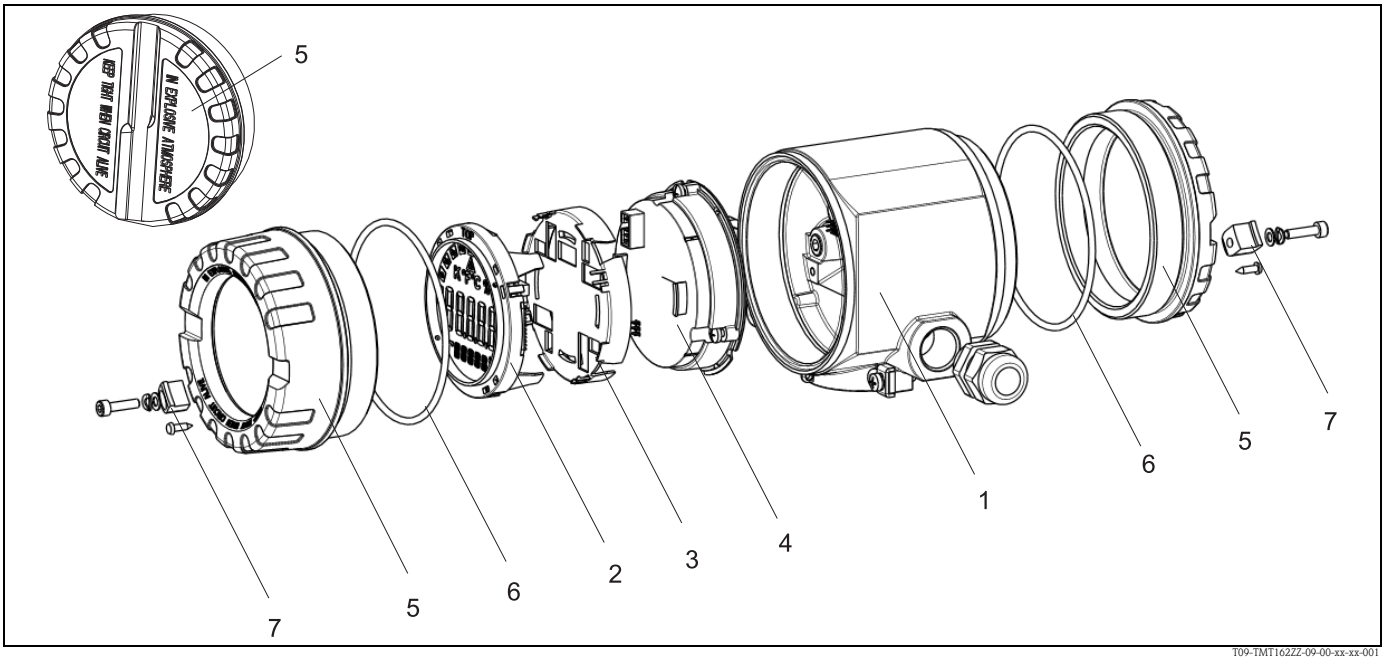
9.4.2 Application errors for TC connection

Sensor types, → Page 43.

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	Set up comparison measuring point (RJ type n), see chapter 11.2.2
	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, → Page 12)
	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

If ordering spare parts, please specify the serial number of the unit!



T09-TMT162ZZ-09-00-xx-xx-001

Housing						
	Certification:					
	A	Non hazardous areas + ATEX Ex ia				
	B	ATEX Ex d				
		Material:				
		A	Aluminum, HART			
		B	Stainless steel 316L, HART			
		C	T17, HART			
		F	Aluminum, FF			
		G	Stainless steel 316L, FF			
		H	T17, FF			
			Cable entry:			
			1	2 x thread NPT ½" + terminal block + 1 blanking plug		
			2	2 x thread M20x1.5 + terminal block + 1 blanking plug		
			4	2 x thread G½" + terminal block + 1 blanking plug		
				Model:		
				A	Standard	
TMT162G-				**A**	**⇐ Order code**	

Electronics						
	Certification:					
	A	Non hazardous areas				
	B	ATEX Ex ia, FM IS, CSA IS				
		Sensor input; communication:				
		A	1x; HART			
		B	2x; config. output sensor 1; HART			
		C	2x; FOUNDATION Fielbus Device Revision 1			
		D	2x; PROFIBUS PA			
		E	2x; FOUNDATION Fielbus Device Revision 2			
			Configuration:			
			A	50 Hz line voltage filter		
			B	According to original order (specify serial no.) 50 Hz mains filter		
			K	60 Hz line voltage filter		
			L	According to original order (specify serial no.) 60 Hz mains filter		
TMT162E-				**⇐ Order code**		

Pos. no.	Order code	Spare part
2, 3	TMT162X-DA	Display HART + fitting kit + twist protection
2, 3	TMT162X-DB	Display PA/FF + fitting kit + twist protection
2, 3	TMT162X-DC	Display fitting kit + twist protection
5	TMT162X-HH	Housing cover blind, Alu Ex d, FM XP with O-ring, CSA XP only as cover of terminal part
5	TMT162X-HI	Housing cover blind, alu + O-ring
5	TMT162X-HK	Housing cover cpl.display, Alu Ex d + O-ring
5	TMT162X-HL	Housing cover cpl. display, alu + O-ring
5	TMT162X-HA	Housing cover blind stainl. st. 316L Ex d, ATEX Ex d, FM XP with O-ring, CSA XP only as cover of terminal part
5	TMT162X-HB	Housing cover blind stainl. st. 316L, with O-ring
5	TMT162X-HC	Housing cover cpl. display, Ex d, stainl. st. 316L, ATEX Ex d, FM XP, CSA XP, with O-ring
5	TMT162X-HD	Housing cover cpl. display, stainl. st. 316L with O-Ring
5	TMT162X-HE	Housing cover blind, T17 316L
5	TMT162X-HF	Housing cover cpl. display, polycarbonate T17, 316L
5	TMT162X-HG	Housing cover cpl. display, glass T17 316L
6	71158816	O-ring 88x3 EPDM70 PTFE coated
7	51004948	Cover latch spares kit field housing screw, washer, spring washer

Currently available accessories and spare parts for your product can be found online at:
http://www.products.endress.com/spareparts_consumables
TMT162

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 and additional enclose a fully completed “Declaration of Contamination” form with the device. A copy of that can be found as pdf file on the CD-ROM. For USA and Canada please follow the Return Authorization Policy which is attached.

9.7 Disposal

The device contains electronic components and must, therefore, be disposed of as electronic waste in the event of disposal. Please observe in particular the local waste disposal regulations of 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
01/2009	1.00.05	Original firmware/software	BA275R/09/en/02.09 71089912
06/2011	1.01.zz	PROFIBUS Profile 3.02 update	BA00275R/09/en/01.11 71137267
06/2011	1.01.zz	-	BA00275R/09/EN/02.12 71192582

10 Technical data

10.0.1 Input

Measured variable	Temperature (temperature linear transmission behaviour), resistance and voltage.
Measuring range	The transmitter records different measuring ranges depending on the sensor connection and input signals.

