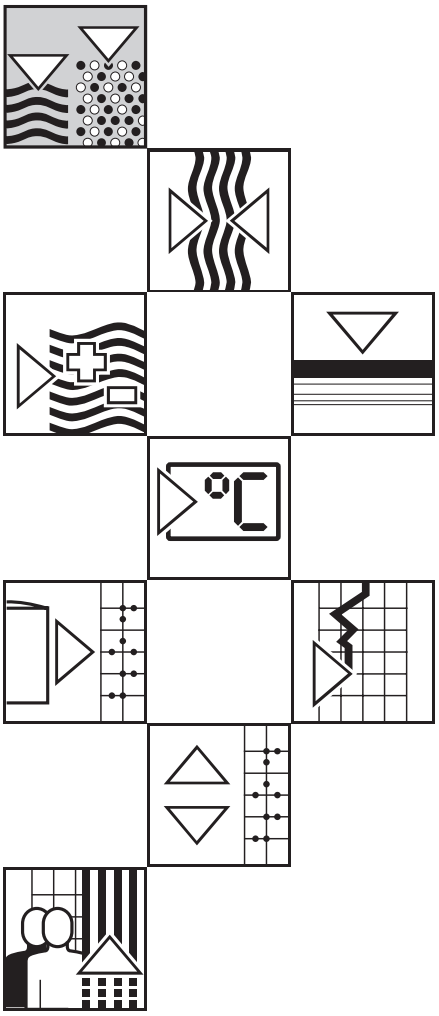
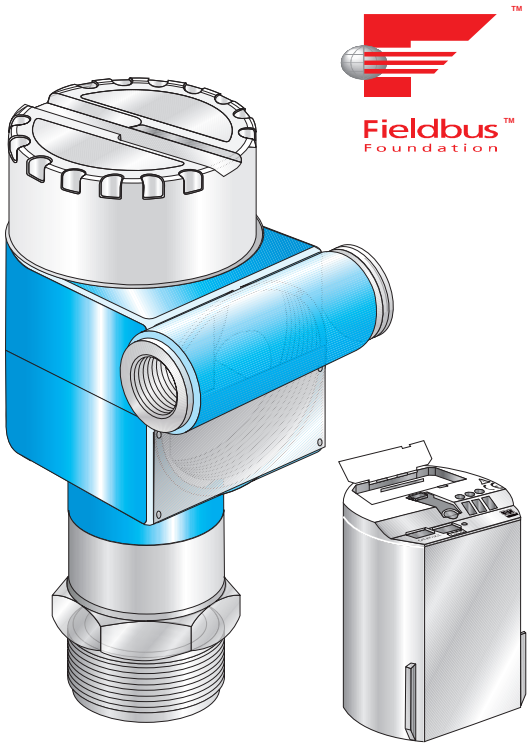
BA232F/00/en/08.08
Software version 1.0
71078908

Deltapilot S
Foundation Fieldbus Hydrostatic Level Measurement

Operating Instructions





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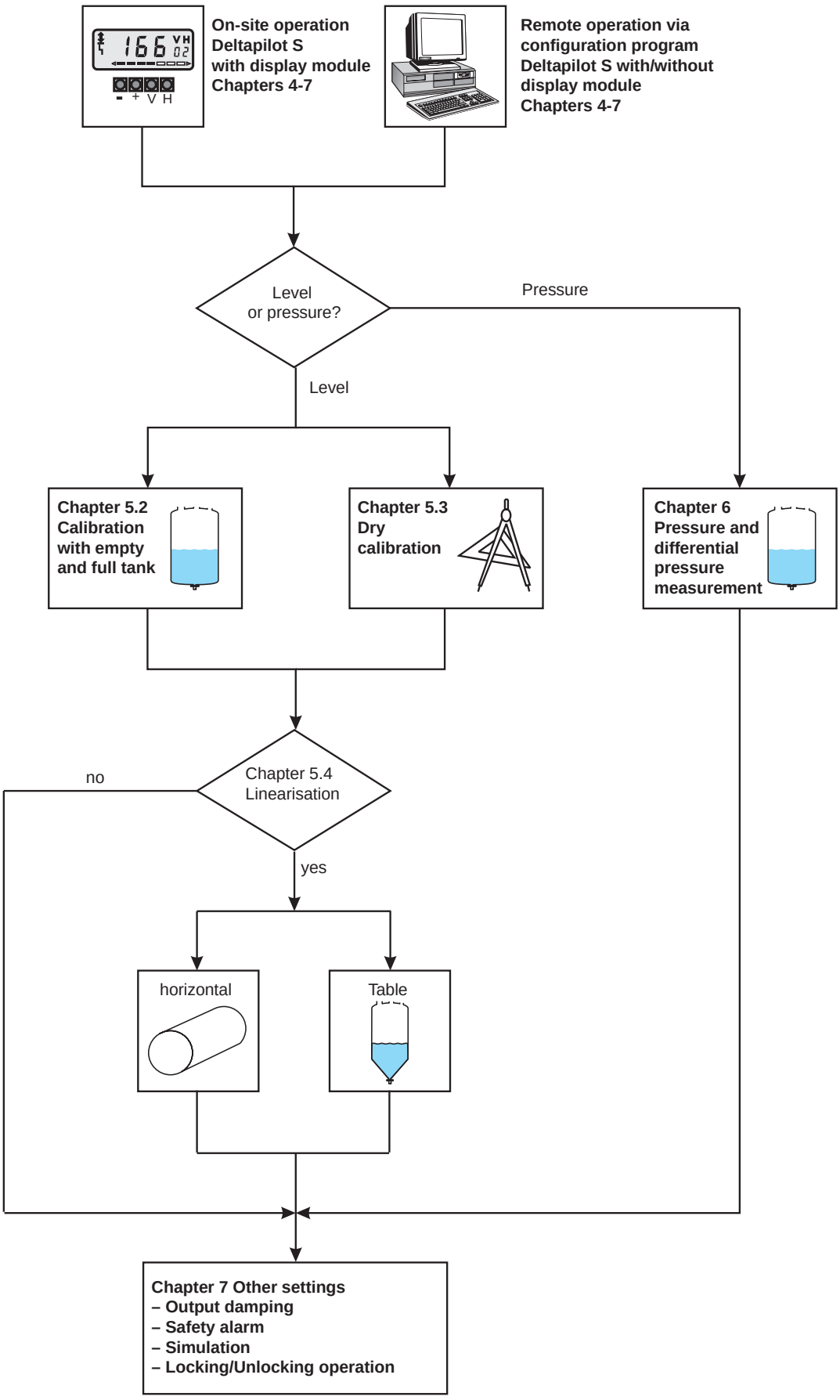
Overview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Approved usage

The hydrostatic pressure sensor Deltapilot S with electronic insert FEB 26 is a Foundation Fieldbus device which is used for continuous level measurement. It can also be used to measure pressure and differential pressure (by using a PLC and a second sensor).

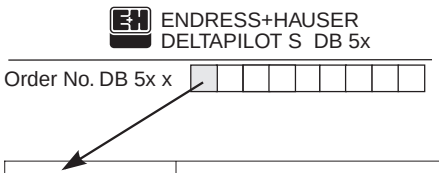
Installation, commissioning, operation

The Deltapilot S has been designed to operate safely in accordance with current technical, safety and EU standards. If installed incorrectly or used for applications for which it is not intended, however, it is possible that application-related dangers may arise, e.g. product overflow due to incorrect installation or calibration. For this reason, the instrument must be installed, connected, operated and maintained according to the instructions in this manual: personnel must be authorised and suitably qualified. The manual must have been read and understood, and the instructions followed. Modifications and repairs to the device are permissible only when they are expressly approved in the manual.

Explosion hazardous areas

If the device is to be installed in an explosion hazardous area, then the specifications in the certificate as well as all national and local regulations must be observed. The instrument can be delivered with the certificates listed in the table below. The certificate can be identified from the first letter of the order code stamped on the nameplate.

- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local regulations.
- Take special care with regard to the grounding of the bus cable screening. Recommendations are to be found in the FF specification or in the IEC 60079-14.



Certificates for applications in explosion hazardous areas

Code	Explosion protection
A	Version for non-hazardous area
E	Version for non-hazardous area, overfill protection WHG
C	ATEX II 1/2 G EEx ia IIC T6, flame barrier
1	ATEX II 1/2 G EEx ia IIB T6, flame barrier
D	ATEX II 1/2 G EEx ia IIC T6, overfill protection WHG
4	ATEX II 1/2 G EEx ia IIB T6, overfill protection WHG
B	ATEX II 1/2 G EEx ia IIC T6, flame barrier, overfill protection WHG
2	ATEX II 1/2 G EEx ia IIB T6, flame barrier, overfill protection WHG
G	ATEX II 1/2 G EEx ia IIC T6
3	ATEX II 1/2 G EEx ia IIB T6
H	ATEX II 2 G EEx ia IIC T6
N	ATEX II 3 G EEx nA II T6
O	FM Class I, Division 1, 2, Groups A-D
S	CSA Class I, Division 1, Groups A-D
T	CSA Class I, Division 2, Groups A-D

Safety Conventions and Symbols

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding icon in the margin.

Safety convention

Symbol	Meaning
 Note!	**Note!** A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.
 Caution!	**Caution!** Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument.
 Warning!	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument.

Explosion protection

	**Device certified for use in explosion hazardous area** If the device has this symbol embossed on its name plate it can be installed in an explosion hazardous area.
	**Explosion hazardous area** Symbol used in drawings to indicate explosion hazardous areas. – Devices located in and wiring entering areas with the designation "explosion hazardous areas" must conform with the stated type of protection.
	**Safe area (non-explosion hazardous area)** Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. – Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas.

Electrical symbols

	**Direct voltage** A terminal to which or from which a direct current or voltage may be applied or supplied.
	**Alternating voltage** A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied.
	**Grounded terminal** A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system.
	**Protective grounding (earth) terminal** A terminal which must be connected to earth ground prior to making any other connection to the equipment.
	**Equipotential connection (earth bonding)** A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice.

1 Introduction

Application

The electronic insert FEB 26 serves as transmitter for the hydrostatic pressure sensors Deltapilot S DB 50 (A), DB 50 L, DB 50 S, DB 51 (A), DB 52 (A) and DB 53 (A). Deltapilot S sensors are used for continuous level measurement of liquids and pastes. They find application in the chemical, pharmaceutical and food industries as well as in fresh and wastewater treatment plants.

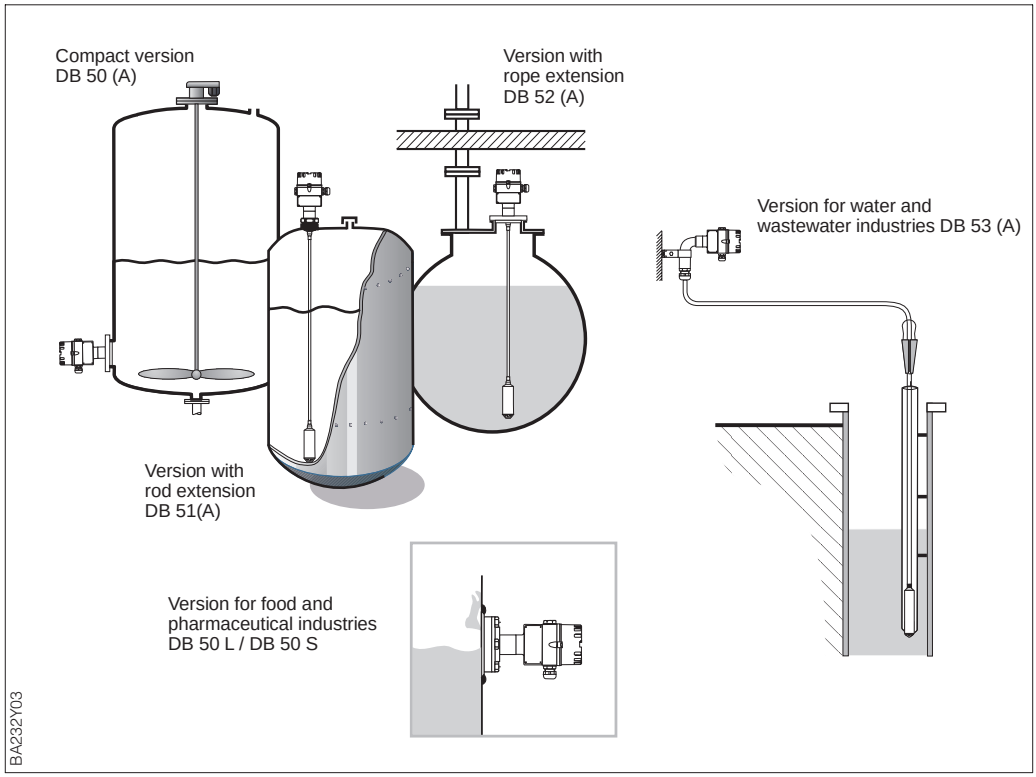
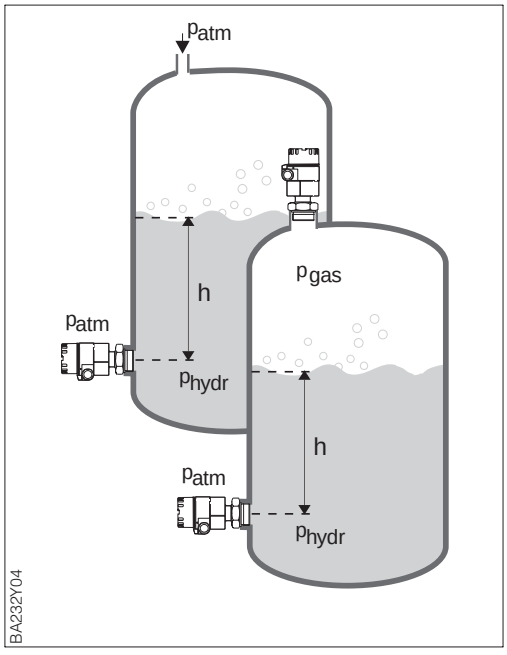


Figure 1.1
Deltapilot S
pressure sensor versions

Operating principle



The level of a column of liquid of known density ρ can be determined by measuring its hydrostatic pressure with a suitable sensor.

$$h = p_{hydr}/\rho \cdot g$$

The pressure sensor Deltapilot S converts the pressure acting upon its process diaphragm into an electrical signal. The electronic insert takes this signal and outputs it as a direct digital signal.

Using two Deltapilot S units, you can, for example, measure the differential pressure in a pressurised tank. The pressure measured values of the probes are sent, for example, to a DCS (= Distributed Control System). The DCS calculates the pressure difference and, if necessary, calculates the level from this.

Figure 1.2
Principle of hydrostatic level measurement

1.1 Measuring system

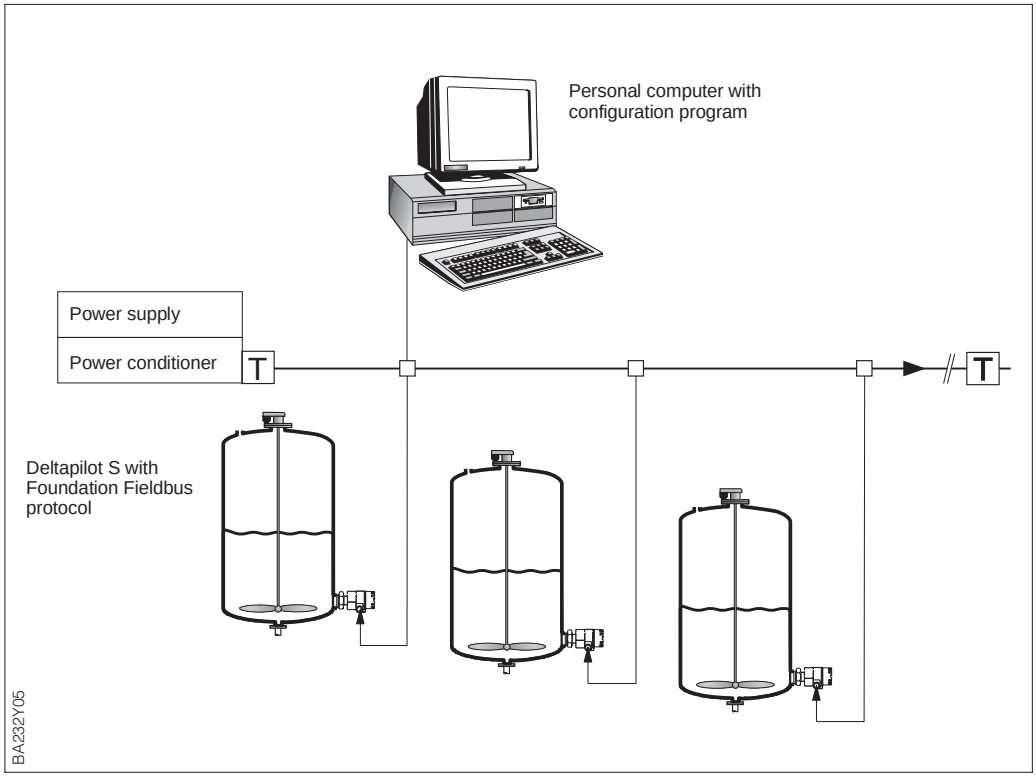


Figure 1.3
Measuring system Deltapilot S with Foundation Fieldbus protocol

T: bus terminator

Measuring point

In the simplest case, the measuring point comprises:

- a Deltapilot S with the FEB 26 electronic insert and
- an FF configuration program.

Number of transmitters

The maximum number of transmitters at a bus segment depends on the current consumption and minimum power supply of the transmitters and also on the required bus length (conductor resistance) and output voltage of the power supply unit.
Normally however:

- max. 9 Deltapilot S for EEx ia application
- max. 32 Deltapilot S for non-hazardous area applications

can be operated on one bus segment. Deltapilot S consumes max. 12 mA per device.

A typical FISCO-model power supply unit has an output current of approx. 110 mA.

For further information refer also to the Foundation Fieldbus specification and the IEC 61158-2, for explosion hazardous areas: EN 50020 (FISCO model) or under the Internet address "http://www.fieldbus.org".

2 Installation

This chapter describes:
- the mechanical installation of the Deltapilot S
- the electrical connection of the electronic insert.

2.1 Installation instructions

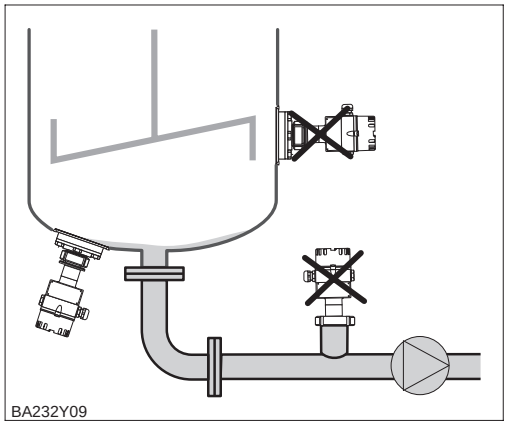


Figure 2.1
Do not mount Deltapilot S in the tank outlet or near agitators.

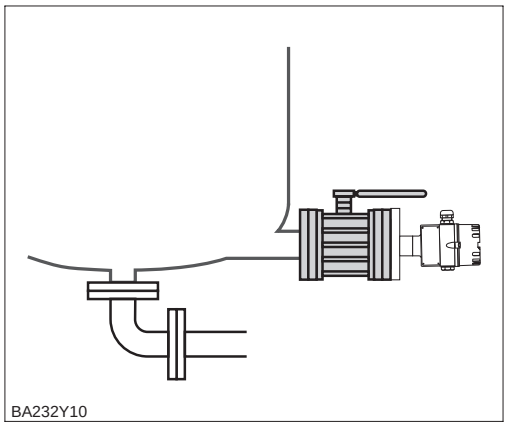


Figure 2.2
Mounting the Deltapilot S device DB 50, DB 50 (A), DB 50 L, DB 50 S downstream of a shut-off device.

Mounting point

Compact version
DB 50, DB 50 (A), DB 50 L, DB 50 S
- Always install the device below the lowest measuring point.
- Do not mount the device at the following locations: in the filling stream, in the tank outlet or at a point in the tank where pressure pulses from an agitator can occur.
- Calibration and functional testing can be carried out more easily if the device is mounted downstream of a shut-off device.

Rod and rope version
DB 51 (A)/DB 52 (A)/DB 53 (A)
- Please note for the installation of rod and rope versions, that the probe is situated at a point free from currents and turbulences. To protect the probe from any contact caused by lateral movement, mount the probe in a guide pipe (preferably plastic) or attach it to a mounting clamp. Please refer also to Certificates and Safety Instructions for hazardous area applications.
- The length of the support cable or the probe rob depends on the zero point of the level. The tip of the probe should be at least 5 cm (2 inch) below it.

Process diaphragm

- Do not use sharp or hard objects to handle or clean the process diaphragm. Build-up has no effect on the measurement result as long as it is porous and does not present a mechanical load on the diaphragm of the pressure measuring cell.
- The process diaphragm on all Deltapilot S with rod or rope extension is protected against mechanical damage by means of a plastic cap.

Temperature effect

- The Deltapilot S must also be insulated in fluids which can harden when cold. The rod or rope version can also be used.
- If there are extreme temperature differences between calibration and operation, then the device needs approx. 10 to 15 minutes to warm up before it can measure correctly.

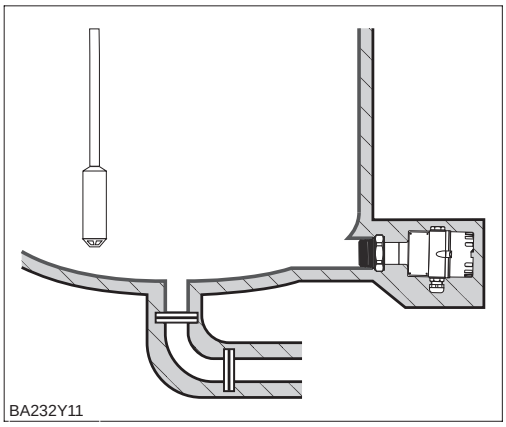


Figure 2.4
In applications where the product can harden, the Deltapilot S must also be covered by insulation.

Seal

Deltapilot S with G 1½-thread:

- When screwing the device into the tank, the flat seal supplied must be placed on the sealing surface of the process connection.
  To avoid additional strain on the process diaphragm, do not seal the thread with hemp or similar materials.

Deltapilot S with NPT thread:

- Wrap and seal the thread with Teflon tape.
- Tighten the device at the hexagon head only. Do not turn the device by the housing.
- Do not screw in the thread too tightly. Max. starting torque 20…30 Nm.

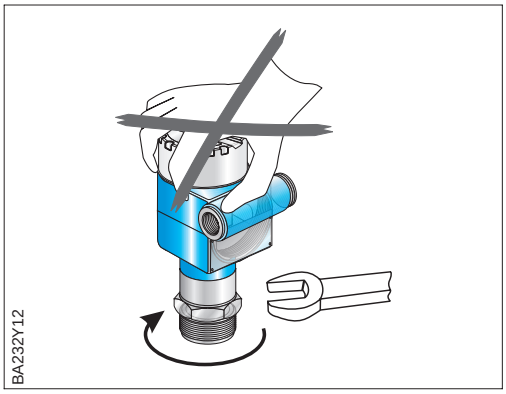


Figure 2.3
Screw in sensor at hexagonal nut only!

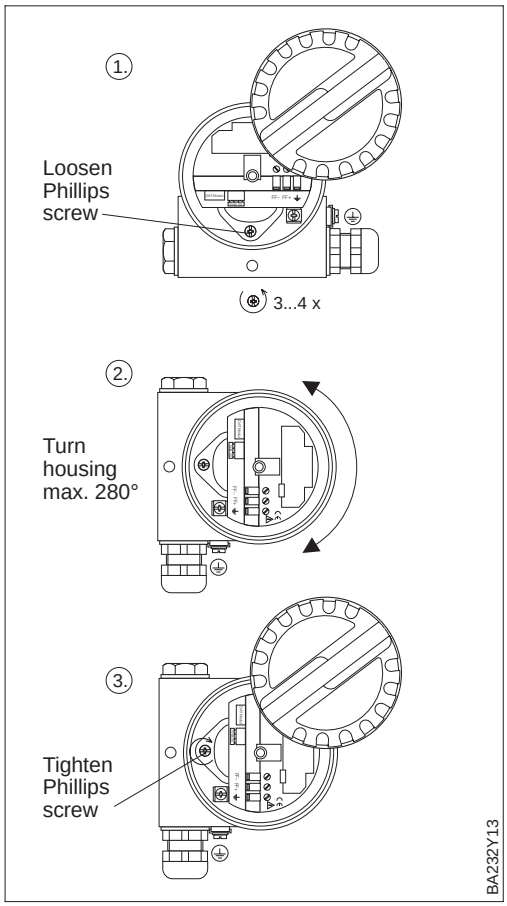


Figure 2.6
Turning the sensor housing

Turning the housing

You can turn the housing to align the cable entry.
- The cable entry should point downwards when the device is mounted laterally in the tank.
- The cable entry should always be horizontal when the device is mounted with a protective cover.
  – Protective cover for devices with sightglass, Order No.: 942262-0001
  – Protective cover for devices with flat cover, Order No.: 942262-0000

Turn the housing as follows:
- Unscrew the cover.
- Loosen Phillips screw.
- Turn housing (max. 280°).
- Tighten Phillips screw.

Sealing the probe housing

No moisture should enter the housing during mounting, when connecting the electronic insert and during operation.
- Always screw the housing cover and the cable entries tight.

The O-ring seal in the housing cover and the thread of the aluminium cover are lubricated. It the lubricant is removed, replace it with silicone grease or graphite paste, for example, so that the cover seals tight. Do not use mineral-oil based greases! These can destroy the O-ring.

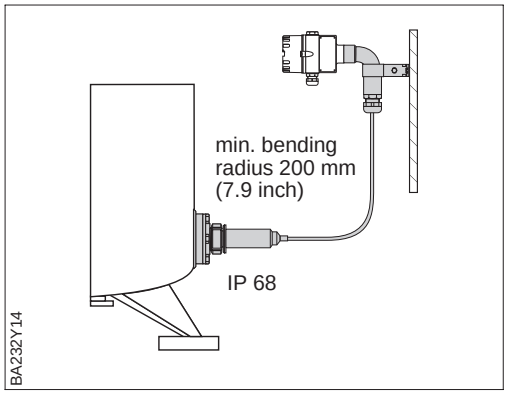


Figure 2.5
Use of the housing adapter

Housing adapter

The housing and the electronic insert can be mounted remotely from the measuring point by using the housing adapter.
– Housing adapter with 5 m cable length or with cable length up to 30 m, Ordercode see TI257P, chapter "Accessories".

