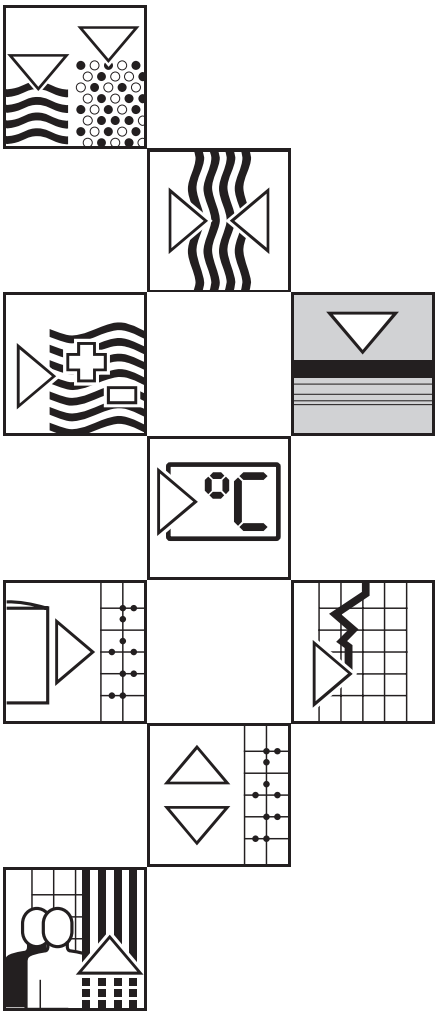
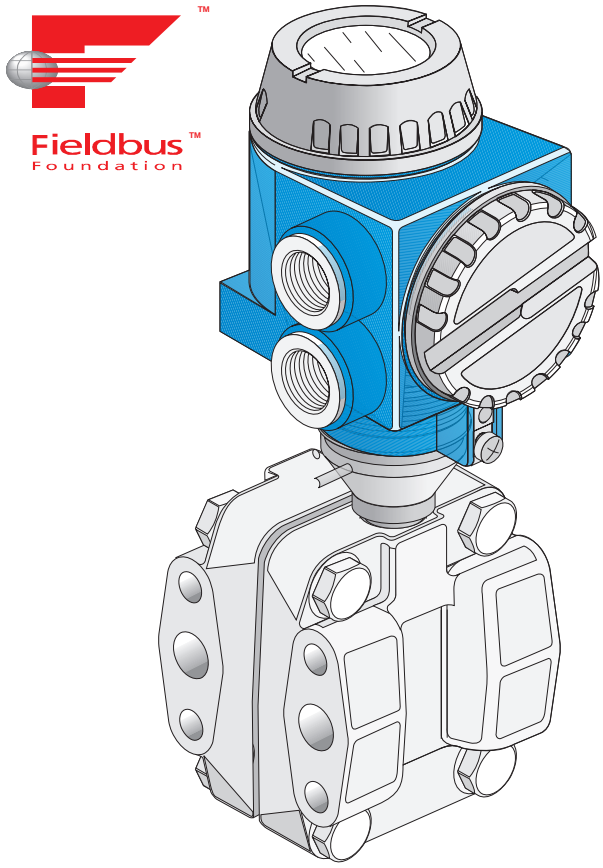
BA 212P/00/en/09.04
Software version 0.3
52006136

deltabar S
Foundation Fieldbus
Pressure Measurement

Operating Instructions

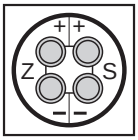




Endress+Hauser

The Power of Know How

Short Operating Instructions



Comissioning on-site
– Differential pressure
– Level
– Flow
Chapter 4.1 and 5

Remote operation via configuration tool

Differential pressure, level, flow?

Differential pressure Chapter 6

– Calibration
– Damping
– Locking/unlocking the operation
– Measuring point information

Level Chapter 7

– Density correction

Empty/full calibration

Dry calibration

– Damping
– Locking/unlocking the operation
– Measuring point information

Flow Chapter 8

– Calibration
– Creep flow suppression
– Damping
– Locking/unlocking the operation
– Measuring point information

Table of Contents

Software History

Software	Changes	Significance
0.3		

Notes on Safety

Approved usage

The pressure transmitter Deltabar S is a Foundation Fieldbus device which, depending upon the version, is used for measuring differential pressure level or flow.

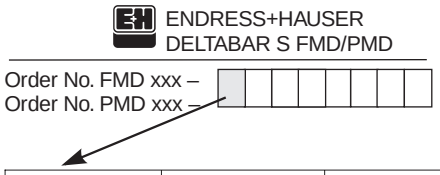
Installation, commissioning, operation

The Deltabar 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 to the instructions in this manual personnel must be authorised and suitably qualiflied. 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 area

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 IEC 79–14.



Certificates for applications in explosion hazardous areas

Code	Certificate	Protection
A, F, K, S, 3, 4, 5	Standard	none
C, I, J, L, 6	PTB	ATEX II 1/2 G EEx ia IIC T4/T6
M, T	PTB	ATEX II 2 G EEx d IIC T6
C, I, J, L, 6	CENELEC	EEx ia IIC T4/T6
M, T	CENELEC	EEx d IIC T5/T6
V, W	FM	IS Class I, II, III, Div. 1, Groups A…G
U	FM	PMD 235, FMD 630, FMD 633: XP Class I, II, III, Div. 1, Groups A…G
1	CSA	PMD 235, FMD 630, FMD 633: XP Class I, II, III, Div. 1, Groups B…G (in preparation)
2	CSA	IS Class I, II, III, Div. 1, Groups A…G

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.

Notes on safety

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.

Ignition 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

Applications

The Deltabar S family of instruments is used for the measurement of differential pressure, level and flow in gases, vapours and liquids. They are used in all sectors of industry.
The full functionality especially for level and flow measurement is accessed by using a FF configuration tool.

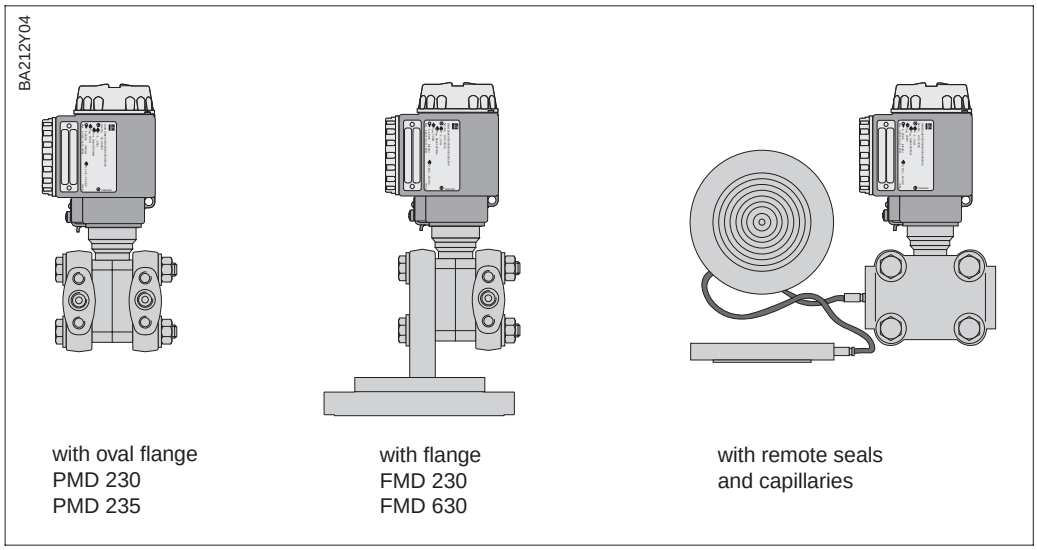
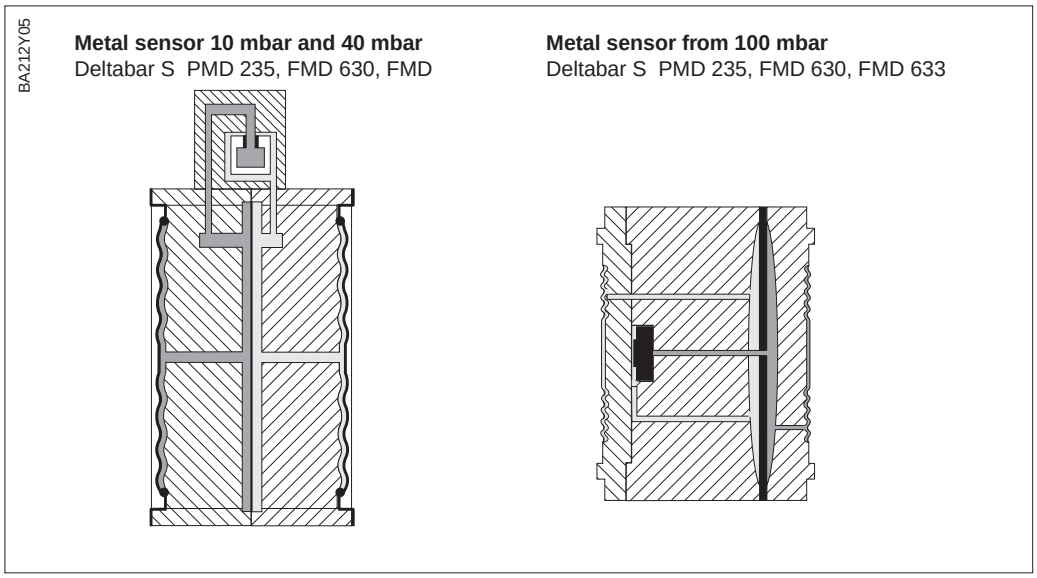


Figure 1.1
Deltabar S versions

Operating principle

Metal sensor
The system pressure deflects the separating diaphragm and a fill fluid transmits the pressure to a resistance bridge. The pressure dependent change in bridge output voltage is measured and processed further.



Metal sensor
10 mbar, 40 mbar
① Measuring element
② Silicon diaphragm
③ Separating diaphragm as nap diaphragm extended
④ Filling fluid
⑤ Integrated overload protection

Metal sensor
from 100 mbar
⑥ Measuring element
⑦ Overload diaphragm
⑧ Filling fluid
⑨ Separating diaphragm as nap diaphragm extended

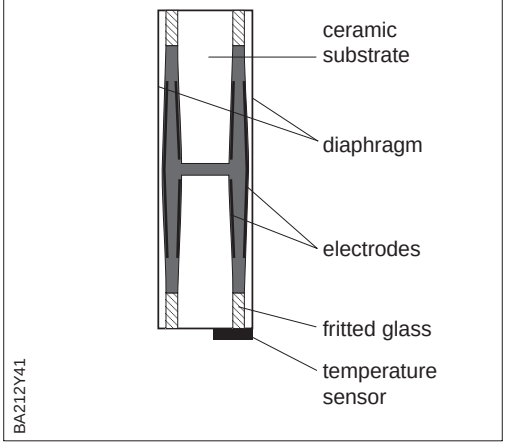
Flow measurement
The flow Q is proportional to the square root of the differential pressure Δp.

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

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

Ceramic sensor
The system pressure acts directly on the robust ceramic diaphragm of the pressure sensor and deflects it by maximum 0.025 mm. A change in capacitance proportional to the pressure acting is measured by electrodes on the ceramic substrate and diaphragm. The measuring range is determined by the thickness of the ceramic diaphragm.

Ceramic sensor
Deltabar S PMD 230, FMD 230



1.1 Measuring system

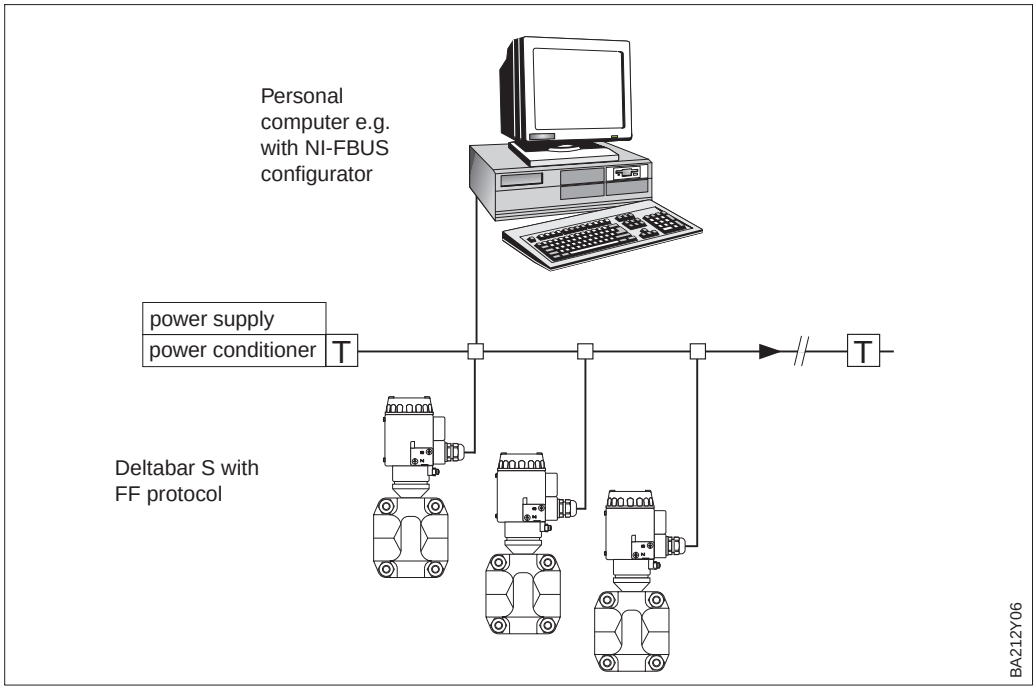


Figure 1.2
Measuring point with Deltabar S

T: bus terminator

Measuring point

In the simplest case, the complete measuring point comprises:
- Deltabar S transmitter with Foundation Fieldbus protocol
- Network Configuration Tool, e.g. National Instruments Fieldmanager

Number of transmitters

The maximum number of transmitters on a bus segment is determined by their current consumption, the required bus length and if installed the power of the link.
Normally, however:

- 10 Deltabar S for EEx ia applications
- max. 32 Deltabar S for non-hazardous application

can be operated on a bus segment. Cerabar S consumes max. 11.5 mA per device.

Refer also to the FF specification or IEC 61158-2 or to the Internet address http://www.fieldbus.org.

Sensor overload limits

The sensor overload limits are to be found in Chapter 11, page 73.

2 Installation

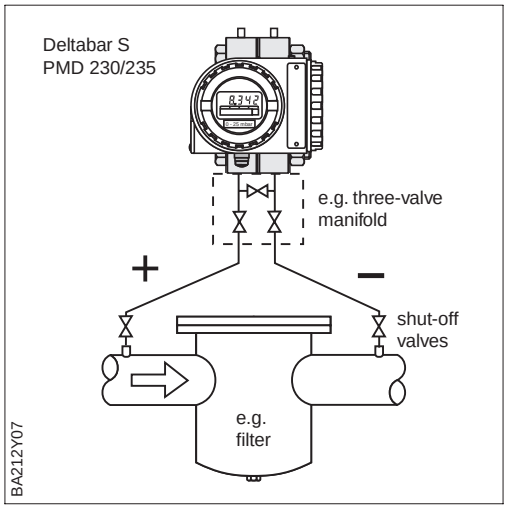
This chapter describes the configuration of the Deltabar S, its electrical connection, mounting of the display as well as exchanging the electronics and the sensor module.