Type of input	Designation	Measuring range limits	Min. span
Resistance thermometer (RTD)			
to IEC 60751	Pt100	-200 to 850 °C (-328 to 1562 °F)	10 °C (18 °F)
(α = 0.00385)	Pt200	-200 to 850 °C (-328 to 1562 °F)	10 °C (18 °F)
	Pt500	-200 to 250 °C (-328 to 482 °F)	10 °C (18 °F)
	Pt1000	-200 to 250 °C (-328 to 482 °F)	10 °C (18 °F)
to JIS C1604-81			
(α = 0.003916)	Pt100	-200 to 649 °C (-328 to 1200 °F)	10 °C (18 °F)
to DIN 43760			
(α = 0.006180)	Ni100	-60 to 250 °C (-76 to 482 °F)	10 °C (18 °F)
	Ni1000	-60 to 150 °C (-76 to 302 °F)	10 °C (18 °F)
to Edison Copper Winding No.15			
(α = 0.004274)	Cu10	-100 to 260 °C (-148 to 500 °F)	10 °C (18 °F)
to Edison Curve			
(α = 0.006720)	Ni120	-70 to 270 °C (-94 to 518 °F)	10 °C (18 °F)
to GOST			
(α = 0.003911)	Pt50	-200 to 1100 °C (-328 to 2012 °F)	10 °C (18 °F)
	Pt100	-200 to 850 °C (-328 to 1562 °F)	10 °C (18 °F)
to GOST			
(α = 0.004280)	Cu50, Cu100	-200 to 200 °C (-328 to 392 °F)	10 °C (18 °F)
	Pt100 (Callendar - van Dusen)	10 to 400 Ω	10 Ω
		10 to 2000 Ω	100 Ω
	Nickel polynomial (only PROFIBUS® PA)	10 to 400 Ω	10 Ω
		10 to 2000 Ω	100 Ω
	Copper polynomial (only PROFIBUS® PA)	10 to 400 Ω	10 Ω
		10 to 2000 Ω	100 Ω
	■ Type of connection: 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 to max. 50 Ω per wire		
Resistance transmitter	Resistance Ω	10 to 400 Ω	10 Ω
		10 to 2000 Ω	100 Ω
Thermocouples (TC)			
to IEC 584 part 1	Type B (PtRh30-PtRh6)[1) 2)]	+40 to +1820 °C (+104 to 3308 °F)	500 °C (900 °F)
	Type E (NiCr-CuNi)	-270 to +1000 °C (-454 to 1832 °F)	50 °C (90 °F)
	Type J (Fe-CuNi)	-210 to +1200 °C (-346 to 2192 °F)	50 °C (90 °F)
	Type K (NiCr-Ni)	-270 to +1372 °C (-454 to 2501 °F)	50 °C (90 °F)
	Type N (NiCrSi-NiSi)	-270 to +1300 °C (-454 to 2372 °F)	50 °C (90 °F)
	Type R (PtRh13-Pt)	-50 to +1768 °C (-58 to 3214 °F)	500 °C (900 °F)
	Type S (PtRh10-Pt)	-50 to +1768 °C (-58 to 3214 °F)	500 °C (900 °F)
	Type T (Cu-CuNi)	-260 to +400 °C (-436 to 752 °F)	50 °C (90 °F)
to ASTM E988	Type C (W5Re-W26Re)	0 to +2315 °C (32 to 4199 °F)	500 °C (900 °F)
	Type D (W3Re-W25Re)	0 to +2315 °C (32 to 4199 °F)	500 °C (900 °F)
to DIN 43710	Type L (Fe-CuNi)	-200 to +900 °C (-328 to 1652 °F)	50 °C (90 °F)
	Type U (Cu-CuNi)	-200 to +600 °C (-328 to 1112 °F)	50 °C (90 °F)
	■ Internal cold junction (Pt100) ■ External cold junction: configurable value -40 to +85 °C (-40 to +185 °F) ■ Max. sensor resistance 10 kΩ (if sensor resistance is greater than 10 kΩ, error message as per NAMUR NE89)[3)]		

Type of input	Designation	Measuring range limits	Min. span
Voltage transmitter (mV)	Millivolt transmitter (mV)	-20 to 100 mV	5 mV

1) Significant measuring error increase for temperature lower than 300 °C (572 °F).

2) When operating conditions are based on a large temperature range, the TMT162 offers the ability to split the range. For example, a Type S or R thermocouple can be used for the low range and a Type B can be used for the upper range. The TMT162 is then programmed to switch at a predetermined temperature. This allows for utilization of the best performance from each individual thermocouple and provides 1 output that represents the process temperature. Note: the dual sensor option must be included in the order code for the HART® protocol. Two sensor inputs are already provided as standard if the FF and PA protocol are selected.

3) Basic requirements NE89: detection of increased sensor resistance (e.g. corrosion of contacts or wires) of TC or RTD/4-wire.

10.0.2 Output

Output signal

PROFIBUS® PA	
Signal encoding	PROFIBUS® PA as per EN 50170 volume 2, IEC 61158-2, Manchester Bus Powered (MBP)
Data transmission rate	31.25 kBit/s, voltage mode
Galvanic isolation	U = 2 kV AC (input/output)

Breakdown information

PROFIBUS® PA
Status and alarms according to specification PROFIBUS® PA Profile 3.01/3.02

Linearization/transmission behavior

Temperature linear, resistance linear, voltage linear

Filter

1st order digital filter: 0 to 60 s

Current consumption

PROFIBUS® PA	
Current consumption (device basic current)	≤ 11 mA
Error current FDE (Fault Disconnection Electronic)	0 mA

Protocol-specific data

PROFIBUS® PA	
Profile	3.02
Manufacturer-specific ID.:	1549 (Hex)
Device or bus address	126 (default) The device or bus address is set either using the configuration software, e.g. FieldCare or with the DIP switches on the electronics compartment.
GSD files	Sources of GSD files and device drivers: ■ GSD file: www.endress.com (→ Download → Software) ■ Profile GSD file: www.profibus.com ■ FieldCare/DTM: www.endress.com (→ Automation → Fieldbus → Fieldbus device integration) ■ SIMATIC PDM: www.endress.com (→ Automation → Fieldbus → Fieldbus device integration) or www.fielddevices.com
Write lock	Write lock activated using hardware setting (DIP switch)

PROFIBUS® PA	
Cyclic data exchange	
Output data	Display value
Input data	Process temperature, internal reference temperature
Short description of blocks	
Physical Block	The Physical Block contains all the data to uniquely identify and characterize the device. It corresponds to an electronic nameplate for the device. In addition to parameters required for operation of the device at the Fieldbus, the Physical Block provides information such as order code, device ID, hardware revision, software revision etc. The display settings are also made using the Physical Block.
Transducer Block "Sensor 1" and "Sensor 2"	The field transmitter Transducer Blocks contain all the measuring and device-specific parameters relating to the measurement of the input variables.
Analog Input (AI)	In the AI function block, the process variables from the Transducer Blocks are processed for the subsequent automation functions in the control system (e.g. scaling, limit value processing).