This allows for trouble-free measurement:
- under especially difficult measuring conditions, e. g. very damp environment, or danger of flooding.
- in narrow or hard-to-reach mounting locations.

2.2 Electrical connection

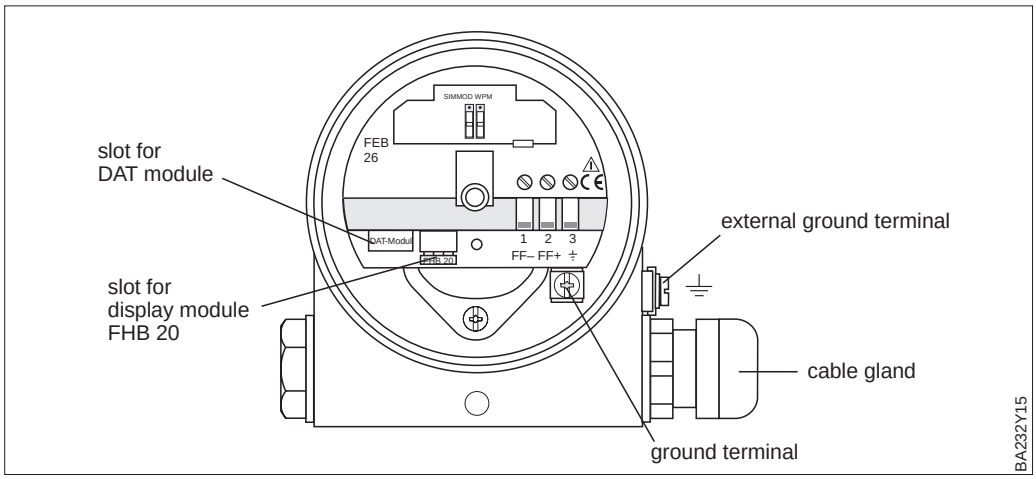


Figure 2.7
Deltapilot S
connection compartment

DAT module

All the specific data of the measuring cell is saved in the DAT module. On device power-up, this data is loaded from the DAT module to the memory of the electronic insert. So that the device produces accurate measured values, the measuring cell and the DAT module must always match. The measuring cell number can be found on the measuring cell, on the DAT module and on a sign inside the housing.
If lost, you can re-order the DAT module individually from Endress+Hauser, Order No.: 542585-0000. Please supply the measuring cell number when ordering.

General note

The Deltapilot S with Foundation Fieldbus output is a two-wire transmitter.
Before connecting the device, please note the following points:

- Turn off the power.
- Only devices for hazardous area: Ground the device using the external ground terminal.

Power

The Deltapilot S has the following power requirements:

I =11 ± 1 mA
Non-hazardous area: U = 9…32 V DC
Ex ia: U = 9…24 V DC

For further technical connection data regarding safety, please refer to Safety Instructions (XA), Installation Drawing (CSA) or Control Drawing (FM).

Bus cable

Always use a twisted, screen two-wire cable. For cable specification, refer either to the FF specification or to the IEC 61158-2. The following specification must be met for explosion hazardous application:

– Loop-resistance (DC): 15…150 Ω/km,
– Specific inductance: 0.4…1 mH/km,
– Specific capacitance: 80…200 nF/km

The following cable types are suitable:

Non-hazardous area:
- Siemens 6XV1 830-5BH10 (grey)
- Kerpen CEL-PE/OSCR/PVC/FRLA FB-02YS(ST)YFL (grey)
- Belden 3076F (orange)

Ex-area:
- Siemens 6XV1 830-5AH10 (blue)
- Kerpen CEL-PE/OSCR/PVC/FRLA FB-02YS(ST+C)YFL (blue)

Screening

For maximum EMC protection, e.g. near to frequency converters, it is advisable to connect the housing and cable screening using a potential equalisation line (PEL) (max. wire cross-section area: 2.5 mm^2, fixed conductor).

Please pay attention to the following points:
- Ground the device using the external ground terminal.
- The bus cable screen may not be interrupted.
- Ground the screen at each end of the cable, and always try to keep the connecting cable between the screening and ground as short as possible.
- If there are large potential differences between the individual points, you only need to connect one point to the reference ground. Connect all the other ends of the screen using a high frequency capable capacitor with reference potential. (e.g. ceramic capacitor 10 nF/250 V~).

Caution!
The multiple grounding of the bus cable in explosion hazardous areas is permissible only under specific conditions, see IEC 60079-14.


Caution!

Further information on structure and grounding of the network is available in IEC 61158-2, EN 50179 (DIN 19245) or Operating Manual BA 013S "Foundation Fieldbus Overview: Installation and Commissioning Guidelines".

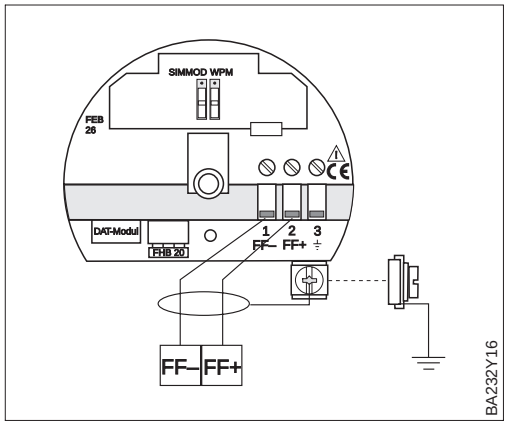


Figure 2.8
Electrical connection Deltapilot S

Connect device

The bus line is connected as follows:
- Switch off power.
- If necessary, connect external ground terminal to potential equalisation line.
- Unscrew the connection compartment lid.
- Thread cable through the cable entry.
- Connect cable cores to FF– and FF+. Reversed polarity has no effect on operation.
- Connect the screen to the internal ground terminal.
- If necessary, plug the display module back in.
- Srew down the connection compartment lid.

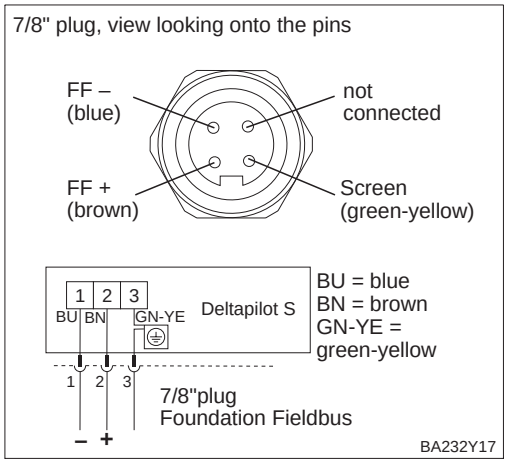
7/8" plug

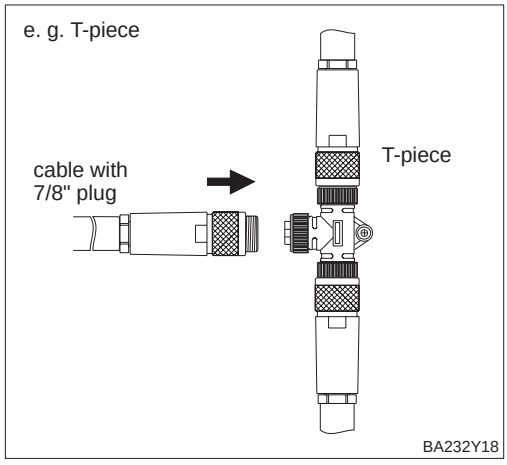
The Deltapilot S Foundation Fieldbus version with 7/8" plug is supplied ready wired and need only be connected to the FF H1 bus by means of a suitable cord set.

Note!
To protect the device against vibrations, always connect the Deltapilot S to the T-piece or to a FF junction box via cable. See Figure, bottom right.


Note!

- Push connector into the socket.
- Securely tighten the knurled screw.
- Ground the device and T-piece or FF junction box using the grounding system selected.





3 Foundation Fieldbus Interface

3.1 Overview

The following figure illustrates the various ways of setting up a Foundation Fieldbus network.

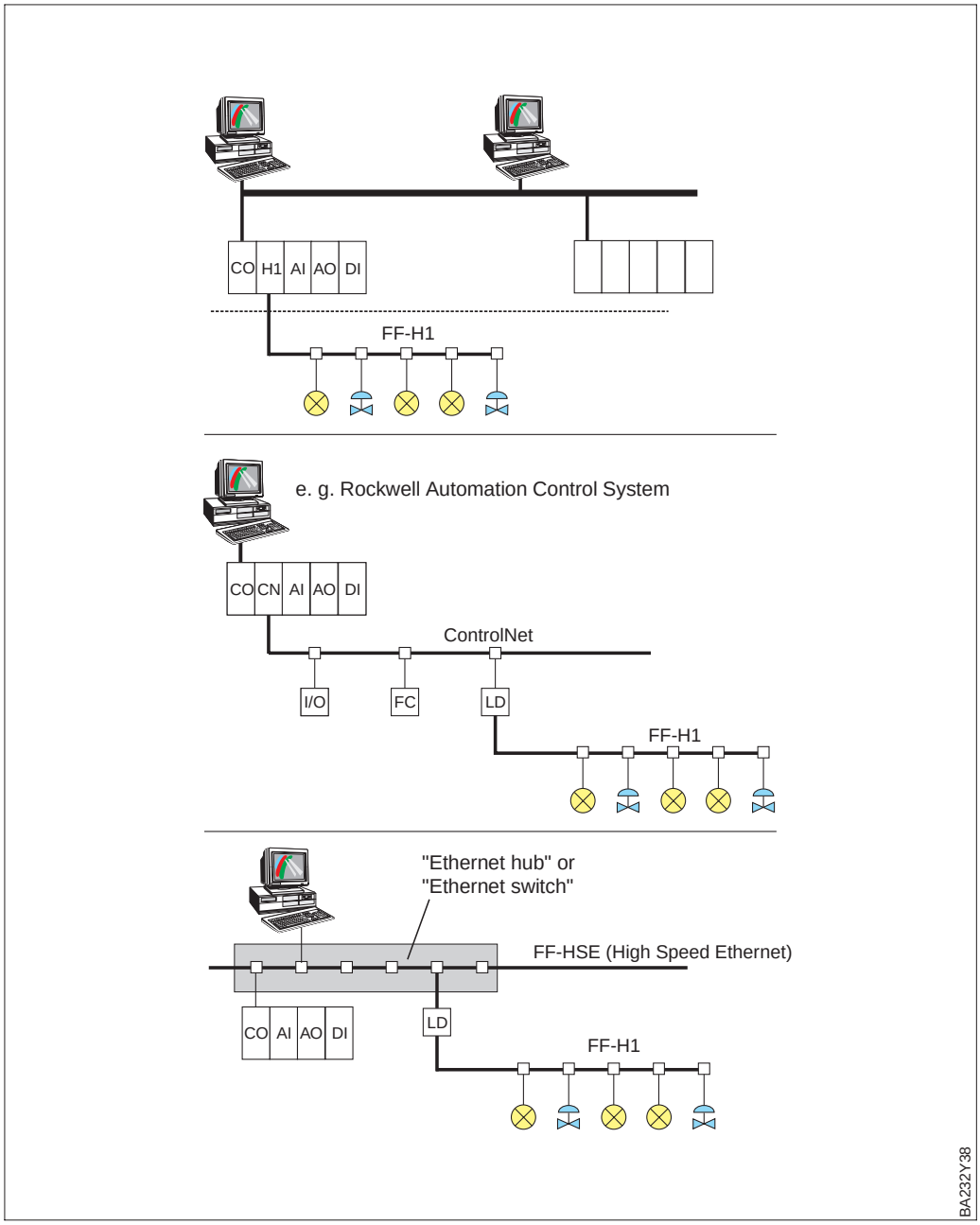


Figure 3.1
Foundation Fieldbus principle of operation

Top:
Connection via FF H1 interface card
Centre:
Connection via ControlNet
Bottom: Connection via HSE (High Speed Ethernet)

AI: Analog input
AO: Analog output
CN: ControlNet interface card
CO: Controller
DI: Digital input
I/O: Input/output
FC: Frequency converter
H1: H1 interface card
LD: Linking device

Note!

Note!
For further information, please refer to the Foundation Fieldbus Specification, the Operating Instructions BA 013S "Foundation Fieldbus Overview, Installation and Commissioning Guidelines" or check out "http://www.fieldbus.org".

3.2 Hardware configuration

The hardware setting for the write protection and simulation functions can be made by means of two DIP switches on the electronic insert.

The factory settings of the DIP switches are as follows:

WP OFF: Write protection is disabled (writing is possible),
SIM ON: Simulation is activated (simulation is possible).

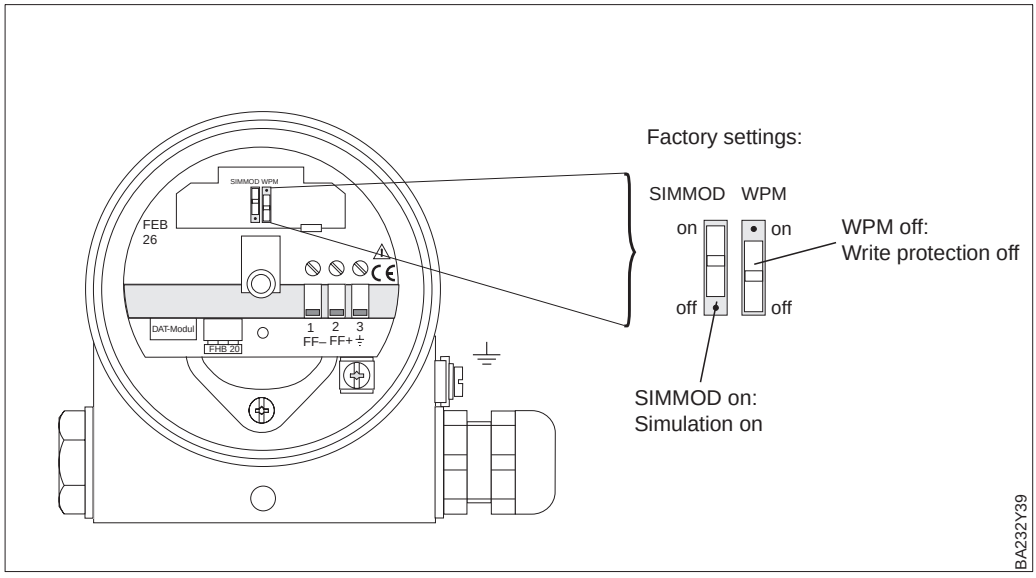


Figure 3.2
Deltapilot S DIP switches

3.3 Network configuration

You require the following to configure a device and integrate it into an FF network:

- An FF configuration program,
- If necessary, the CFF file (common file format: *.cff) for integrating the device into the system and
- The DD (device description: *.sym, *.ffo or *.fhx), to configure the device parameters.

The files for the Deltapilot S can be obtained as follows:

- INTERNET:
  Endress+Hauser → *http://www.endress.com*
  → select your country
  → Automation
  → Fieldbus → Fieldbus device integration
  → FOUNDATION Fieldbus
- As a CD-ROM directly from Endress+Hauser, Order No.: 56003896

The device can be integrated into the FF network as follows:

- Start the FF configuration program.
- Configure the interface, see "Note" in Chapter 3.12 "Checklist for commissioning".
- If necessary, download the CFF file.
- Download the device descriptions (*.ffo and *.sym or *.fhx files).
- Exit the program once the configuration is complete.

Note!

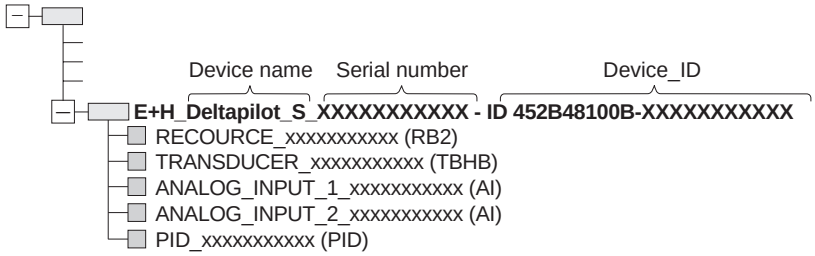
Note!
For further information on integrating the device into the FF system, please refer to the Operating Instructions of the configuration program used.

3.4 Device identification

The Foundation Fieldbus identifies the device by means of its identity code and automatically assigns it a suitable field address. The address cannot be altered.

The device appears in the network display once you have started your FF configuration program and have integrated the device into the network.
The blocks available are displayed underneath the device name. The relationships between the blocks are illustrated in Figure 3.3. The blockmodel is descriped in chapter 4.3. The functions of the individual blocks and the most important FF parameters are explained in Chapters 3.5 to 3.10.
The blocks report "Unknown" or "(UNK)" if the device description has not yet been loaded.

The device reports the following information, for example:



The device name comprises the following device data:

PD_TAG	the physical name of the device, the tag name,
DEVICE_ID	the unique device ID,
NODE_ADDRESS	the address in the network (automatically assigned by the configuration program).

The tag name can be changed (PD_TAG).

Device ID

The device ID for the Deltapilot S is:

Device_ID = 452B48100B-XXXXXXXXXXX

The device ID is made up of the following components:

452B48 =	ID code for Endress+Hauser
100B =	ID code for Deltapilot S
XXXXXXXXXXX =	Serial number of the device as specified on the nameplate.

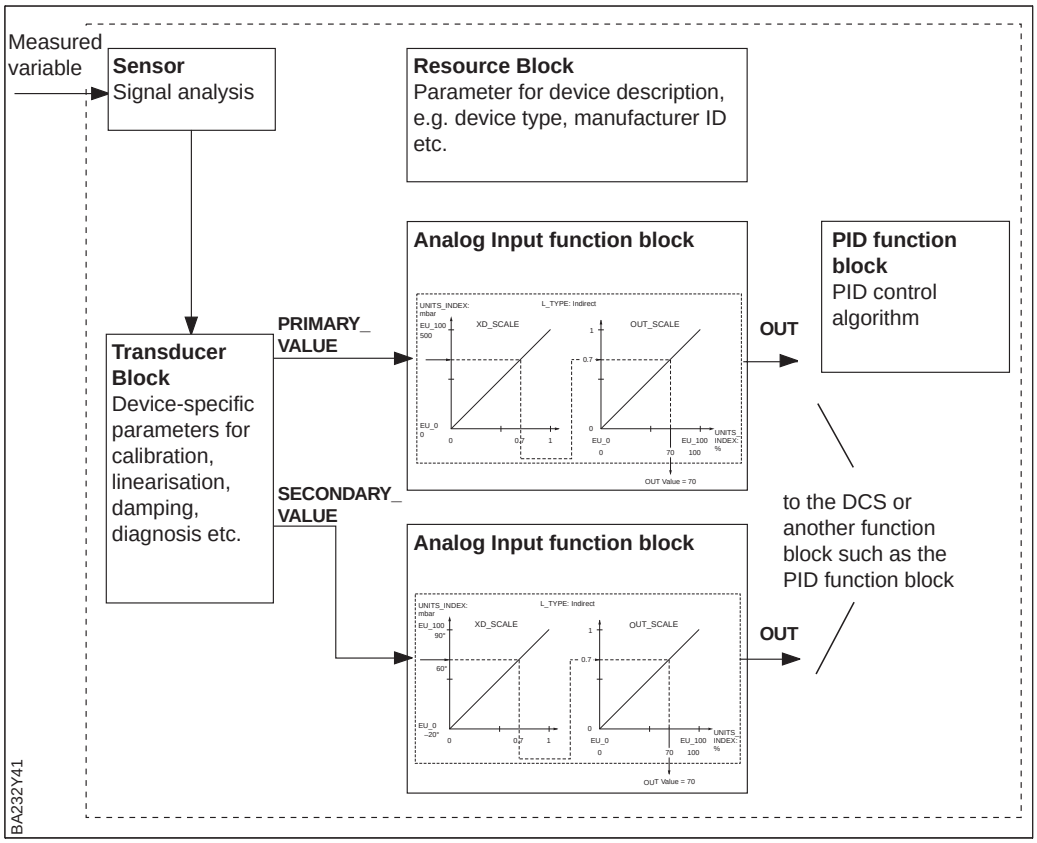


Figure 3.3
Deltapilot S Block model

3.5 General block parameters and instructions

This chapter describes the most important Foundation Fieldbus parameters which are available in all blocks and also provides general instructions on changing parameters. Chapters 3.6 to 3.10 describe the FF blocks of the Deltapilot S and also the most important FF parameters.

Note!
For further information, please refer to the Foundation Fieldbus Specification, the Operating Instructions BA 013S "Foundation Fieldbus Overview, Installation and Commissioning Guidelines" or check out "http://www.fieldbus.org".

Note!

To carry out a parameter change, open the relevant block by double-clicking on the block name, for example.
Many parameters require you to switch to the OOS (out-of-service) block mode before you can make changes to these parameters. Set the MODE_BLK parameter to OOS for the OOS block mode.
In the parameter descriptions that follow, the block modes listed in the "Write access (BLK_MODE)" column refer to the modes in which the parameter in question can be write accessed.
Once you have made all the changes, the MODE_BLK parameter must be set to AUTO or to AUTO, CAS or RCAS for the PID Block.

Note!
For further information on parameter changes, block linking etc., please refer to the Operating Instructions of the configuration program used.

Note!

General FF parameters

Parameter	Write enabled (BLK_MODE)	Description
ALERT_KEY	**AUTO, OOS**	An identification number for the device or for each individual block is entered. Input range: 1 to 255. This identification number is used by the host system to sort alarms and events and to introduce other processing tasks. **Note:** A number must be assigned to this parameter.
BLOCK_ERR	**read only**	This parameter displays the error messages which occurred in the software and hardware of the related block. In addition, this parameter also triggers an alarm. Several errors can be displayed simultaneously. The error messages possible depend on the block type. See Chapter 3.10 also.
MODE_BLK	**AUTO, OOS**	This parameter group displays information on the block mode. This parameter group contains: Target: The block mode can be changed here. The block mode must be permitted. See "Permitted". Actual: Displays the current block mode. Permitted: Displays the modes permitted for the block. Normal: Displays the normal mode of the block.
ST_REV	**read only**	Revision counter for changes to static parameters of the block in question. The counter is increased by one each time a static parameter is modified.
TAG_DESC	**AUTO, OOS**	A description of the relevant block or the measuring point can be entered here, (max. 32 characters).
UPDATE_EVT	**read only**	The "Unacknowledged" parameter of the UPDATE_EVT parameter group is set to "Unacknowledged" as soon as a static parameter has been modified. Use the "Unacknowledged" parameter to acknowledge the message. The date and time are also transmitted with the alarm and the revision counter "ST_REV" is increased. The "Relative Index" parameter indicates which parameter has been changed. See also FF Specification, Part 2.

3.6 Resource Block

The Resource Block comprises all the data which identify and characterise a device, such as the device type, the device name, the manufacturer ID, the serial number etc.

The Resource Block contains all higher-order parameters and functions which have an impact on the execution of the other function blocks in the device, e.g. RESTART. The Resource Block cannot be linked to other blocks as it does not have an input or an output.

The following important FF parameters are available in the Resource Block:

Parameter	Write enabled (BLK_MODE)	Description
DD_REV	**read only**	The revision number of the device description (DD) is displayed.
DEV_REV	**read only**	The revision number of the device is displayed.
DEV_TYPE	**read only**	A model number assigned by the device manufacturer is displayed. The model number for the Deltapilot S is "4107" (HEX 100B).
ITK_VERS	**read only**	The revision status of the ITKs (Interoperability Test Kits) is displayed.
RESTART	**AUTO, OOS**	The reset mode is selected, options: Run: Normal operating mode Resource: This mode is not supported by E+H. Defaults: Device data and function block connections are reset to the factory settings. **Note:** The manufacturer-specific parameters of the Transducer Block are not reset to the factory setting. See Chapter 8.2 "Reset" also. Processor: Warm start of the device, processor restart.
RS_STATE	**read only**	This parameter displays the current status of the Resource Block. Options: Standby, On-line linking, On-line, Undefined, Start/Restart, Initialization, Failure Standby: Displayed if the Resource Block is in OOS (out-of-service) mode. On-line linking: Blocks are currently being linked. On-line: Normal block mode, the Resource Block is in AUTO mode. All configured connections between the function blocks have been made. If a link is missing, this parameter displays the "On-line linking" status. See also FF Specification, Part 1.
WRITE_LOCK	**read only**	The setting of the "WPM" DIP switch on the electronic insert is displayed. See Chapter 3.2 also "Hardware configuration". Locked: Write protection activated. No write access to the parameters. Unlocked: Write protection deactivated. It is possible to write-access the parameters, depending on the block mode in question. See also the following tables, "write-access (MODE_BLK)" column.

Block mode

Use the MODE_BLK_Target parameter to select the block mode. The Resource Block supports the modes AUTO and OOS.

Block mode	Description
AUTO	Automatic mode, normal Resource Block operating mode.
OOS	The block is out-of-service. The BLOCK_ERR parameter displays the OOS block status.

Block process alarms (BLOCK_ERR)

Parameter	Write enabled (BLK_MODE)	Description
BLOCK_ERR	**read only**	This parameter displays the error messages which occurred in the software and hardware of the Resource Block. The following error messages can appear: Out-of-Service: The block is out-of-service (OOS mode). Simulation active: The SIMMOD DIP switch on the electronic insert is "on", i.e. simulation is possible.

Note!

Note!
For further information, please refer to the Foundation Fieldbus Specification, the Operating Instructions BA 013S "Foundation Fieldbus Overview, Installation and Commissioning Guidelines" or check out "http://www.fieldbus.org".

3.7 Transducer Block

The Transducer Block contains all the device-specific parameters such as the sensor type, calibration and linearisation modes, damping, diagnosis etc. The Transducer Block acts as an interface between the sensor-specific measured values and the Analog Input Blocks for automation.

The Transducer Block of the Deltapilot S outputs the two process values, PRIMARY_VALUE (Measured Value) and SECONDARY_VALUE (Temperature). Use the CHANNEL parameter to transfer the relevant process value to an Analog Input Block.