2.1 Measuring system for differential pressure measurement

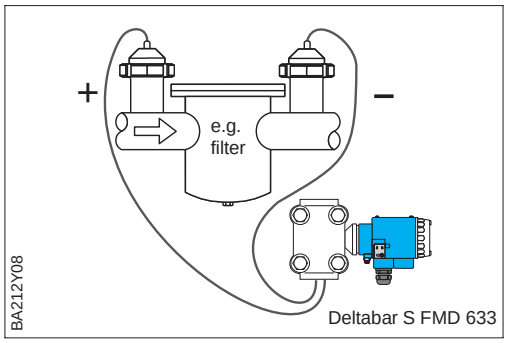
Note!

Note!
- General recommendations for the routing of pressure piping can be taken from national or international standards, e.g. ISO 2186, ISO 5167 etc. or the appropriate national or international standards.
- Check that pressure piping installed outdoors is adequately insulated and/or heated.

Gases and vapours

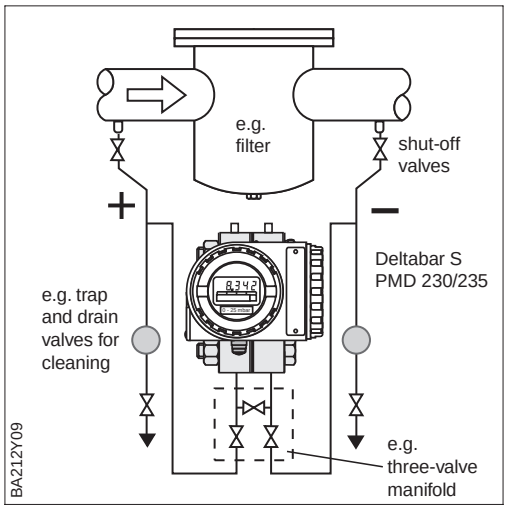


- Mount the Deltabar S above the tapping point, so that condensation can run back into the process piping.
- Use a three-valve manifold for simple mounting without interruption of the process.
- Install the pressure piping with a continuous fall of at least 10%.



- FMD 633: Mount the remote seals on flanges above the process pipe.
- For vacuum: Mount the transmitter below the tapping point.
- There should be no temperature difference between the capillaries.

Liquids

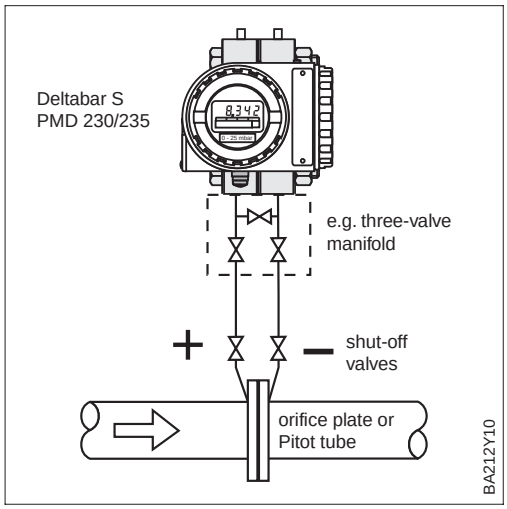


- Mount the Deltabar S below the tapping point, so that the pressure piping is always filled with liquid and gas bubbles can run back into the process pipe.
- Use a three-valve manifold for simple mounting without interruption of the process.
- In order to avoid build-up in dirty liquids, it is recommended that traps and drain valves are used.
- Install the pressure piping with a continuous fall of at least 10%.

2.2 Measuring system for flow measurement

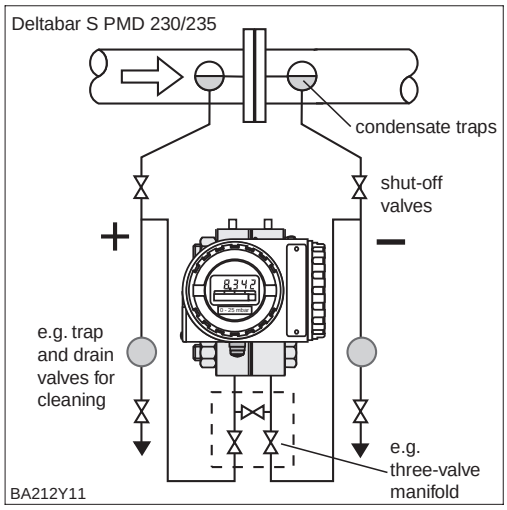
Note!
General recommendations for the routing of pressure piping can be taken from national or international standards, e.g. ISO 2186, ISO 5167 etc. or appropriate national or international standards.

Note!



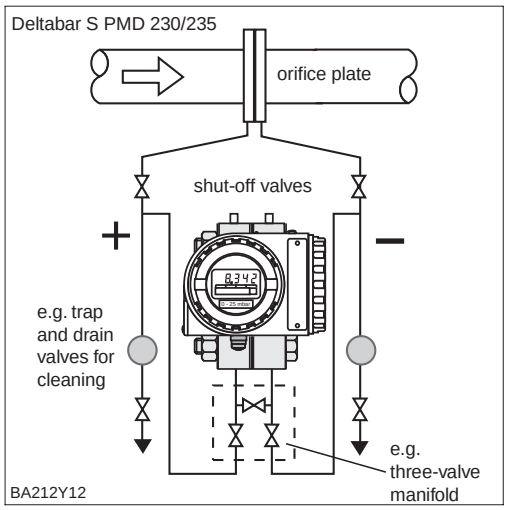
Gases

- Mount the Deltabar S above the tapping point, so that condensation can run back into the process piping.
- Use a three-valve manifold for simple mounting without interruption of the process.
- Install the pressure piping with a continuous fall of at least 10%.



Vapours

- Mount the Deltabar S below the tapping point.
- Mount condensate traps at the same level as the tapping points.
- Fill the traps with liquid before calibration.
- Use a three-valve manifold for simple mounting without interruption of the process.
- Install the pressure piping with a continuous fall of at least 10%.



Liquids

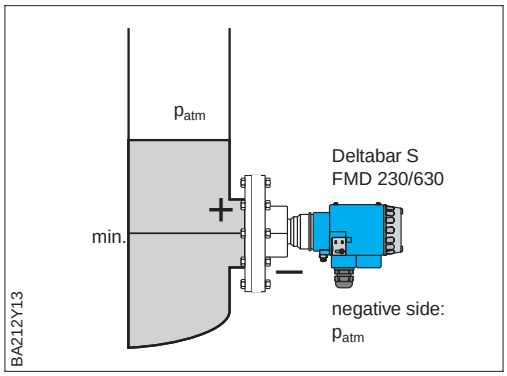
- Mount the Deltabar S below the tapping point, so that the pressure piping is always filled with liquid and gas bubbles can run back into the process pipe.
- Use a three-valve manifold for simple mounting without interruption of the process.
- In order to avoid build-up in dirty liquids, it is recommended that traps and drain valves are used.
- Install the pressure piping with a continuous fall of at least 10%.

2.3 Measuring system for level measurement

Note!

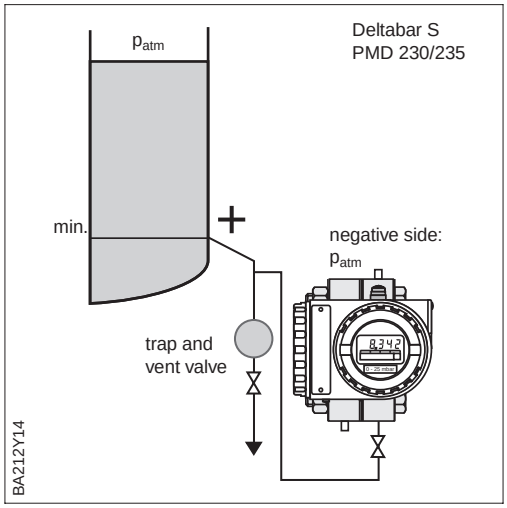
Note!
General recommendations for laying pressure piping may be taken from DIN 19 210 "Pressure piping for pressure equipment" or the appropriate national or international standards.

Open tank



FMD 230, FMD 630

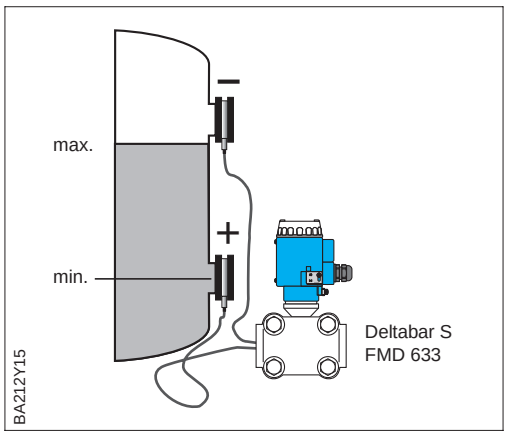
- Mount the Deltabar S direct on the tank.
- The negative side is open to atmosphere pressure.



PMD 230, PMD 235

- Mount the Deltabar S below the lower tapping, so that the pressure piping is always filled with liquid.
- The negative side is open to atmosphere pressure.
- A trap prevents the build up of dirt in the pressure piping.
- Install the pressure piping with a continuous fall of at least 10%.

Closed tank

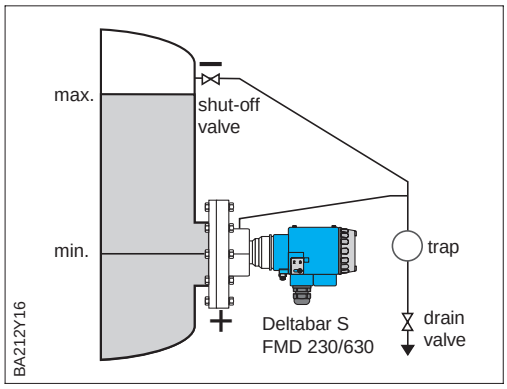


FMD 633

- Mount the Deltabar S below the tapping point.
- Mount the remote seals with capillaries onto the tank.
- There should be no temperature difference between the capillaries.

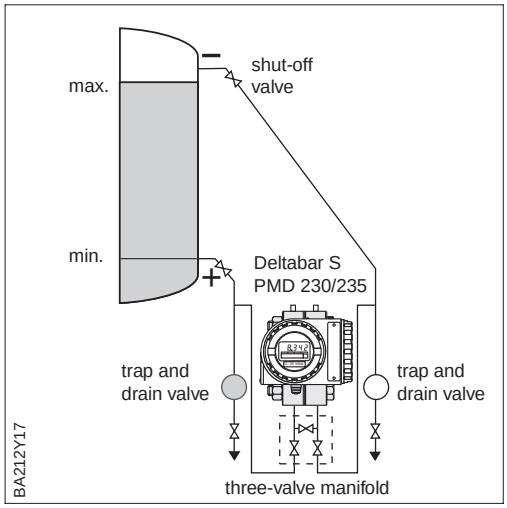
Note!
Level measurement can only be carried out between the upper edge of the lower remote seal and the lower edge of the upper remote seal.

Closed tank



FMD 230, FMD 630

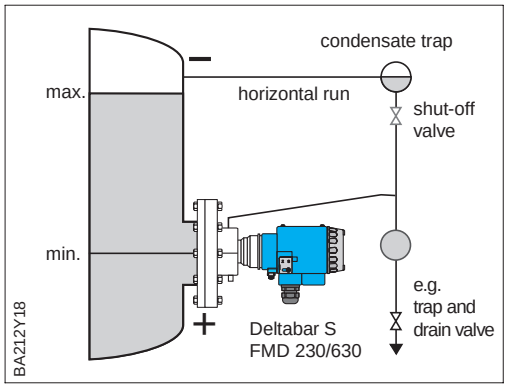
- Mount the Deltabar S direct on the tank.
- The tapping for the negative side must be above the maximum level to be measured.
- Install the pressure piping with a continuous fall of at least 10%.



PMD 230, PMD 235

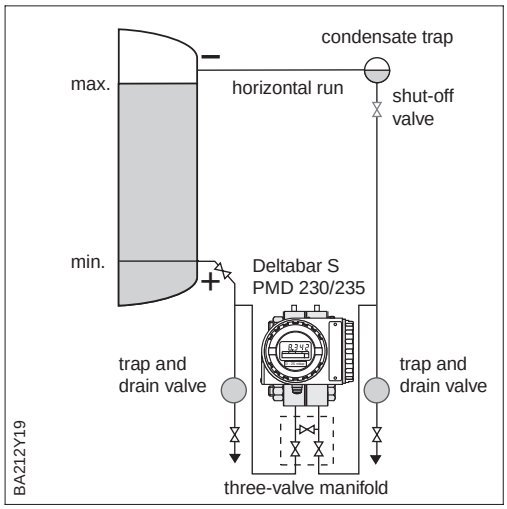
- Mount the Deltabar S below the lower tapping so that the pressure piping is always filled with liquid.
- The negative side must be above the maximum level to be measured.
- Traps prevent the build up of dirt in the pressure piping.
- Use a three-valve manifold for simple mounting without interrupting the process.
- Install the pressure piping with a continuous fall of at least 10%.

Closed tank with steaming liquid



FMD 230, FMD 630

- Mount the Deltabar S direct on the tank.
- The tapping for the negative side must be above the maximum level to be measured.
- A condensation trap ensures constant pressure on the negative side.
- Install the pressure piping with a continuous fall of at least 10%.



PMD 230, PMD 235

- Mount the Deltabar S below the lower tapping, so that the pressure piping is always filled with liquid.
- The tapping for the negative side must be above the maximum level to be measured. The condensation trap ensures a constant pressure.
- Traps prevent the build up of dirt in the pressure piping.
- Use a three-valve manifold for simple mounting without interruption of the process.
- Install the pressure piping with a continuous fall of at least 10%.

2.4 Mounting

Diaphragm seal

- Do not clean or touch the diaphragm seal with pointed or hard objects.
- Remove the protective cap just before installation.

Seal for flange mounting

The recommended seal depends on the flange: DIN 2690 or ANSI B 16.5.

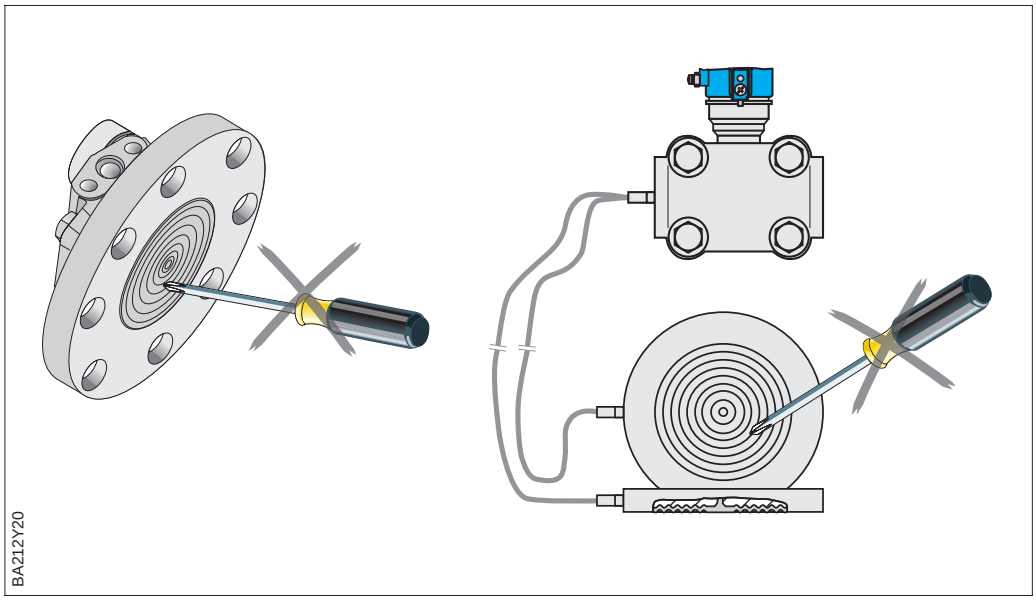


Fig. 2.1
Handle diaphragm seals with care!