Switch-on delay

PROFIBUS® PA
8 s

10.0.3 Power supply

Supply voltage

PROFIBUS® PA
U_b= 9 to 32 V, reverse polarity protection, max. voltage U_b = 35 V According to IEC 60079-27, FISCO/FNICO

Cable entry

Overview see chapter 8 ’Accessories’

10.0.4 Performance characteristics

Response time

1 s per channel

Reference operating conditions

Calibration temperature: + 25 °C ± 5 K (77 °F ± 9 °F)

Maximum measured error

	Designation	Accuracy	
		Digital	D/A[1)]
Resistance thermometer (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)	0.02% 0.02% 0.02% 0.02%
Thermocouples (TC)	K, J, T, E, L, U N, C, D S, B, R	typ. 0.25 °C (0.45 °F) typ. 0.5 °C (0.9 °F) typ. 1.0 °C (1.8 °F)	0.02% 0.02% 0.02%
	Measuring range	**Accuracy**	
		Digital	D/A[1]
Resistance transmitter (Ω)	10 to 400 Ω 10 to 2000 Ω	± 0.04 Ω ± 0.8 Ω	0.02% 0.02%
Voltage transmitter (mV)	-20 to 100 mV	± 10 µV	0.02%

1) % relates to the set span. Accuracy = digital + D/A accuracy, for 4 to 20 mA output

Physical input range of the sensors	
10 to 400 Ω	Cu10, Cu50, Cu100, Polynom RTD, Pt50, Pt100, Ni100, Ni120
10 to 2000 Ω	Pt200, Pt500, Pt1000, Ni1000
-20 to 100 mV	Thermocouple type: C, D, E, J, K, L, N, U
-5 to 30 mV	Thermocouple type: B, R, S, T

Sensor transmitter matching

Resistance thermometers have high linearity. However, every sensor has an individual temperature resistance characteristic curve. This characteristic curve must be described as accurately as possible in order to achieve a high level of accuracy in the linearization of the measured values in the transmitter. The TMT162 allows you to utilize the following method:
Callendar - Van Dusen coefficients
The Callendar - Van Dusen equation is described as:

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

where A, B and C are constants, commonly referred to as Callendar - Van Dusen coefficients. The precise values of A, B and C are derived from the calibration data and are specific to each RTD sensor.
The process involves programming the device with curve data for a specific RTD, instead of using the standard curve.
Sensor transmitter matching using the above method substantially improves the temperature measurement accuracy of the entire system. This is as a result of the transmitter using the sensor's actual resistance vs. temperature curve data instead of the ideal curve data.

Repeatability

0.0015% of the physical input range (16 Bit)
Resolution A/D conversion: 18 Bit

Long term stability

≤ 0.1 °C/year (≤ 0.18 °F/year) or ≤ 0.05%/year
Data under reference conditions. % relates to the set span. The larger value applies.

Influence of ambient temperature (temperature drift)

Effect on the accuracy when ambient temperature changes by 1 K (1.8 °F):	
Input 10 to 400 Ω	0.001% of measured value, min. 1 mΩ
Input 10 to 2000 Ω	0.001% of measured value, min. 10 mΩ
Input -20 to 100 mV	0.001% of measured value, min. 0.2 µV
Input -5 to 30 mV	0.001% of 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: 10 µV/K	C: 20 µV/K	D: 20 µV/K	E: 75 µV/K	J: 55 µV/K	K: 40 µV/K
L: 55 µV/K	N: 35 µV/K	R: 12 µV/K	S: 12 µV/K	T: 50 µV/K	U: 60 µV/K

Examples of calculating the measured error with ambient temperature drift:

Example 1:

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

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

Example 2:

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

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

Total measurement inaccuracy of the measuring point

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

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

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

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

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

Influence of reference junction (cold junction)

Pt100 DIN EN 60751 Class B, internal reference point for thermocouples TC

10.0.5 Environment conditions

Ambient temperature limits

- Without display: -40 to +85 °C (-40 to +185 °F)
- With display: -40 to +80 °C (-40 to +176 °F)

For use in Ex area, see Ex certificate

At temperatures < -20 °C (-4 °F), the display may react slowly. Readability of the display cannot be guaranteed at temperatures < -30 °C (-22 °F).

Storage temperature

- Without display: -40 to +100 °C (-40 to +212 °F)
- With display: -40 to +80 °C (-40 to +176 °F)

Altitude

Up to 2000 m (6560 ft) above sea level according to IEC 61010-1, CSA 1010.1-92

Climate class

As per IEC 60654-1, Class C

Degree of protection

- Aluminum die-cast or stainless steel housing: IP67, NEMA 4X
- Stainless steel housing for hygienic applications (T17 housing): IP66/IP68 (1.83 m H_2O for 24 h), NEMA 4X, NEMA 6P

Shock and vibration resistance

3g / 2 to 150 Hz as per IEC 60 068-2-6

Care should be taken when using L-form brackets (see wall/tube 2" brackets in Section 'Accessories') since this can cause resonance. Caution: vibrations at the transmitter must not exceed the specified values.

Electromagnetic compatibility (EMC)

CE Electromagnetic Compatibility Compliance
EMC meets all relevant requirements listed under EN 61326 Series and NAMUR NE21. Details as per declaration of conformity.

This recommendation is a uniform and practical way of determining whether the devices used in laboratories and process control are immune to interference with an objective to increase its functional safety.

ESD (Electrostatic discharge)	IEC 61000-4-2	6 kV cont., 8 kV air	
Electromagnetic fields	IEC 61000-4-3	0.08 to 2 GHz (0.08 to 4 GHz for FF) 0.08 to 2 GHz for HART 2 to 2.7 GHz	10 V/m 10 V/m 30 V/m 1V/m
Burst (fast transient)	IEC 61000-4-4	1 kV (2 kV for HART)	
surge	IEC 61000-4-5	1 kV asym. (0.5 kV sym. for HART)	
Conducted RF	IEC 61000-4-6	0.01 to 80 MHz	10 V

Condensation

Permitted

Measuring category

Measuring category II as per IEC 61010-1. The measuring category is provided for measurements at circuits with a direct electrical connection to the low voltage supply.