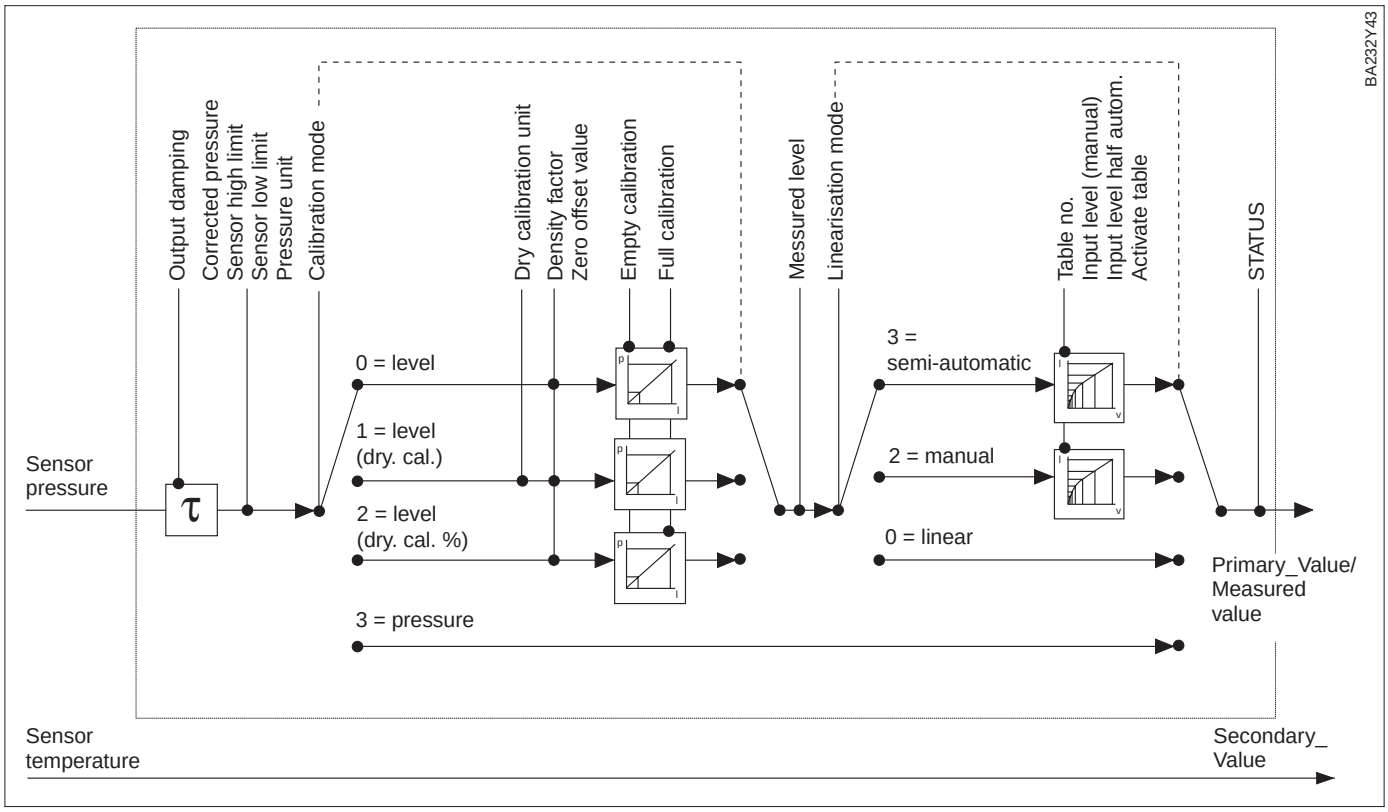


Figure 3.4
Schematic diagram of the Transducer Block: The parameters shown illustrate a typical calibration sequence for a standard application.

Block mode (MODE_BLK)

Use the MODE_BLK_Target parameter to select the block mode. The Transducer Block supports the modes AUTO and OOS.

Block mode	Description
AUTO	Automatic mode, normal Transducer Block operating mode.
OOS	The block is out-of-service. The BLOCK_ERR parameter displays the OOS block status. The measured values (Measured Value, Temperature) are updated but the Analog Input Parameters PV and OUT adapt the status BAD.

Block process alarms (BLOCK_ERR)

Parameter	Write enabled (BLK_MODE)	Description
BLOCK_ERR	**read only**	This parameter displays the error messages which occurred in the software and hardware of the Transducer Block. The following error messages can appear: Out-of-Service: The block is out-of-service (OOS mode). Simulation active: The SIMMOD DIP switch on the electronic insert is "on", i.e. simulation is possible.

Output values

Parameter	Write enabled (BLK_MODE)	Description
PRIMARY_ VALUE	**read only**	The "Measured Value" process variable is processed in the Transducer Block and output as the PRIMARY VALUE. The status is transmitted with this value. A value for pressure, level, volume or weight can be output as the PRIMARY VALUE. If the CHANNEL parameter in the Analog Input Block is set to "Measured Value", the PRIMARY VALUE serves as the input value for this Analog Input Block. See the Transducer Block and Analog Input Block figures.
SECONDARY_ VALUE	**read only**	The "Temperature" process variable is processed in the Transducer Block and output as the SECONDARY VALUE. The status is transmitted with the value. If the CHANNEL parameter in the Analog Input Block is set to "Temperature", the SECONDARY VALUE serves as the input value for this Analog Input Block. See the Transducer Block and Analog Input Block figures.

Other FF parameters

Parameter	Write enabled (BLK_MODE)	Description
PRIMARY_ VALUE_ RANGE	**read only**	The upper and lower scale value, the unit and the number of digits after the decimal point for displaying the PRIMARY VALUE parameter is displayed. This parameter corresponds to the XD_SCALE parameter in the Analog Input Block if "Measured Value" has been selected for the CHANNEL parameter.
Transducer Error	**read only**	An active device error or warning is displayed. This parameter is not supported by the Deltapilot S. The "Diagnostic Code" and "Last Diagnostic Code" parameters display a current fault or warning message and the last fault or warning message. See Chapter 8 also, "Diagnosis and Troubleshooting".
Transducer Type	**read only**	Displays the Transducer Block type. Here: "E+H Hydrostatic Pressure with Calibration"
Secondary Value Unit	**read only**	Displays the unit of the SECONDARY VALUE. This parameter corresponds to the XD_SCALE_Unit_Index parameter in the Analog Input Block if "Temperature" has been selected for the CHANNEL parameter.

Note!

Note!
Depending on the measuring task, the manufacturer-specific parameters are listed in Chapters 5 to 7. Please refer to Chapter 11 "Operating Matrix and Parameter Description" for a description of these parameters.

3.8 Analog Input Block (function block)

The Deltapilot S has two Analog Input Blocks. Use the CHANNEL parameter to assign the PRIMARY_VALUE (Measured Value) or the SECONDARY_VALUE (Temperature) to the Analog Input Block. The PRIMARY_VALUE or the SECONDARY_VALUE can also be assigned to both Analog Input Blocks at the same time .
The PRIMARY_VALUE or SECONDARY_VALUE is prepared in the Analog Input Block, see Figure 3.5. The output signal, OUT parameter is forwarded to the DCS or to other function blocks.

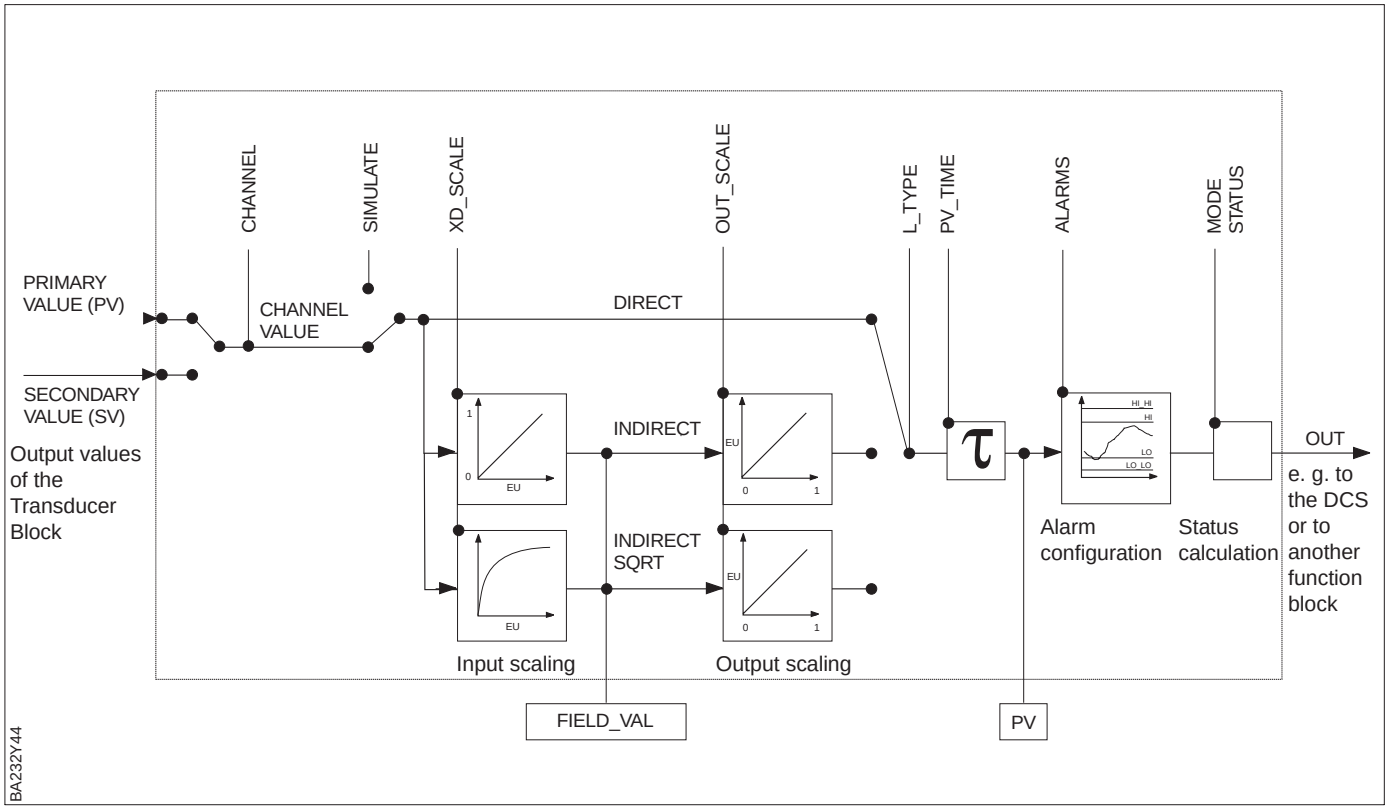


Figure 3.5
Schematic diagram of an Analog Input Block

Block mode (MODE_BLK)

Use the MODE_BLK_Target parameter to select the block mode. The Transducer Block supports the modes AUTO, MAN and OOS.

Block mode	Description
AUTO	Automatic mode, normal Analog Input Block operating mode.
MAN	Manual operation; you can manually set a value and a status for the OUT parameter group in this mode. See this Chapter, "Simulation" section.
OOS	The block is out-of-service. The BLOCK_ERR parameter displays the OOS block status. The OUT parameter outputs the last valid value and the status changes to BAD.

Block process alarms (BLOCK_ERR)

Parameter	Write enabled (BLK_MODE)	Description
BLOCK_ERR	**read only**	This parameter displays the error messages which occurred in the software and hardware of the Analog Input Block. The following error messages can appear: – Out-of-Service: The block is out-of-service (OOS mode). – Simulation active: The SIMMOD DIP switch on the electronic insert is "on", i.e. simulation is possible. – Input failure: Process variable error (BAD status). – Block configuration error: – Scaling (XD_SCALE and OUT_SCALE) is not possible in the "Direct" linearisation mode. – If you assign the same process variable, e.g. "Measured value", to two Analog Input Blocks, then the same scaling values and units must be set for both blocks in the XD_SCALE parameter group.

Output parameters

Parameter	Write enabled (BLK_MODE)	Description
PV	**read only**	This parameter displays the value and status of the process variables after the input and output scaling of the Analog Input Block. It is possible to simulate a value and status for the PV parameter using the SIMULATE parameter. See this Chapter, Figure 3.5 also.
OUT	**MAN, OOS**	Output value of the Analog Input Block. The status is also transmitted with this value. The OUT parameter is normally calculated as a result of executing the Analog Input Block. It is possible to simulate a value and status for the OUT parameter group using the SIMULATE parameter or in the MAN block mode. See this Chapter, "Simulation" section. Use the OUT_SCALE parameter to set the upper and lower scale value and the unit. See this Chapter, Figure 3.5 also and the OUT_SCALE parameter description, Page 25.
FIELD_VALUE	**read only**	This parameter displays the value of the process variables after input scaling of the Analog Input Block. The value is output as a percentage, based on the scale range of XD_SCALE. The status of the Transducer Block is also displayed with the value. See this Chapter, Figure 3.5 also. This parameter is replaced by a simulation value if a simulation is active. Please refer to the FF Specification, Part 2, Analog Input Block for the equation.

Parameter	Write enabled (BLK_MODE)	Description
CHANNEL	**OOS**	Use this parameter to assign the process variables to an I/O block, here to an Analog Input Block. The Deltapilot S has two channels. 1 = Measured value, here a value for pressure, level, volume or weight 2 = Temperature See this Chapter, Figure 3.5 also.
XD_SCALE	**MAN, OOS**	Use this parameter group to specify the upper and lower scale value and the unit for the input scaling of the Analog Input Block. The unit is for display purposes only. The output value OUT is also transmitted if it is outside the scale range. The XD_SCALE parameter group corresponds to the PRIMARY_VALUE_RANGE parameter group in the Transducer Block, see Page 22.
OUT_SCALE	**MAN, OOS**	Use this parameter group to specify the upper and lower scale value and the unit for the output scaling of the Analog Input Block. The unit is for display purposes only. The output value OUT is also transmitted if it is outside the scale range.
L_TYPE	**OOS**	Select the linearisation mode for the input values PRIMARY_VALUE (Measured Value) and SECONDARY_VALUE (Temperature). – Direct: The PRIMARY_VALUE and/or the SECONDARY_VALUE avoid the scaling functions. You cannot modify XD_SCALE and OUT_SCALE in this linearisation mode. – Indirect: The PRIMARY_VALUE and/or the SECONDARY_VALUE is directed through the linear scaling functions. – Indirect SQRT: The PRIMARY_VALUE and/or the SECONDARY_VALUE is directed through the square root scaling functions. See this Chapter, Figure 3.5 also. Please refer to the FF Specification, Part 2, Analog Input Block for the equation.

Scaling

Use the XD_SCALE_Min and XD_SCALE_Max parameters to scale the output value of the Transducer Block. The factory setting is 0 % for XD_SCALE_Min and OUT_SCALE_Min and 100 % for XD_SCALE_Max and OUT_SCALE_Max. The input scaling results in a standardised value between 0…1.

The value "0" is assigned to the XD_SCALE_Min parameter and the value "1" to the XD_SCALE_Max parameter. Use the OUT_SCALE_Min and OUT_SCALE_Max parameters to destandardise the value and rescale it to your own requirements.

Use the XD_SCALE_Units_Index and OUT_SCALE_Units_Index parameters to select a unit. The units do not have an effect on the output value OUT_Value. They are for display purposes only.

Example

A Deltapilot S with a 0…1200 mbar measuring cell is used for level measurement in a tank 10 m in height.

Task: Scaling the OUT Value to the 0…100 % range.

#	Parameter	Entry	Significance
1	Carry out dry calibration as per Chapter 5.3. Use the "Dry calibration unit" parameter to select the unit "m".		
2	– Display XD_SCALE_Min = 0 (%) – Display XD_SCALE_Max = 100 (%)		
3	XD_SCALE_ Units_Index	m	Select unit
4	XD_SCALE_ Min	–	Value remains set at 0
5	XD_SCALE_ Max	100	Set value to 10
6	OUT_SCALE_ Units_Index	%	Select unit
7	OUT_SCALE_ Min	–	Value remains set at 0
8	OUT_SCALE_ Max	100	Set value to 100

Note!

Note!
The values and units for XD_SCALE and OUT_SCALE cannot be altered if the "Direct" mode has been selected for the L_TYPE parameter.

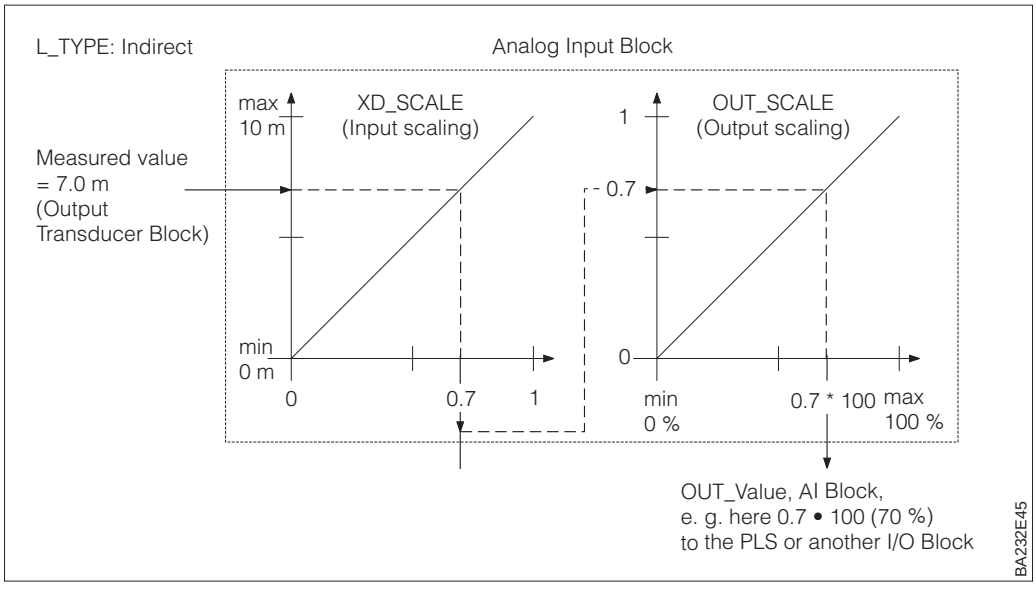


Figure 3.6
Example of an input and output scaling in the Analog Input Block

Other FF parameters

Parameter	Write enabled (BLK_MODE)	Description
PV_FTIME	**AUTO, MAN, OOS**	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 FIELD_VAL parameter to have an effect on the value of PV.
SIMULATE	**MAN, OOS**	Simulation of an input value and status is possible with this parameter group. This simulation value runs through the entire algorithm which means that the behaviour of the Analog Input Block can be checked. Simulation of the Analog Input Block is possible if the BLOCK_ERR parameter of the Resource Block displays the "Simulation active" message. See this Chapter, "Simulation" section.

Alarm detection and processing

You have the option of setting limit values for the output value OUT_Value. An alarm is triggered if one of the limit values is exceeded or undershot. For further information, please refer to Chapter 3.10 "Alarm detection and processing".

Simulation

You can simulate either the output value and status (OUT) or the function of the Analog Input Block.

The output value and status (OUT) can be simulated as follows:

1. Set the Analog Input Block to the MAN block mode.
2. Enter the value for the OUT parameter.
   The simulation value must be within the following range:
   Lower limit: OUT_SCALE_Min – 10 % • (OUT_SCALE_Max - OUT_SCALE_Min)
   Upper limit: OUT_SCALE_Max + 10 % • (OUT_SCALE_Max - OUT_SCALE_Min)
3. Set the block mode to AUTO after simulation.

The function of the Analog Input Block, such as input and output scaling, can be simulated as follows:

1. Switch the "SIMMOD" DIP switch on the electronic insert to "on".
2. Set the "Simulate En-/Disabled" parameter of the SIMULATE parameter group to "Active".
3. Set the Analog Input Block to the AUTO block mode.
4. Now you can specify the value and status for the "Simulation Value" and "Simulation Status" parameters. During the simulation, the output value and status of the Transducer Block are replaced by the simulated value or status. The OUT parameter displays the result.
5. After the simulation, set the "Simulate En-/Disabled" parameter of the SIMULATE parameter group to "Disabled".

Note!
The "Simulation" and "Simulation Value" parameters are available in the Transducer Block. Use the "Simulation" parameter to select the pressure, level or volume simulation mode and use the "Simulation Value" parameter to specify a simulation value. See Chapter 7.3 "Simulation" also.

Note!

3.9 PID Block (function block)

The PID Block has a flexible control algorithm which can be configured differently depending on the application. This function block works according to the following control algorithm:

$$y = GAIN \bullet \left(e + \frac{1}{RESET} \bullet \int e \bullet \Delta t + RATE \bullet \frac{\Delta e}{\Delta t} \right) + F$$

y = actuating variable
GAIN = gain (P-term)
RESET = integral action time T_N (I-term) in [s]
RATE = derivative action time T_V (D-term) in [s]
e = control deviation, e = set point – PV
F = disturbance variable, F = FF_VAL FF_GAIN

Parameter	Write enabled (BLK_MODE)	Description
GAIN	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Entry of the proportional gain (P-term). **Note:** The value of the OUT parameter changes to BAD if the value "0" is specified for this parameter.
PV	**read only**	Assign the process variable which is to be controlled to the IN parameter. If necessary, scale this parameter using PV_SCALE and assign it a time constant using PV_FTIME. The PV (Primary value) parameter displays the result. See this Chapter, Figure 3.7 also.
RESET	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Entry of the time constant for the integral function (integral action time T_N, I-term). **Note:** The integral function is switched off if 0 seconds is entered.
RATE	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Entry of the time constant for the differential function (derivative action time T_V, D-term).

The configuration of the PID Function Block depends on the control or automation task. The following lists some of the options available:

– basic closed-control loops,
– feedforward control,
– cascade control and
– cascade control with limiting.

The following are some of the options available for data processing within the PID Block.

– signal scaling,
– set point limiting,
– block mode control,
– alarm detection,
– output limiting and
– signal status forwarding.

Note!

Note!
The most important parameters of the PID Block are described on the following pages. For further information on parameter descriptions and functions, please refer to the Foundation Fieldbus Specification or the Operating Instructions BA 013S "Foundation Fieldbus Overview, Installation and Commissioning Guidelines".

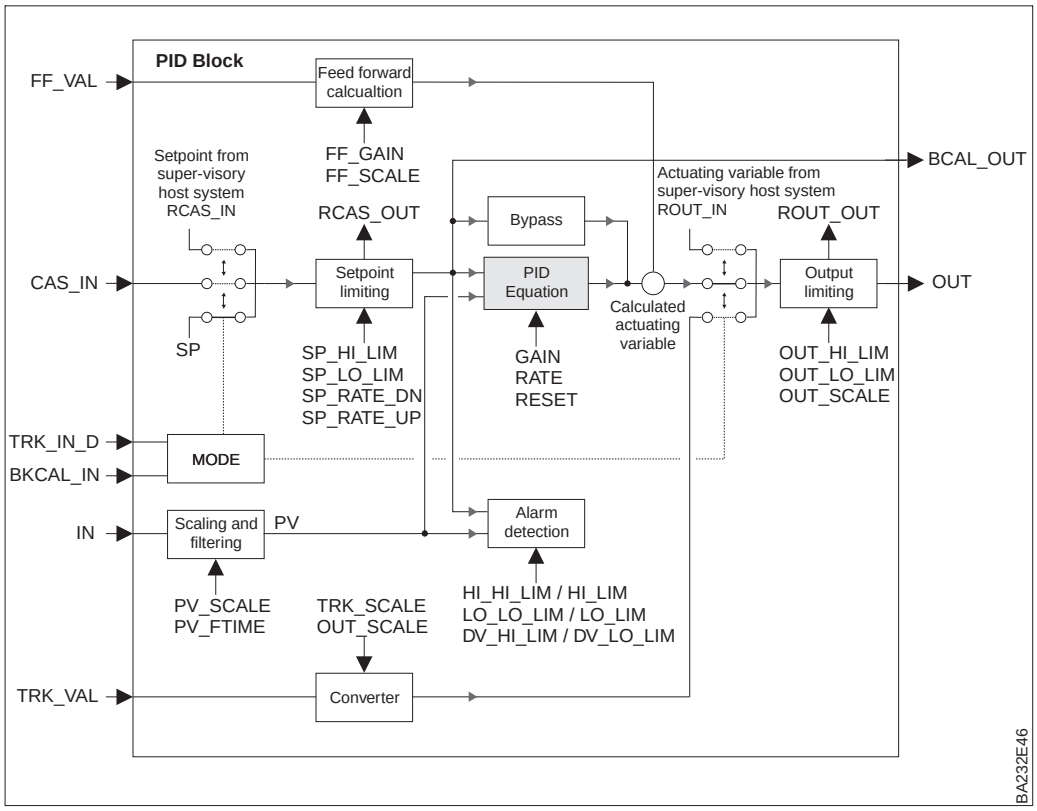


Figure 3.7
Block circuit diagram of the PID Function Block

Block mode (MODE_BLK)

Use the MODE_BLK_Target parameter to select the block mode. The PID Block supports the modes AUTO, MAN, LO, OOS, CAS, RCAS and ROUT.

MODE_BLK	Description
AUTO	Normal operating mode of the PID Block. The SP parameter returns the set point in this block mode. The control deviation is calculated from the difference between the set point and PV (Primary value), e = SP – PV. The value is specified manually by the operator.
MAN	You can manually set a value and status for the OUT parameter in this mode.
LO	Local override. This mode is available to all function and output blocks which support the TRK_VAL parameter. The current block mode changes to the LO mode once tracking is activated (TRK_IN_D parameter). The TRK_VAL value is sent to the output value OUT via a converter. **Note:** The "Track Enable" or "Track in Manual" option (for the MAN block mode) of the CONTROL_OPTS parameter must be activated prior to commissioning.
OOS	The block is out-of-service. The BLOCK_ERR parameter displays the OOS block status. Write access is enabled and all parameters can be accessed if the WPM DIP switch on the electronic insert is set to "off".
CAS	Cascade In this block mode, the CAS_IN parameter supplies the set point for internal calculation of the actuating variable. The CAS_IN parameter is specified by an upstream function block or a DCS (= Distributed Control System).
RCAS	Remote cascade The PID Block receives the set point and the status directly from the host system by means of the RCAS_IN parameter. The set point is used for calculating the (internal) actuating variable. The PID algorithm is executed. The actuating variable is output via the RCAS_OUT parameter.
ROUT	Remote output The PID Block receives the manipulated value point and the status directly from the host system by means of the ROUT_IN parameter. The PID algorithm is not executed. The actuating variable is output again via the ROUT_OUT parameter.