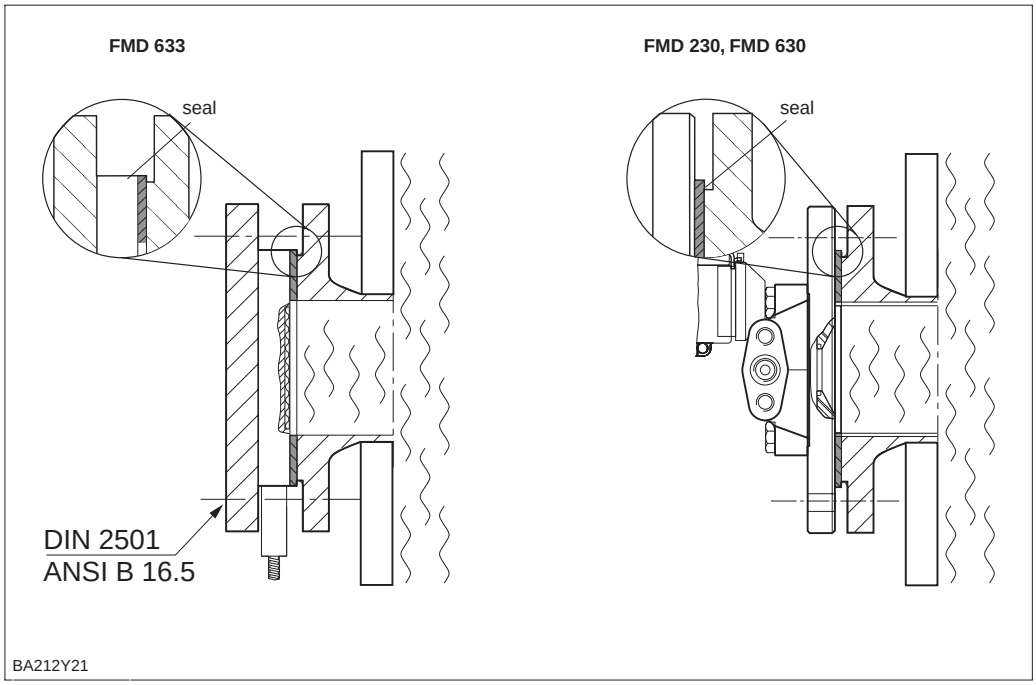


Fig. 2.2
Mounting of the version with flange or diaphragm seal

Wall- and pipe-mounting

If transmitters with remote seals are mounted on vertical pipes, sufficient tension relief must be provided otherwise the capillaries may kink.

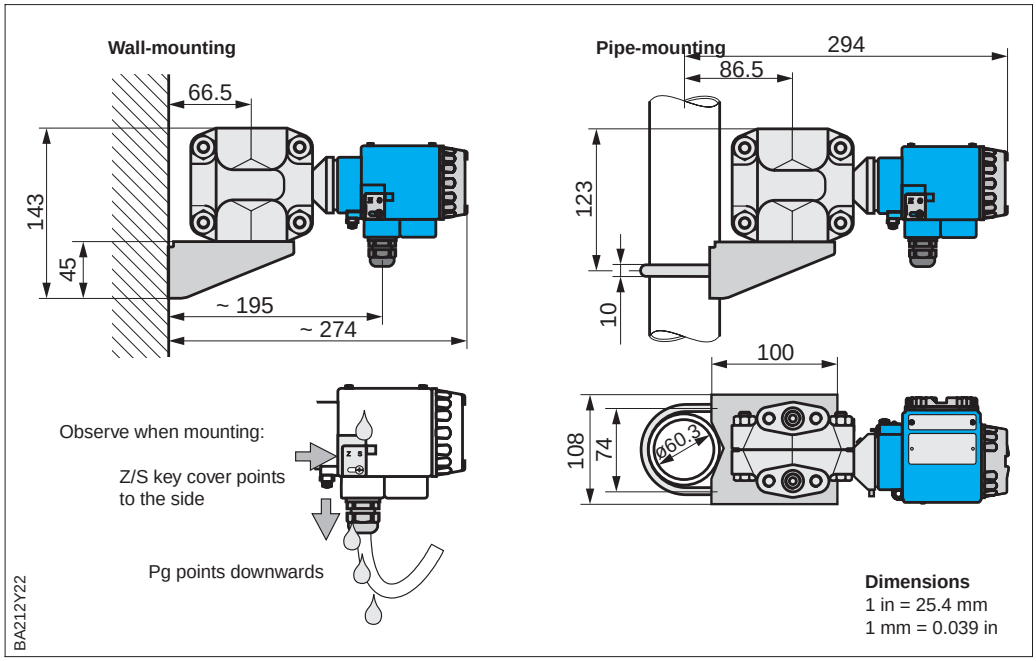


Fig. 2.3
Wall- and pipe-mounting

Caution!

Caution!
Mount the housing such that:
- *The cable gland always points downwards so that condensation on the connecting cable runs off and not into the housing.*
- *The Z/S key cover points to the side so that it's protected from water.*

Align housing

After the Deltabar S has been mounted, the housing can be aligned such that:

- the terminal compartment is easily accessible,
- the display can be easily read,
- the cable gland and the cover of the Z/S keys are protected from water.

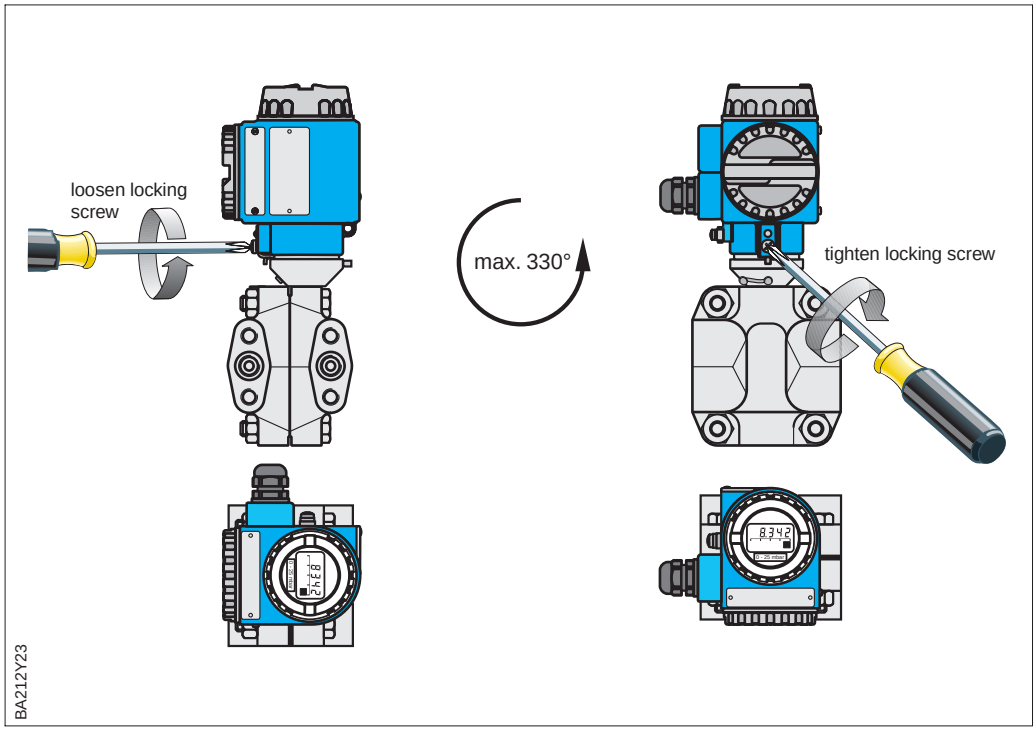


Fig. 2.4
Align housing

2.5 Connection

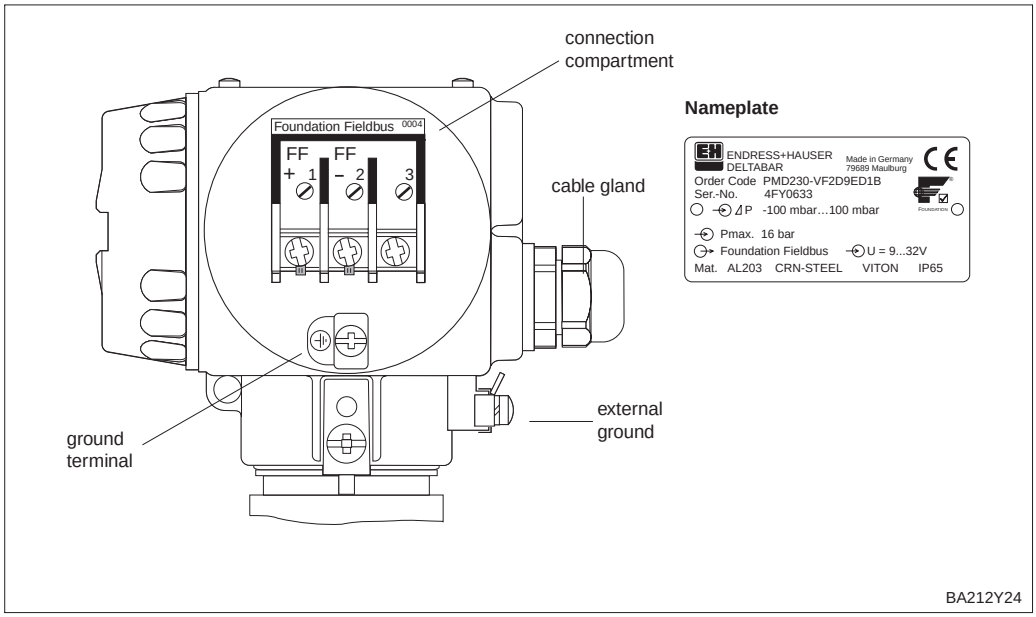


Figure 2.5
Deltabar S connection compartments and nameplate

General notes

Deltabar S is loop-powered transmitter (type 111) with Foundation Fieldbus output. Note the following before connecting up:

- Turn off the power before connecting up.
- Connect the external ground terminal of the transmitter to the plant grounding system before connecting up.

Power

The Cerabar S has the following power requirements:
I = 10.5 mA ± 1 mA
Non-Ex: U = 9...32 VDC
Ex: U = 9…24 VDC

Cable

Twisted, shielded pairs must be used. The cable specifications can be taken from the FF specification or IEC 61158-2. The following have been found suitable:

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

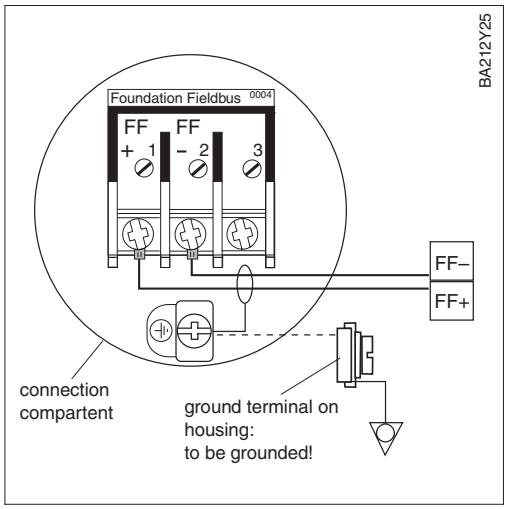
Ex-area: Siemens 6XV1 830-5AH10,
Belden 3076F,
Kerpen CEL-PE/OSCR/PVC/FRLA FB-02YS(ST)YFL

Screening

General information on wiring can be found at the Fieldbus Foundation website: www.fieldbus.org. For maximum protection against electromagnetic interference, e.g. when the bus is operating near frequency converters, it is recommened that high integrity potential bonding be provided between the housing and the cable screening:

The external ground terminal on the transmitter must be connected to ground.
The continuity of the cable screening between tapping points must be ensured.
The screening must be grounded at each end of the cable.
If there are large differences in potential between grounding points, the grounding should run via a capicitor that is suitable for high frequency use
(e.g. ceramic 10 nF/250 V~).

2.6 Wiring examples



Cable connection

The bus line also carries power and is connected as follows:

- Switch off power
- If necessary, connect external ground terminal to plant grounding system.
- Unscrew the connection compartment lid.
- Thread cable through cable entry.
- Connect cable cores to FF+ and FF–. Reversed polarity has no effect on operation.
- Connect the screen to the internal ground terminal
- Screw down the connection compartment lid.

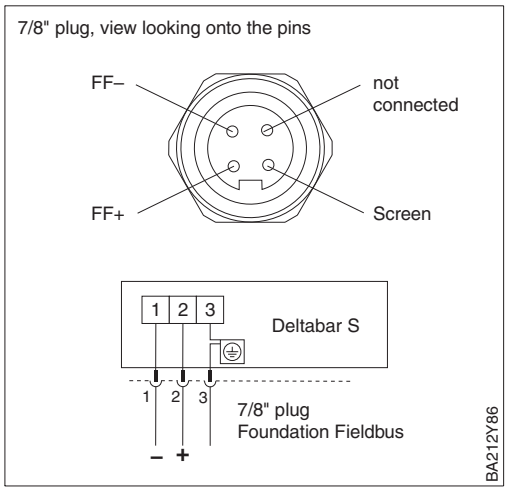
7/8" plug

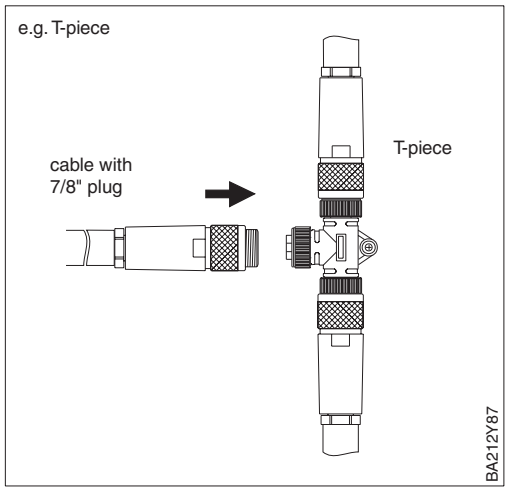
The Deltabar S Foundation Fieldbus version with 7/8" plug is supplied ready wired and need only be connected to the FF H1 bus by means of a suitable cord set.

Note!

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

- 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 Synopsis

There are two possibilities of connecting up a foundation fieldbus:

- either with a direct connection to a FF/H1 card
- or with an indirect connection via a linking device

Fig. 3.1 illustrates both possibilities.