Pollution degree

Pollution degree 2 as per IEC 61010-1

10.0.6 Mechanical construction

Design, dimensions

Dimensions in mm (inch)

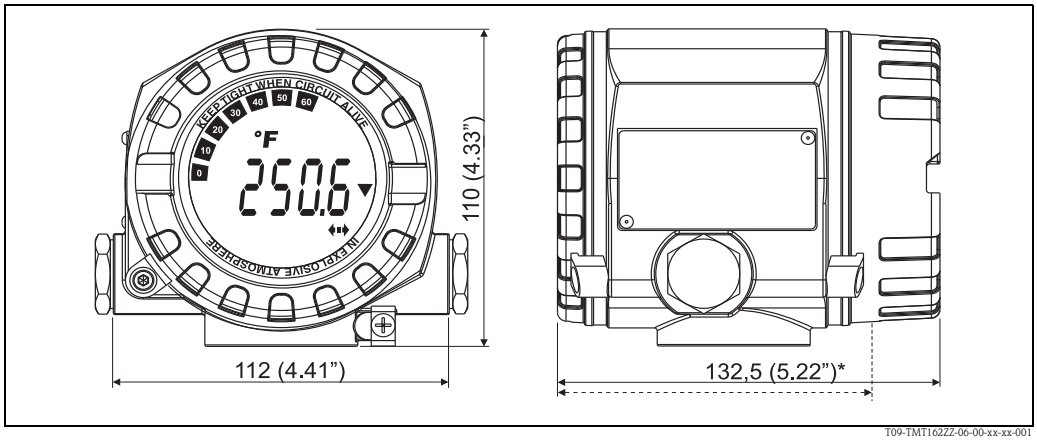


Fig. 14: Die-cast aluminum housing for general purpose or, as option, stainless steel housing (316L)
** Dimensions without display = 112 mm (4.41")*

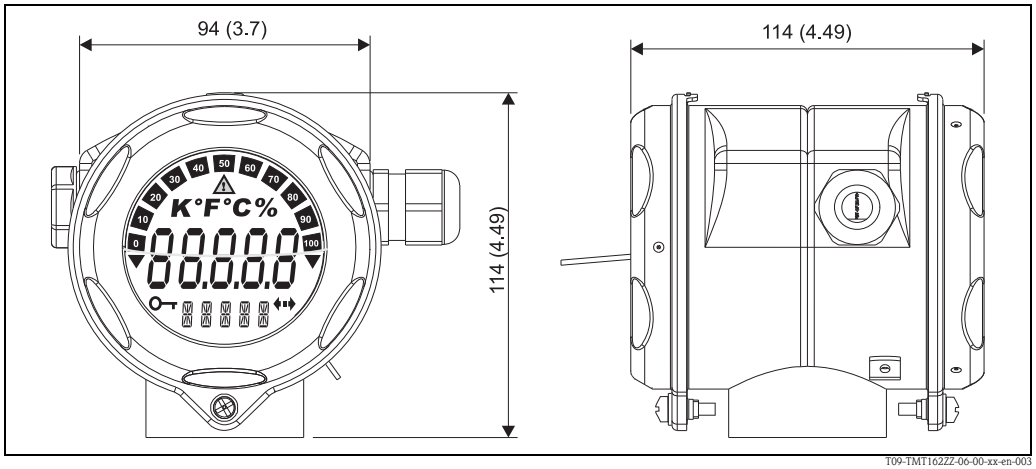


Fig. 15: Optional T17 stainless steel housing for hygienic applications

- Separate electronics compartment and connection compartment
- Display pluggable in 90° stages

Weight

- Approx. 1.4 kg (3 lbs), with display, aluminum housing
- Approx. 4.2 kg (9.3 lbs), with display, stainless steel housing
- Approx. 1.25 kg (2.76 lbs), with display, T17 housing

Material

Housing	Nameplate
Die-cast aluminum housing AlSi10Mg/AlSi12 with powder coating on polyester basis	Aluminum AlMgI, anodized in black
Stainless steel 1.4435 (AISI 316L)	1.4404 (AISI 316L)
Stainless steel 1.4435 (AISI 316L) for hygienic applications (T17 housing)	-

Terminals

2.5 mm^2 (12 AWG) plus wire end ferrules

10.0.7 Certificates and approvals

CE-Mark

The device meets the legal requirements of the EC directives. Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

MTBF

PROFIBUS® PA: 126 a
according to Siemens Standard SN29500

Ex approval

■ ATEX II1G EEx ia IIC T4/T5/T6 FM IS, NI I/1+2/ABCD CSA IS, NI I/1+2/ABCD ■ ATEX II2G EEx d IIC T6 FM XP, NI, DIP I,II,III/1+2/A-G CSA XP, NI, DIP I,II,III/1+2/A-G	■ ATEX EEx d, EEx ia FM XP, DIP, IS, NI I,II,III/1+2/A-G CSA XP, DIP, IS, NI I,II,III/1+2/A-G ■ ATEX II3G EEx nA nL IIC T4/T5/T6 ■ FM+CSA XP, DIP, IS, NI I,II,III/1+2/A-G ■ ATEX II1/2D

Other standards and guidelines

- IEC 60529: Degree of protection by housing (IP-Code)
- IEC 61010-1: Safety requirements for electrical measurement, control and laboratory instrumentation.
- EN 61326-series: Electrical equipment for measurement, control and laboratory use - EMC requirements.
- NAMUR: User association of automation technology in process industries (www.namur.de)
- NEMA: Standardization association for the electrical industry in North America.

CSA GP

CSA General Purpose

Certification PROFIBUS® PA

The temperature transmitter is certified and registered by the PNO (PROFIBUS® Nutzerorganisation e. V.), PROFIBUS user organization. The device meets all the requirements of the following specifications:

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

10.0.8 Documentation

Ex supplementary documentation:
- ATEX 2IIG Ex d: XA058R/09/a3
- ATEX II1/2D: XA059R/09/a3
- ATEX II1G: XA060R/09/a3
- ATEX Ex ia + Ex d: XA061R/09/a3
- ATEX II1/2GD: XA067R/09/a3
- Guidelines for planning and commissioning 'PROFIBUS® DP/PA' Field communication (BA034S/04/en)

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 section 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 (→ page 86).

11.1 Operating structure

→ **Display/Operation** → page 52

→ **Setup** → page 54

→ Advanced setup (→ page 59)	→ Sensor 1	
	→ Sensor 2	
	→ Security settings	

→ **Diagnostics** → page 61

→ System information (→ page 62)		
→ Measured value (→ page 63)	→ Min./max. values	
→ Device test/reset (→ page 64)		

→ **Expert** → page 65

→ System (→ page 65)	→ Display	
→ Sensory mechanism (→ page 67)	→ Sensor 1	→ Special linearization 1
	→ Sensor 2	→ Special linearization 2
→ Communication (→ page 73)	→ Analog Input 1	
	→ Analog Input 2	
	→ Analog Input 3	
	→ Analog Input 4	
→ Diagnostics (→ page 83)	→ 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 field 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 local display are made in the Display/Operation menu. The following parameters can be found in the **Display/Operation** group and under Expert → System → Display.