Block process alarms (BLOCK_ERR)

Parameter	Write enabled (BLK_MODE)	Description
BLOCK_ERR	**read only**	This parameter displays the error messages which occurred in the software and hardware of the PID Block. The following error messages can appear: Block Configuration Error, Link Configuration Error, Local Override, Device Fault State Set, Input Failure, Output Failure, Memory Failure, Lost Static Data, Lost VV Data, Readback Check Failed, Power-up, Out-of-Service

Note!

Note!
You have the option of setting limit values for the output value OUT_Value and for the control deviation. An alarm is triggered if one of the limit values is exceeded or undershot. For further information, please refer to Chapter 3.10 "Alarm detection and processing".

Input parameters

Parameter	Write enabled (BLK_MODE)	Description
IN	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Assign the process variable which is to be controlled to the IN parameter. If necessary, scale this parameter using PV_SCALE and assign it a time constant using PV_FTIME. The PV (Primary value) parameter displays the result. The control deviation is calculated in the AUTO mode from the difference between the set point and the primary value, e = SP – PV.
BKCAL_IN	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Link this parameter to the BKCAL_OUT parameter of a downstream block. Assign the value and status of the BKCAL_OUT parameter (and thereby of the downstream block) to the BKCAL_IN parameter. By linking BKCAL_OUT and BKCAL_IN, you close the closed-control loop, see Chapter 3.11, Figure 3.11 also.
CAS_IN	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	This parameter returns the set point in the CAS mode. The CAS_IN parameter is specified by an upstream function block or a DCS (= Distributed Control System) by means of a defined link.
RCAS_IN	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	The PID Block receives the set point and the status directly from the host system by means of the RCAS_IN parameter. The set point is used for calculating the (internal) actuating variable. **Note:** – This parameter is only active in RCAS mode. – The unit and the scaling of the PV_SCALE parameter group are valid for the RCAS_IN parameter. – If the PV_SCALE scaling values are modified, the value of the RCAS_IN should be adjusted accordingly.
ROUT_IN	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	he PID Block receives the manipulated value point and the status directly from the host system by means of the ROUT_IN parameter. The PID algorithm is not executed. **Note:** – This parameter is only active in ROUT mode. – The unit and the scaling of the OUT_SCALE parameter are valid for the RCAS_IN parameter.
TRK_IN_D	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	This separate input is used to initiate external tracking of the output value. The value and status are supplied to the PID Block by means of the TRK_VAL parameter group. The value and status are passed through directly to the output. The current block mode changes to the LO mode when the external tracking is activated.
TRK_VAL	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	This value is used as the input value for the block if external tracking is activated by means of the TRK_IN_D parameter. The value and status are specified via an upstream block or manually by the operator.
FF_VAL	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	A value and status of a disturbance variable are displayed and entered. The value and status are specified via an upstream block or manually by the operator.

Output parameters

Parameter	Write enabled (BLK_MODE)	Description
BKCAL_OUT	**read only**	Link this parameter to the BKCAL_IN parameter of an upstream block. Assign the value and status of the BKCAL_OUT parameter to the BKCAL_IN parameter. By linking BKCAL_OUT and BKCAL_IN, you close the closed-control loop, see Chapter 3.11, Figure 3.11 also.
OUT	**MAN, OOS**	This parameter group returns the output value and status of the PID Block. The OUT parameter is normally calculated as a result of executing the PID algorithm. Use the OUT_SCALE parameter group to set the upper and lower scaling value and the unit for the output value OUT_Value. Use the OUT_LO_LIM and OUT_HI_LIM parameters to set an upper and lower limit value for the output value OUT_Value. See the following section in this Chapter "Limit values, hysteresis and scaling for OUT" and Figure 3.8 also.
RCAS_OUT	**read only**	This parameter returns the actuating variable which is transferred in the event of cascade control of the host system. The cascade control is initialised with this value to ensure bumpless switching of the operating mode. See the RCAS_IN parameter description also. **Note:** – This parameter is only active in RCAS mode. – The unit and the scaling of the PV_SCALE parameter are valid for the RCAS_IN parameter. – If the PV_SCALE scaling values are modified, the value of the RCAS_IN should be adjusted accordingly.
ROUT_OUT	**read only**	This parameter returns the actuating variable which is transferred in the event of cascade control of the host system. The cascade control is initialised with this value to ensure bumpless switching of the operating mode. See the ROUT_IN parameter description also. **Note:** – This parameter is only active in ROUT mode. – The unit and the scaling of the OUT_SCALE parameter are valid for the RCAS_IN parameter.

Limit values, hysteresis and scaling for OUT

Parameter	Write enabled (BLK_MODE)	Description
BKAL_HYS	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	This parameter specifies the hysteresis for the limit values OUT_LO_LIM and OUT_HI_LIM. The hysteresis value is a percentage of the scaling range of the OUT_SCALE parameter group. If the actuating variable calculated exceeds or drops below the OUT_LO_LIM or OUT_HI_LIM limit values, this limit value violation is displayed in the LIMITS monitoring parameter of the OUT parameter group and communicated to the subsequent blocks. The limit value violation remains active until the value of the actuating variable calculated returns to begin within a permitted range, see Figure 3.8, Page 32. The following values are possible for the LIMITS monitoring parameter: – NotLimited = No limit value violation – HighLimited =Limit value violation is output – LowLimited = Limit value violation is output
OUT_SCALE	**MAN, OOS**	Use this parameter group to specify the upper and lower scale value and the unit for the output scaling of the PID Block. The unit is for display purposes only.

Limit values for OUT (continuation)

Parameter	Write enabled (BLK_MODE)	Description
OUT_LO_LIM	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Lower limit value for the OUT_Value. The value should be set in the same unit as OUT_SCALE. The input range is based on the OUT_SCALE: (OUT_SCALE max + 10 % • (OUT_SCALE max – OUT_SCALE min) to OUT_SCALE min – 10 % • (OUT_SCALE max – OUT_SCALE min)). If you change the settings for OUT_SCALE, you should also change OUT_LO_LIM accordingly.
OUT_HI_LIM	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Upper limit value for the OUT_Value. The value should be set in the same unit as OUT_SCALE. The input range is based on OUT_SCALE, see OUT_LO_LIM parameter description. If you change the settings for OUT_SCALE, you should also change OUT_HI_LIM accordingly.

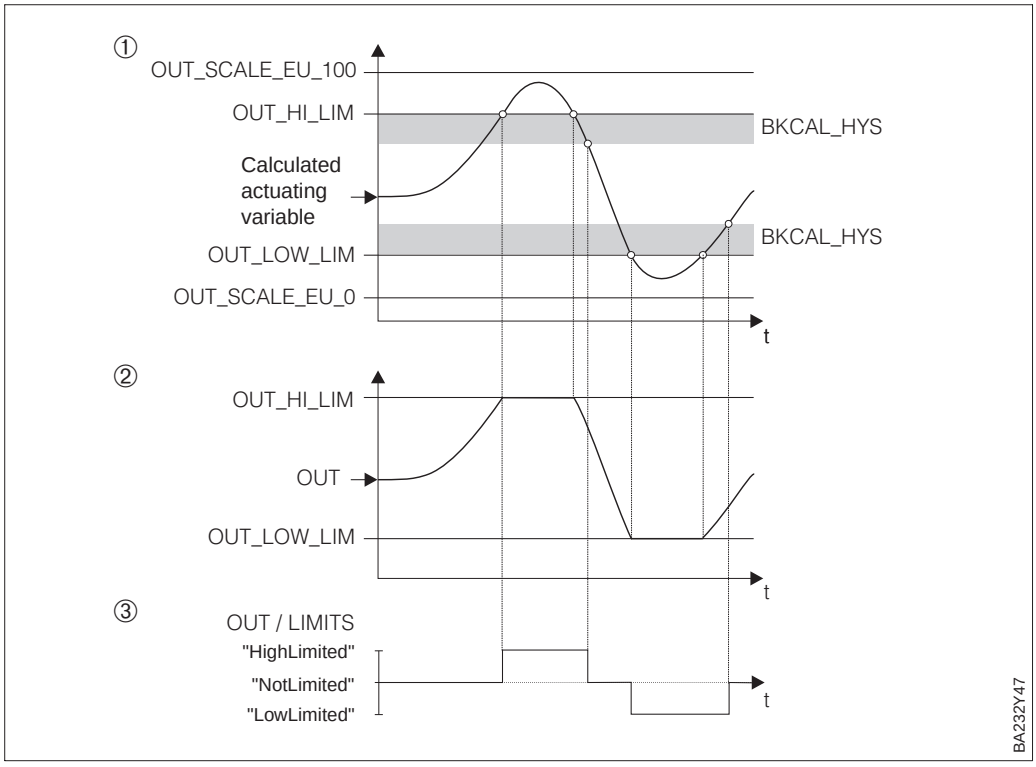


Figure 3.8
1: Illustrates the calculated actuating variable with the defined OUT_LO_LIM and OUT_HI_LIM limit values and also the BKCAL_HYS hysteresis.
2: Illustrates the output variable OUT within the OUT_HI_LIM and OUT_LO_LIM limit values
3: Illustrates the LIMITS limit value monitoring of the OUT parameter group

Set point limiting

Use the SP_LO_LIM and SP_HI_LIM parameters to set the upper and lower limit value for the set point SP. Use the SP_RATE_DN and SP_RATE_UP parameters to set a speed restriction for downward or upward set point changes. These parameters are only active in the AUTO block mode.

Parameter	Write enabled (BLK_MODE)	Description
SP_HI_LIM	**AUTO, MAN, OOS**	Upper limit value for the set point SP. The value should be set in the same unit as PV_SCALE. The input range is based on the PV_SCALE: (PV_SCALE max + 10 % • (PV_SCALE max – PV_SCALE min) to PV_SCALE min – 10 % • (PV_SCALE max – PV_SCALE min)). **Note:** – If you change the settings for PV_SCALE, you should also change SP_HI_LIM accordingly. – This parameter normally only has an effect in the AUTO block mode. This parameter also has an effect on the CAS and RCAS modes if you activate the "Obey SP limits if CAS or RCAS" (= 1) option for the CONTROL_OPTS parameter.
SP_LO_LIM	**AUTO, MAN, OOS**	Lower limit value for the set point SP. See parameter, also SP_HI_LIM parameter description. **Note:** – If you change the settings for PV_SCALE, you should also change SP_LO_LIM accordingly. – This parameter normally only has an effect in the AUTO block mode. This parameter also has an effect on the CAS and RCAS modes if you activate the "Obey SP limits if CAS or RCAS" (= 1) option for the CONTROL_OPTS parameter.
SP_RATE_DN	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Specify the ramp rate for downward setpoint changes for this parameter. **Note:** – The set point is used immediately if you set this parameter to "0". – The speed limit is only active in the AUTO block mode.
SP_RATE_UP	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Specify the ramp rate for upward setpoint changes for this parameter. **Note:** – The set point is used immediately if you set this parameter to "0". – The speed limit is only active in the AUTO block mode.

BYPASS

Parameter	Write enabled (BLK_MODE)	Description
BYPASS	**MAN, OOS**	Use this parameter to switch on or switch off the PID control algorithm for calculating the actuating variable. OFF: Bypass switched off. The actuating variable calculated by the PID control algorithm is output via the OUT_Value parameter. ON: Bypass switched on. The value of the set point SP is output directly via the OUT_Value parameter. **Note:** The "Bypass enable" option of the CONTROL_OPTS parameter must be activated (= 1) before commissioning.

Feedforward

In feedforward control, the main disturbance variable is measured and acts directly on the controller input, (here FF_VAL). If the disturbance variable changes, its new value is noticeable immediately at the controller input. See equation, Page 28, F-term of the control algorithm and Figure 3.7, Page 29 also.
The FF_VAL parameter is multiplied by an FF_GAIN gain factor and scaled by means of the FF_SCALE parameter.

Parameter	Write enabled (BLK_MODE)	Description
FF_GAIN	**MAN, OOS**	For entering the disturbance gain for feedforward control. The disturbance gain is multiplied by the input value FF_VAL.
FF_SCALE	**MAN, OOS**	Use this parameter group to specify the upper and lower scale value, the unit and the number of digits after the decimal point for the FF_VAL parameter group. The unit is for display purposes only.
FF_VAL	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	A value and the status of the disturbance variable are displayed and entered. The value and status for FF_VAL are provided as follows: – as an output value from another block which is linked to FF_VAL or – as a value entered manually in FF_VAL if the FF_VAL parameter is not linked to an output of another block.

Tracking

Output value tracking is normally used to bring the control to a safety position in the event of an error in the closed-control loop. When the tracking is activated, the value and status of the TRK_VAL parameter group is forwarded directly to the OUT or BKCAL_OUT output parameter. See Figure 3.7, Page 29.
The "Track Enable" or "Track in Manual" option (for the MAN block mode) of the CONTROL_OPTS parameter must be activated prior to commissioning.

Parameter	Write enabled (BLK_MODE)	Description
TRK_IN_D	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	This separate input is used to initiate external tracking of the output value. The value and status are supplied to the PID Block by means of the TRK_VAL parameter group. The value and status are passed through to the output without running the PID control algorithm. The current block mode changes to the LO mode when the external tracking is activated.
TRK_SCALE	**MAN, OOS**	Use this parameter group to specify the upper and lower scale value, the unit and the number of digits after the decimal point for the TRK_VAL parameter. Normally the same scaling is used for TRK_SCALE as for OUT_SCALE.
TRK_VAL	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	The TRK_VAL parameter is used as the input value as soon as the TRK_IN_D parameter is activated. The value and status for TRK_VAL are provided as follows: – as an output value from another block which is linked to TRK_IN_D or – as a value entered manually in TRK_VAL if the TRK_IN_D parameter is not linked to an output of another block.

Other FF parameters

Parameter	Write enabled (BLK_MODE)	Description
CONTROL_ OPTS	**OOS**	Selects the control options to specify the automation strategy. An option is activated if the relevant bit is set to "1". 0 = Bypass activated 1 = SP-PV Track in MAN 2 = SP-PV Track in ROUT 3 = SP-PV Track in LO or IMAN 4 = SP Track retained target 5 = Reserved 6 = Direct Acting 7 = Track Enable 8 = Track in Manual 9 = Use PV for BKCAL_OUT 10 = Act on IR 11 = Use BKCAL_OUT With IN_! 12 = Obey SP limits if Cas or CAS 13 = No Out limits in Manual For further information, please refer to the FF Specification, Part 2 or the Operating Instructions BA 013S "Foundation Fieldbus, Overview".
PV_FTIME	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	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 controlled variable at input IN to have an effect on the value of PV.
PV_SCALE	**OOS**	Use this parameter group to specify the upper and lower scale value and the unit for the IN parameter. The unit is for display purposes only.
SHED_OPT	**ROUT, RCAS, CAS, AUTO, MAN**	Selects the action to be taken in the event of monitoring time being exceeded in the RCAS and ROUT operating mode. See SHED_RCAS and SHED_ROUT parameters also. During the monitoring time parameter updating between the fieldbus host system and the PID Block is checked. If the parameters are not updated, the PID Block changes from the RCAS or ROUT block mode to the mode selected via SHED_OUT once the monitoring time has expired. For further information, please refer to the FF Specification, Part 1 or the Operating Instructions BA 013S "Foundation Fieldbus, Overview".
SHED_RCAS	**AUTO, OOS**	Specifies the monitoring time in the RCAS block mode. During this monitoring time, the link between the fieldbus host system and the PID Block is checked. Once the monitoring time expires, the PID Block changes from the RCAS mode to the block mode selected via the SHED_OPT parameter.
SHED_ROUT	**AUTO, OOS**	Specifies the monitoring time in the ROUT block mode. During this monitoring time, the link between the fieldbus host system and the PID Block is checked. Once the monitoring time expires, the PID Block changes from the ROUT mode to the block mode selected via the SHED_OPT parameter.
STATUS_OPTS	**OUT**	Use this parameter to specify the status processing and the processing of the output parameter OUT. The following options are available for the PID Block: – IFS if BAD IN – IFS if BAD CAS_IN – Use uncertain as Good – Target in Manual if BAD IN For further information, please refer to the FF Specification, Part 2 or the Operating Instructions BA 013S "Foundation Fieldbus, Overview".

3.10 Alarm detection and processing

Process alarms provide information on certain block statuses and events. There are block and limit value process alarms.
Use the ACK_OPTION parameter to specify the alarms which are automatically acknowledged by the host system. The ALARM_SUM parameter displays the current status of all the block and limit value process alarms.

Block process alarms

A block process alarm is triggered by means of the BLOCK_ERR parameter. The block process alarms are displayed by means of the BLOCK_ALM parameter and conveyed to the host system. The process alarms possible depend on the block type, see Chapter 3.6, 3.7, 3.8 and 3.9, "Block process alarms" section also. If automatic acknowledgement by the host system has not been activated for the ACK_OPTION parameter, the alarm can only be acknowledged using the parameter BLOCK_ALM_Unacknowledged.

Limit value process alarms

You can set limit values for the particular output value of the Analog Input and PID Block and also for the control deviation (DV_HI and DV_LO). If a limit value is exceeded or undershot, the specified priority is checked before the alarm is sent to the host system. Use the XX_PRI or XX_XX_PRI parameters to specify the priority which determines the behaviour in the event of an active limit value violation.
Use the XX_LIM and XX_XX_LIM parameters to set the limit values. The ALARM_HYS parameter specifies the hysteresis for the HI_HI_ALM, HI_ALM, LO_LO_ALM, LO_ALM, DV_HI_ALM, DV_LO_ALM limit values. The status of the limit value process alarms is conveyed to the host system by means of the XX_ALM or XX_XX_ALM parameters.

Note!

Note!
The output value of the PID Block can also be limited by means of the OUT_HI_LIM and OUT_LO_LIM parameters. See Chapter 3.9, "Limit values, hysteresis and scaling for OUT" section.

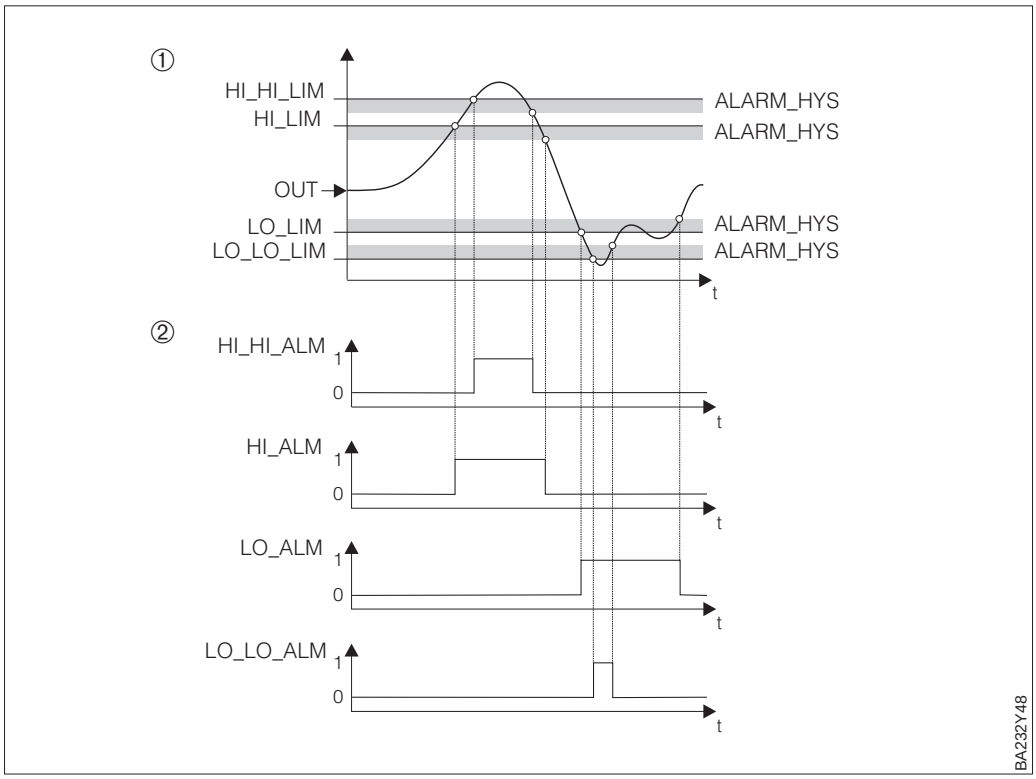


Figure 3.9
1: Illustrates the OUT output value with limit values and hysteresis
2: Illustrates the HI_HI_ALM, HI_ALM, LO_ALM and LO_LO_ALM alarms

Description of general parameters for alarm detection and processing

Parameter	Block type	Write enabled (MODE_BLK)	Description
ACK_OPTION	**RES, AI PID**	**AUTO, MAN, OOS, CAS, RCAS, ROUT**	Use this parameter to specify the alarms which are automatically acknowledged by the host system. The alarms possible depend on the block type. If the "automatic acknowledgement" (Unack 8) option has not been activated for the block process alarm (BLOCK_ALM), the alarm can only be acknowledged using the BLOCK_ALM parameter. Please refer to the FF Specification, Part 1 for the other possible options.
ALARM_HYS (AI, PID)	**AI, PID**	**AUTO, MAN, OOS**	This parameter specifies the hysteresis for the following alarms in the block. HI_HI_ALM, HI_ALM, LO_LO_ALM, LO_ALM, DV_HI_ALM, DV_LO_ALM. Specify the hysteresis as a percentage, based on the scale range of XD_SCALE. **Example:** ALARM_HYS: 2 %, HI_HI_LIM: 95 %, XD_SCALE min: 0 %, XD_SCALE max: 100 %: The alarm is activated if the output value reached 95 %. If the output value drops below 93 %, the alarm is deactivated again. See Figure 3.9 also.
ALARM_SUM	**RES, AI PID**	**AUTO, MAN, OOS**	This parameter group displays the current status of all the block and limit value process alarms of the associated block. The parameter group comprises the following parameters: Current: Displays the current alarms Unacknowledged: Displays the alarms not yet acknowledged Unreported: Displays the alarms not yet reported Disabled: Use this parameter to specify the alarms you wish to disable. The options depend on the block type.
BLOCK_ALM	**all**	**AUTO, OOS**	This parameter group reports configuration, hardware, connection and system errors of the associated block to the host system. The block process alarms possible depend on the block type. Options: Simulation active, Input failure, Out-of-Service (OOS), Readback failure and Block configuration error. The parameter group comprises the following parameters: Unacknowledged: This parameter displays "Unacknowledged" if an alarm occurs and is not automatically acknowledged by the system, see ACK_OPTION parameter. Use the "Acknowledged" option to acknowledge the message. Alarm State: Indicates whether the alarm is still active and whether it has already been reported to the control level. Time Stamp: Indicates the time when the alarms were registered by the control level and when the alarm stops again. Subcode: Reason for the alarm See also FF Specification, Part 1.
BLOCK_ERR	**all**	**read only**	This parameter displays the error messages which occurred in the software and hardware of the block in question. In addition, this parameter also triggers an alarm. Several errors can be displayed simultaneously. The error messages possible depend on the block type. See Chapters 3.6, 3.7, 3.8 and 3.9, "Block process alarms" section and FF Specification, Part 1.

The following section describes all the parameters for alarm limit values and priority assignment for the Analog Input Block and PID Block. It also explains the meaning of the priorities and describes the parameters for alarm detection.

Alarm limit values (OUT)

Parameter	Block type	Write enabled (BLK_MODE)	Description
HI_HI_LIM	**AI, PID**	**AUTO, MAN, OOS**	Entry of a critical upper limit value. The HI_HI_ALM parameter displays the alarm if the OUT output value exceeds this limit value.
HI_LIM	**AI, PID**	**AUTO, MAN, OOS**	Entry of an upper limit value. The HI_ALM parameter displays the alarm if the OUT output value exceeds this limit value.
LO_LIM	**AI, PID**	**AUTO, MAN, OOS**	Entry of a lower limit value. The LO_ALM parameter displays the alarm if the OUT output value drops below this limit value.
LO_LO_LIM	**AI, PID**	**AUTO, MAN, OOS**	Entry of a critical lower limit value. The LO_LO_ALM parameter displays the alarm if the OUT output value drops below this limit value.

Alarm limit values (control deviation)

Parameter	Block type	Write enabled (BLK_MODE)	Description
DV_HI_LIM	**PID**	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Entry of an upper limit value for the control deviation.
DV_LO_LIM	**PID**	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Entry of a lower limit value for the control deviation.

Priorities (assignment – OUT)

Parameter	Block type	Write enabled (BLK_MODE)	Description
HI_HI_PRI	**AI, PID**	**AUTO, MAN, OOS**	Use this parameter to specify the action taken if the HI_HI_LIM limit value is exceeded.
HI_PRI	**AI, PID**	**AUTO, MAN, OOS**	Use this parameter to specify the action taken if the HI_LIM limit value is exceeded.
LO_PRI	**AI, PID**	**AUTO, MAN, OOS**	Use this parameter to specify the action taken if the LO_LIM limit value is undershot.
LO_LO_PRI	**AI, PID**	**AUTO, MAN, OOS**	Use this parameter to specify the action taken if the LO_LO_LIM limit value is undershot.

Priorities (assignment – control deviation)

Parameter	Block type	Write enabled (BLK_MODE)	Description
DV_HI_PRI	**PID**	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Use this parameter to specify the action taken if the DV_HI_LIM limit value is exceeded.
DV_LO_PRI	**PID**	**ROUT, RCAS, CAS, AUTO, MAN, OOS**	Use this parameter to specify the action taken if the DV_LO_LIM limit value is undershot.

Priorities

Priority	Description
0	The alarm is disabled.
1	The alarm is detected by the system. No notification is given.
2	Reserved for block alarms
3 – 7	Informative alarms with increasing priority, 3: low priority, 7: high priority
8 – 15	Critical alarms with increasing priority, 8: low priority, 15: high priority

Alarms (OUT)

Parameter	Block type	Write enabled (BLK_MODE)	Description
HI_HI_ALM	**AI, PID**	**AUTO, MAN, OOS**	Status display for the HI_HI_LIM limit value. This parameter group contains the following parameters: Unacknowledged: The "Unacknowledged" parameter – if an alarm occurs but was not acknowledged automatically by the system, see the ACK_OPTION parameter. (Use the "Acknowledged" option to acknowledge the message.) Alarm State: Displays the alarm status: active, no longer active and displays the report status: alarm not reported, alarm reported Time Stamp: Indicates the time when the alarms were registered by the host system. Subcode: Reason for the alarm Float Value: Displays the output value, e.g. OUT Value, which has exceeded the limit value. The Float Value is updated as long as the output value is above the limit value.
HI_ALM	**AI, PID**	**AUTO, MAN, OOS**	Status display for the HI_LIM limit value. See the description of the HI_HI_ALM parameter.
LO_ALM	**AI, PID**	**AUTO, MAN, OOS**	Status display for the LO_LIM limit value. See the description of the HI_HI_ALM parameter.
LO_LO_ALM	**AI, PID**	**AUTO, MAN, OOS**	Status display for the LO_LO_LIM limit value. See the description of the HI_HI_ALM parameter.