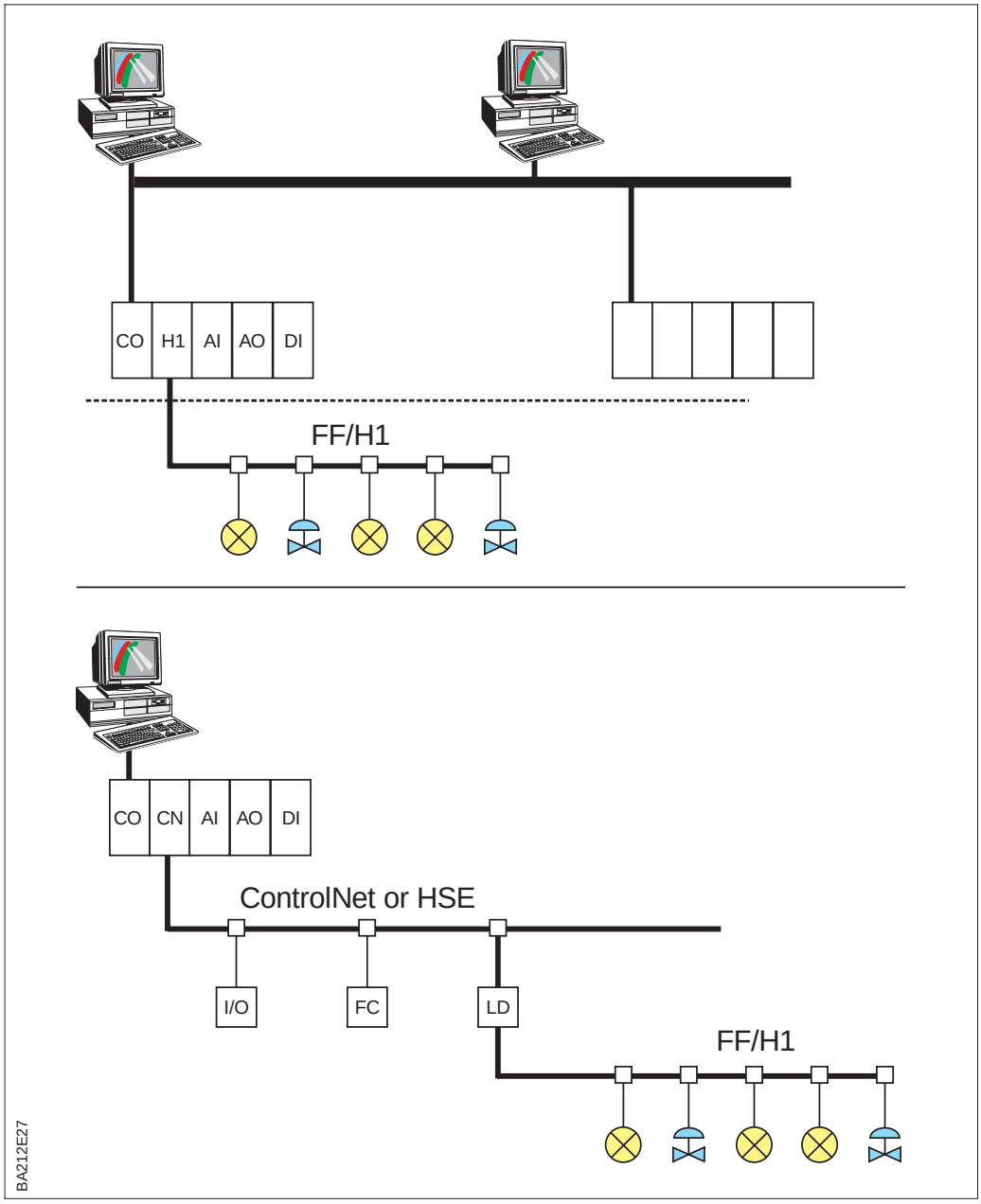


Figure 3.1
Foundation Fieldbus principle of operation

Above: Direct connection to FF/H1 card
Below: Connection via a linking device

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

3.2 Hardware settings

A DIP-switch in the connection compartment of the Deltabar S controls allows the write protection and simulation functions to be set via hardware.

The default settings of the switches are as follows:

WP OFF: write protection via hardware is disabled
SIM ON: simulation is enabled (= allowed in configuration tool).

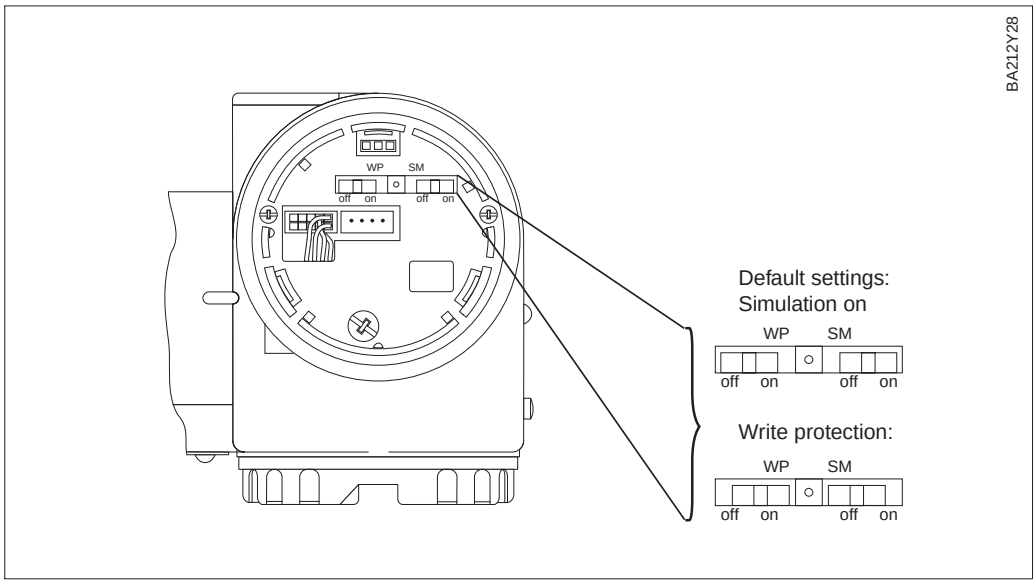


Figure 3.2
Deltabar S DIP-switch

Device identification

Foundation Fieldbus identifies the device by its identification code and automatically allocates an appropriate field address. There is no separate hardware switch for this purpose.

When the device has been integrated into the network, see Chapter 3.3, it appears as follows in the bus tree:

E+H_DELTABAR_S_XXXXXXXX

A click on the name reveals the device tag, device ID and node address. The device ID is made up of the following components:

Device_ID = 452B481009-XXXXXXXX

whereby:
452B48 = ID code for Endress+Hauser
1009 = ID code for Deltabar S
XXXXXXXX = Device serial number, as printed on the name plate

A right-hand mouse click on the name opens up a menu from which the PD_TAG and NODE_ADDRESS can be changed.

3.3 Network configuration

During the configuration of the FF network, the device description (DD) of the Deltabar S must be downloaded into the directory foreseen for it.

- Start the interface configuration tool.
- Configure the interface.
- Call the DD download routine
- Download the device descriptions (.ffo and .sym files) to the directory offered.
- When the configuration is complete, close the tool and the FF stack (if open).

The Deltabar S device descriptions can be ordered direct from Endress+Hauser or downloaded from our website *www.endress.com*. They contain all data necessary to operate Endress+Hauser Foundation Fieldbus devices.

Start-up

Start the bus configuration tool. After start-up, the tool shows the network configuration in the form of an expandable tree. If the Deltabar S has been connected correctly, it can now be identified:

—
—E+H_DELTABAR_S_XXXXXXXX
—

A double click on the name reveals the device data, see also page 18:

PD_TAG	the physical name of the device
DEVICE_ID	the unique device identifier
NODE_ADDRESS	the fieldbus node to which the device is connected (is automatically allocated by the Configurator)

A click on the name expands the device tree to show the function blocks available for it:

—
—E+H_DELTABAR_S_XXXXXXXX
—RESOURCE_XXXXXXXX (RB)
—TRANSDUCER_XXXXXXXX (TBPR)
—ANALOG_INPUT_XXXXXXXX (AI)

The relationship between the blocks is shown in Fig. 3.3, the function of each block in Chapters 3.4 to 3.6.

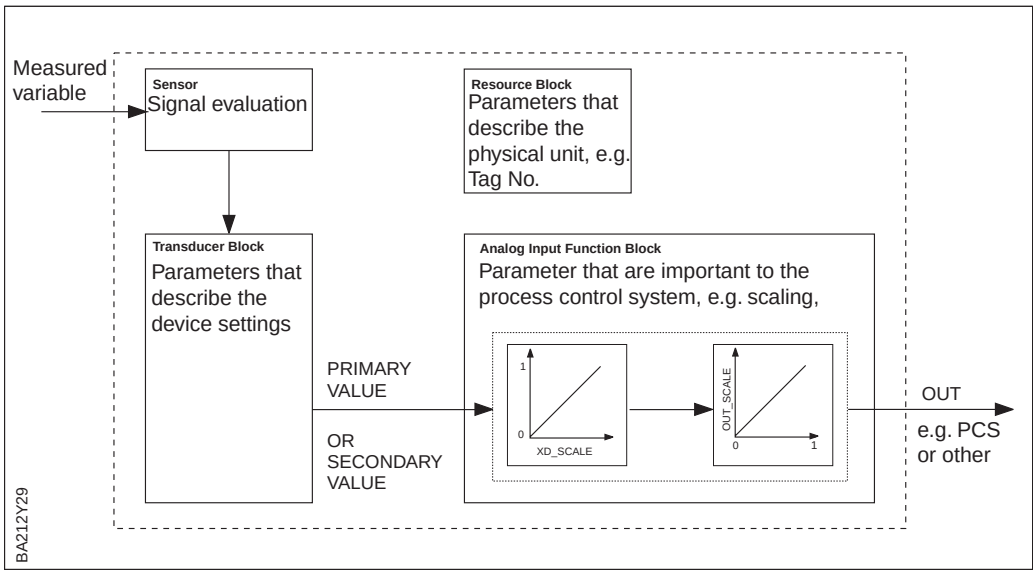


Figure 3.3
Block model of device

3.4 Resource block

The resource block contains the parameters used to describe physical resources of the device. It has no linkable inputs or outputs. It is opened by a click on the resource line.

—
—E+H_DELTABAR_S_XXXXXXXX
—RESOURCE_XXXXXXXX (RB)
—TRANSDUCER_XXXXXXXX (TBPR)
—ANALOG_INPUT_XXXXXXXX (AI)

If the NI-FBUS Configurator is being used, a series of file tabs appears on the screen. The files can be opened to view and/or edit the parameters in the following table. A short description of the parameter function appears on the side of the screen. A change in the parameter is stored by pressing the WRITE CHANGES button when the block is out of service. Press the READ ALL button to check the values stored in the device. The following are of particular interest.

Parameter	Description
TAG_DESC	User description of the intended application of the block.
MODE_BLK	Lists the actual, target, permitted and normal operating modes of the block. Target: changes the operating mode of the block Actual: indicates the current operating mode of the block Permitted: states which operating modes are allowed Normal: indicates the normal operating mode of the block The possible operating modes of the resources block are: AUTO: the block is operating as normal OOS: the block is out of service. If the resource block is out of service, then all blocks within the device (resource) are forced into the same status.
RS_STATE	Indicates the state of the resource block application state machine On-line: block in AUTO mode Standby: block in OOS mode
WRITE_LOCK	Indicates the status of DIP-switch WP.
RESTART	Allows a manual restart: UNINITIALISED: no status RUN: normal operational status RESOURCE: resets the resource block parameters DEFAULTS: Resets all Foundation Fieldbus parameters within the device, but not the manufacturer specific parameters. PROCESSOR: make a warm start of the processor
BLOCK_ERROR	Shows error status of software and hardware components Out-of-Service: the block is in OOS mode Simulation active: shows the setting of DIP-switch WP
BLOCK_ALM	Shows any configuration, hardware, connection and system problems in the block. The cause of the alert is to be seen in the subcode field.

The function of the resource block parameters not described here can can be taken from the Foundation Fieldbus specification, see *"http://www.fieldbus.org"*.

3.5 Transducer block

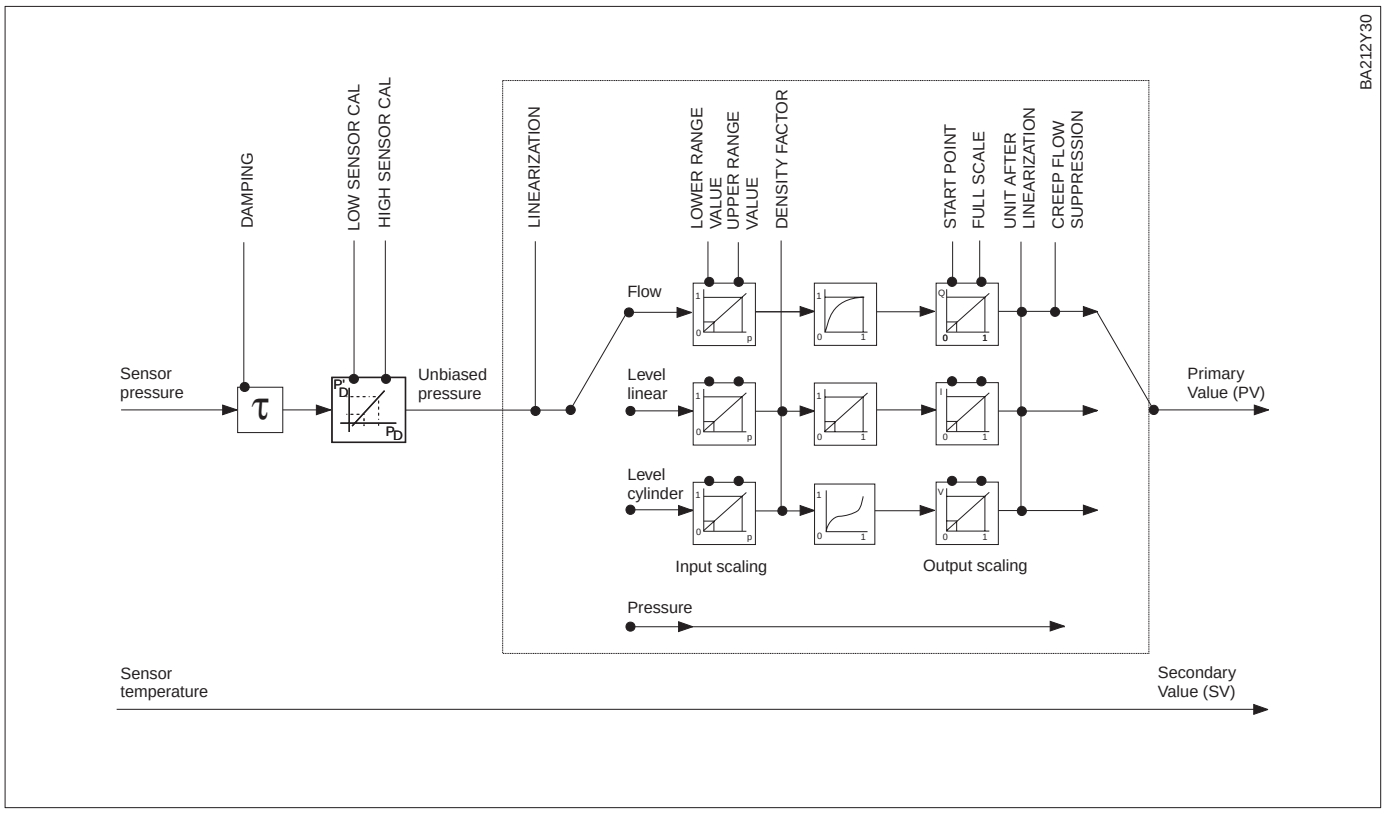


Fig. 3.4
Schematic diagram of transducer block: the parameters shown represent a typical calibration sequence for a standard application

The transducer block contains the parameters required to calibrate the device.