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	**Parameters**		
"Display/Operation" (Expert → System → Display)	**Designation**	**Parameter access**	**Description**
	Display interval	**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
	Source Display value 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 ■ Display Value **Factory settings:** Primary Value 1 If all 3 display channels are switched off ('Off' option), the value for 'Display Value' automatically appears on the display. If this value is not available (e.g. 'Display Value' not configured at the control system) or its status is set to "BAD", "——" is displayed on the 7 segment display.
	Description of display value n	**Read/ Write**	Description of the display value shown. **Factory settings:** "P1 " Maximum 16 letters. The value is not shown on the display.
	Format of display value 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:** 4 - Auto

Display/Operation			
Menu item	**Parameters**		
"Display/Operation" (Expert → System → Display)	**Designation**	**Parameter access**	**Description**
	Bar graph min. n	**Read/ Write**	Entry of lower limit on bar graph display. **Factory settings:0**
	Bar graph max. n	**Read/ Write**	Entry of upper limit on bar graph display. **Factory settings:100**

n = Number of display channels (1 to 3)

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
Bar graph min.: 0 (= default)
Bar graph max.: 100 (= default)

■ Value 2:
Measured value to be displayed: RJ Value
Measured value unit: ° C
Decimal places: 1
Bar graph min.: 0 (= default)
Bar graph max.: 50

■ Value 3:
Measured value to be displayed: Sensor Value 2 (measured value) of Sensor Transducer 2 (SV2)
Unit: ° C
Decimal places: 2
Bar graph min.: 0 (= default)
Bar graph max.: 100 (= default)

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

Parameters	Value
Display interval	12
Source of display value 1	'Primary Value 1'
Description of display value 1	TEMP PIPE 11
Format of display value 1	'xxx.xx'
Bar graph min. 1	0
Bar graph max. 1	100
Source of display value 2	'RJ Value'
Description of display value 2	INTERN TEMP
Format of display value 2	'xxxx.x'
Bar graph min. 2	0

Parameters	Value
Bar graph max. 2	50
Source of display value 3	'Sensor value 2'
Description of display value 3	PIPE 11 BACK
Format of display value 3	'xxx.xx'
Bar graph min. 3	0
Bar graph max. 3	100

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 54	→ Advanced setup (→ page 59)	→ 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 55).
The Physical Block supports the following operating modes:
- AUTO (automatic mode)
- Out of Service (OOS)

OOS can only be configured if the Condensed Status and Diagnosis (as per Profile 3.02) are activated. Otherwise, only AUTO is supported.

Procedure for configuring a measuring input:

1. Start
2. Select sensor type (linearization type) e.g. Pt100
3. Select unit (°C)
4. Select connection mode e.g. 3-wire
5. Configure the type of measurement e.g. PV=SV1
6. Enter the offset (optional)

7. Select the reference measuring point and enter the value in the event of external reference measurement (only for TC measurement)

▼

8. If a second measuring channel is used, repeat steps 2 to 5

▼

9. End

Setup			
Menu item	**Parameters**		
Setup	**Designation**	**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 - current mode	**Read**	Displays the current operating mode of the Physical Block.
	Physical Block - target mode	**Read/ Write**	For selecting the desired 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
	Characteristic type n[1]	**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 Please observe the terminal assignment in Section 4.1 when connecting the individual sensors. In the case of 2-channel operation, the possible connection options in Section 4.2 also have to be observed.

Setup			
Menu item	**Parameters**		
Setup	**Designation**	**Parame-ter access**	**Description**
	Input range 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 temperature unit for PV value n **Options:** ■ 1000 - K ■ 1001 - °C ■ 1002 - °F ■ 1003 - Rk ■ 1281 - Ohm ■ 1243 - mV ■ 1342 - % **Factory settings:** ■ ° C
	Connection mode 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	**Parameters**		
Setup	**Designation**	**Parameter access**	**Description**
	Measuring mode 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 > T value **(Parameter: Sensor switching 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 1 Sensor Transducer 2 (Measuring mode 2): SV1 always refers to the sensor, which is allocated to the Transducer Block, whereas SV2 always displays the value of the other sensor. Therefore, the configuration options are the same for the two blocks. **Sensor Transducer 1** → SV1 = Sensor 1 → SV2 = Sensor 2 **Sensor Transducer 2** → SV1 = Sensor 2 → SV2 = Sensor 1 ■ PV = SV1: Secondary value 1 (= Sensor 2) ■ 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 2 fails, the value of sensor 1 automatically becomes the Primary Value. ■ PV = SV2 (OR SV2 if SV1>T): PV changes from Sensor 2 value to Sensor 1 value if Sensor 2 value > T value (parameter: Sensor switching **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

Setup			
Menu item	**Parameters**		
Setup	**Designation**	**Parameter access**	**Description**
	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**
	Sensor switching 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
	RJ 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
	Fixed RJ temperature n	**Read/ Write**	Value for temperature compensation (see **Reference Junction Type n**). **Factory settings:** 0.0

1.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 and 3-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 =(|SV1-SV2|) if PV < sensor drift alert value**", a status message is output if the limit value is undershot or, in the case of "**PV =(|SV1-SV2|) if PV> sensor drift alert value**", if the limit value is overshot.

Procedure for configuring drift detection for sensor 1:

1. Start

▼

2. Select Type of measurement "**PV =ABS(SV1-SV|) if PV < sensor drift alert value**" or "**PV =ABS(SV1-SV2) if PV > sensor drift alert value**"

▼

3. Set sensor drift alert value 1 to the desired value.

▼

4. Where necessary, set the sensor drift detection to "Warning" or "Failure"

▼

5. End

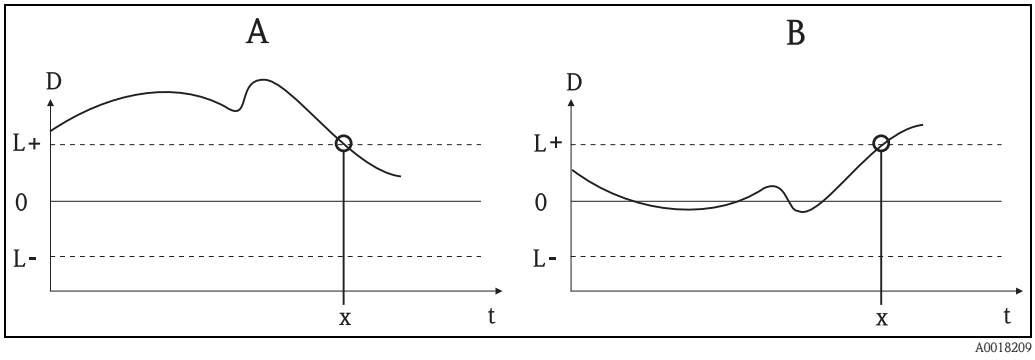


Fig. 16: Drift detection

- *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 lock
Hardware write protection for the device parameters is enabled and disabled via a DIP switch on the electronics module.
The **Hardware write protection** (→ page 60) 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