Alarms (control deviation)

Parameter	Block type	Write enabled (BLK_MODE)	Description
DV_HI_ALM	**PID**	**read only**	Status display for the DV_HI_LIM limit value. See the HI_HI_ALM description also.
DV_LO_ALM	**PID**	**read only**	Status display for the DV_LO_LIM limit value. See the HI_HI_LIM description also.

3.11 Closed-control loops

The following example illustrates a closed-control loop which uses the following components: analog level input block, analog flow input block, two PID Blocks (e. g. from the level transmitter and from the valve) and an analog valve output block. Use a configuration program to define the links between the function blocks.

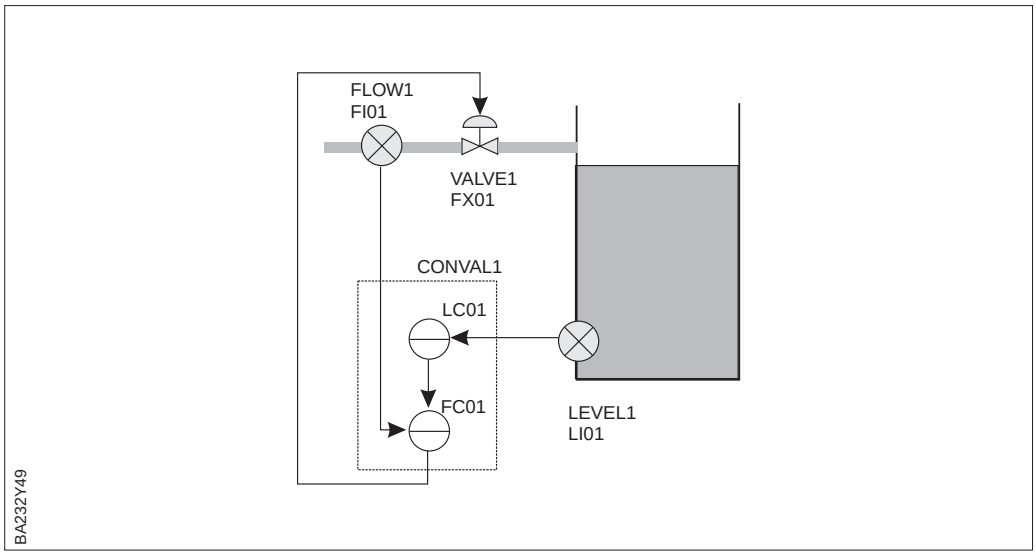


Figure 3.10
Schematic diagram of the closed-control loop

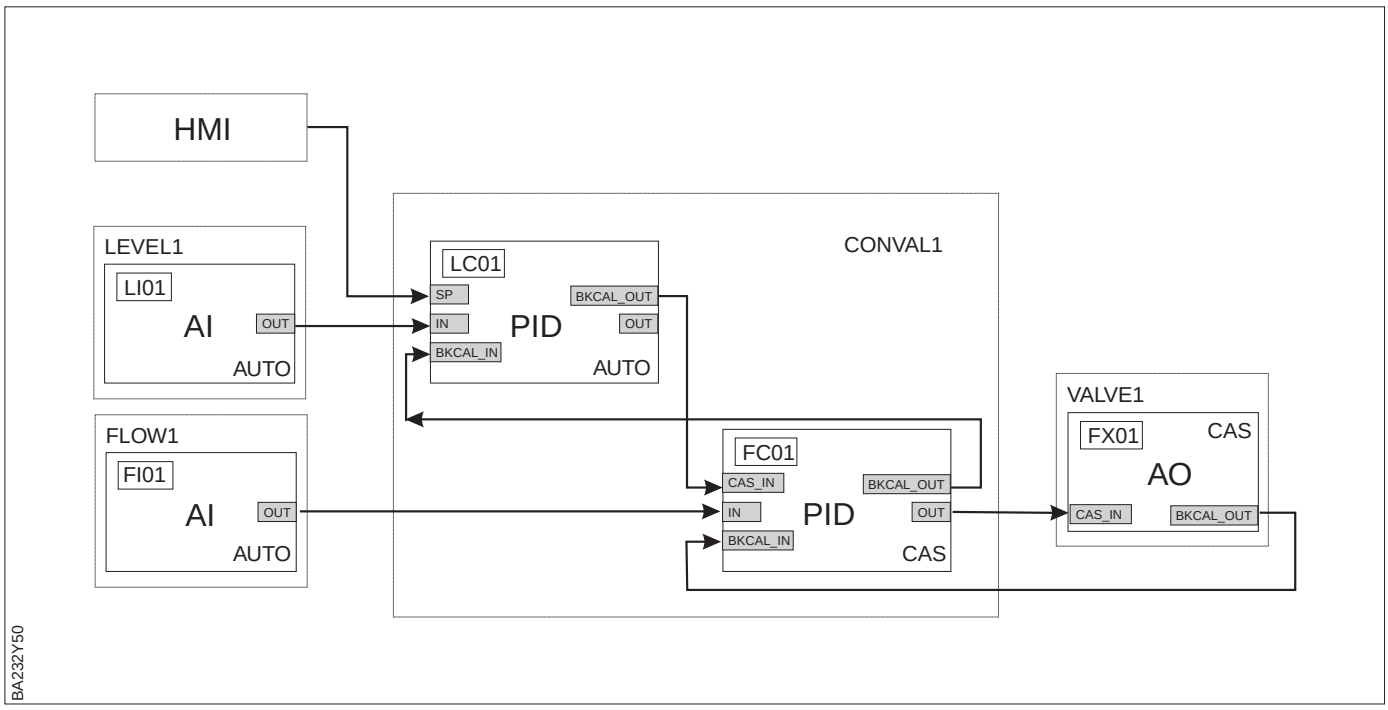


Figure 3.11
Links between the function blocks

3.12 Checklist for commissioning

1. Configure the FF network and integrate the device.
   – Identify the device using the device ID and the serial number.
   – If necessary, assign the measuring point a tag name by means of the PD_TAG parameter, see Chapter 3.3 and 3.4.

2. Configure the Resource Block, see Chapter 3.5 and 3.6.
   – Check the "WPM" DIP switch setting in the WRITE_LOCK parameter. If the parameter displays "Locked", set the "WPM" DIP switch to "off". See Chapter 3.2 also.
   – If necessary, change the block name in the network structure. See the Operating Instructions of the configuration program used.
   – Set MODE_BLK_Target parameter to OOS (out-of-service block mode).
   – If necessary, use the RESTART Defaults parameter to set the device to the factory settings.
   – Assign an identification number from 1 to 255 to the ALERT_KEY parameter.
   – If necessary, assign a description to the block by means of the "TAG_DESC" parameter.
   – If necessary, change other parameters to suit your requirements.
   – Once you are finished entering the parameters, reset the MODE_BLK_Target parameter to AUTO.

3. Configure the Transducer Block, see Chapter 3.7 and Chapters 5 to 7.
   – If necessary, change the block name in the network structure. See the Operating Instructions of the configuration program used.
   – Set MODE_BLK_Target parameter to OOS (out-of-service block mode).
   – Assign an identification number from 1 to 255 to the ALERT_KEY parameter.
   – If necessary, assign a description to the block by means of the "TAG_DESC" parameter.
   – Configure the device to suit the measuring task, see Chapter 5 " Level Measurement", 6 "Pressure and Differential Pressure Measurement" and 7 "Other Settings".
   – Once you are finished entering the parameters, reset the MODE_BLK_Target parameter to AUTO.

4. Configure Analog Input Block(s), see Chapter 3.8.
   – If necessary, change the block name in the network structure. See the Operating Instructions of the configuration program used.
   – Set MODE_BLK_Target parameter to OOS (out-of-service block mode).
   – Assign an identification number from 1 to 255 to the ALERT_KEY parameter.
   – If necessary, assign a description to the block by means of the "TAG_DESC" parameter.
   – Assign the desired process variable to the CHANNEL parameter, here "Measured value" (= 1) or "Temperature" (= 2).
   – If necessary, use the L_TYPE, XD_SCALE and OUT_SCALE parameter groups to scale the process variable, see Chapter 3.8, "Scaling" section.
   – If necessary, set other parameter values, such as PV_FTIME.
   – If necessary, configure limit values and alarms, see Chapter 3.10.
   – Once you are finished entering the parameters, reset the MODE_BLK_Target parameter to AUTO.

5. Depending on the control or automation task, configure other function blocks and output blocks, if necessary.
   For further information on function blocks and output blocks, please refer to the Foundation Fieldbus Specification or the Operating Instructions BA 013S "Foundation Fieldbus Overview, Installation and Commissioning Guidelines".

6. Link the function and output blocks in the function block editor.

7. Download the configuration.

Note!

Note!
If a warning message is displayed when downloading a configuration, this can be due to the network parameter settings. The settings depend on the configuration program and the computer type and configuration. The following setting values are reference values.

Parameter	Setting	Parameter	Setting
Def Min Token Deleg Time	84	DIpdu Phl Overhead	2
Def Token Hold Time	150	Min Inter-Pdu Delay	8
Target Token Rot Time	4096	Time Sync Class	1 ms
Link Maint Tok Hold Time	0x40	T1	0x8000
Time Distribution Period	2000	T2	0x100000
Slot Time	10	T3	0x75300
Max Response Delay	5		

4 Operation

4.1 On-site operation

Operating matrix

The Deltapilot S is configured and operated by means of a 10 x 10 matrix. The matrix is illustrated in Chapter 11.1. In this matrix,

- each row is assigned to a function group and
- each field is assigned to a parameter.

The possible settings are described in Chapters 5-7. After entering all the parameters, you can lock the operation against unauthorised inputs, see Chapter 7.4.

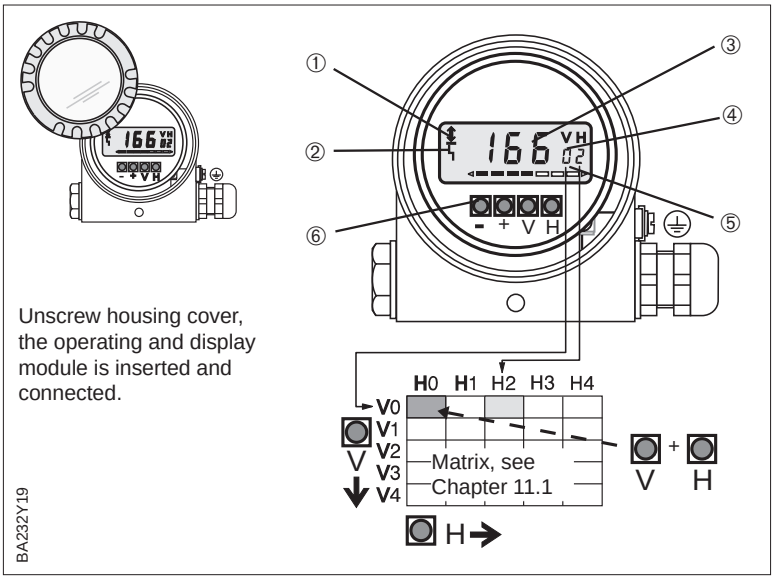


Figure 4.1
User interface of electronic insert with operating and display module FHB 20
① *Communication signal: lights on operation via FF interface*
② *Fault indication*
③ *4½-figure display of measured values and entry parameters*
④ *Current matrix position*
⑤ *Bar graph of measured value*
⑥ *Operating keys*

4.2 Operating and display module FHB 20

If ordered, the operating and display module is stowed away in the housing. It functions as follows:

Keys	Function
Selection of matrix field	
V	Selection of vertical matrix position
H	Selection of horizontal matrix position
V and H	Display springs to V0H0 when V and H pressed simultaneously
Parameter entry	
+ or –	Activates selected matrix position. The selected digit flashes.
+	Changes value of flashing digit by +1
–	Changes value of flashing digit by –1
+ and –	Resets the value entered to the original value, provided it has not yet been registered.
Registering entry	
V or H; V and H	Registers entry and quits the matrix field
Locking/Unlocking	
+ and V or – and H	+ and V lock, – and H unlock the matrix

Note!
Once you have set your device using the operating and display module FHB 20, you can disconnect it and use it to configure other Deltapilot S sensors.

Note!

4.3 Operation with an FF configuration program

You can also use a configuration program to carry out basic calibration and make other settings. The possible settings are described in Chapters 5 to 7. The manufacturer-specific parameters are in the Transducer Block, see Chapter 3.7 "Transducer Block" also.

Block model

In the case of Foundation Fieldbus devices, the entire device parameters are categorised according to their functional properties and tasks and are assigned to different blocks. A block can be seen as a container which holds parameters and the related functionalities. Various automation tasks can be carried out depending on how the individual blocks are linked.

The Deltapilot S has a Resource Block, a Transducer Block, two Analog Input Blocks and a PID Block, see Chapter 3.5, Figure 3.3 also.

- Resource Block (device block)
  This block comprises all the data which identify and characterise a device such as the device type, the device name, the manufacturer ID, the serial number etc. See Chapter 3.6 "Resource Block" also.

- Transducer Block (transmission block)
  The Transducer Block acts as an interface between the sensor-specific measured values and the Analog Input Blocks for automation. This block contains all the manufacturer-specific parameters for calibration, selecting the linearisation mode, damping, diagnosis etc., see Chapter 3.7 "Transducer Block" also.

- Analog Input Block (function block)
  You assign a process variable to the Analog Input Block. The Deltapilot S has two process variables, "Measured value" and "Temperature". The process variable is scaled in the Analog Input Block and provided with limit values. The output value is forwarded to another function block or to the DCS. See Chapter 3.8 "Analog Input Block" also.

- PID Block (function block) The PID Block has a flexible control algorithm which can be configured differently depending on the application, see Chapter 3.9 "PID Block" also.

Note!

Note!
Further information is provided in Chapter 3 "Foundation Fieldbus interface", in the Foundation Fieldbus Specification, in the Operating Instructions BA 013S "Foundation Fieldbus Overview, Installation and Commissioning Guidelines" and at "http://www.fieldbus.org".

5 Level Measurement

This chapter describes the configuration which is required for level measurement with a Deltapilot S with electronic insert FEB 26.

- Note on on-site operation
- Mounting position effects
- Empty and full calibration
- Dry calibration
- Linearisation

Other possible settings, such as damping or locking/unlocking the operation are explained in Chapter 7 "Other Settings".

Note on on-site operation!

Note!

If you carry out configuration via the FHB 20 display module, select the appropriate matrix position for your entry. Refer also to Chapter 4.1 "On-site operation", 4.2 "Operating and display module FHB 20" and 11.1 "Matrix on-site operation". The respective matrix positions are listed in this chapter in brackets, e. g. (V0H0).
You must confirm every parameter entry if you are configuring via the FHB 20 display module. Use the keys "V", "H" or "V" and "H" to confirm your entries. When you confirm with the "V" key, the display automatically goes forward a vertical matrix position, e.g. from V0H0 to V1H0. When you confirm with the "H" key, the display automatically goes forward a horizontal matrix position, e. g.: from V0H0 to V0H1. Confirm your entry by pressing the "V" and "H" keys simultaneously – the matrix position V0H0 is automatically displayed.
You have a choice for some parameters. Numbers are assigned to the various options for these parameters. Enter the corresponding number if configuring via the display module. The corresponding numbers are listed in brackets in the "Entry" column in the following tables, e. g. (=1).

5.1 Mounting position effects

Depending on the orientation of the device, there may be a slight shift in the measured value. This means that if the container is empty, the on-site display does not display zero but rather a very slight pressure. Please refer also to Chapter 10 "Technical data", "Position when calibrating". To correct the reading, enter the pressure difference for the "Position factor" parameter (V3H7). The "Sensor pressure" parameter (V3H6) displays the pressure currently measured.

#	Parameter	Entry	Significance
1	Reset parameter to factory setting if required please refer to Chapter 8.2 also. **Please note that a customer-specific calibration carried out by the factory is also reset to the default values during a reset!**		
	Reset (V9H5)	333 or 7864	Reset parameter
2	Measured value (V0H0) display in calibration mode "Pressure" (V3H0) = = Sensor pressure (V3H6) display = position-dependent pressure = 2.0 mbar		
3	Read off currently measured pressure in "Sensor pressure" (V3H6). The current pressure unit is indicated by the "Pressure unit" parameter (V3H4).		
	Sensor presssure (V3H6)	–	Read off value e. g. 2 (mbar)
4	Corrected pressure (V3H7)	2 (mbar)	Correct display value

Result:
- The pressure value entered for the "Position factor" parameter (V3H7) is subtracted from the "Sensor pressure" (V3H6) currently measured.
- The "Corrected pressure" parameter (V0H8) displays the corrected pressure value.

5.2 Empty and full calibration

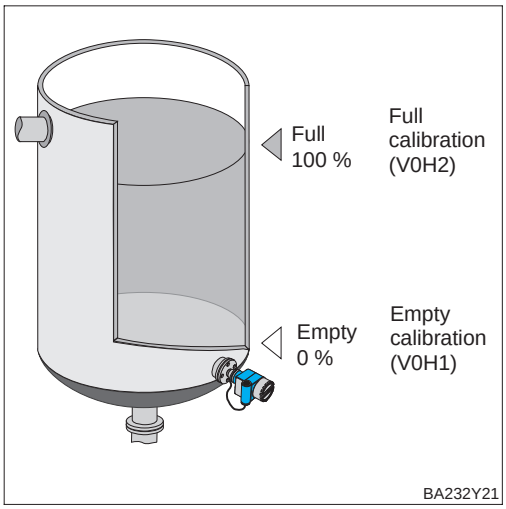
The container is filled or emptied for this calibration. If the container cannot be completely filled or emptied, partial filling or emptying is also possible. The further apart the "empty" and "full" calibration points are, the more exact the measurement result. By entering a value for each of the parameters "Empty calibration" (V0H1) and "Full calibration" (V0H2), you assign a level to the currently measured pressure.
Empty and full calibration can also be carried out in reversed order. In this case, carry out the calibration for the "empty" point first and then for the "full" point.

Calibration mode "Level"

The prerequisites for an empty and full calibration are as follows:

- The Deltapilot S is mounted.
- The container can be filled or emptied.

#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 5.1.		
2	Calibration mode (V3H0)	Level (= 0)	Select calibration mode
3	Unit before linearisation	%	Select unit
4	Fill container to the "empty" level.		
5	Empty calibration (V0H1)	e. g. 0 %	Assign a value for "empty" level to the measured pressure
6	Fill container to the "full" level.		
7	Full calibration (V0H2)	e. g. 100 %	Assign a value for "full" level to the measured pressure



Result:
- The "Measured value" parameter (V0H0) displays the measured value in the unit of calibration – here in % for example.

Selecting unit (Unit before linearisation)

For the "Level" calibration mode, a unit for level, volume or weight can be selected by means of the "Unit before linearisation" parameter. The unit is for display purposes only. This means that if a new unit is selected, the parameters are not converted. You can choose from the units in the following table.

Units for "Unit before linearisation" parameter			
%	m	cm	dm
ft	inch	l	hl
m^3	dm^3	cm^3	ft^3
us gal	Imp gal	kg	t
lb	ton	None	

#	Parameter	Entry	Significance
1	e. g. Measured value (V0H0) = 45 (%)		
2	Unit before linearisation	e. g. hl	Select new unit
3	Measured value (V0H0) = 45 (hl)		

Note!

Note!
The "Unit before linearisation" parameter cannot be selected by means of the display module.

Density correction

If calibration is to take place with water, or if the product changes at a later stage, simply correct your calibration values by entering a density factor.

$$\text{Density factor} = \text{current factor} \times \frac{\text{new density}}{\text{old density}}$$

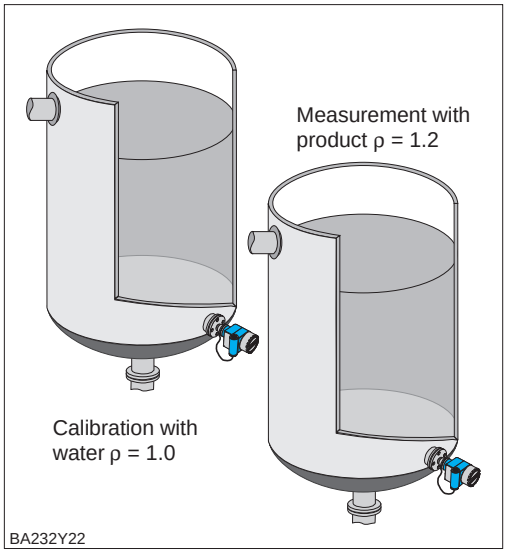
Calculating the density factor

Example: A container is filled with water and calibrated. The density of water (old density) is 1 g/cm^3. The container is used later as a storage tank and is filled with the new fluid to be measured. The new density is 1.2 g/cm^3. The "Density factor" parameter (V3H2) still displays the factory setting "1", i.e. the current factor is 1.

$$\text{Density factor} = 1 \times \frac{1.2\ \text{g/cm}^3}{1\ \text{g/cm}^3} = 1.2$$

#	Parameter	Entry	Significance
1	e. g. Measured value (V0H0) = 75 %		
2	Density factor (V3H2)	e. g. 1.2	Set density factor
3	Measured value (V0H0) = 62.5 %		

Result:
- The "Measured value" parameter (V0H0) displays the measured value adjusted to the new product.



Note!
- The density factor affects the level measurement. Please ensure that you use the new density factor if the product density changes.
- If you change from the "Level" calibration mode to the "Dry calibration" or "Dry calibration [%]" calibration mode, the "Zero offset value" (V3H3) and "Density factor" (V3H2) parameters are reset to the factory setting.


Note!

5.3 Dry calibration

Dry calibration is a theoretical calibration which you can carry out even if the Deltapilot S is not mounted or if the container is empty. The "Empty" calibration point is always at the probe mounting point. The "Empty calibration" parameter (V0H1) is not displayed in the "Dry calibration" and "Dry calibration [%]" calibration modes. The parameter is automatically set to zero. Zero offset must be carried out if measurement is to start at another level.

You have a choice between two dry calibration modes via "Calibration mode" (V3H0):

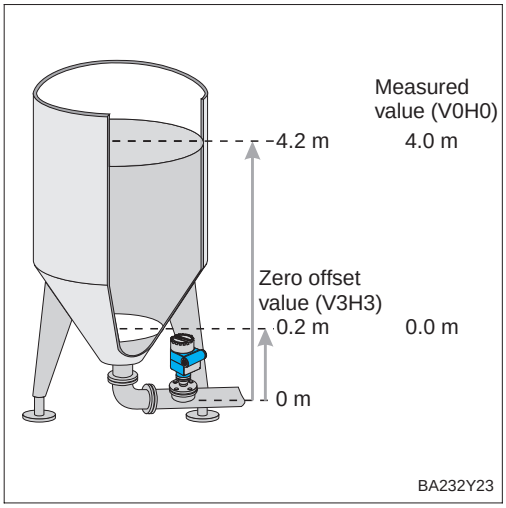
- Dry calibration (= 1): Measured value display in the unit selected
  Select the unit by means of the "Dry calibration unit" parameter (V3H1).
- Dry calibration [%] (= 2): Measured value display in %

Calibration mode "Dry calibration"

The prerequisites for a dry calibration are as follows:

- The density factor is known.
- The pressure for the maximum level should not exceed the high sensor limit (p = ρgh).

#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 5.1.		
2	Calibration mode (V3H0)	Dry calibration (= 1)	Select calibration mode
3	Dry calibration unit (V3H1)	e. g. m (= 0)	Select unit
4	Density factor (V3H2)	e. g. 1.2	Set density factor
5	Zero offset value (V3H3)	e. g. 0.2 m	Set zero offset value



Result:

- The "Measured value" parameter displays the current level at the value corrected by the zero offset, e.g. in meters in this example.

Selecting unit (Dry calibration unit – V3H1)

A unit for level can be selected for the "Dry calibration" calibration mode by means of the "Dry calibration unit" parameter (V3H1). Once a new unit is selected, the parameters, such as the "Measured value", are converted and displayed with the new unit. You can choose from the units in the following table. Enter the corresponding number if configuring via the display module.

No.	Unit	No.	Unit	No.	Unit
0	m	1	cm	2	ft
3	inch				

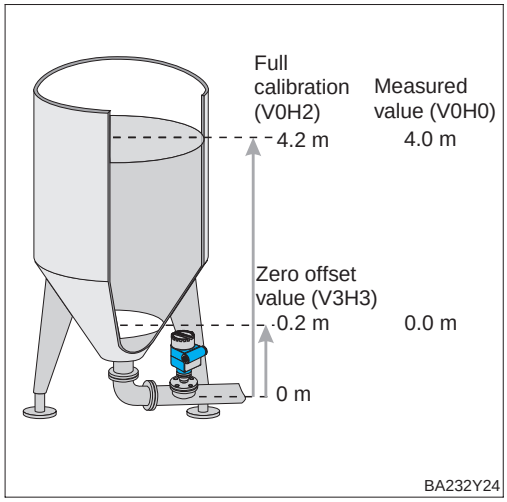
#	Parameter	Entry	Significance
1	e. g. Measured value (V0H0) = 4 (m)		
2	Dry calibration unit (V3H1)	e. g. inch (= 3)	Select new unit
3	Measured value (V0H0) = 157.48 (inch)		

Calibration mode "Dry calibration [%]"

In the "Dry calibration [%]" calibration mode, enter the maximum level value for the "Full calibration" parameter (V0H2). 100% is automatically assigned to this value. The measured value is automatically converted to a %.
Always enter a unit of length for the maximum level for the "Full" calibration point (V0H2) and the "Zero offset value" (V3H3). Select the unit with the "Select unit" parameter (V3H1).

The prerequisites for the dry calibration [%] are as follows:

- The density factor is known.
- The level for the "full" calibration point is known for the "Dry calibration [%]" calibration mode. Any zero offset value is taken into account.
- The pressure for the maximum level should not exceed the high sensor limit ($p = \rho g h$).