Operation

The transducer block is opened by clicking on the transducer line.

—
—E+H_DELTABAR_S_XXXXXXXX
—RESOURCE_XXXXXXXX (RB)
—TRANSDUCER_XXXXXXXX (TBPR)
—ANALOG_INPUT_XXXXXXXX (AI)

Parameters changes from the tool are made off-line while the device is operating. The changes are downloaded by first setting MODE_BLK = OOS then pressing the WRITE CHANGES button. Press the READ ALL button to check the values stored in the device. Normally operation is resumed as soon as MODE-BLK is set to AUTO.

Block administration

Parameter	Description
MODE_BLK	See description in Resource block. The possible operating modes of the transducer block are: AUTO: the block is operating as normal. MAN: the block is operated with a manually entered primary value. OOS: the block is out of service.
TAG_DESC	User description of the intended application of the block.
BLOCK_ERROR	Shows the error status associated with the block components Out-of-Service: the block is in OOS mode. Simulation active: shows the setting of DIP-switch WP. Input failure/process variable has BAD status.

Output values

Parameter	Description
PRIMARY_VALUE	Primary value output by transducer block, here it is pressure or linearization value
SECONDARY_ VALUE	Secondary value output by transducer block, here it is temperature

Configuration parameters

The parameters listed in the following table are manufacturer-specific and can be used to configure the device as described in Chapter 5. Refer also to Fig.: 3.4.

The transducer block also contains standard profile parameters. Some of these, e.g. CAL_POINT_HI and CAL_POINT_LO can be changed but have no effect on the device. If the user desires, however, he can enter data relevant to the calibration in the SENSOR_CAL_ parameters and enter a tag description for the transducer block in TAG_DESC.

Parameter	Description
Measured Value *	Indicates the current value measured by the device.
Lower Range Value	Entry of pressure for lower range-value – zero, (affects bargraph)
Upper Range Value	Entry of pressure for upper range-value – span, max. turndown 20:1 (affects bargraph)
Set Lower Range Value	Acting pressure is taken as lower range-value – zero, (affects bargraph)
Set Upper Range Value	Acting pressure is taken as lower range-value – span, max. turndown 20:1, (affects bargraph)
Set Bias Pressure	Entry of bias pressure, parameter "Biased Pressure" adopts the new value. Operating mode "linear (pressure)": Display correction for parameters "Measured Value", "Upper Range Value" and "Lower Range Value"
Bias Pressure Automatically	Acting pressure is taken as bias pressure, parameter "Biased Pressure" adopts the new value. Operating mode "linear" (pressure): Display correction for parameters "Measured Value", "Upper Range Value" and "Lower Range Value"
Set Output Damping	Sets the damping time for the transducer block output signal (Primary Value), Range: 0 - 40 s

* Display value

Configuration parameters (cont.)

Parameter	Description
Select Pressure Unit	Changes the pressure units. Options: mbar, bar, Pa, hPa, kPa, MPa, mm H_2O, m H_2O, in H_2O, ft H_2O, psi, g/cm^2, kg/cm^2, kgf/cm^2, atm, lb/ft^2, Torr, mm Hg or in Hg (All pressure-specific parameters are recalculated and shown in these units.)
Diagnostic Code *	Indicates the current diagnostic code with associated message of any device alarm, see Chapter 9.1.
Last Diagnostic Code*	Indicates the previous diagnosic code with message registered by the device, see Chapter 9.1.
Clear Last Diagnostic Code	Clears last diagnostic code. Options: # – no action, clear – message is delected
Transducer_sw_ vers *	Indicates the measuring software version of the device.
Min. Pressure *	Maximum pointer function for the smallest measured pressure value.
Reset Min. Pres Peak Hold	Options: # – no action, reset – Acting pressure value is adopted for the parameter "Min. Pressure".
Max. Pressure *	Maximum pointer function for the largest measured pressure value.
Reset Max. Pres Peak Hold	Options: # – no action, reset – Acting pressure value is adopted for the parameter "Max. Pressure".
Integer Counter high *	Counter for pressure values above the upper range-limit (parameter "High Sensor Calibration"), max value = 255 Options: # – no action, clear – counter is reset to "0"
Sensor Temperature *	Display of actual measured temperature in the selected unit.
Min. Temperature *	Maximum pointer function for the smallest measured temperature.
Reset min Temp. Peak Hold	Options: # – no action, reset – Current temperature is adopted for the parameter "Min. Temperature".
Max. Temperature *	Maximum pointer function for the largest measured temperature.
Reset max Temp. Peak Hold	Options: # – no action, reset – Current temperature is adopted for the parameter "Max. Temperature".
Default Values	When "5140" is entered here the device parameters are reset to their factory setting, see Chapter 9.3
Linearization (operating mode)	Adjusting the operating mode. Options: linear (pressure), square root function (flow), level linear (level, volume or weight), level horizontal cylinder (volume and weight)
Start Point	For operating modes: "square root function", "level linear" and "level horizontal cylinder" – zero for output scaling (corresponds to lower range-value)
Full Scale	For operating modes: "square root function", "level linear" and "level horizontal cylinder" – scale value for output scaling (corresponds to upper range-value)
Unit After Liniarization	Selecting units for measuring the level, volume, weight or flow – the options depend on the operating mode selected. The linearized value is shown in "Measured Value" in these units. The measured value is not converted into the new units.

* Display value

Configuration parameters (cont.)

Parameter	Description
Density Factor	For operating modes: "level linear" and "level cylinder" - applications with media with a density not equal to 1 gm/cm³. The pressure is divided by this factor before carrying out the linearization function. This ensures that it is adapted to the material.
Creep Flow Suppression	Only for operating mode: square root function (flow). Entry is always in % of flow. Suppresses the display on small flow rates.
Low Sensor Calibration	Sets the low sensor calibration value.
High Sensor Calibration	Sets the high sensor calibration value.
Low Sensor Limit *	Lower range-limit of sensor (Unit selectable with "Select Pressure Unit")
High Sensor Limit *	Upper range-limit of sensor (Unit selectable with "Select Pressure Unit")
Sensor Pressure *	Sensor pressure (Unit selectable with "Select Pressure Unit")
Temperature Unit	Changes the temperature units. Options: °C, K,°F
Unbiased Pressure *	Display of current pressure value without bias correction
Biased Pressure *	Display of current pressure value with bias correction, (corresponds to the parameter "Measured Value", when the operating mode is set to "linear" (pressure)).
Security Locking	Software write lock for the parameters: a number ≠ to 130 locks the parameter, 130 unlocks the parameter, see Chapters 6.4, 7.6, 8.4
Serial-No. SENS. *	Display of the sensor serial number
Process Conn. P+	Material of process connection + side
Process Conn. P–	Material of process connection – side
Gasket	Material of seal
Process Diaphram.	Material of diaphragm
Fill Liquid	Oil filling

* Display value

3.6 Analog input block

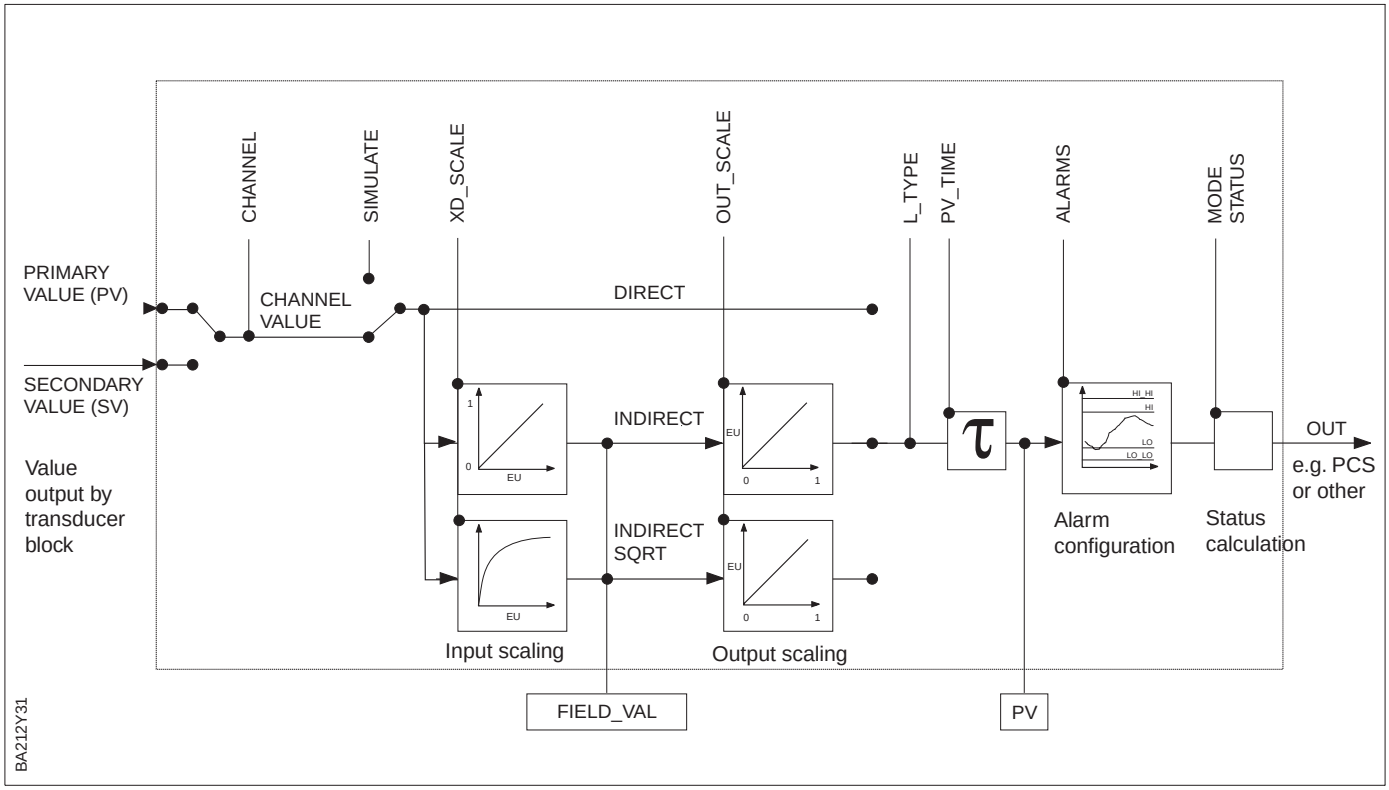


Fig. 3.5
Schematic diagram of analog input block as used in AUTO mode

The analog input block conditons the signal output by the transducer block and outputs signal to the PCS or other function blocks.

Operation

The block is opened by a click on the analog input line.

—E+H_DELTABAR_S_XXXXXXXX
—RESOURCE_XXXXXXXX (RB)
—TRANSDUCER_XXXXXXXX(TBPR)
—ANALOG_INPUT_XXXXXXXX (AI)

Parameters changes from the tool are made off-line while the device is operating. The changes are downloaded by first setting MODE_BLK = OOS then pressing the WRITE CHANGES button. Press the READ ALL button to check the values stored in the device. Normally operation is resumed as soon as MODE-BLK is set to AUTO.

Block administration

Parameter	Description
TAG_DESC	User description of the intended application of the block.
MODE_BLK	See description in Resource block The possible operating modes of the analogue input block are: AUTO: the block is operating as normal. MAN: the block is operated with a manually entered primary value. OOS: the block is out of service.
BLOCK_ERROR	Shows the error status associated with the block components. Out-of-Service: the block is in OOS mod.e Simulation active: shows the setting of DIP-switch WP. Input failure/process variable has BAD status

Output values

Parameter	Description
PV	Either the primary transducer block value used to execute the block or a process value associated with it. Comprises value and status.
OUT	The primary value output as a result of executing the analog input block. Comprises value and status.
FIELD_VALUE	Raw value of field device in % of PV range with a status reflecting the transducer condition before signal characterisation L_Type or filtering PV_TIME. Comprises value and status.

Scaling

Parameter	Description
CHANNEL	Selects the measured value to be input to the analogue input block 0 = no channel defined 1 = primary value, here it is pressure and linearization value 2 = secondary value, here it is: sensor temperature
XD_SCALE	Scales the transducer block value in the required engineering units (EU).
OUT_SCALE	Scales the output value in the required engineering units (EU).
L_TYPE	Sets the linearization type: DIRECT: the transducer block value bypasses the scaling functions INDIRECT:the transducer block value is fed through the linear scaling functions INDIRECT SQRT: the transducer block value is fed through the square root scaling functions

The relationship between the output values and scaling paramaters for the Deltabar S is as follows:

$$FIELD\_VAL = 100 \times \frac{(CHANNEL\ VALUE - XD\_SCALE\_MIN)}{(XD\_SCALE\_MAX - XD\_SCALE\_MIN)}$$

The L_TYPE parameter influences the signal conversion.

Direct:

$$PV = CHANNEL\_VALUE$$

Indirect:

$$PV = \frac{FIELD\_VAL}{100} \times (OUT\_SCALE\_MAX - OUT\_SCALE\_MIN) + OUT\_SCALE\_MIN$$

Indirect square root:

$$PV = \sqrt{\frac{FIELD\_VAL}{100}} \times (OUT\_SCALE\_MAX - OUT\_SCALE\_MIN) + OUT\_SCALE\_MIN$$

The XD_SCALE and OUT_SCALE values are expressed in engineering units at 0% for MIN and 100% for MAX.

Output response

Parameter	Description
LOW_CUT	**Not relevant to level measurement!** Determines a threshold for square root linearization below which the output value is set to zero.
PV_FTIME	Sets the time constant for the output value.

Alarms

Parameter	Description
ACK_OPTION	Sets the way in which alarms and warnings are to be acknowledged.
ALARM_HYS	Sets the hysteresis (in output engineering units) for all configured alarms. A hysteresis of e.g. 2% on a HI_HI_LIMIT of 95% would cause the alarm to activate when the level reaches 95% and to deactivate when the level drops below 93%. A hysteresis of e.g. 2% on a LO_LO_LIMIT of 5% would cause the alarm to activate when the level drops below 5% and to deactivate when the level rises to 7%.
HI_HI_PRI	The priority (1 – 15) of the HI_HI alarm
HI_HI_LIM	Sets the HI_HI alarm limit in output engineering units
HI_PRI	The priority (1 – 15) of the HI alarm
HI_LIM	Sets the HI warning limit in output engineering units
LO_PRI	The priority (1 – 15) of the LO alarm
LO_LIM	Sets the LO warning limit in output engineering units
LO_LO_PRI	The priority (1 – 15) of the LO_LO alarm
LO_LO_LIM	Sets the LO_LO alarm limit in output engineering units

Alarm prorities

Priority	Description
0	Alarm is suppressed
1	Recognised by the system but not reported
2	Reported to the operator, but does not require his attention
3 – 7	Advisroy alarms of increasing priority
8 – 15	Critical alarms of increasing priority

Alarm status

Parameter	Description
HI_HI_ALM	The status of the HI_HI alarm
HI_ALM	The status of the HI alarm
LO_ALM	The status of the LO alarm
LO_LO_ALM	The status of the LO_LO alarm

Simulation

The SIMULATE parameter allows transducer block output value to be simulated, provided simulation has also been enabled at the device DIP switch. The simulation must be enabled, a value and/or status entered and the block must be in AUTO mode. During simulation the transducer output value is substituted by the simulated value.

A simulation is also possible by switching the block to manual and entering a value for OUT, see Chapter 9.2.