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

Advanced setup			
Menu item	**Parameters**		
"Setup" Submenu "Advanced setup"	**Designation**	**Parameter access**	**Description**
	Hardware 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 temperature alarm	**Read/ Write**	Status message in the event of the operating temperature of the transmitter being undershot or overshot < -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): (Warning) identified: ■ 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 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)

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 61	→ System information (→ page 62)	
	→ Measured value (→ page 63)	→ Min./max. values
	→ Device test/reset (→ page 64)	

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	**Parameters**		
"Diagnostics" (Expert → Diagnostics)	**Designation**	**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)
	Description of current diagnostics	**Read**	Displays the status information as description text, see Section 9.3.
	Channel information status	**Read**	Displays where in the device the highest priority error occurs. 0: Device 1: Sensor 1 2: Sensor 2
	Number status	**Read**	The number of status messages currently pending in the device.
	Bus address	**Read**	Displays the device bus address. **Factory settings:** 126

Submenu Diagnostics - System information

System information			
Menu item	Parameters		
"Diagnostics" Submenu "System information"	Designation	Parame-ter access	Description
	Firmware version	**Read**	Revision status of device firmware.
	Serial number	**Read**[1]	Displays the serial number of the device.
	Order code	**Read**[1]	Displays the device order code.
	Tag name (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 name	**Read**	Displays the manufacturer-specific device designation. **Display:** iTEMP TMT162
	PROFIBUS Ident Number	**Read**	Displays the Profibus User Organization identification number of the device. – 0x1549 → TMT162 – 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:** 0x1549

1. These parameters can be changed if the "**Service locking**" parameter is configured accordingly in the Expert system menu.

Submenu Diagnostics - Measured values

This menu is only visible in the online mode.

Measured values			
Menu item	**Parameters**		
"Diagnostics" Submenu "Measured values"	**Designation**	**Parameter access**	**Description**
	PV value n	**Read**	Displays the primary output value of the Transducer Block. 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.
	RJ 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.

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

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	**Parameters**		
"Diagnostics" Submenu "Device test/reset"	**Designation**	**Parameter access**	**Description**
	Resets to delivery status	**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  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 73) 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 65

→ System (→ page 65) Settings and description of the measuring point	→ Display (→ page 52)	
→ Sensory mechanism (→ page 67) Settings of the two measuring inputs	→ Sensor 1	→ Special linearization 1
	→ Sensor 2	→ Special linearization 2
→ Communication (→ page 73) 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 83) Displays device information and status for service and maintenance purposes.	→ System information (→ page 62)	
	→ Measured value	→ Min./max. values (→ page 63)
	→ Device test/reset (→ page 64)	

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	**Parameters**		
"Diagnostics"	**Designation**	**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.	
	Current mode	**Read**	Displays the current operating mode. **Display:** AUTO

System			
Menu item	**Parameters**		
"Diagnostics"	**Designation**	**Parameter access**	**Description**
(only online editable)	**PROFIBUS Ident Number Selector**	**Read/ Write**	For selecting the configuration behavior. 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 Indent Number 1549 (TMT162) – 127→ Automatic (0x9700, 0x9701, 0x9702, 0x9703, 0x1549) – 129 → Profile-specific Ident Number 9700(1xAI) – 130 → Profile-specific Ident Number 9701 (2xAI) – 131→ Profile-specific Ident Number 9702 (3xAI) **Factory settings:** 127
	Description	**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)	**Hardware 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 Write protection is enabled/disabled using a DIP switch (see Section 5.4.1).

System			
Menu item	Parameters		
"Diagnostics"	Designation	Parameter access	Description
	System alarm delay	**Read/ Write**	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 This setting does not affect the display.
	Mains frequency filter	**Read/ Write**	Mains filter for the A/D converter **Options:** ■ 0 - 50 Hz ■ 1 - 60 Hz **Factory settings:** 0 - 50 Hz
	Ambient temperature alarm	**Read/ Write**	Status message in the event of the operating temperature of the transmitter being undershot or overshot < -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→ page 54

Submenu "Sensor 1" or "Sensor 2"

Sensor 1 / Sensor 2			
Menu item	Parameters		
"Sensory mechanism" Submenu "Sensor 1" or "Sensor 2"	Designation	Parameter access	Description
	Characteristic 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 Please observe the terminal assignment in Section 4.1 when connecting the individual sensors. In the case of 2-channel operation, the possible connection options in Section 4.2 also have to be observed.

Sensor 1 / Sensor 2			
Menu item	**Parameters**		
"Sensory mechanism" Submenu "Sensor 1" or "Sensor 2"	**Designation**	**Parameter access**	**Description**
	Input range 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 temperature unit for PV value n **Options:** ■ 1000 - K ■ 1001 - °C ■ 1002 - °F ■ 1003 - Rk ■ 1281 - Ohm ■ 1243 - mV ■ 1342 - % **Factory settings:** ° C
	Connection mode 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	**Parameters**		
"Sensory mechanism" Submenu "Sensor 1" or "Sensor 2"	**Designation**	**Parameter access**	**Description**
	Measuring mode n	**Read/ Write**	Displays the calculation process for Primary Value 1, also see → page 54 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 > T value (Parameter: **Sensor switching 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 1 (→ page 54) Sensor Transducer 2 (Measuring mode 2): ■ PV = SV1: Secondary value 1 (= Sensor 2) ■ 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 2 fails, the value of sensor 1 automatically becomes the Primary Value. ■ PV = SV1 (OR SV2 if SV1>T): PV changes from Sensor 2 value to Sensor 1 value if Sensor 2 value > T value (parameter: **Sensor switching 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

Sensor 1 / Sensor 2			
Menu item	**Parameters**		
"Sensory mechanism" Submenu "Sensor 1" or "Sensor 2"	**Designation**	**Parameter access**	**Description**
	2-wire compensation n	**Read/ Write**	Two-wire compensation for RTDs. The following values are permitted: 0 to 30 Ohm
	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
	Lower sensor limit n	**Read**	Displays the lower, physical sensor range.
	Upper sensor limit n	**Read**	Displays the upper, physical sensor range.
	Sensor switching 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).
	RJ 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
	Fixed RJ temperature 1	**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 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:

1. Start
2. Configure the type of measurement e.g. PV=SV1
3. Select unit (°C)
4. Select the sensor type (linearization type) "RTD platinum (Callendar-Van Dusen)"
5. Select connection mode e.g. 4-wire
6. Enter the four coefficients A, B, C and R0
7. If special linearization is also used for a second sensor, repeat steps 2 to 6
8. End

Special linearization 1 / Special linearization 2			
Menu item	**Parameters**		
"Sensory mechanism" Submenu "Special linearization n"	**Designation**	**Parameter access**	**Description**
	Call.-v. Dusen start of range	**Read/ Write**	Lower calculation limit for Callendar-Van Dusen linearization. **Factory settings:** 0.0
	Call.-v. Dusen end of range	**Read/ Write**	Upper calculation limit for Callendar-Van Dusen linearization. **Factory settings:** 100.0
	Call.-v. Dusen coeff. R0	**Read/ Write**	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	**Parameters**		
"Sensory mechanism" Submenu "Special linearization n"	**Designation**	**Parameter 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**	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 trimming**	**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" The original linearization can be established by resetting this parameter to "Factory Trim Standard Calibration".
(only visible in online mode)	**Sensor trimming lower range value**	**Read/ Write**	Lower point for linear characteristic calibration (this affects offset and slope). To write to this parameter, "**Sensor trimming**" must be set to "user trim standard calibration".
(only visible in online mode)	**Sensor trimming upper range value**	**Read/ Write**	Upper point for linear characteristic calibration (this affects offset and slope). To write to this parameter, "Sensor Calibration Method" must be set to "user trim standard calibration".
(only visible in online mode)	**Sensor trimming min. span**	**Read**	Span of the measurement range, depending on the sensor type set.
	Polynomial start of range	**Read/ Write**	Lower calculation limit for the RTD polynomial (nickel/copper) linearization. **Factory settings:** For Characterization Type = copper: 0 For Characterization Type = nickel: -60
	Polynomial end of range	**Read/ Write**	Upper calculation limit for the RTD polynomial (nickel/copper) linearization. **Factory settings:** For Characterization Type = copper: 200 For Characterization Type = nickel: 100
	Polynomial coeff. R0	**Read/ Write**	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	**Parameters**		
"Sensory mechanism" Submenu "Special linearization n"	**Designation**	**Parameter access**	**Description**
	Polynomial coeff. A	**Read/ Write**	Sensor linearization of copper/nickel resistance thermometers (RTD).  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
	Polynomial coeff. B	**Read/ Write**	
	Polynomial 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	**Parameters**		
"Communication"	**Designation**	**Parameter access**	**Description**
	Bus address	**Read**	Displays the device bus address. **Factory settings:** 126

Communication			
Menu item	**Parameters**		
"Communication"	**Designation**	**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 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 59. 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 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.
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, Section 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 (see Page xx). 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 55) and directly specify the desired output value in the **Output value** parameter (→ page 74).

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 82) 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.
The factory setting is WRONG VALUE.	

The failsafe behavior is only effective in the "Auto" operating mode!
In the "Out of Service" operating mode, the measured value is set to NAN (Not a Number = 0x7FC00000L) and the status to "Bad - Passivated" (for Profile 3.02) or to "Bad - Out of Service" (for Profile 3.01/3.0). The limit bits are set to "Const".
- "Bad - Passivated" = 0x23
- "Bad - Out of Service" = 0x1F

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 81).

The limit values are based on the OUT output value. If the output value OUT exceeds or undershoots 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 80	LO LO LIM	→ page 80
HI LIM	→ page 80	LO LIM	→ page 80

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 79)		**Parameter group OUT SCALE (→ page 79)**	
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.

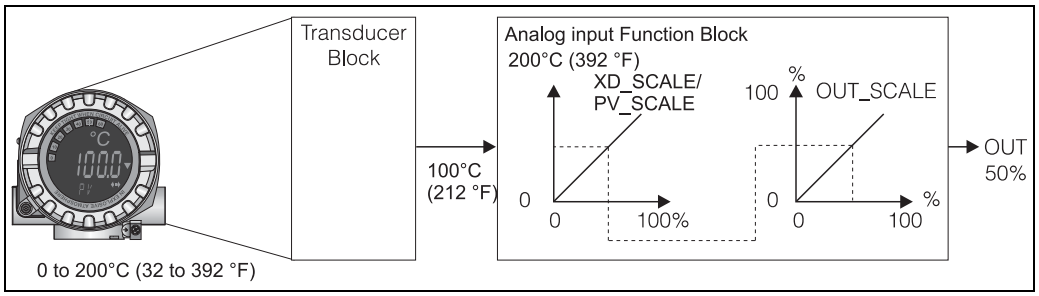
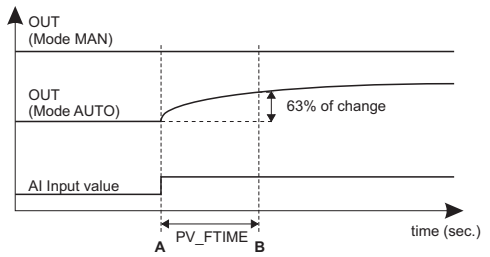


Fig. 17: Scaling procedure in the Analog Input function block

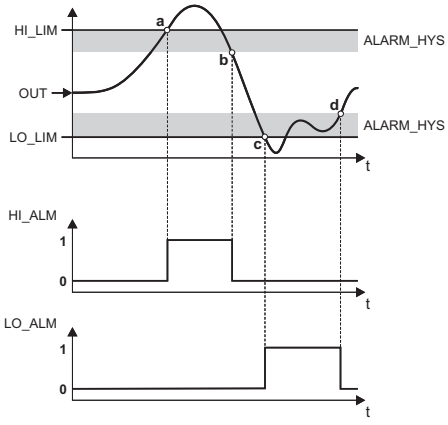
Analog Input			
Menu item "Communication"	**Parameters Designation**	**Parame-ter access**	**Description**
	Static Rev. No.	**Read**	A block operates static parameters (Static attribute) that are not changed by the process. Static parameters, whose values change during optimization or configuration, 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. The counter can be reset to the default value "0". 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:** 32 space characters (no text)
	Target mode	**Read/ Write**	For selecting the required operating mode. **Options:** 0x08 AUTO 0x10 MAN 0x80 OOS **Factory settings:** AUTO

Analog Input			
Menu item "Communication"	Parameters Designation	Parameter access	Description
	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.	
	Current 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 TMT162 makes five different measured values available to the input channel of the Analog Input function block. **Factory settings:** AI1: Primary Value Transducer 1 AI2: Secondary Value Transducer 1 AI3: Primary Value Transducer 2 AI4: Secondary Value Transducer 2 **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 alarm sum**	**Read**	Displays the device's current alarms.
(only visible in online mode)	**Unacknowledged alarm sum**	**Read**	Displays the device's unacknowledged alarms.
(only visible in online mode)	**Unregistered alarm sum**	**Read**	
(only visible in online mode)	**Disabled 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.