#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 5.1.		
2	Calibration mode (V3H0)	Dry calibration [%] (= 2)	Select calibration mode
3	Dry calibration unit (V3H1)	e. g. m (= 0)	Select unit
4	Density factor (V3H2)	e. g. 1.2	Set density factor
5	Zero offset value (V3H3)	e. g. 0.2 m	Set zero offset value
6	Full calibration (V0H2)	e. g. 4.2 m	Assign maximum level value 100%

Result:
- The "Measured value" parameter (V0H0) displays the current level at the value corrected by the zero offset. The measured value is automatically displayed in %.

Note!
After the zero offset, all further entries, e.g. for linearisation as per Chapter 5.4, refer to the adjusted zero point.


Note!

Correction after installation

The first filling of the container should be supervised carefully after a dry calibration so that any possible errors or inaccuracies can be identified immediately. A dry calibration which has been carried out can be applied to the "Level" calibration mode. Any errors or inaccuracies can then be corrected in this calibration mode.

Note!

Note!

- If you change from the "Dry calibration" or "Dry calibration [%]" calibration mode to the "Level" calibration mode, the "Zero offset value" (V3H3)" and "Density factor" parameters (V3H1) are carried over. Pay special attention to both parameters when making corrections in the "Level" calibration mode. For example, if you have carried out a zero offset during the dry calibration, the values for the "empty" (V0H1) and "full" (V0H2) calibration points always refer to the installation site of the sensor.
- If you change from the "Dry calibration [%]" calibration mode to the "Level" calibration mode, the parameters "Empty calibration" (V0H1), "Full calibration" (V0H2) and "Zero offset value" (V3H3) are converted to %. The pressure values assigned to the "Empty calibration" and "Full calibration" parameters are displayed in the "Service data 1 parameter, pressure value at empty calibration" and "Service data 3, pressure value at full calibration".

Example

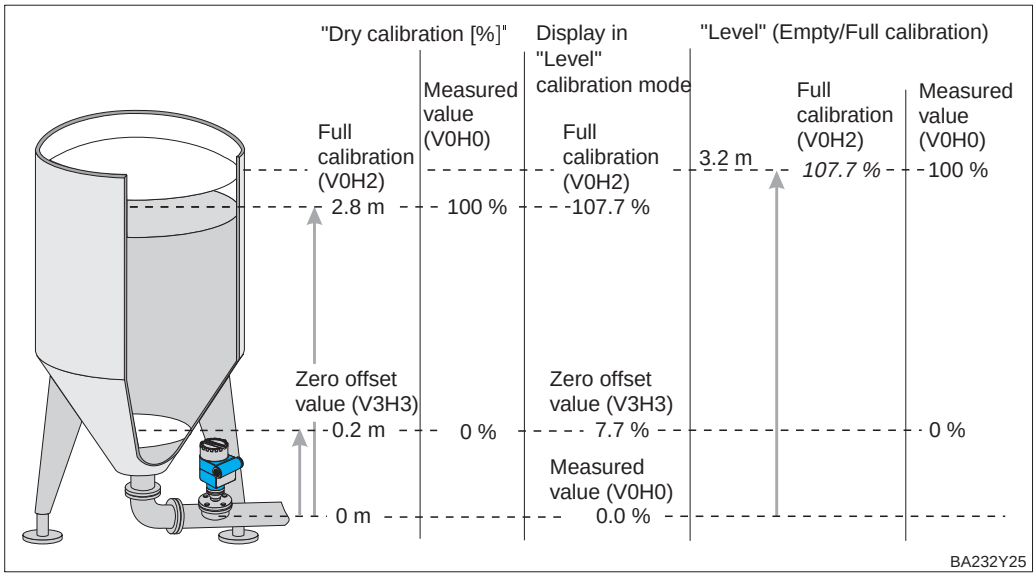
A dry calibration is carried out for level measurement. The actual maximum level is achieved during operation. The value for the "Full" calibration point is corrected in the "Level" calibration mode.

#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 5.1.		
2	Calibration mode (V3H0)	Dry calibration [%] (= 2)	Select calibration mode
3	Dry calibration unit (V3H1)	e. g. m (= 0)	Select unit
4	Zero offset value (V3H3)	e. g. 0.2 m	Set zero offset value
5	Full calibration (V0H2)	e. g. 2.8 m	Assign maximum level value 100%

#	Parameter	Entry	Significance
6	Calibration mode (V3H0)	Level (= 0)	Change calibration mode
	Display in "Level" calibration mode: – Empty calibration (V0H1) = 0.0% – Full calibration (V0H2) = 107.7% – Zero offset value (V3H3) = 7.7%		
7	The container is filled to the maximum level e. g. 3.2 m, for example.		
8	Full calibration (V0H2)	e. g. 107.7 %	Assign a value for "full" level to the measured pressure

Result:

- The "Measured value" parameter (V0H0) now displays the corrected level.



5.4 Linearisation

Linearisation mode

Linearisation makes volume or weight measurement possible in containers with a conical outlet, for example, in which the volume or weight is not directly proportional to the level. The table provides an overview of the linearisation functions which are available for the "Level", "Dry calibration" and "Dry calibration [%]" calibration modes. Enter the corresponding number if configuring via the display module.

Entry (V2H0)	Linearisation mode (V2H0)	Significance
0	linear (factory setting)	The container is linear, e. g. vertical cylindrical tank. If calibration was carried out in a volume unit, the measured value can be read off in the volume unit without any further input.
1	Activate table	A linearisation table entered does not come into effect until it is activated.
2	Manual	The container must neither be filled nor emptied for manual mode. A max. of 11 value pairs made up of a level and the corresponding volume or weight are entered for a linearisation curve.
3	Semiautomatic	The tank is gradually filled or emptied in semiautomatic mode. The Deltapilot S automatically records the level via the hydrostatic pressure; the associated volume is entered.
4	Clear table	Any tables which may exist must be cleared before entering a linearisation table. In doing so, the linearisation mode automatically switches to linear.

Warnings

While entering a linearisation table, the "Diagnostic code" parameter (V9H0) and the display module display the error code "E605".

Code	Type	Significance
E605	Error	The manual linearisation curve is incomplete. The error message disappears once the linearisation curve is activated.

Once activated, the plausibility of the linearisation curve is checked.
The following warnings can occur:

Code	Type	Significance
E602	Warning	The linearisation curve does not increase monotonically. The "Table no." parameter (V2H1) indicates the number of the last valid value pair. It may be necessary to re-enter all value pairs starting from this number.
E604	Warning	The linearisation curve comprises less than two value pairs. Add another value pair.

Prerequisites

The prerequisites for a manual and semiautomatic linearisation are as follows:

- Basic calibration, empty, full or dry calibration, was carried out.
- The value pairs for the points of the linearisation curve are known, min.: 2 value pairs, max.: 11 value pairs.
- The linearisation curve must be monotonic ascending.
- To achieve a more exact measurement result, the levels for the first and last point of the linearisation curve should correspond to the minimum and maximum level.
- The parameter by means of which you select the unit for the parameters "Input level mode" (V2H2) or "Input level half automatic" (V2H2), is dependent on the calibration mode. Please refer also to this chapter, Section "Units".

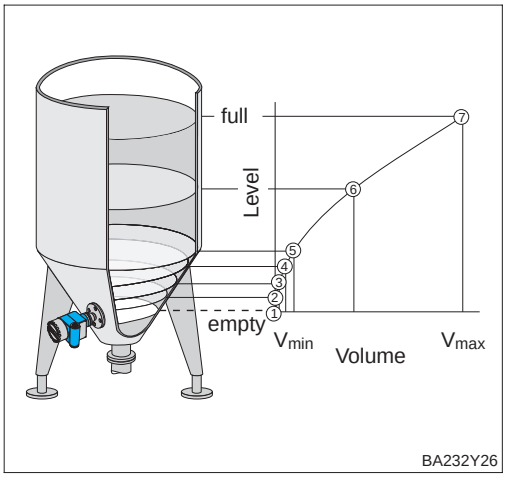
Note!

Note!

- If you have carried out a zero offset, all further entries refer to the adjusted zero point.

Linearisation mode "Manual"

#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 5.1.		
2	Carry out calibration as per Chapter 5.2 or 5.3.		
3	Linearisation (V2H0)	Clear table (= 4)	Clear existing curve
4	Linearisation (V2H0)	Manual (= 2)	Select linearisation mode
5	Unit after linearisation (VAH3)	e. g. hl	Select unit
6	Table no. (V2H1)	e. g. 1	1st value pair
7	Input level manual (V2H2)	e. g. 0	Level point 1
8	Input volume (V2H3)	e. g. 0.6 (hl)	Volume point 1
9	Repeat steps 6...8, min.: 2 value pairs, max.: 11 value pairs		
10	Linearisation (V2H0)	Activate table (= 1)	Activate table



Result:

- The "Measured value" parameter (V0H0) displays the current volume, e.g. in hectolitres in this example.
- The "Measured level" parameter (V0H9) displays the current level.

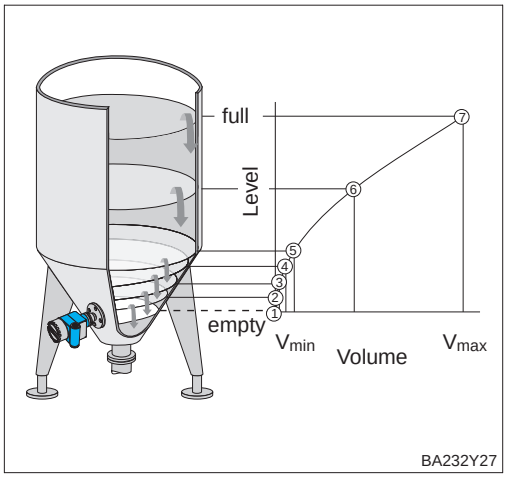
Linearisation mode "Semi-automatic"

The container can, for example, be filled during calibration and emptied gradually during linearisation. The level is automatically calculated via the hydrostatic pressure. You must enter the associated volume or weight.

Note!
- If you empty the container and then enter the linearisation curve, start with the highest value pair. See table below, steps 6…8.
- Entering a table in the transducer block can only be performed in the OOS mode, see chapter 3.5.
- When entering a linearisation table via a configuration program, please observe the following: In order that the correct value pairs are saved in the linearisation table, prior to entering the volume value the "Input level manual" and "Input level half automatic" parameters must show the same value.

Note!

#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 5.1.		
2	Carry out calibration as per Chapter 5.2 or 5.3.		
3	Linearisation (V2H0)	Clear table (= 4)	Clear existing curve
4	Linearisation (V2H0)	Semi-automatic (= 3)	Select linearisation mode
5	Unit after linearisation (VAH3)	e. g. hl	Select unit
6	Table no. (V2H1)	e. g. 7	7th value pair
7	Input level half automatic (V2H2)	Read value (see "Note" above)	Current level
8	Input volume (V2H3)	e. g. 0.6 (hl)	Enter volume for point 7
9	Repeat steps 6...8, min.: 2 value pairs, max.: 11 value pairs		
10	Linearisation (V2H0)	Activate table (= 1)	Activate table



Result:
- The "Measured value" parameter (V0H0) displays the current volume or weight.
- The "Measured level" parameter (V0H9) displays the current level.

Units

The parameter by means of which you select the unit for the "Input level mode" (V2H2) and "Input level half automatic" (V2H2) parameters, is dependent on the calibration mode. In the "Level" calibration mode, the parameters are not converted when a new unit is selected.
Always select the unit for the "Input volume" (V2H3) and "Measured value" (V0H0) parameters by means of the "Unit after linearisation" parameter. The parameters are not converted if a new unit is selected.

The following table shows the assignment of the calibration mode and the choice of unit:

	Calibration mode (V3H0)		
	Level	**Dry calibration**	**Dry calibration [%]**
Select unit for – basic calibration as per Chapter 5.2 or 5.3 – Input level manual (V2H2) – Input level half autom. (V2H2)	Unit before linearisation	Dry calibration unit	automatisch in %
Convert parameter mentioned above if unit is changed.	no	yes	–
Select unit for – Input volume (V2H3) – Measured value (V0H0)	Unit after linearisation	Unit after linearisation	Unit after linearisation
Convert parameter mentioned above if unit is changed.	no	no	no

Selecting unit (Unit after linearisation)

The following units are available by means of the "Unit after linearisation" parameter:

Units for "Unit after linearisation" parameter			
%	m	cm	dm
ft	inch	l	hl
m^3	dm^3	cm^3	ft^3
us gal	Imp gal	kg	t
lb	ton	None	

Note!

Note!
The "Unit after linearisation" parameter cannot be selected by means of the display module.

6 Pressure and Differential Pressure Measurement

In the "Pressure" calibration mode, the on-site display and the "Measured value" parameter (V0H0) display the measured pressure value. The measuring range corresponds to the data on the nameplate.
Using two Deltapilot S units, you can, for example, measure the differential pressure in a pressurised tank. This chapter contains the following information:

- Note on on-site operation
- Mounting position effects
- Pressure measurement
- Differential pressure measurement

Other possible settings, such as damping or locking/unlocking the operation are explained in Chapter 7 "Other Settings".

Note on on-site operation!

Note!

If you carry out configuration via the FHB 20 display module, select the appropriate matrix position for your entry. Refer also to Chapter 4.1 "On-site operation", 4.2 "Operating and display module FHB 20" and 11.1 "Matrix on-site operation". The respective matrix positions are listed in this chapter in brackets, e. g. (V0H0).
You must confirm every parameter entry if you are configuring via the FHB 20 display module. Use the keys "V", "H" or "V" and "H" to confirm your entries. When you confirm with the "V" key, the display automatically goes forward a vertical matrix position, e.g. from V0H0 to V1H0. When you confirm with the "H" key, the display automatically goes forward a horizontal matrix position, e. g.: from V0H0 to V0H1. Confirm your entry by pressing the "V" and "H" keys simultaneously – the matrix position V0H0 is automatically displayed.
You have a choice for some parameters. Numbers are assigned to the various options for these parameters. Enter the corresponding number if configuring via the display module. The corresponding numbers are listed in brackets in the "Entry" column in the following tables, e. g. (=1).

6.1 Mounting position effects

Depending on the orientation of the device, there may be a slight shift in the measured value. This means that if the container is empty, the on-site display does not display zero but rather a very slight pressure. Please refer also to Chapter 10 "Technical data", "Position when calibrating". To correct the reading, enter the pressure difference for the "Position factor" parameter (V3H7). The "Sensor pressure" parameter (V3H6) displays the pressure currently measured.

#	Parameter	Entry	Significance
1	Reset parameter to factory setting if required please refer to Chapter 8.2 also. **Please note that a customer-specific calibration carried out by the factory is also reset to the default values during a reset!**		
	Reset (V9H5)	333 or 7864	Reset parameter
2	Measured value (V0H0) display in calibration mode "Pressure" (V3H0) = = Sensor pressure (V3H6) display = position-dependent pressure = 2.0 mbar		
3	Read off currently measured pressure in "Sensor pressure" (V3H6). The current pressure unit is indicated by the "Pressure unit" parameter (V3H4).		
	Sensor pressure (V3H6)	–	Read off value e. g. 2 (mbar)
4	Corrected pressure (V3H7)	2 (mbar)	Correct display value

Result:

- The pressure value entered for the "Position factor" parameter (V3H7) is subtracted from the "Sensor pressure" (V3H6) currently measured.
- The "Corrected pressure" parameter (V0H8) displays the corrected pressure value.

6.2 Pressure measurement

In this calibration mode, the measured pressure is output directly as "Measured value" (V0H0). Select the pressure unit by means of the "Pressure unit" parameter (V3H4).

#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 6.1.		
2	Calibration mode (V3H0)	Pressure (= 3)	Select calibration mode
3	Pressure unit (V3H4)	e. g. mbar (= 0)	Select pressure unit (see table below)

Result:
- The "Measured value" parameter (V0H0) displays the current pressure measured value in the pressure unit selected, e.g. here in mbar.

Selecting the pressure unit

You can select another pressure unit by means of the "Pressure unit" parameter (V3H4). If a new pressure unit is selected in V3H4, all pressure-specific parameters are converted and displayed with the new pressure unit in FF-Konfiguration tool. You do not have to recalibrate. You can choose from the pressure units in the table below. Enter the corresponding number if configuring via the display module.

#	VH	Entry	Significance
1	ll pressure-specific parameters are displayed in the pressure unit mbar. e. g. Measured value (V0H0) = 100 mbar		
2	V3H4	psi (= 4)	Select new pressure unit
3	All pressure-specific parameters are displayed in the pressure unit psi. Measured value (V0H0) = 1.45 psi		

No.	Unit	No.	Unit	No.	Unit
0	mbar	1	bar	2	m H_2O
3	mm H_2O	4	psi	5	ft H_2O
6	in H_2O	7	Pa	8	MPa
9	hPa	10	mm Hg	11	in Hg
12	g / cm^2	13	kg / cm2	14	lb / ft^2
15	kgf / cm^2				

6.3 Differential pressure measurement

Using two Deltapilot S units, you can, for example, measure the differential pressure in a pressurised tank. The pressure measured values of the two probes are sent e. g. to a DCS (Distributed Control System). The DCS calculates the pressure difference and, if necessary, calculates the level or the density from this.

Example

Sample measurement in a pressurised tank:

- Probe ① measures the total pressure (hydrostatic pressure and head pressure).
- Probe ② only measures the head pressure.

Note!

Note!
- The measuring cells of the two probes must be suitable for the measuring task.
- The measuring diaphragm of probe ② must not be flooded. This creates an additional hydrostatic pressure which makes the measurement incorrect.
- The ratio of hydrostatic pressure to head pressure should be max. 1:6.
- The pressure units selected and the scaling of the OUT Value for both probes must match. Please refer to Chapter 6.2 "Selecting pressure unit" and Chapter 3.8, "Scaling" section.

#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 6.1.		
2	Calibration mode (V3H0)	Pressure (= 3)	Select calibration mode
3	Pressure unit (V3H4)	e. g. mbar (= 0)	Select pressure unit (see Table page 57)
4	Scale OUT Value, see Chapter 3.8		
5	Calibrate probe 2 as per steps 1-4.		

Result:
- The DCS calculates the pressure difference from the total pressure and head pressure. If necessary, the level and density can also be calculated.
- The "Measured value" parameters (V0H0) and on-site displays both display the measured pressure.
  Deltapilot ①: hydrostatic pressure and head pressure;
  Deltapilot ②: head pressure

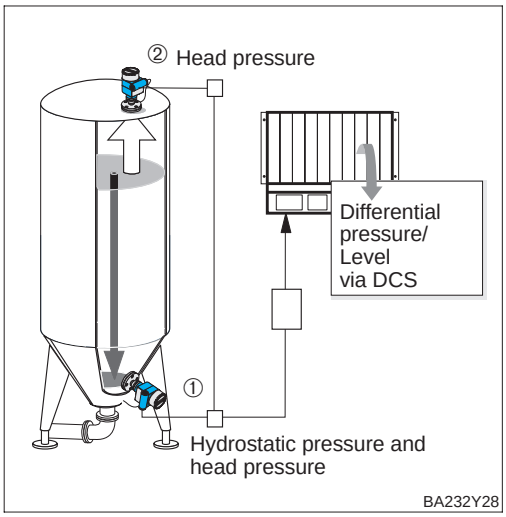


Figure 6.1
Example: measurement in a pressurised tank

7 Other Settings

This chapter describes additional possible settings for a Deltapilot S with electronic insert FEB 26.

- Note on on-site operation
- Output damping (Integration time τ)
- Safety alarm
- Simulation
- Operation locking/unlocking
- Measuring point information

Note on on-site operation!

Note!

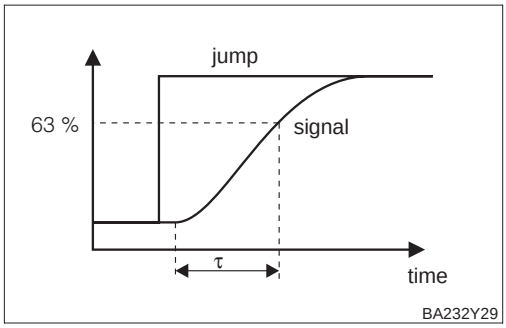
If you carry out configuration via the FHB 20 display module, select the appropriate matrix position for your entry. Refer also to Chapter 4.1 "On-site operation", 4.2 "Operating and display module FHB 20" and 11.1 "Matrix on-site operation". The respective matrix positions are listed in this chapter in brackets, e. g. (V0H0).
You must confirm every parameter entry if you are configuring via the FHB 20 display module. Use the keys "V", "H" or "V" and "H" to confirm your entries. When you confirm with the "V" key, the display automatically goes forward a vertical matrix position, e.g. from V0H0 to V1H0. When you confirm with the "H" key, the display automatically goes forward a horizontal matrix position, e. g.: from V0H0 to V0H1. Confirm your entry by pressing the "V" and "H" keys simultaneously – the matrix position V0H0 is automatically displayed.
You have a choice for some parameters. Numbers are assigned to the various options for these parameters. Enter the corresponding number if configuring via the display module. The corresponding numbers are listed in brackets in the "Entry" column in the following tables, e. g. (=1).

7.1 Damping

Output damping (Integration time τ)

The output damping affects the speed at which the on-site display and the "Measured value" (V0H0), "Corrected pressure" (V0H8) and "Measured level" (V0H9) displays react to changes in the level. By increasing the output damping, the influence of agitated fluid surfaces on the measured value display and the maximum indicator function, for example, can be attenuated.

#	Parameter	Entry	Significance
1	Output damping (V0H4)	e. g. 30 (s)	Integration time (0...99 s)



Note!

Note!

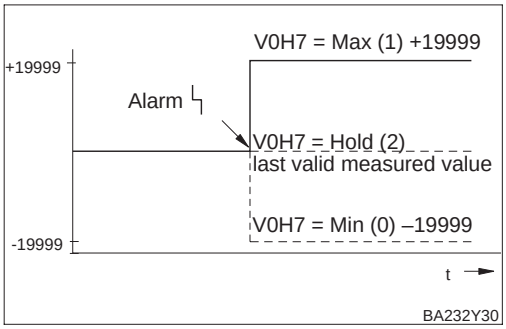
For the Analog Input Block and the PID Block, the FF Parameter PV_FTIME is available in each case. You can use the parameter to set additional damping. See also Chapters 3.8 and 3.9.

7.2 Safety alarm

Safety alarm

In the event of a fault, an error code is transmitted with the measured value. The display adopts the value you selected. This parameter can only be accessed via the on-site operation. Refer to Chapter 8.1 for a description of the error codes.

#	Parameter	Entry	Significance
1	Safety alarm (V0H7)	e. g. Min (0)	Safety alarm Min (0) = –19999 Max (1) = +19999 Hold (2) = last valid measured value



Note!

Note!

The "Safety alarm" parameter (V0H7) only affects the on-site display and the "Measured value" parameter (V0H0). With the output value of the Analog Input Block and the PID Block, a status is transferred simultaneously. In the case of a device fault, the status changes to BAD. Please refer to the Foundation Fieldbus specification for further information.

7.3 Simulation value

Simulation gives you the possibility of checking your calibration and simulating a measured value. You have the following options:

- Pressure simulation
- Level simulation
- Volume simulation

The simulation modes "Level" and "Volume" are not available for the "Pressure" calibration mode (V3H0).

When operating by means of the display module, select the simulation mode by entering the corresponding number.

No.	Mode	No.	Mode	No.	Mode
0	Off	1	–	2	Pressure
3	Level	4	Volume		

Note!
- As soon as you activated the simulation, the error message signal flashes on the display and the "Diagnostic code" parameter (V9H0) displays the warning W 613. This status remains for the duration of the simulation.
- To return to standard operation, you must deactivate the simulation by means of the "Simulation" parameter (V9H6) = Off.
- The device automatically returns to normal operation after an interruption in power supply, after a reset or after a change in calibration mode.

Note!

Pressure simulation

A pressure measured value is simulated in this simulation mode. The corrected pressure (V0H8) is always simulated. Depending on the calibration and linearisation mode, the "Measured value" parameter (V0H0) displays a value for pressure, level or volume. Select the unit for the simulation value by means of the "Pressure unit" parameter (V3H4). The value entered must lie between the low and high sensor limit (see "Low sensor limit" and "High sensor limit" parameters).

#	Parameter	Entry	Significance
1	Simulation (V9H6)	Pressure (= 2)	Select simulation mode
2	Pressure unit (V3H4)	mbar (= 0)	Select unit
3	Simulation value (V9H7)	e. g. 40 mbar	Set simulation value

Result:
- In the "Pressure" calibration mode, the "Measured value" (V0H0) displays the pressure value entered, for example 40 mbar here.

#	Parameter	Entry	Significance
1	If necessary, correct reading due to mounting position effects as per Chapter 5.1 or 6.1.		
2	Calibration mode (V3H0)	Dry calibration (=1)	Select calibration mode
3	Dry calibration unit (V3H1)	e. g. m (= 0)	Select unit
4	Density factor (V3H2)	e. g. 1.2	Set density factor
5	Simulation (V9H6)	Pressure (= 2)	Select simulation mode
6	Pressure unit	mbar (=0)	Select unit
7	Simulation value	e. g. 40 mbar	Set simulation value

Result:
- In the "Dry calibration" calibration mode, the measured value displays the calculated level value.

Level simulation

A level value is simulated in this simulation mode. The value entered must lie between –19999 and +19999. If you have selected "Linear" linearisation (V2H0), the "Measured value" parameter (V0H0) displays a level value. If you have selected "Activate table" linearisation (V2H0), the "Measured value" parameter (V0H0) displays the matching volume value. In this way you can check the linearisation curve entered, for example.
The units for the "Simulation value" (V9H7) and "Measured value" (V0H0) parameters depend on the calibration mode and linearisation mode selected. In the "Dry calibration" calibration mode, always enter the simulation values in meters.

#	Parameter	Entry	Significance
1	Simulation (V9H6)	Level (= 3)	Select simulation mode
2	Dry calibration unit (V3H1)	e. g. m (=0)	Select unit
3	Simulation value (V9H7)	40 m	Set simulation value

Volume simulation

A volume value is simulated in this simulation mode. The value entered must lie between –19999 and +19999. In this way, the settings for "PV Scale min" and "PV Scale max" are checked, for example.
Select the unit for the simulation value by means of the "Unit after linearisation" parameter. The volume corresponds to the level if no linearisation curve has been entered.

#	Parameter	Entry	Significance
1	Simulation (V9H6)	Volume (=4)	Select simulation mode
2	Unit after linearisation	e. g. hl	Select unit
3	Simulation value (V9H7)	e. g. 40 hl	Set simulation value

Note!

Note!
You have also the option of simulating either the output value and status (Parameter group OUT) or the function of the Analog Input Block. For more information on this, please refer to Chapter 3.8, "Simulation" section.