Parameter	Description
SIMULATE	Enables, sets and displays a simulated value, options: enable/disable simulated value output value

3.7 Control loops

The following is an example of a simple control loop which uses the level analog input block, flow analog input block, two PID blocks (e.g. from flowmeter and valve) and a valve analog output block. The connections between the function blocks can be made in the configuration tool.

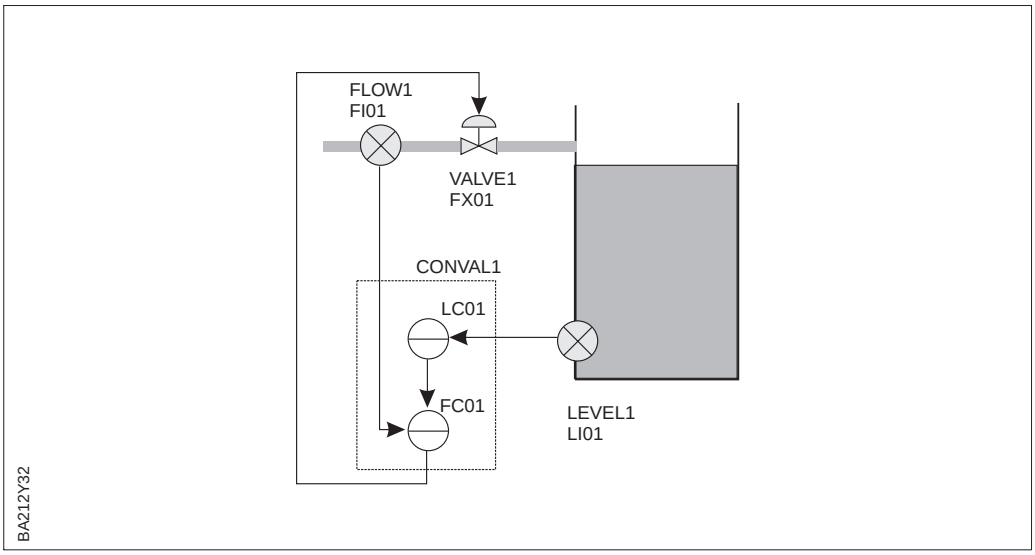


Figure 3.6
Schematic diagram of control loop

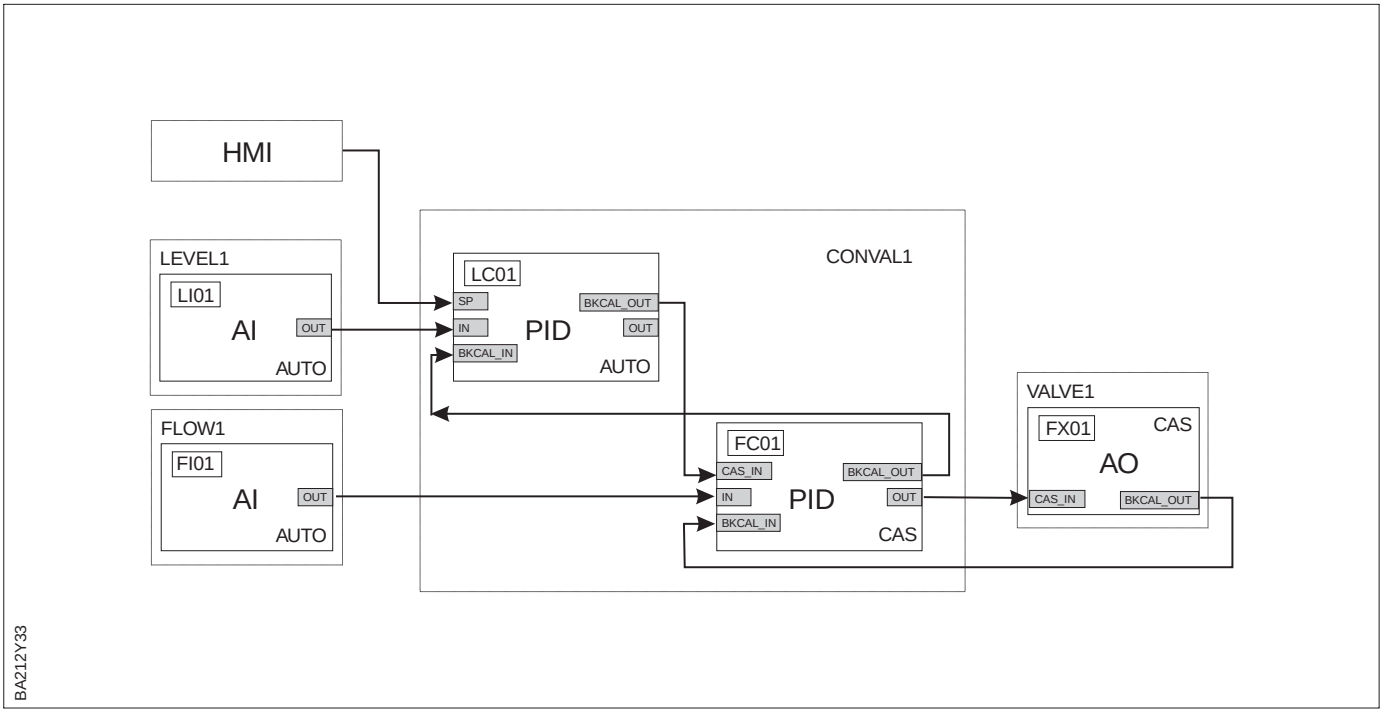


Fig. 3.7
Function block connections

3.8 Methods

The Foundation Fieldbus specification provides for the use of so-called methods to simplify the operation of the device. A method is an interactive sequence of steps that must be followed in order to obtain a particular function from the device.

Thus, for example, the steps given in Chapters 6.1 and 6.2 for the basic calibration of the device:

- Reset
- Lower Range Value
- Upper Range Value
- Bias Pressure
- Damping

might comprise a method named "Basic calibration step 1". The user could call up this method to calibrate the device. He need do nothing else but supply the information which the method asks for as it progresses through each step. The setting of the block mode, reading, writing and checking of the parameters etc. are automatically done by the program.

A method is part of the device description supplied with the device. It is intended that methods will be provided for all Endress+Hauser devices. The current device description of the Deltabar S, however, does not support methods at this stage.

3.9 Checklist for commissioning

1. Configure the network and integrate the device.
   – Identify the device by means of the device ID and serial number.
   – If appropriate, assign a new PD_TAG, see page 19.

2. Configure the resource block, see Chapter 3.3.
   – Check the position of the hardware switch in WRITE_LOCK:
   – If "locked" is displayed, change the position of the DIP-switch, see Chapter 3.2.
   – If appropriate, change the block tag (right-hand click on tree).
   – Set MODE_BLK_TARGET to Out-of-Service.
   – Reset the device to factory values by using the function RESTART => Defaults
   (this function may also be available with a right-hand click on the device name)
   – If appropriate, assign a tag description (TAG_DESC).
   – Set MODE_BLK_TARGET to Auto.

3. Configure the transducer block, see Chapters 3.5 and 6 to 8.
   – If appropriate, change the block tag (right-hand click on tree).
   – Set MODE_BLK_TARGET to Out-of-Service.
   – If appropriate, assign a tag description (TAG_DESC)
   – Configure the device as described in Chapters 6 to 8 (via FF configurator).
   – Set MODE_BLK_TARGET to Auto.

4. Configure the analog input block, see Chapters 6.5, 7.7 and 8.5.
   – If appropriate, change the block tag (right-hand click on tree).
   – Set MODE_BLK_TARGET to Out-of-Service.
   – If appropriate, assign a tag description (TAG_DESC).
   – Set Channel to 1.
   – Set L_TYPE to "DIRECT" if the OUT value is to be in technical units e.g. bar
   to "INDIRECT" if the OUT value is to be scaled, see page 26 or Chapters 6.5, 7.7 and 8.5 .
   – Set the desired output damping in PV_TIME.
   – If appropriate, set the advisory and critical alarms.
   – Set MODE_BLK_TARGET to Auto.

5. Link the function blocks in the function block editor.

6. If appropriate, check the configuration by using the SIMULATE function,
   see also Chapter 9.2.

7. Download the configuration (right-hand click on device name).

4 Operation

4.1 On-site operation

Operating elements

Four keys, which allow the zero and span to be set, are available for on-site operation. In the "pressure" operating mode, they are effective only for the bargraph and numerals in the display module. The key functions are listed in the table below.

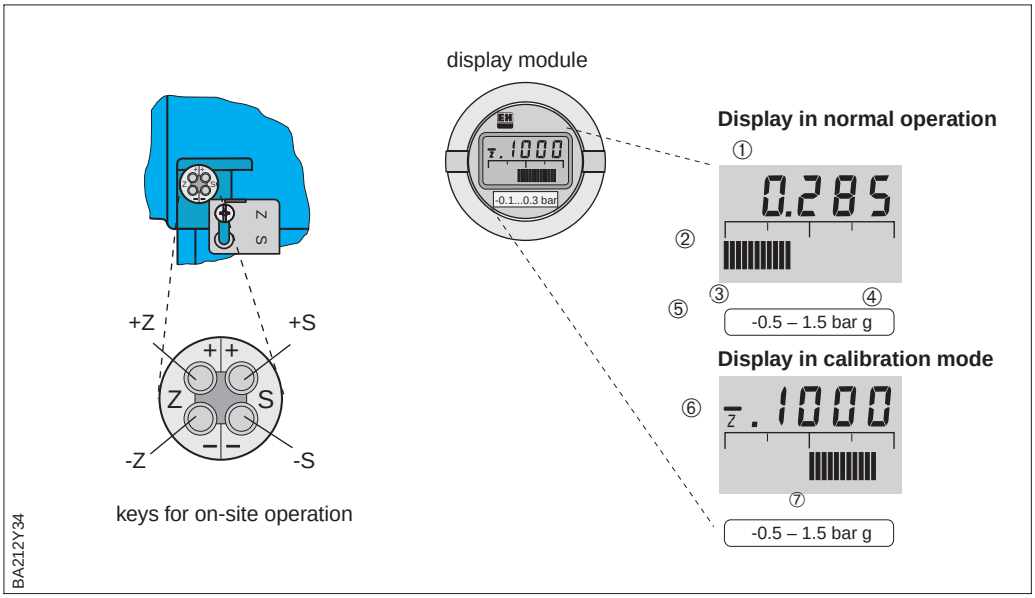


Figure 4.1
User interface of the Cerabar S with optional display module

Display in normal operation
① *4-figure dispaly of measured value and entered parameters*
② *Bargraph of measured value*
③ *Lower range-value (zero)*
④ *Upper range-value (span)*
⑤ *Nominal measuring range*
In addition for display in calibration mode
⑥ *Display of the calibration point (Z=Zero, S=Span)*
⑦ *Set measurement range within the limits of the measuring point*

Key functions	
+Z	increases the lower range-value (zero) by +1 digit
–Z	decreases the lower range-value (zero) by –1 digit
+S	increases the upper range-value (span) by +1 digit
–S	decreases the upper range-value (span) by –1 digit
Key combinations (Press keys simultaneously)	
Keys	Function
Calibration	
1x +Z and –Z	the acting pressure is taken as zero (lower range-value)
1x +S and –S	the acting pressure is taken as span (upper range-value)
Bias pressure	
2x +Z and +S	the acting pressure is taken as bias pressure
1x +Z and +S	the current bias pressure is displayed
2x –Z and –S	the current bias pressure is deleted
Secure measuring point	
1x +Z and –S	lock measuring point
1x –Z and +S	unlock measuring point

Table 4.1
Key functions

Display module

A display module is available as an option. It has two display modes:
Display during measurement: standard operational mode
Display during calibration: is activated by pressing one of the keys +Z, –Z, +S or –S twice. Automatically returns to measurement mode after 2 s.

4.2 Calibration via a configuration tool

The basic calibration and other functions can be set using a configuration tool. See Chapter 6 for pressure measurement, Chapter 7 for level measurement and Chapter 8 for flow measurement. The majority of the parameters are to be found as manufacturer's parameters in the transducer block, see Chapter 3.5. The scaling of the analog input block, Chapter 3.6, is also to be found in Chapters 6.5, 7.7 and 8.5.

Procedure

1) Integrate the device into the configuration tool before calibrating, see Chapter 3.2.
2) Select the transducer block to perform the calibration, select the analog input block for the scaling.
3) Set the MODE_BLK parameter to “Out of Service” before proceeding.
4) **Download the edited parameter before proceding with the next step.**
5) Switch the MODE_BLK to “Auto” when the calibration is complete.

Note!
For the NI-FBUS configurator, the transducer block parameters are to be found in the “Others” folder, the analog input block parameters in the “Scaling” folder.

Note!

5 Commissioning: Calibration and Valve Operation

Deltabar PMD 230/235: The chapter describes how measuring points equipped with three-valve manifolds are operated. Since the valves are usually operated manually, the position calibration (bias pressure) is made on-site using the keys.

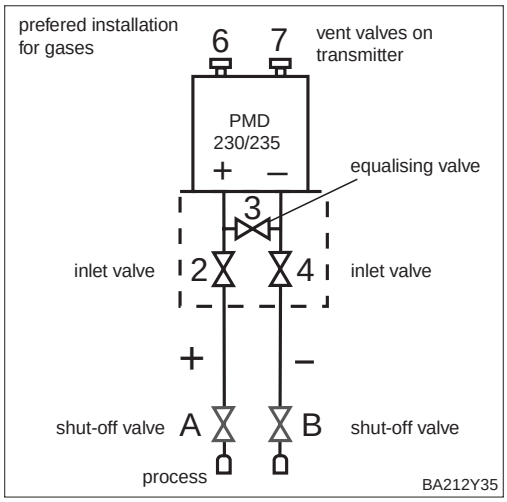
Deltabar S FMD 230/630/633: After the opening of any shut-off valves, the transmitter can be calibrated on-site or via Foundation Fieldbus.

Note!

Note!
Extended functions, e.g. damping, flow or level measurement are set via a configuration tool as described in the appropriate chapter. Zero and span affect the bargraph and linearization start and end points only.

5.1 Function of the manifolds

Three-valve manifold



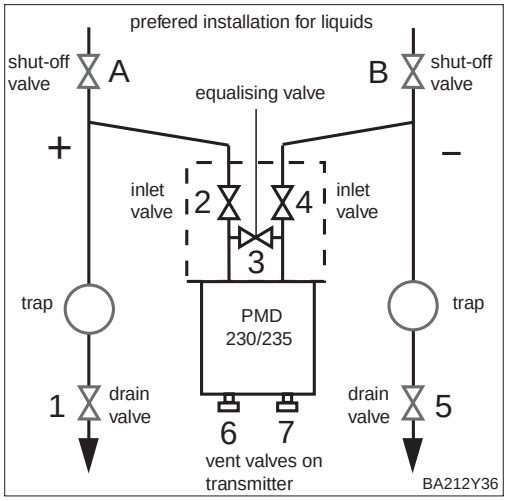
The three-valve manifold comprises two inlet valves and an equalising valve.

- Inlet valves (2 and 4):
  Cut off the transformer from the pressure piping.
- Equalising valve (3):
  Equalises the pressure on the positive and negative sides.

It is often necessary to shut-off the pressure piping from the tapping points by using two shut-off valves (A and B).