Analog Input			
Menu item	Parameters		
"Communication"	Designation	Parameter access	Description
(only visible in online mode)	**Output value**	**Read**	Displays the (output) value OUT of the process variable selected in the CHANNEL parameter
(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 only) 0xBC - Good: Function check/local overlap (Pr. 3.02 only) 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 only) 0x73 - Uncertain: Simulated value, start (Pr. 3.02 only) 0x74 - Uncertain: Simulated value, end (Pr. 3.02 only) 0x78 - Uncertain: Process fault /no maintenance required (Pr. 3.02 only) 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 only) 0x24 - Bad: Maintenance alarm (Pr. 3.02 only) 0x2B - Bad: Process fault/no maintenance required (Pr. 3.02 only) 0x3C - Bad: Function check/local overlap (Pr. 3.02 only)
(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 "Communication"	**Parameters** Designation	Parame-ter access	Description
	Filter time constant	**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:  A0003913-EN **A** → The Analog Input changes. **B** → OUT reacted 63% to the change of the Analog Input. **Factory settings:** 0 s
	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 75.	
	PV SCALE lower range value	**Read/ Write**	This parameter is used to enter the lower value for input scaling. **Factory settings:** 0
	PV SCALE upper range 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 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 - upper value	**Read/ Write**	Entry of the upper value for output scaling. **Factory settings:** 100
	Out Scale - lower value	**Read/ Write**	Entry of the lower value for output scaling. **Factory settings:** 0

Analog Input			
Menu item "Communication"	Parameters Designation	Parame-ter access	Description
	Unit	**Read/ Write**	For selecting the output unit **Factory settings:** Analog Input function block = 0x07CD (1997) 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". This parameter is not supported by the device.
	Upper alarm limit value	**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 warning limit value	**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 warning limit value	**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 alarm limit value	**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 "Communication"	Parameters Designation	Parameter access	Description
	Limit value 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 alarm limit value HI ALM → Upper warning limit value LO LO ALM → Lower alarm limit value LO ALM → Lower warning limit value **User input:** 0 to 50% **Factory settings:** 0.5% of the measurement range ■ The hysteresis value is expressed as a percentage and refers to 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).  A0003915 **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.

Analog Input			
Menu item "Communication"	Parameters Designation	Parameter access	Description
	Failsafe 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). The status information only applies to diagnostics as per Profile 3.0/3.01. For Profile 3.02, see Section 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 "Failsafe 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 TMT162 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
	Failsafe 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, see → page 78 **Factory settings:** Bad
	A(n) simulation status	**Read/ Write**	Simulation of Analog Input function block status. 0x00 - OK 0x01 - Limit underflow 0x02 - Limit overflow 0x03 - Value constant
	A(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
	A(n) simulation	**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:

Diagnostics			
Menu item	**Parameters**		
"Diagnostics"	**Designation**	**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)
	Description of current diagnostics	**Read**	Displays the status information as description text, see Section 9.3.
	Channel information status	**Read**	Displays where in the device the highest priority error occurs. 0: Device 1: Sensor 1 2: Sensor 2
	Number status	**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 - Selfcalibration 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 channel information status	**Read**	Displays where in the device the last highest priority error occurred. 0: Device 1: Sensor 1 2: Sensor 2
	Delete 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	**Parameters**		
"Diagnostics"	**Designation**	**Parameter access**	**Description**
	Advanced diagnostics	**Read**	Manufacturer-specific diagnostics information encoded in bits. Several messages are possible. See "Status diagnostic bits" at end of these instructions.
	Advanced diagnostics screen	**Read**	Displays the bit mask that outputs the manufacturer-specific diagnostic messages
(only visible in online mode)	**Enabled functions**	**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 functions**	**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
	Configuration for accumulative status and 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 **Factory settings:** 1
(only visible in online mode)	**Service locking**	**Read/ Write**	Configuration for enabling service functions.

Submenu "System information"

In addition to the system information described from → page 62 onwards, the following parameter is also available in the Expert setup.

Measured values			
Menu item	**Parameters**		
"Diagnostics" Submenu "System information"	**Designation**	**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	**Parameters**		
"Diagnostics" Submenu "Measured values"	**Designation**	**Parameter access**	**Description**
	PV value n	**Read**	Displays the primary output value of the Transducer Block. 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, see → page 78
	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	**Read**	Displays the internal reference temperature.
	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 value n (not linearized)	**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, OctetString, 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	Unsigned16	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
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

Name Parameter	Index	Read	Write	Object Type	Data Type	Byte Size	Storage Class	Parameter
DEVICE_DIAGNOSIS	73	X	-	Simple	OctetString	10	D	M
not used	74	–	–	–	–	–	–	–
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
not used	106	–	-	–	–	–	–	–
ELECTRONIC_SERIAL_NUMBER	107	X	-	Simple	Visible String	16	Cst	M
not used	108 - 112	–	–	–	–	–	–	–
DEV_BUS_ADDR_CONFIG	113	X	–	Simple	Unsigned 8	1	N	O
CAL_IDENTNUMBER	114	X	–	Simple	Unsigned 16	2	C	O
not used	115 - 117	–	–	–	–	–	–	–
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	–	–	–	–	–	–	–
DISP_BARGRAPH_MIN_1	123	X	X	Simple	Float	4	S	O
DISP_BARGRAPH_MIN_2	124	X	X	Simple	Float	4	S	O
DISP_BARGRAPH_MIN_3	125	X	X	Simple	Float	4	S	O
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
DISP_BARGRAPH_MAX_1	136	X	X	Simple	Float	4	S	O
DISP_BARGRAPH_MAX_2	137	X	X	Simple	Float	4	S	O
DISP_BARGRAPH_MAX_3	138	X	X	Simple	Float	4	S	O
not used	139	–	–	–	–	–	–	–
VIEW_PHYSICAL_BLOCK	140	X	X	Simple	Unsigned16, 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_MEAS_RANGE_MAX	138	X	X	Simple	Float	4	S	M
CVD_MEAS_RANGE_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_MIN_SPAN	147	X	-	Simple	Float	4	S	M
CAL_POINT_TEMP_HI	148	X	-	Simple	Float	4	S	M
CAL_POINT_TEMP_LO	149	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→ page 89	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	Parameter
All parameters as in → page 91	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	Parameter
All parameters as in → page 91	0-65	–	–	–	–	–	–	–
not used	66 - 255	–	–	–	–	–	–	–

11.4.9 Analog Input Block (AI 4) slot 4

Der 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	Parameter
All parameters as in → page 91	0-65	–	–	–	–	–	–	–
not used	66 - 255	–	–	–	–	–	–	–

Index

www.endress.com/worldwide

Endress+Hauser

People for Process Automation

BA00275R/09/EN/02.12
71192582
FM9.0