7.4 Operation locking/unlocking

Once all parameters have been entered, the operation can be locked:

- by means of the keys on the display and operating module FHB 20 or
- by entering a code for the parameter "Unlock parameter" (V9H9). The code number entered can be a number between 0 and 9997 – except the number 333.

In this way, the entries in your measuring point are safeguarded against any unintentional or unauthorised change. The parameter "Unlock parameter" (V9H9) displays "9999" if operation was locked by means of the keys on the on-site operation. In this case, you can only undo the locking by means of the keys on the display module.

#	Parameter	Entry	Significance
Locking operation			
1	Unlock parameter (V9H9)	e. g. 100	Operation locked (except "Unlock parameter" – V9H9)
Unlocking operation			
2	Unlock parameter (V9H9)	333	Operation locked

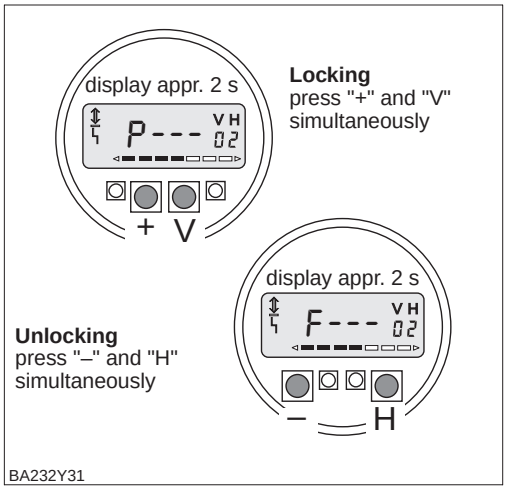


Figure 7.1
Locking and unlocking the matrix using FHB 20

The table provides an overview of the locking functions:

Locking via	Display/reading of parameters	Changing/Writing via		Unlocking via	
		Keys	Communication	Keys	Communication
Keys	yes	no	no	yes	no
Communication	yes	no	no	yes	yes

7.5 Measuring point information

You can call up the following information on the measuring point:

Parameter	Display or Entry
Meßwerte	
Measured value	Measured value: level, volume, weight or pressure
Sensor pressure (V0H8)	Sensor pressure (unit selectable via "Pressure unit" parameter – V3H4)
Measured level (V0H9)	Level before linearisation
Measured temperature (V7H3)	Sensor temperature [1)] (unit selectable via "Temperature unit" parameter – V3H5)
Sensor data	
Low sensor limit (V7H0)	Low sensor limit (units selectable via "Pressure unit" parameter – V3H4)
High sensor limit (V7H1)	High sensor limit (units selectable via "Pressure unit" parameter – V3H4)
Measuring point information	
Instrument and software number (V9H3)	Instrument and software number
Display error codes	
Diagnostic code (V9H0)	Current diagnostic code
Last diagnostic code (V9H1)	Last diagnostic code

1) This value displays the temperature measured value of the internal temperature sensor. The temperature measured value of the internal measuring sensor is used in the measuring sensor is used in the measuring cell for compensation purposes. In other words, this is only a temperature value is close to the process.

Maximum indicator function

The maximum indicator function makes it possible to call up the largest measured value for pressure and temperature at a later stage. The parameters "Reset max. sensor pressure" or "Reset max. temperature" are used to reset the respective maximum value.

Parameter	Display
Max sensor pressure (V7H2)	Max. pressure (units selectable via "Pressure unit" parameter – V3H4)
Reset max sensor pressure	The parameter is used to reset the parameter "Max. sensor pressure" to the currently measured sensor pressure.
Max. temperature (V7H4)	Max. temperature (unit selectable via "Temperature unit" parameter – V3H5)
Reset max. temperature	The parameter is used to reset the parameter "Max. temperature" to the currently measured temperature.

Service data

The following parameters can only be called up and configured via a FF configuration program.

Parameter	Display or selection
Unit before linearisation	Selection of units before linearisation
Unit after linearisation	Selection of units after linearisation
Service data	
Service data 1 [1]	Display pressure at empty calibration
Service data 2 [1]	Display density factor at empty calibration
Service data 3 [2]	Display pressure at full calibration
Service data 4 [2]	Display density factor at full calibration

1) Display only relevant for "Level" calibration mode.
2) Display only relevant for "Level" and "Dry calibration [%]" calibration mode.

8 Diagnosis and Troubleshooting

8.1 Warning and error diagnosis

Errors

If the Deltapilot S detects an error:

- an error code is transmitted with the measured value,
- the error message signal on the on-site display lights up,
- the on-site display and the measured value indicate the selected value for fault message
  (min.: –19999, max.: +19999 or Hold: the last value measured value is retained).
- The current error code can be read off in "Diagnostic code" parameter (V9H0) and the previous error code in "Last diagnostic code" parameter (V9H1).

Warnings

If the Deltapilot S detects a warning:

- an error code is transmitted with the measured value,
- the error message signal on the display or the red LED flashes; the Deltapilot S continues measuring.
- The current error code can be read off in "Diagnostic code" parameter (V9H0) and the previous error code in "Last diagnostic code" parameter (V9H1).

Note!

Note!

- In the case of an error, the status of the output value of the Analog Input Block OUT changes to BAD.
- The FF parameter BLOCK_ERR displays the error messages of the corresponding block. See also Chapters 3.6, 3.7, 3.8 and 3.9, "Block process alarms" section.

Error codes

If several errors occur at the same time, the sequence in which they are displayed corresponds to the priority of the error.

Code	Type	Cause and Remedy	Priority
E 101	Error	Check sum error, sensor EEPROM (DAT module) Error when reading the check sum from the sensor EEPROM. – *Switch off and then switch on supply voltage.* – Faulty DAT module electronic insert connection. *Check connection. Replace DAT module, if necessary.* *Please supply the cell number when ordering.* – Check sum incorrect, transmission error during reading as EMC influences larger than specified, Chapter 10 "Technical Data". *Block off EMC influences.*	4
E 102	Warning	Electronic instrument error in maximum indicator function – *Reset "Max. pressure" (V7H2) and "Max. temperature" (V7H4) parameters by pressing the Enter key.* – *Perform reset, code 333 or code 7864, if necessary.*	17
E 103	Warning	Initialisation active, duration approx. 6 The electronics are initialised when the data are first written to the EEPROM. – *Wait until initialisation is completed.* – *Replace electronic insert if the warning remains for an extended period and after several restarts.*	2
E 106	Error	Download active – *Wait until download is completed.*	9
E 110	Error	Check sum error, electronic insert EEPROM, configuration data not loaded – The power supply is interrupted when writing to the processor. *Reconnect power supply.* – *Perform reset, code 333 or code 7864, if necessary.* – EMC influences greater than specified in Chapter 10, "Technical data". *Block off EMC influences.* – Electronic insert faulty. *Replace electronic insert.*	11

Error codes (continuation)

Code	Type	Cause and Remedy	Priority
E 112	Error	No connection electronic insert sensor EEPROM (DAT module) This fault can only be detected during power-up. The device does not display a fault if the connection is interrupted after power-up. – Faulty DAT module – electronic insert connection. *Check connection DAT module electronic insert.* *Replace DAT module, if necessary. Please supply the cell number when ordering.* – Electronic insert connection faulty. *Replace electronic insert.*	5
E 114	Error	Writing error, electronic insert EEPROM – *Switch off and then switch on supply voltage.* – The electronic insert is faulty if the fault continues to be displayed. *Replace electronic insert.*	1
E 116	Error	Download error (PC → transmitter) – *Perform reset, code 333 or code 7864, if necessary.* – Incorrect data record downloaded, e.g. older software version. Time allowed exceeded due to transmission problems. *Carry out download again.*	10
E 117	Error	Sensor electronics error, temperature signal too small – Sensor electronics faulty. *Replace the measuring cell.* Please refer also to the note on the following page.	8
E 121	Error	Check sum error electronic insert EEPROM, production data – Electronic insert faulty. *Replace electronic insert.*	3
E 122	Error	No connection electronic insert – measuring cell. – DB 50: Faulty electronic insert – measuring cell connection. *Check connection. Replace measuring cell and/or electronic insert, if necessary.* – *DB 51 (pipe version), DB 52 and DB 53 (rope versions):* Faulty electronic insert – measuring cell connection. *Check signal line. Replace pipe or support cable if necessary.* – Electronic insert faulty. *Replace electronic insert.* – Sensor electronics faulty. *Replace the measuring cell.* Please refer also to the note on the following page.	7
E 125	Error	Sensor electronics error, signal exceeded or not achieved. – DB 50: Faulty electronic insert measuring cell connection. *Check connection. Replace measuring cell and/or electronic insert, if necessary.* – DB 51 (pipe version), DB 52 and DB 53 (rope versions): Faulty electronic insert – measuring cell connection. *Check signal line. Replace pipe or support cable if necessary.* – Sensor electronics faulty. *Replace the measuring cell.* – Electronic insert faulty. *Replace electronic insert.* Please refer also to the note on the following page.	6
E 602	Warning	Linearisation curve is not monotone ascending. – Value pairs for the linearisation curve have not been entered correctly. Check plausibility of manual characteristic curve (e. g. does the volume increase with the level?) *If necessary, perform linearisation again or re-enter value pairs, see Chapter 5.4, "Linearisation".*	15
E 604	Warning	The linearisation curve comprises less than 2 value pairs. – *Check manual characteristic curve. If necessary, perform linearisation again or add more value pairs.* *See Chapter 5.4 "Linearisation".*	14
E 605	Error	Linearisation curve editing active. – The "manual" or "semi-automatic" mode is switched on via the "Calibration mode" parameter (V2H0). *Set "Calibration mode" parameter to equal either "Activate table" or "Linear". Activate the linearisation curve by means of the parameter "Calibration mode" = "Activate table".*	16

Error codes (continuation)

Code	Type	Cause and Remedy	Priority
E 610	Error	Calibration error, same pressure value for the "Empty calibration" (V0H1) and "Full calibration" (V0H2) parameters. – *Check calibration, see also "Service data 1" and "Service data 3" parameters (pressure values for "Empty calibration" and "Full calibration"). Perform calibration again.* – *If necessary, perform reset, code 333.*	13
E 613	Warning	Device in simulation operation – *Switch off simulation by means of the "Simulation" parameter (V9H6).*	12
E 620	Warning	This warning message is not relevant for Deltapilot S Foundation Fieldbus devices.	18


Note!

Note!

Changing the measuring cell:

- The Deltapilot S is available with snap (replaceable) and welded measuring cells. To replace a snap measuring cell you require an Endress+Hauser Service Tool, the extractor, Order No.: 015860-0000. Snap measuring cells are ordered as spare parts; please refer also to Chapter 9.4, "Spare parts." Welded measuring cells are ordered with the process connection by means of the product structure, see Endress+Hauser Price List.

Replacing the pipe or support cable:

- DB 51 with snap (replaceable) or welded measuring cell: In these versions, replace the extension pipe with process connection and measuring cell, see Endress+Hauser Price List.
- DB 52/DB 53, snap measuring cell: In these versions, replace the support cable with process connection and measuring cell pipe, see Chapter 9.4, "Spare parts."
- DB 52/DB 53, welded measuring cell: In these versions, replace the support cable with process connection, measuring cell pipe and measuring cell, see Endress+Hauser Price List.

8.2 Reset

By entering a certain code, you can completely, or partially, reset the entries in the manufacturer´s-specific parameters in the Transducer Block to the factory setting. Please note, any customer-specific configuration carried out by the factory is reset to the default values in the event of a reset!

#	Parameter	Entry	Significance
1	Reset (V9H5)	e. g. 333	Reset parameters partially

The Deltapilot S differentiates between two reset codes with different effects. Please refer to the following table for information as to which parameters are reset to the factory setting by the reset codes 7864 or 333.


Note!

Note!

Operation must be unlocked before carrying out a reset. To unlock the operation, enter the codes "2457" or "333" for the parameter "Unlock parameter (V9H9). The operation has been locked by means of the display module if the "Unlock parameter" (V9H9) displays "9999". In this case, undo the locking by means of the "–" and "H" keys on the display module. Please refer to Chapter 7.4 also.

Parameter	Reset code 7864	Reset code 333
Measured value (V0H0)		
Empty calibration (V0H1)	0.0 % [1]	0.0
Full calibration (V0H2)	0.0 % [1]	0.0
Output damping (V0H4)	0	0
Safety alarm (V0H7)	Max. (=1) [2]	Max. (=1) [2]
Corrected pressure (V0H8)	= Sensor pressure	= Sensor pressure
Measured level (V0H9)		
Linearisation (V2H0)	Linear [%]	Linear [%]
Table no. (V2H1)	1	[3]
Input level half automatic (V2H2)	0	[3]
Input level manual (V2H2)	0	[3]
Input volume (V2H3)	0	[3]
Calibration mode (V3H0)	Linear [%]	Linear [%]
Dry calibration unit (V3H1)	m [4]	
Density factor (V3H2)	1.0	1.0
Zero offset factor (V3H3)	0.0 %	0.0
Pressure unit (V3H4)	mbar	
Temperature unit (V3H5)	°C	
Sensor pressure (V3H6)		
Position factor (V3H7)	0.0 mbar [5]	0.0

Parameter	Reset code 7864	Reset code 333
Low sensor limit (V7H0)		
High sensor limit (V7H1)		
Max. sensor pressure (V7H2)		
Measured temperature (V7H3)		
Max. temperature (V7H4)		
Diagnostic code (V9H0)		
Last diagnostic code (V9H1)	0	0
Instrument and software number (V9H3)		
Reset (V9H5)		
Simulation (V9H6)	Off	Off
Simulation value (V9H7)		
Unlock parameter (V9H9)		
Unit before linearisation	%	
Unit after linearisation	%	
Service Data 1	1.0	1.0
Service Data 2	= Low sensor limit	= Low sensor limit
Service Data 3	1.0	1.0
Service Data 4	= High sensor limit	= High sensor limit

1) The values are reset to the factory settings after a "333" reset. The unit selected remains. Select the unit for these parameters by means of the "Unit before linearisation" parameter
2) This parameter is onlay available via the on-site operation.
3) After a "333" reset, the calibration mode is "Level" and the linearisation "Linear". The linearisation table is not cleared.
4) This parameter is only reset after a change from the calibration mode "Linear [%]" to the calibration mode "Dry calibration".
5) The value is reset to the factory setting after a "333" reset. The unit selected remains. Select the unit for this parameter by means of the "Pressure unit" parameter (V3H4).

9 Maintenance and Repair

9.1 Maintenance

In general, no special maintenance is required on the Deltapilot S.

Cleaning

In general, the measuring probe must neither be cleaned nor cleared of material build-up. Build-up has no effect on the measurement result as long as it is porous and does not present a mechanical load on the diaphragm of the pressure measuring cell.

Note!

Note!
Maintenance during cleaning processes with strong temperature deviations, measuring errors may occur over a short period.

Please note the following when cleaning the device:

- The cleaning agent used should not corrode the surfaces and seals.
- Avoid mechanical damage to the diaphragm or the pipe or supporting cable.

9.2 Repair

The Endress+Hauser repairs concept provides for measuring devices to have a modular design and the customer may carry out repairs.

Note!

Note!
- For certified devices, please consult Chapter 9.3 "Repair of certified devices".
- For more information on service and spare parts contact the Endress+Hauser Service.

9.3 Repair of certified devices

Warnung!

Warning!
When repairing certified devices, please note the following:

- Only specialist personnel or Endress+Hauser Service may undertake repairs of certified devices.
- Relevant standards, national hazardous area regulations and Safety Instructions (XA…) and Certificates must be observed.
- Only genuine Endress+Hauser spare parts may be used.
- When ordering spare parts, please check the device designation on the nameplate. Identical parts may only be used as replacements.
- Electronic inserts or measuring cells already in use in a standard instrument may not be used as spare parts for a certified device.
- Carry out repairs according to the instructions. After repairs, the device must fulfil the requirements of the specified tests.
- A certified device may only be converted into another certified variant by Endress+Hauser Service.
- All repairs and modifications must be documented.

Note!

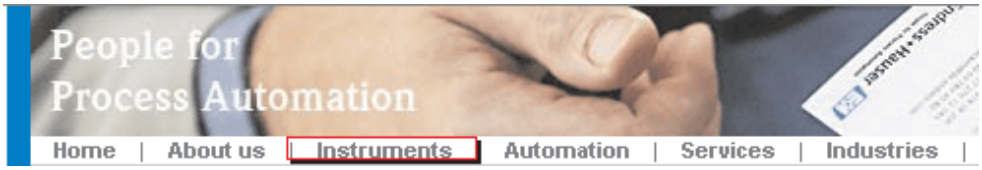
Note!
For more information on service and spare parts contact the Endress+Hauser Service

9.4 Spare parts

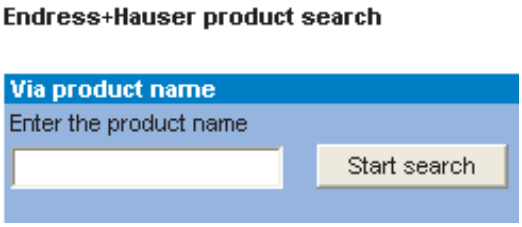
An overview of the spare parts for your device is available in the internet at www.endress.com. To obtain information on the spare parts, proceed as follows:

1. Go to "www.endress.com" and select your country.

2. Click "Instruments".

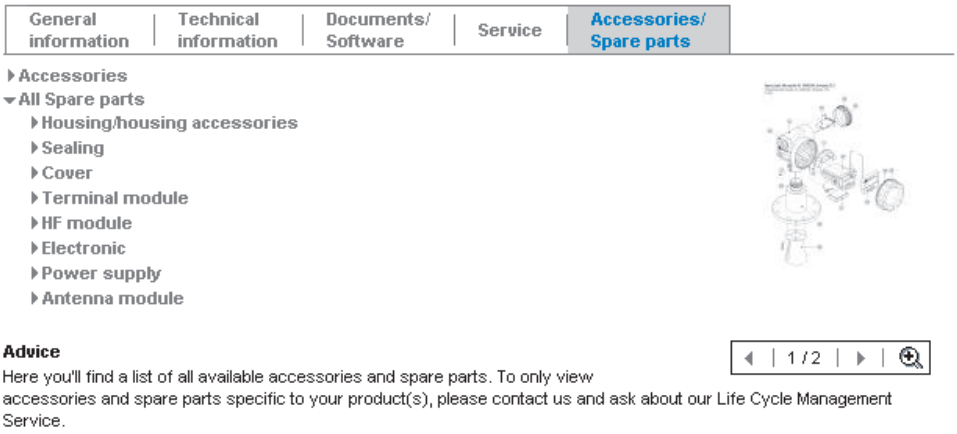


3. Enter the product name into the "product name" field.



4. Select the device.

5. Click the "Accessories/Spare parts" tab



6. Select the required spare parts (You may also use the overview drawing on the right side of the screen.)

When ordering spare parts, always quote the serial number indicated on the nameplate. As far as necessary, the spare parts also include replacement instructions.

9.5 Returning the device

Before you send in a device for repairs or checking:

- Remove all signs of fluids, paying particular attention to seal grooves and gaps in which fluid can become lodged. This is especially important if the fluid is hazardous to health. Please refer also to the "Declaration of Contamination", Page 87.

Please enclose the following when returning the device:

- Please fill out completely and sign the "Declaration of Contamination", see Page 87.
  It is only then possible for Endress+Hauser to inspect or repair the returned device.
- The chemical and physical properties of the fluid.
- A description of the application.
- A description of the error which occurred.
- Special instructions on handling, if necessary, e.g. a safety data sheet as per EN 91/155/EEC.


Caution!

Caution!
With regard to devices with certificates of conformity or design approval, the entire device must be returned when in need of repair.

10 Technical Data

General Information

Manufacturer	Endress+Hauser
Designation	Deltapilot S with electronic insert FEB 26 (Foundation Fieldbus)
Technical Documentation	TI257P/00/en

Input

Measured variables	Level using hydrostatic pressure of a column of liquid
Measuring range	

Measuring range [mbar]	Overload bar]	Vacuum resistance [mbar]
0…100	8	–100
0…400	8	–400
0…1200	24	–900
0…4000	24	–900
–100…100	8	–100
–400…400	8	–400
–900…1200	24	–900
–900...4000	24	–900
–9...10	40	–0.9

Output

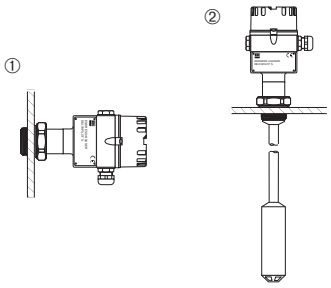
Output signal	Digital communication signal Foundation Fieldbus
Transmission rate	31.25 kByte/s
Signal on alarm	– Foundation Fieldbus: Status bit set – On-site display: optional –19999, +19999 or HOLD (last valid measured value), see also Chapter 7.2
Damping (Integration time)	0…99 s configurable via the FHB2 display and operating module, PC with operating program or handheld terminal, factory setting: 0 s
Physical layer	IEC 61158-2

Measuring accuracy

Reference conditions	According to DIN 16086, calibration temperatur: 25°C (77°F)
Linearity (to terminal-based method)	± 0.2% of set measuring range optional: ± 0.1% of set measuring range
Hysteresis	± 0,1% of full scale
Long-term drift	± 0,1% of full scale per 6 month
Influence of ambient temperature	± 0,1%/10 K of full scale
Influence of medium temperature	± 0,1%/10 K of full scale

Operation conditions

Installation conditions

Calibration conditions ① DB 50 (A), DB 50 L, DB 50 S ② DB 51 (A), DB 52 (A), DB 53 (A)	
Orientation	– DB 50 (A), DB 50 L, DB 50 S: always below the lowest measuring point – DB 51 (A), DB 52 (A), DB 53 (A): installation from above, see also Chapter 1.1 For further information see Chapter 2.1. Orientation-dependent measuring errors can be completely corrected, see also Chapter 5.1.

Ambient conditions

Ambient temperature range	–20…+60°C (–4 to +14°F) with separate electronics: –20...+85°C (–4 to +185°F) For devices for use in hazardous areas, see Safety Instructions (XAs), Installation or Control Drawing (ZDs)..
Ambient temperature limits	–40…85°C (–4 to +185°C) The device can be operated in this temperature range. When commissioning the device, the temperature cannot go below –20°C (–4°F). The values of the specification such as accuracy can be overshot here.
Storage temperature range	–40…+85°C (–40 to +185°F)
Climatic class	D to DIN IEC 654-1
Ingress protection	Housing: IP 66/NEMA 4X Housing adapter: IP 68 (1 mH_2O for 24 h)
Shock resistance	to DIN IEC 68-2-6
Vibrational resistance	10…55 Hz, 2 g, to DIN IEC 68-2-6
Electromagnetic compatibility	Interference emission to EN 61326, Equipment Class B Interference immunity to EN 61326, Appendix A (industrial usage) and NAMUR recommendation EMC (NE21)

Process conditions

Medium temperature range	– DB 50 (A), DB 50 L, DB 50 S: –10…+100°C (+14...+212°F) – DB 51 (A), DB 52 (A) and DB 53 (A) with rope insulation FEP: –10…+80°C (+14...176°C) – DB 53 (A) with rope insulation PE: –10…+70°C (+14...158°F) For devices approved for use in hazardous areas, see Certificate, Safety Instructions (XA...), Installation Drawing (CSA) or Control Drawing (FM).
Cleaning temperature	Only DB 50 L, DB 50 S: +135°C (+275°F) for max. 30 min
Medium pressure limits (permissible pressure range)	See table "Measuring range", Page 73

Construction

Design

Dimensions	Sew Technical Information TI257P and Page 76
Process connection	– DB 50 (A), DB 51 (A), DB 52 (A): several customary flanges and threads available – DB 50 L, DB 50 S: several sanitary connections available For further information see Technical Information TI257P.

Construction (Continuation)

Materials

Housing	– Aluminium housing (housing type F6): Material: GD-Al Si 10 Mg, with plastic coating (blue/grey) Sealing for housing cover: O-ring in EPDM – Stainless steel housing (housing type F8): Material: Stainless steel AISI 316 L (DIN 1.4404), Sealing for housing cover: profiled O-ring in silicone VMQ – Polyester housing (housing type F 10) Material: Glass fibre reinforced polyester blue/grey (PBT) Sealing for housing cover: O-Ring in silicone
Elektronic insert	Housing plastic ABS, potted electronic insert
Process connections	Thread and flange versions*) and all sanitary connection in stainless steel 1.4435 (AISI 316L) or Hastelloy C4 (2.4610)
Probe tube DB51	1.4435 (AISI 316L) or Hastelloy C4 (2.4610)
Measuring cell tube DB51/52/53	1.4435 (AISI 316L) or Hastelloy C4 (2.4610)/C22 (2.4602)
Extension cable DB52, DB53	Multi-core cable with steel wire braiding, insulation FEP (max. 80°C/176°F) or PE (max. 70°C/158°F)
*) DIN/EN-Flange: Endress+Hauser supplies DIN/EN flanges made of stainless steel AISI 316L as per material numbers 1.4435 or 1.4404. With regard to their stability-temperature property, the materials 1.4435 and 1.4404 are grouped together under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.	

Seals	– DB 50 (A), DB 51 (A), DB 52 (A), DB 53 (A): Measuring cell seal optional Viton, EPDM, Kalrez or measuring cell welded on (elastomer-free) – DB 50 L, DB 50 S: Measuring cell seal welded on or silicone profiled seal for universal process adapter, suitable for foodstuffs as per BGA XV and FDA 177.2600 Seal welding flange DB 50 L, DB 50 S: PTFE
Process membrane	Hastelloy C276 (2.4819)
Protective cover for diaphragm	DB 51 (A), DB 52 (A), DB 53 (A): plastic PFA (Perflouralkoxy)
Attachment accessories	– For DB 50 (A), DB 51 (A), DB 52 (A): Housing adapter with mounting bracket – For DB 53 (A): Mounting clamp, galvanised steel with plastic jaws

Display- and operating interface

Display and operating module FHB 20 (optional)	Plug-in display module with digital display and bar graph and four keys for operation
On-site operation	Via four taste –, +, V, H on the display and operating module FHB 20
Remote operation	Foundation Fieldbus H1: – PC operation with configuration program by means of interface card H1 – PC operation with configuration program by means of interface card Control Card (e.g. Rockwell) Foundation Fieldbus HSE: – PC operation with configuration program by means of linking device FF-HSE/FF-H1
Communication interface	Foundation Fieldbus

Power supply

Supply voltage	– Standard: 9…32 V DC, – Ex: 9…24 V DC, see also Certificate, Safety Instructions (XA…), Installation Drawing (CSA) or Control Drawing (FM).
Current consumption	11 mA ±1 mA, For devices approved for use in hazardous areas, see Certificate, Safety Instructions (XA…), Installation Drawing (CSA) or Control Drawing (FM).
Power up current	Corresponds to table 4, IEC 61158-2

Certificates and Approvals

CE mark	By attaching the CE mark, Endress+Hauser confirms that the instrument fulfils all the requirements of the relevant EC directives.