Dirty liquids

Drain valves or blow-off valves are usually required in dirty liquids which tend to build-up. The arrangement comprises:



- Drain valves or blow-off valves (1 and 5):
  Drain or blow off deposits in the pressure piping
- Inlet valves (2 and 4):
  Cut off the transformer from the pressure piping.
- Equalising valve (3):
  Equalises the pressure on the positive and negative sides.

It is often necessary to shut-off the pressure piping from the tapping points by using two shut-off valves (A and B).

Note!

Note!
In power stations, this arrangement is often realised as a special five-way manifold.

5.2 Differential pressure measurement

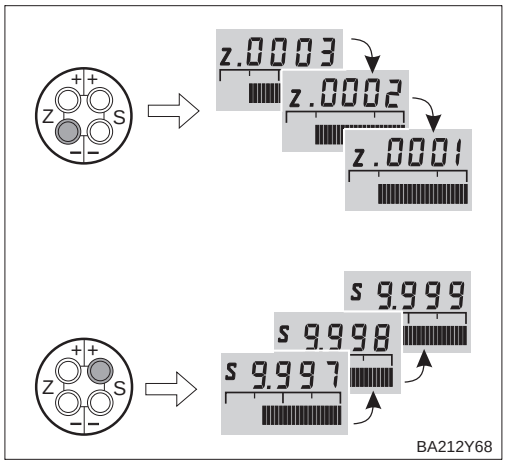
This chapter contains the following information:

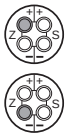
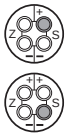
- General description of operating with keys
- Commissioning the measuring point

Chapter 6 describes pressure measurement and commissioning via a configuration tool.

Zero and span: calibration without reference pressure

The desired zero and span (lower and upper range values) are set using keys.



#	Key	Entry
1		Press +Z or –Z repeatedly to calibrate zero (lower range-value) (As the span remains constant, the upper range value is shifted to the same extent as the lower range value.)
2		Press +S or –S repeatedly to calibrate span (upper range-value) (The lower range is unaffected.)

Zero and span: calibration with reference pressure

A reference pressure is available that corresponds exactly to zero and span (lower range and upper range values) required.

#	Key	Entry
1	Exact pressure for zero is acting	
2		Press +Z and –Z simultaneously once (As the span remains constant, the upper range value is shifted to the same extent as the lower range value.)
3	Exact pressure for span is acting	
4		Press +S and –S simultaneously once (The lower range is unaffected.)

Bias pressure (only display)

If the display does not show zero after zero point adjustment (due to position), then this can be corrected to zero by entering a bias pressure or by adopting the bias pressure acting (depending on position).

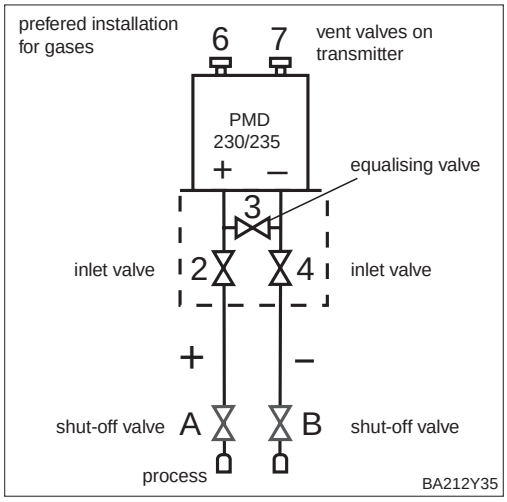
#	Key	Entry
1		**Correcting the display** Press +Z and +S simultaneously twice: The bias pressure acting is adopted.
2		**Displaying the bias pressure** Press +Z and +S simultaneously once: The bias pressure entered is shown briefly.
3		**Deleting the bias pressure** Press –Z and –S simultaneously twice: The bias pressure entered is deleted.

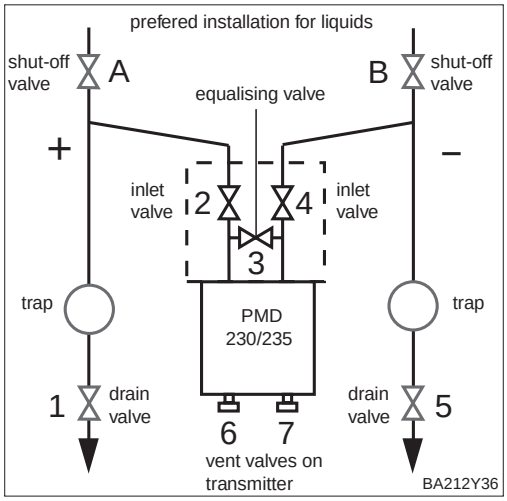
Comissioning the measuring point

The span (span–zero) is either preset (without reference pressure), or is calibrated during operation (with or without reference pressure).

Caution!

Caution!
When opening and closing valves to the process, care must be taken to avoid overheating or one-sided overloading (beyond specifications) of the measuring cell. If the measuring range is adjusted, the ouput signal may not lead to impermissible jumps in the control loop.





#	Valve	Significance
1	Close 3	
2	Fill measuring system with medium	
	Open A, B, 2, 4	Let in medium
3	Clean pressure pipes if required* – for gases with compressed air – for liquids by washing out	
	Close 2 and 4	Shut off transmitter
	Open 1 and 5*	Blow out/wash out pressure piping
	Close 1 and 5*	Close valves after cleaning
4	Let air out of transmitter	
	Open 2 and 4	Let in medium
	Close 4	Close negative side
	Open 3	Connect positive and negative side
	Briefly open 6 and 7 then close again	Fill transmitter with medium and let out air
5	Set measuring point for measurement	
	Close 3	Shut off positive from negative side
	Open 4	Connect negative side
	Now: 1*, 3, 5*, 6 and 7 are closed 2 and 4 are open A and B are open (if present)	
6	Set zero to initial pressure and display to zero – Filters: Shut off flow or enter minimum flow for clean filters – Tanks or pipe pressure: enter initial pressure	
		Zero: Press +Z and –Z simultaneously once
		If appropriate correct the display.: Press +Z and +S simultaneously twice
7	Set span to final pressure – Filters: Shut off or allow minimum flow for contaminated filters – Tanks or pipe pressure: enter final pressure	
		Span: Press +S and –S simultaneously twice
7	Select operating mode "Pressure linear" (parameter "Linearization") via configuration tool. Set parameter "Output Damping" etc. via configuration tool. See Chapter 6.	
8	Measuring point is ready for measurement	

* For arrangements with five valves only

5.3 Level measurement

This chapter contains the following information:

- General description of operating with keys
- Commissioning the measuring point

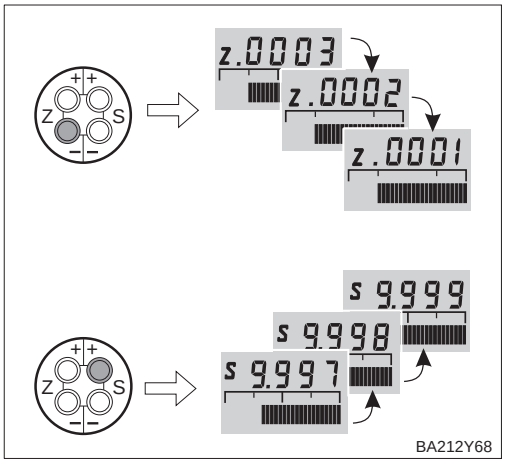
Note: Calibration with keys
If initial start-up is not carried out via a configuration tool then any display mounted will show pressure values with zero point compensation. After initial settings via a configuration tool, level can be shown in other units (level, volume, mass). See chapter 7.2.

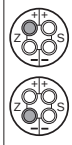
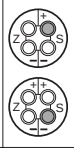
Note!

Chapter 7 describes level measurement and commissioning via a configuration tool.

Zero and span: calibration without reference pressure

The desired zero and span (lower and upper range values) are set using keys.



#	Key	Entry
1		Press +Z or –Z repeatedly to calibrate zero (lower range-value) (As the span remains constant, the upper range value is shifted to the same extent as the lower range value.)
2		Press +S or –S repeatedly to calibrate span (upper range-value) (The lower range is unaffected.)

Zero and span: calibration with reference pressure

A reference pressure is available that corresponds exactly to zero and span (lower range and upper range values) required.

#	Key	Entry
1	Exact pressure for zero is acting	
2		Press +Z and –Z simultaneously once (As the span remains constant, the upper range value is shifted to the same extent as the lower range value.)
3	Exact pressure for span is acting	
4		Press simultaneously +S and –S once (The lower range is unaffected.)

Bias pressure (only display)

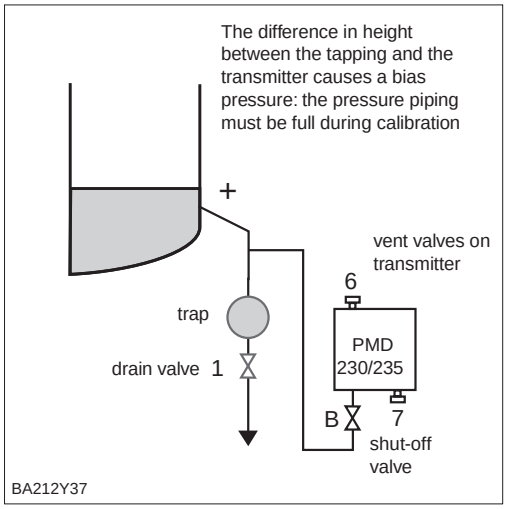
If the display does not show zero after zero point adjustment (due to position), then this can be corrected to zero by entering a bias pressure or by adopting the bias pressure acting (depending on position).

#	Key	Entry
1		**Correcting the display** Press +Z and +S simultanously twice: The bias pressure acting is adopted.
2		**Displaying the bias pressure** Press +Z and +S simultanously once: The bias pressure entered is shown briefly.
3		**Deleting the bias pressure** Press –Z and –S simultanously twice: The bias pressure entered is deleted.


Caution!

Caution!
When opening and closing valves to the process, care must be taken to avoid overheating or one-sided overloading (beyond specifications) of the measuring cell. If the measuring range is adjusted, the ouput signal may not lead to impermissible jumps in the control loop.

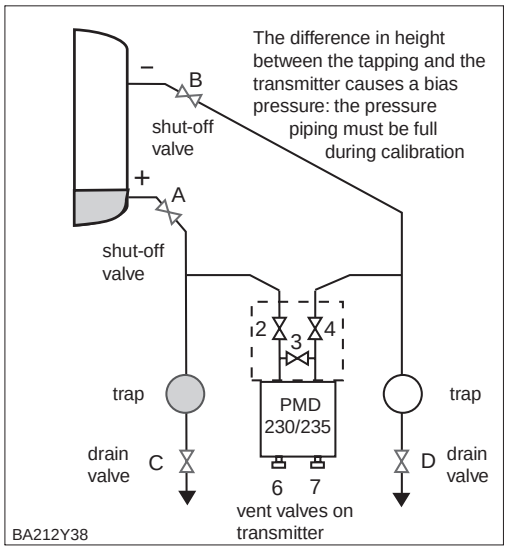
Commissioning the measuring point – open tank



#	Valve	Significance
1	Fill tank to a level above the tapping	
2	Fill measuring system with medium	
	Open B	Open shut-off valve
3	Let air out of transmitter	
	Briefly open 6 then shut again	Fill transmitter with medium and let out air
4	Set measuring point for measurement	
	Now: A and 6 are closed B is open	
5	Calibrate zero (lower range-value) and span (upper range-value) via keys (see page 37) or via configuration tool (see Chapter 7.2 or 7.3)	
6	Select operating mode "level linear" or "level cylinder" (parameter "Linearization") via configuration tool. Set parameters "Start Point", "Full Scale", "Unit After Linearization", "Output Damping" etc. via configuration tool. See Chapters 7.4-7.8.	
7	Measuring point is ready for measurement	


Note!

Note!
- If present, the trap is washed out with drain valve 1.
- The negative side of the Deltabar S is open to atmospheric pressure.
- For calibration, the positive pressure piping must be filled with medium.
- Version FMD 230/630 is ready for measurement after the opening of the shut-off valve (if present).



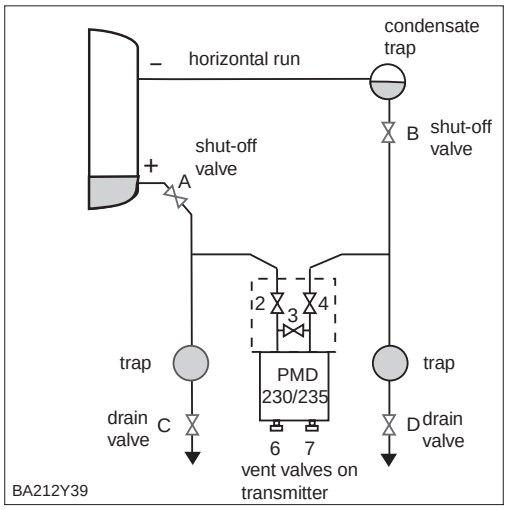
#	Valve	Significance
1	Fill tank to a level above the lower tapping	
2	Fill measuring system with medium	
	First close 3 Open A and B	Shut off positive from negative side Open shut-off valves
3	Let out air on positive side (If necessary drain negative side)	
	Open 2 and 4	Let medium into positive side
	Briefly open 6 and 7 then shut again	Fill positive side with medium and let out air
4	Set measuring point ready for measurement	
	Now: 3, 6 and 7 are closed 2 and 4 are open A and B are open (if present)	
5	Calibrate zero (lower range-value) and span (upper range-value) via keys (see page 37) or via configuration tool (see Chapter 7.2 or 7.3)	
6	Select operating mode "level linear" or "level cylinder" (parameter "Linearization") via configuration tool. Set parameters "Start Point", "Full Scale", Unit After Linearization", "Output Damping" etc. via configuration tool. See Chapters 7.4-7.8.	
7	Measuring point is ready for measurement	

Commissioning the measuring point – closed tank

Note!
- Traps, if present, are washed or blown out with valves 1 and 5.
- For calibration, the positive pressure piping must be filled with medium.
- Version FMD 230/630 is ready for measurement after the opening of the shut-off valves (if present).
- Version FMD 633 is immediately ready for measurement.


Note!

Comissioning the measuring point – closed tank with steaming liquid



#	Valve	Significance
1	Fill tank to a level above the lower tapping	
2	Fill measuring system with medium	
	Open A and B	Open shut-off valves
	Fill condensate trap or wait until enough condensate has collected. This can take some minutes.	
3	Let air out of transmitter	
	Slowly open 2 and 4	Let in medium
	Open 4	Shut off negative side
	Open 3	Connect positive and negative side
	Briefly open 6 and 7 then shut again	Fill transmitter with medium and let out air
4	Set measuring point for measurement	
	Close 3	Shut off positive from negative side
	Open 4	Connect negative side
	Now: 3, 6 and 7 are closed 2 and 4 are open A and B are open (if present)	
5	Calibrate zero (lower range-value) and span (upper range-value) via keys (see page 37) or via configuration tool (see Chapter 7.2 or 7.3)	
6	Select operating mode "level linear" or "level cylinder" via parameter "Linearization". Set parameters "Start Point", "Full Scale", "Unit After Linearization", "Output Damping" etc. See Chapters 7.4-7.8.	
7	Measuring point is ready for measurement	

Note!

Note!

- Any dirt or condensate trap is washed out with drain valves 1 or 5.
- For calibration, both positive and negative pressure piping must be filled with medium.
- Version FMD 230/630 is ready for measurement after the opening of the shut-off valves (if present).
  The "–" pressure piping must be filled with medium.
- Version FMD 633 is immediately ready for measurement.