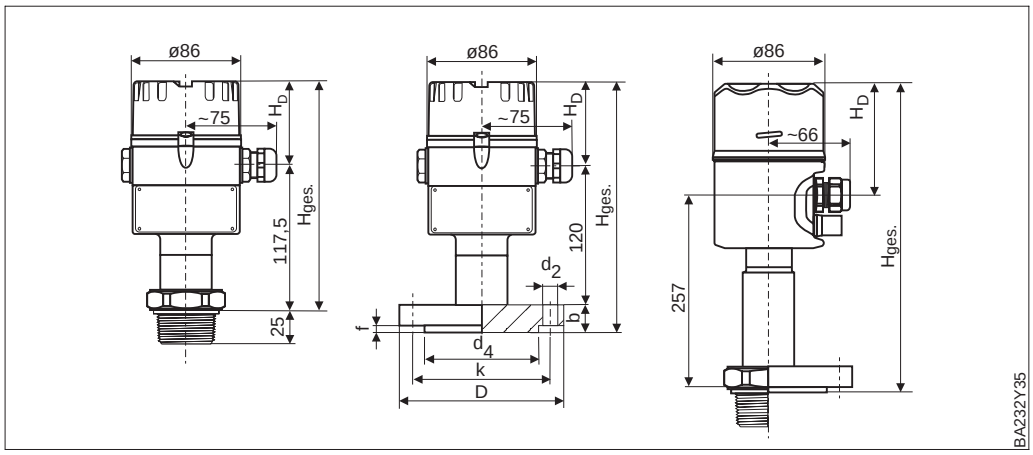
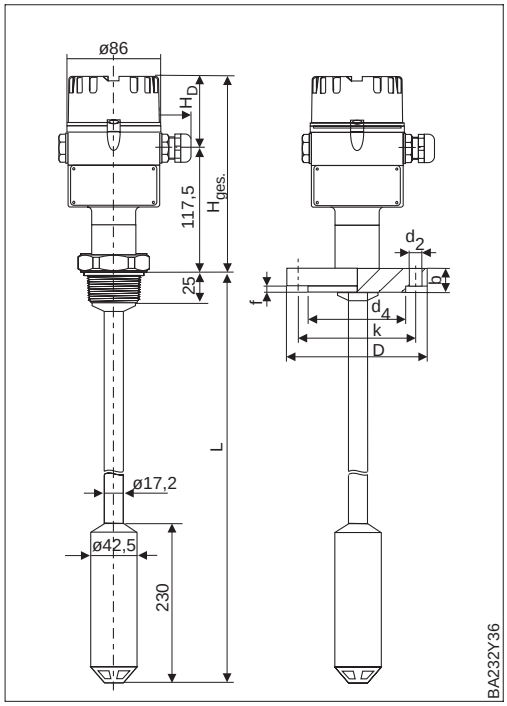


Figure 10.1
Deltapilot S DB 50
left: with thread G 1 ½ or 1 ½ NPT
centre: with flange, see Table
right: Version Ex Zone 0 FRG stainless steel housing

		Housing F10 (polyester)	Housing F6 (aluminium)	Housing F8 (stainless steel)
Cover height		75.0	86.0	80
Process connection $H_{ges.}$				
Process connection	Thread	192.5	203.5	190
	Flange	b + 195	b + 206	b + 193
Version Ex Zone 0	Thread	342	353	337
	Flange	b + 542	b + 353	b + 337



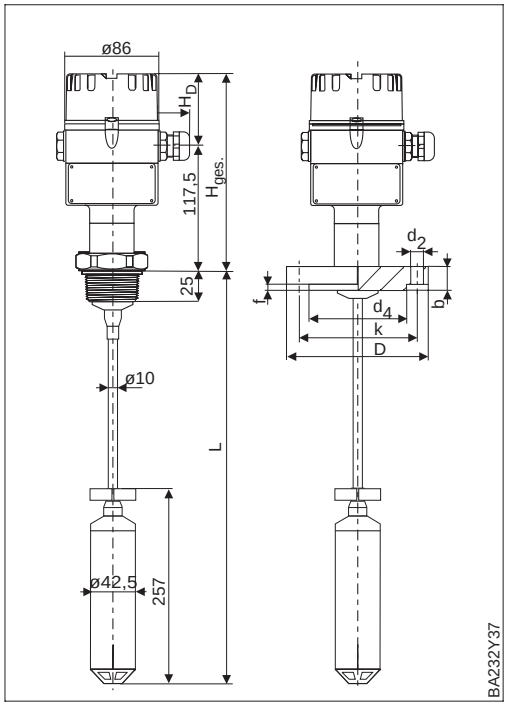


Figure 10.2
left: Deltapilot S DB 51 (rod version)
right: Deltapilot S DB 52 (rope version)
with G 1 ½ or 1 ½ NPT or Flange

Size	Flange			Raised face		Bore	
	D	b	k	d_4	f_d	Number	d_2
DN40 PN16	150	16	110			4	18
DN50 PN16	165	18	125			4	18
DN80 PN16	200	20	160	70	2	8	18
DN100 PN16	220	20	180	90	2	8	18
ANSI 1 1/2"	127	127.5	98.6	73.2	1.6	4	15.7
ANSI 2"	152.4	19.1	120,7	91.9	1.6	4	19.1
ANSI 3"	190.5	23.5	152.4	127.0	1.6	4	19.1
ANSI 4"	228.6	23.9	190.5	157.2	1.6	8	19.1

11 Operating Matrix and Parameter Description

11.1 Matrix on-site operation

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 Calibration	Measured Value	Empty calibration [1, 2]	Full calibration1	(min. current) 3	Output damping 0…99 s	(Value for 4 mA) [3]	(Value for 20 mA) [3]	Safety alarm	Corrected pressure	Measured level [1]
V1										
V2 Linearisation	Linearisation [1, 5]	Table no. [1]	Input level [1]	Input volume [1]						
V3 Extended calibration	Calibration mode [6]	Dry calibration unit [1, 4]	Density factor [1]	Zero offset value [1]	Pressure unit	Temperature unit	Sensor pressure	Position factor		
V4…V6										
V7 Transmitter info	Low sensor limit	High sensor limit	Max. sensor pressure	Measured temperature	Max. temperature					
V8										
V9 Service/ Simulation	Diagnostic code	Last diagnostic code		Instrument and software number		Reset – 333 – 7864	Simulation	Simulation value	(Display current value)[3]	Unlock parameter (Locking/ Unlocking operation)

Display field

1: In calibration mode "Pressure", these parameters have no influence on the measurement result.
2: In calibration mode "Dry calibration", these parameters have no influence on the measurement result.
3: These parameters have no influence on the measurement result.
4: In calibration mode "Level", these parameters have no influence on the measurement result.
5: Choice of linearisation – Linear, Activate table, Manual and Semi-automatic.
6: Choice of calibration – Level, Dry calibration, Dry calibration [%] and Pressure.

This matrix provides a summary off all factory settings. You can also enter your own values here.

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0		0.000 %	100.00 %		0 s			max. (1)	= V3H6	
V1										
V2	linear [%] (0)	1	0.000 %	0.000 %						
V3	level (0)	m (0)	1.000	0.000 %	mbar (0)	°C (0)		0 mbar		
V4…V6										
V7										
V8										
V9		0		7920			Sim. off (0)			333

11.2 Parameter description (Transducer Block)

Parameter	Description
Measured value (V0H0)	This parameter displays the value currently measured. The "Measured value" parameter (V0H0) corresponds to the on-site display. The unit with which this parameter is displayed depends on the calibration mode (V3H0) and linearisation mode (V2H0) selected. Select the unit as follows: – For the "Level" calibration mode and the "Linear" linearisation, select the unit by means of the "Unit before linearisation" parameter. The "Measured value" parameter is not converted to the unit selected. – For the "Dry calibration" calibration mode and the "Linear" linearisation, select the unit by means of the "Dry calibration unit" parameter (V3H1). The "Measured value" parameter is converted to the unit selected. – In the "Dry calibration [%]" calibration mode and the "Linear" linearisation, the "Measured value" parameter is displayed in %. – For the "Level", "Dry calibration" and "Dry calibration [%]" calibration modes and the "Table on" linearisation, select the unit by means of the "Unit after linearisation" parameter. The "Measured value" parameter is not converted to the unit selected. – For the "Pressure" calibration mode, select the unit by means of the "Pressure unit" parameter (V3H4). The "Measured value" parameter is converted to the unit selected.
Empty calibration (V0H1)	"Level" calibration mode: The container is either empty or partly full. By entering a value for this parameter you assign a level value to the pressure currently measured. In the event of a partial filling, enter the relevant value here, e.g. 10%. (Select the unit by means of the "Unit before linearisation" parameter). Please refer also to Chapter 5.2, "Empty and full calibration." Factory setting: 0.0% "Dry calibration" and Dry calibration [%]" calibration modes: The parameter is not displayed in these calibration modes. The "empty" calibration point is always at the probe mounting point for these calibration modes. Zero offset must be carried out if measurement is to start at another level. Please refer also to Chapter 5.2, "Dry calibration."
Full calibration (V0H2)	"Level" calibration mode: The container is either completely full or almost full. By entering a value for this parameter you assign a level value to the pressure currently measured. In the event of partial filling, enter the relevant value here, e.g. 90%. (Select the unit by means of the "Unit before linearisation" parameter). Please refer also to Chapter 5.2, "Empty and full calibration." Factory setting: 100.0% "Dry calibration [%]" calibration mode: In this calibration mode, 100% is automatically assigned to the value entered here, e.g. 4 m correspond to 100%. The "Measured value" (V0H0) is converted to a %, e.g. 2 m would then correspond to 50%. Select the unit for this parameter by means of the "Dry calibration unit" parameter (V3H1). Please refer also to Chapter 5.3, "Dry calibration." Factory setting: 100.0% "Dry calibration" calibration mode: For this calibration mode the "Full calibration" parameter is not relevant. Factory setting: Height, taken from the high sensor limit (V7H1)
Output damping (V0H4)	The output damping affects the speed at which the on-site display and the "Measured value" (V0H0), "Corrected pressure" (V0H8) and "Measured level" (V0H9) displays react to changes in the level. The damping can be set between 1 and 99 s. Factory setting: 1 Note: For the Analog Input Blocks and the PID Block, the FF Parameter PV_FTIME is available in each case. You can use this parameter to set additional damping. See also to Chapters 3.8 and 3.9.

Parameter description (continuation)

Parameter	Description
Safety alarm (V0H7)	This parameter can only be accessed via the on-site operation. In the event of an error, the "Measured value" (V0H0) and the on-site display are set to the value selected here. – Min (0) = –19999 – Max (1) = +19999 – Hold (2) = last valid measured value is retained. Note: The "safety alarm" parameter only affects the on-site display and the "Measured value" parameter. With the output value of the Analog Input Block OUT_Value a status is transferred simultaneously. In the case of a device fault, the status changes to BAD. The Foundation Fieldbus specification.
Corrected pressure (V0H8)	The pressure currently measured is displayed, corrected with position factor. The following applies: Corrected pressure (V0H8) = Sensor pressure (V3H6) – Position factor (V3H7). In the "Pressure" calibration mode, this parameter corresponds to the "Measured value" parameter (V0H0). Select the unit by means of the "Pressure unit" parameter (V3H4). Please refer also to Chapter 5.1 or 6.1. Factory setting: 0.0 mbar
Measured level (V0H9)	Only for "Level", "Dry calibration" and "Dry calibration [%]" calibration modes. In the "Table on" linearisation, the "Measured value" parameter (V0H0) displays the measured value as a value converted by means of the linearisation table. The "Measured level" parameter displays the associated level currently measured. After a zero value offset, and if "Linear" linearisation is selected, this parameter displays the current level without the zero offset value. The unit with which this parameter is displayed depends on the calibration mode (V3H0) selected. Select the unit as follows: "Level" calibration mode: Unit before linearisation, "Dry calibration [%]" calibration mode: Display automatically in %, "Dry calibration" calibration mode: Dry calibration unit (V3H1)
Linearisation (V2H0)	Only for "Level", "Dry calibration" and "Dry calibration [%]" calibration modes. Options: Linear [%]/not activated (0) , Activate table (1), Manual (2), Semi-automatic (3) and Clear table(4). Enter the corresponding number if configuring via the display module. Please refer also to Chapter 5.4, "Linearisation". Factory setting: Linear [%]
Table no. (V2H1)	Only for "Level", "Dry calibration" and "Dry calibration [%]" calibration modes. A line number for the linearisation table is entered. For the linearisation mode "Manual" enter the linearisation table via the following parameters "Table no." (V2H1), "Input level manual" (V2H2) and "Input volume" (V2H3). For the linearisation mode "Semi-automatic", enter the linearisation table via the following parameters "Table no." (V2H1), "Input level half automatic" (V2H2) and "Input volume" (V2H3). Number of lines for linearisation table: Min =2 and Max = 11. Please refer also to Chapter 5.4 "Linearisation". Factory setting: 1

Parameter description (continuation)

Parameter	Description
Input level manual (Entry level value for "Manual" linearisation mode – V2H2)	Only for "Level", "Dry calibration" and "Dry calibration [%]" calibration modes. "Manual" linearisation (V2H0) must be selected. Here, enter a level value in the linearisation table which matches the current line number and volume/weight. The unit with which this parameter is displayed depends on the calibration mode (V3H0) selected. Select the unit as follows: "Level" calibration mode: Unit before linearisation, "Dry calibration [%]" calibration mode: Display automatically in %, "Dry calibration" calibration mode: Dry calibration unit (V3H1). Please refer also to Chapter 5.4, "Linearisation". Factory setting: 0.0%
Input level half automatic (Entry level value for "Semi-automatic" linearisation mode – V2H2)	Only for "Level", "Dry calibration" and "Dry calibration [%]" calibration modes. "Semi-automatic" linearisation (V2H0) must be selected. Here, enter a level value in the linearisation table which matches the current line number and volume/weight. The unit with which this parameter is displayed depends on the calibration mode (V3H0) selected. Select the unit as follows: "Level" calibration mode: Unit before linearisation, "Dry calibration [%]" calibration mode: Display automatically in %, "Dry calibration" calibration mode: Dry calibration unit (V3H1). Please refer also to Chapter 5.4, "Linearisation". Factory setting: 0.0%
Input volume (V2H3)	Only for "Level" "Dry calibration" and "Dry calibration [%]" calibration modes. "Manual" or "Semi-automatic" linearisation (V2H0) must be selected. Here, enter a value for volume/weight in the linearisation table which matches the level and the current line number. (Select the unit by means of the "Unit after linearisation" parameter). Please refer also to Chapter 5.4, "Linearisation". Factory setting: 0.0%
Calibration mode (V3H0)	The calibration mode can be selected here. Options: Level (0) , Dry calibration (1), Dry calibration [%] (2) and Pressure (3). Enter the corresponding number if configuring via the display module. Level" calibration mode: The container is filled or emptied for this calibration. By entering a value for each of the parameters "Empty calibration" (V0H1) and "Full calibration" (V0H2), a level value is assigned to the pressure value currently measured. Please refer also to Chapter 5.2, "Empty and full calibration." "Dry calibration" calibration mode: Dry calibration is a theoretical calibration. The level is calculated from the measured pressure and the density, "Density factor" parameter (V3H2), using the formula $h = p/(\rho \cdot g)$. Please refer also to Chapter 5.3, "Dry calibration." "Dry calibration [%]" calibration mode: Dry calibration [%] is a theoretical calibration. The level is calculated as in the "Dry calibration" calibration mode. In this calibration mode, enter the maximum level value for the "Full calibration" parameter (V0H2). 100% is automatically assigned to this value, e.g. 4 m correspond to 100%. The "Measured value" (V0H0) is converted to a %, e.g. 2 m would then correspond to 50%. Please refer also to Chapter 5.3, "Dry calibration". "Pressure" calibration mode: In this calibration mode, the measured pressure is output directly as "Measured value" (V0H0). Select the unit by means of "Pressure unit" (V3H4). Please refer also to Chapter 6 "Pressure and Differential Pressure Measurement". Factory setting: Level

Parameter description (continuation)

Parameter	Description
Dry calibration unit (V3H1)	Only for "Dry calibration" and "Dry calibration [%]" calibration modes. A unit of length is selected. In the "Dry calibration" calibration mode, the "Measured value" (V0H0), "Full calibration" V0H2, "Measured level" (V0H9), "Input level manual" (V2H2), "Input level half automatic" (V2H2) and "Zero offset value" (V3H3) parameters are displayed in the unit selected and converted if a new unit is selected. In the "Dry calibration [%]" calibration mode, only the "Full calibration" (V0H2) and "Zero offset value" (V3H3) parameters are displayed with the unit selected and converted if a new unit is selected. The "Measured value" (V0H0), "Measured level" (V0H9), "Input level half automatic" (V2H2) and "Input level manual" (V2H2) parameters are displayed in %. Example: 100 cm correspond to 1 m or 3.2808 feet. Options: m (1), cm (2), feet (3), inch (4). Enter the corresponding number if configuring via the display module. Factory setting: m
Density correction (V3H2)	Only for "Level", "Dry calibration" and "Dry calibration [%]" calibration modes. The density factor adjusts the "Measured value" (V0H0) and the digital output value to the density of the medium. The density factor is calculated from the ratio of the "new density" to the "old density". Please refer also to Chapter 5.2, "Density correction" and "Calculating the density factor" sections. Input range 0.01 to 9.999. Factory setting: 1.0
Zero offset value (V3H3)	Only for "Level", "Dry calibration" and "Dry calibration [%]" calibration modes. Carry out a zero offset if the measurement is not to start at the mounting point of the measuring probe. The "Measured value" (V0H0) displays the corrected measured value. The "Measured level" parameter (V0H9) displays the current level without the zero offset value. Please refer also to Chapter 5.3, "Calibration – Dry calibration", "Calibration – Dry calibration [%]" and "Correction after installation" sections. "Dry calibration" and "Dry calibration [%]" calibration modes: Select the unit by means of the "Dry calibration unit" parameter (V3H1). Factory setting: Height, taken from the minimum sensor limit ("Low sensor limit" parameter – V7H0)
Pressure unit (V3H4)	Only for "Pressure" calibration mode. A pressure unit is selected. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new pressure unit. Options: mbar (0), bar (1), mH_2O (2), mmH_2O (3), psi (4), ftH_2O (5), inH_2O (6), Pa (7), MPa (8), hPa (9), mmHg (10), inHg (11), g/cm^2 (12), kg/cm^2 (13), lb/ft^2 (14), kgf/cm^2 (15). Enter the corresponding number if configuring via the display module. Factory setting: mbar
Temperature unit (V3H5)	A temperature unit can be selected here. If a new temperature unit is selected, the "Measured temperature" (V7H3) and "Max. temperature" (V7H4) parameters are converted and displayed with the new temperature unit. Options: °C (0), °F (1). Enter the corresponding number if configuring via the display module. Factory setting: °C
Sensor pressure (V3H6)	The pressure currently detected is displayed.
Position factor (V3H7)	Depending on the orientation of the device, there may be a slight shift in the measured value. This means that if the container is empty, the on-site display and the "Measured value" (V0H0) do not display zero but rather a very slight pressure. To correct the reading, enter the pressure difference for this parameter. The "Sensor pressure" parameter (V3H6) displays the pressure currently measured. The following applies: Measured value (V0H0) = Sensor pressure (V3H6) – Position factor (V3H7). Please refer also to Chapter 5.1 or 6.1. Factory setting: 0.0 mbar

Parameter description (continuation)

Parameter	Description
Low sensor limit (V7H0)	The low sensor limit is displayed.
High sensor limit (V7H1)	The high sensor limit is displayed.
Max. sensor pressure (V7H2)	The largest pressure value measured is displayed (maximum indicator).
Reset max. sensor pressure (Reset maximum pressure)	This parameter is used to reset the parameter "Max. sensor pressure" (V7H2) to the currently measured sensor pressure. Options: # – "Max. sensor pressure" parameter is not reset. reset – "Max. sensor pressure" parameter is reset.
Measured temperature (V7H3)	This value displays the temperature measured value of the internal temperature sensor. The temperature measured value of the internal sensor is used in the measuring cell for compensation purposes. In other words, this is only a temperature value which is close to the process. The unit can be selected by means of the "Temperature unit" (V3H5) parameter.
Max. temperature (V7H4)	The highest temperature measured is displayed (maximum indicator).
Reset max. temperature (Reset maximum temperature)	This parameter is used to reset the parameter "Max. temperature" (V7H4) to the currently measured temperature pressure. Options: # – "Max. temperature" parameter is not reset. reset – "Max. temperature" parameter is reset.
Diagnostic code (V9H0)	An error code is output if the device detects an error or a warning. This parameter displays the current error code. Please refer to Chapter 8.1. for a description of the error codes.
Last diagnostic code (V9H1)	The last error code is displayed. This parameter is reset to "0" by confirming with the Enter key. Please refer to Chapter 8.1. for a description of the error codes. Factory setting: 0
Reset last diagnostic code	Use this parameter to delete the last error message or fault message, "Last diagnostic code" parameter (V9H1). Options: # – "Last diagnostic code" parameter is not reset. clear – "Last diagnostic code" parameter is reset.
Instrument and software number (V9H4)	The instrument and software number is displayed. The first two digits indicate the device number. Deltapilot S Foundation Fieldbus SW 1.0 =7920
Reset (V9H5)	A reset code is entered. Possible reset codes are: 333 and 7864. Chapter 8.2 lists the parameters which are reset to the factory setting by the individual reset codes.
Simulation (V9H6)	The type of simulation is selected. Options: Off (0), Pressure (2), Level (3) and Volume (4). The "Level" and "Volume" types of simulation cannot be selected for the "Pressure" calibration mode. Enter the corresponding number if configuring via the display module. Please refer also to Chapter 7.3. Factory setting: Off
Simulation value (V9H7)	A simulated measured value is entered to check a calibration or configuration. The value entered must lie between the low and high sensor limit (V7H0/V7H1) for the "Pressure" simulation option. You can enter values between –19999 and +19999 for the "Level" and "Volume" simulation options. This field is not displayed if you have selected "Off" for the "Simulation" parameter (V9H6). During simulation, the "Last diagnostic code" (V9H1) parameter displays the warning "613". Please refer also to Chapter 7.3.

Parameter description (continuation)

Parameter	Description
Unlock parameter (V9H9)	A code is entered to lock or unlock the operating matrix and the on-site operation. Locking the operation: – by means of the parameter "Unlock parameter" (V9H9): enter a number between 0 and 9998, apart from the numbers 2457 and 333, – by means of the on-site operation: simultaneously press the "+" key and the "V" key once. Unlocking the operation: – by means of the parameter "Unlock parameter" (V9H9): enter the number 2457 or 333, – by means of the on-site operation: simultaneously press the "–" key and the "H" key once. The matrix field V9H9 can only be edited if the operation has not been locked beforehand by means of the on-site keys. Please refer also to Chapter 7.4.
Unit before linearisation	Only for the "Level" calibration mode and "Linear" linearisation. A unit is selected for level, volume or weight for the "Measured value" (V0H0), "Empty calibration" (V0H1), "Full calibration" (V0H2), "Measured level" (V0H9), "Input level half automatic" (V2H2), "Input level manual" (V2H2) and "Zero offset value" (V3H3) parameters. The unit is for display purposes only. The parameters are not converted. This parameter cannot be selected by means of the display module. Options: %, m, cm, dm, ft, inch, l, hl, m^3, dm^3, cm^3, ft^3, us gal, i gal, kg, t, lb, ton, None. Factory setting: %
Unit after linearisation	Only for the "Level", "Dry calibration.H" and "Dry calibration.%" calibration modes. "Activate table" or "Horiz. cylindrical" linearisation must be selected. A unit is selected for level, volume or weight for the "Measured level" (V0H9), "Input volume" (V2H3) and "Zero offset value" (V3H3) parameters. The unit is for display purposes only. The parameters are not converted. This parameter cannot be selected by means of the display module. Options: %, m, cm, dm, ft, inch, l, hl, m^3, dm^3, cm^3, ft^3, us gal, i gal, kg, t, lb, ton, None. Factory setting: %
Service Data 1 (Pressure at empty calibration)	Only for the "Level" calibration mode. The corrected pressure is displayed which was saved when the value for the "Empty calibration" parameter (V0H1) was entered. Factory setting: Low sensor limit (V7H0)
Service Data 2 (Density factor at empty calibration)	Only for the "Level" calibration mode. The "Density factor" (V3H2) is displayed which was saved when entering the value for the "Empty calibration" parameter (V0H1). Factory setting: 1.0
Service Data 3 (Pressure at full calibration)	Only for the "Level" and "Dry calibration.%" calibration modes. The corrected pressure is displayed which was saved when the value for the "Full calibration" parameter (V0H2) was entered. Factory setting: High sensor limit (V7H1)
Service Daten 4 (Density factor at full calibration)	Only for the "Level" and "Dry calibration.%" calibration modes. The "Density factor" (V3H2) is displayed which was saved when entering the value for the "Full calibration" parameter (V0H2). Factory setting 1.0

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Endress+Hauser

People for Process Automation

Declaration of Hazardous Material and De-Contamination

Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.

Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

Process data/ *Prozessdaten*

Temperature / *Temperatur*_____ [°F] _____ [°C]
Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* _____ [µS/cm]
Viscosity / *Viskosität* _____ [cp] _____ [mm²/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits-schädlich/ reizend*	other * *sonstiges**	harmless *unbedenklich*
Process medium / *Medium im Prozess*								
Medium for process cleaning / *Medium zur Prozessreinigung*								
Returned part cleaned with / *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* _____

_____

_____

Company data / *Angaben zum Absender*

Company / *Firma* _____

Address / *Adresse*

_____

_____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*

_____

Fax / E-Mail _____

Your order No. / *Ihre Auftragsnr.* _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."
"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

_____ (place, date / *Ort, Datum)*

_____ Name, dept./ *Abt.* (please print / *bitte Druckschrift*)

_____ Signature / *Unterschrift*

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