5.4 Flow measurement

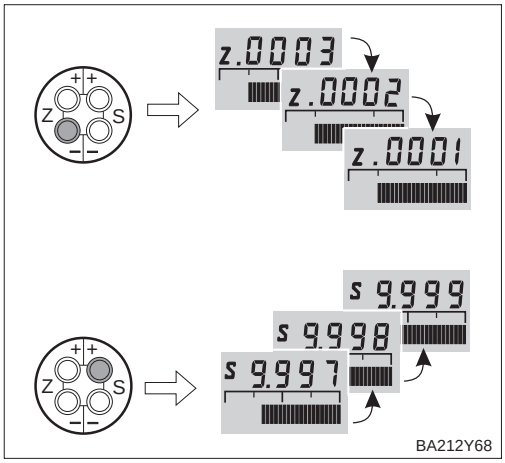
This chapter contains the following information:

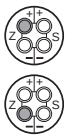
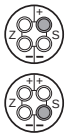
- General description of operating with keys
- Commissioning the measuring point

Chapter 8 describes flow measurement and comissioning via a configuration tool.

Zero and span: calibration without reference pressure

Zero and span (lower and upper range values) desired are calibrated with the keys. Zero corresponds to zero flow. Span is zero plus the final given in the design documentation of the transmitter.



#	Key	Entry
1		Press +Z or –Z repeatedly to calibrate zero (lower range-value) (As the span remains constant, the upper range value is shifted to the same extent as the lower range value.)
2		Press +S or –S repeatedly to calibrate span (upper range-value) (The lower range is unaffected.)

Zero and span: calibration with reference pressure

A reference pressure which corresponds exactly to the desired zero and span is available. The reference pressure for zero corresponds to zero flow. The reference pressure for span corresponds to zero plus the final pressure given in the design documentation of the transmitter.

#	Key	Entry
1	Exact pressure for zero is acting	
2		Press +Z and –Z simultaneously once
3	Exact pressure for span is acting	
4		Press simultaneously +S and –S once

Bias pressure (Display only)

If the display does not show zero with zero flow then this pessure can be corrected by entering a bias pressure.

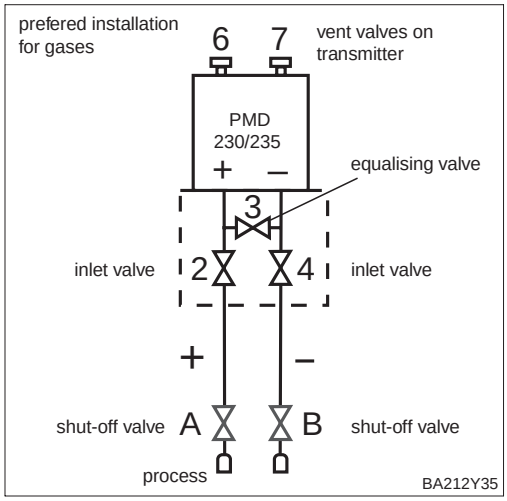
#	Key	Entry
1		**Correcting the display** Press +Z and +S simultanously twice: The bias pressure acting is adopted.
2		**Displaying the bias pressure** Press +Z and +S simultanously once: The bias pressure entered is shown briefly.
3		**Deleting the bias pressure** Press –Z and –S simultanously twice: The bias pressure entered is deleted.

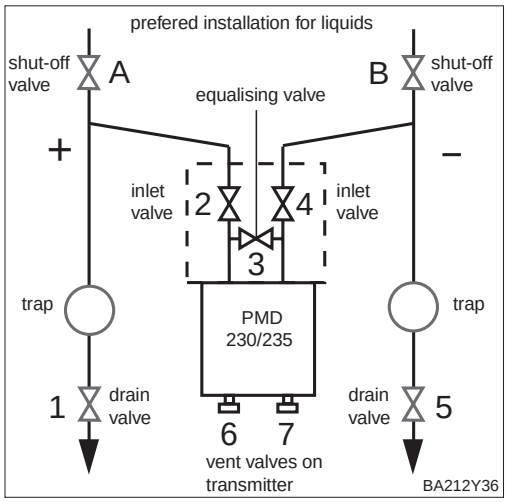
Comissioning the measuring point

The span (span–zero) is either preset (without reference pressure), or is calibrated during operation (with or without reference pressure).

#	Valve	Significance
1	Close 3	
2	Fill measuring system with medium	
	Open A, B, 2, 4	Let in medium
3	Clean pressure pipes if required* – for gases with compressed air – for liquids by washing out	
	Close 2 and 4	Shut off transmitter
	Open 1 and 5*	Blow out/wash out pressure piping
	Close 1 and 5*	Close valves after cleaning
4	Let air out of transmitter	
	Open 2 and 4	Let in medium
	Close 4	Close negative side
	Open 3	Connect positive and negative side
	Briefly open 6 and 7 then close again	Fill transmitter with medium and let air out
5	Set zero and display to zero **Note:** The following entries are only appropriate here if: – the process cannot be shut off **and** – the tapping points (A and B) are at the same height. If the flow can be shut off then this calibration of zero and display is to be carried out **after** step 6.	
		Zero: Press +Z and –Z simoultaneously once
		If appropriate correct the display: Press +Z and +S simoultaneously twice
6	Set the measuring point for measurement	
	Close 3	Shut off positive from negative side
	Open 4	Connect negative side
	Now: 1*, 3, 5*, 6 and 7 are closed 2 and 4 are open A and B are open (if present)	
7	Set zero and display to zero If flow can be shut off, then the calbration of zero and display is to be carried out here. Step 5 is then ignored.	
	Shut off flow	
		Zero: Press +Z and –Z simultaneously once
		If appropriate correct the display.: Press +Z and +S simultaneously twice
	Open flow	

#	Valve	Significance
8	Select operating mode "square root function (flow)" (parameter "Linearization") via configuration tool. Set parameters "Start Point", "Full Scale", "Unit After Linearization", "Output Damping" etc. via configuration tools. See Chapter 8.	
9	Measuring point is ready for measurement	





Caution!

When opening and closing valves to the process, care must be taken to avoid overheating or one-sided overloading (beyond specifications) of the measuring cell. If the measuring range is adjusted, the ouput signal may not lead to impermissible jumps in the control loop

6 Differential Pressure Measurement

The Deltabar S is immediately ready for measurement. The measuring range and pressure units correspond to those on the nameplate. The acting pressure is always transmitted via Foundation Fieldbus in these units. Other settings are possible via a configuration tool.

It is not possible to adjust zero and span in the conventional sense. The resolution of the measured value, however, is such that the specified accuracy of 0.1% of span is offered for "turndowns" down to 10:1. The "turndown" can be displayed via a configuration tool and the bargraph. This chapter contains the following information:

- Calibration via tool
- Locking/unlocking of the manufacturer's-specific parameters
- Analog input block parameters
- Measuring point information

6.1 Calibration via a configuration tool

The calibration is made via a configuration Fieldbus tool (remote operation).

Parameter	Description
Lower Range Value	Entry of lower range-value – zero (bargraph)
Upper Range Value	Entry of upper range-value – span; max. turndown 20:1 (bargraph)
Set Lower Range Value	Acting reference pressure is taken as lower range-value (bargraph)
Set Upper Range Value	Acting reference pressure is taken as upper range-value; max. turndown 20:1 (bargraph)
Set Bias Pressure	Entry bias pressure (only affects display module)
Bias Pres Autom	Acting pressure is taken as bias pressure (only affects display module)
Set Output Damp.	Entry of damping τ (0...40 s)
Select Press Unit	Options pressure unit: mbar, bar, Pa, hPa, kPa, MPa, mm H_2O, m H_2O, in H_2O, ft H_2O, psi, g / cm^2, kg / cm^2, kgf / cm^2, atm, lb / ft^2, torr, mm Hg or in Hg.
Linearization	Operating mode: linear (pressure)

Selecting pressure units

The units for pressure is selected with the parameter "Select Pressure Unit". After selecting new pressure units all information on the pressure are converted into the new units. Example: After selecting the units "psi" the measuring range from 0…10 bar is converted in 0…145.5 psi.

Calibration without reference pressure

A pressure for the bargraph zero and span is entered into the device. No particular pressure must be acting.

#	Parameter	Entry	Significance
1	Default Values	5140	Reset to factory setting
2	Lower Range Value	e.g. 0	Zero
3	Upper Range Value	e.g. 100	Span
4	Measured Value	e.g. 15.5	Measured value in e.g. kPa

Calibration with reference pressure

An acting reference pressure or process pressure corresponds exactly to the desired bargraph zero and span.

#	Parameter	Entry	Significance
1	Default Values	5140	Reset
2	The exact pressure for zero is acting		
3	Set Lower Value	Confirm	Register zero
4	The exact pressure for span is acting		
5	Set Upper Value	Confirm	Register span
6	Measured Value	e.g. 15.5	Measured value in e.g. kPa

Bias pressure (display only)

If the display (when present) does not display zero after calibration when the process pressure p_e = 0, then it can be corrected to zero by registering the bias pressure.

Entry of a bias pressure

#	Parameter	Entry	Significance
1	Set Bias Pressure	e.g. 0.1	Enter bias pressure

Registration of an acting bias pressure

#	Parameter	Entry	Significance
1	Bias Press Autom	Confirm	Register bias pressure

Note!

Note!
In liquids and steam a bias pressure can only be adopted if the pressure piping is filled.

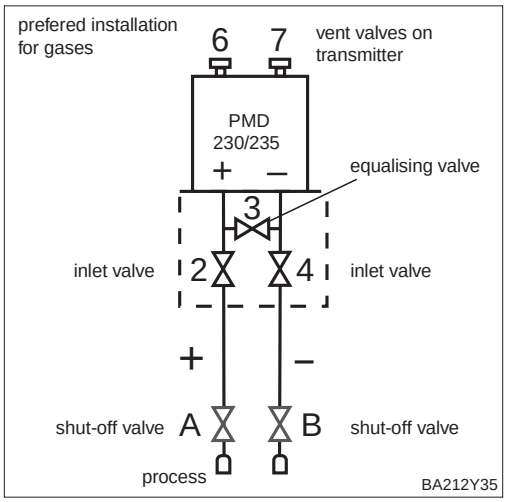
Pressure output in %

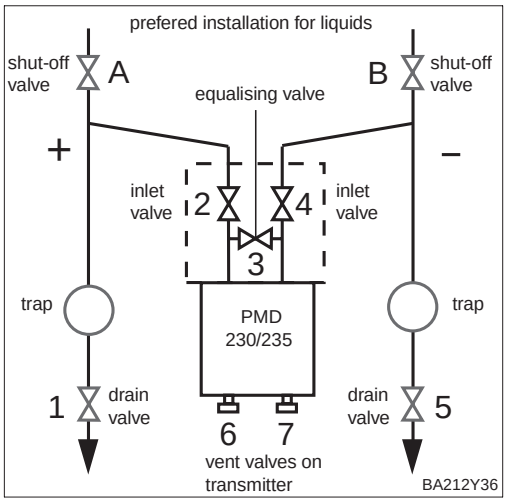
If it is desired that 0...100% pressure is output via Foundation Fieldbus, then the parameter "Linearization" has to be set to "level linear". The zero and span of the Foundation Fieldbus-Signal are automatically assigned the values 0% and 100%.

Comissioning the measuring point

The span (span–zero) is either present (without reference pressure), or is calibrated during operation (with or without reference pressure).

#	Valves	Significance
1	Close 3	
2	Fill measuring measuring system with medium	
	Open A, B, 2, 4	Lets medium in
3	If appropriate clean pressure piping * – for gases with compressed air – for liquids by washing out	
	Close 2 and 4	Shut off transmitter
	Open 1 and 5*	Blow out/wash out pressure piping
	Close 1 and 5*	Close valves after cleaning
4	Let air out of transmitter	
	Open 2 and 4	Let in medium
	Close 4	Close negative side
	Open 3	Connect positive and negative side
	Briefly open 6 and 7 then close again	Fill transmitter with medium and let out air
5	Set measuring point for measurement	
	Close 3	Shut off positive from negative side
	Open 4	Close negative side
	Now: 1*, 3, 5*, 6 and 7 are closed 2 and 4 open A and B are open (if present)	
6	Set zero and display to zero – Filters: Shut off or allow minimum flow for clean filters – Tanks or pipe pressure: Enter zero pressure	
	➤ Parameter Set Lower Value	Acting pressure is taken for zero
	➤ Parameter Bias Pres Autom	Set display to "0" (of display)
7	Set span to final pressure – Filters: Minimum flow is acting for contaminated filters – Tanks or pipe pressure: Final pressure is acting	
	➤ Parameter Set Upper Value	Acting pressure is taken for span
6	➤ Parameter Linearization: "pressure linear"	Select operation mode "pressure linear"
7	Set parameter "Output Damping" etc. See this Chapter page 46 onwards	
8	Measuring point is ready for measurement	





* For arrangements with five valves

Caution!
When opening and closing valves to the process, care must be taken to avoid overheating or one-sided overloading (beyond specifications) of the measuring cell. If the measuring range is adjusted, the output signal may not lead to impermissible jumps in the control loop.

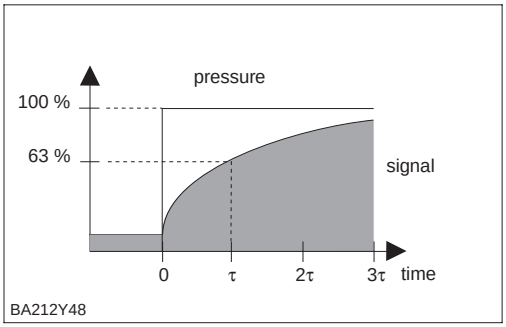

Caution!

6.2 Damping

Output damping

The damping influences the time it takes for the display in "Measured Value" to react to a change in pressure.

#	Parameter	Entry	Significance
1	Set Output Damping	e.g. 30	Damping in transducer block incrreased to 30 s



Note!

Both the transducer block output and the analog input block can be damped. We recommend that the damping be set in the transducer block during commissioning and increased if necessary in the analog input block during normal operation. This prevents the device switching to "Out of Service" when the parameter is edited.

Note!

6.3 Maximum pointer function

Maximum pointer function

The maximum pointer function displays the maximum and minimum pressure and temperature measured since the last pointer reset.

The units for pressure and temperature are selected with the parameter "Select Pressure Unit" and "Select Temperature Unit" respectively. Please note that any change in the pressure units affects all pressure entries.

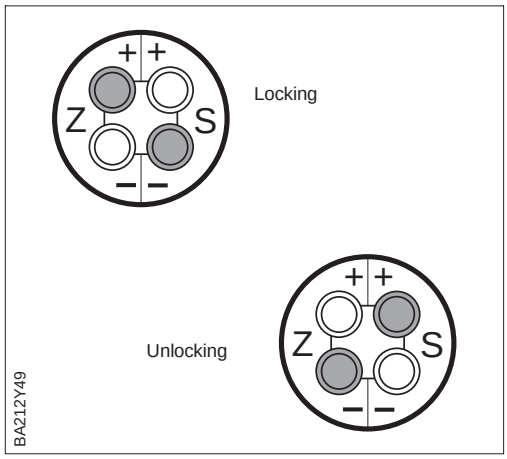
Parameter	Significance
Min. Pressure	Minimum pressure, Reset via the option "reset" to the acting pressure value using the parameter "Reset Min Pres Peak Hold"
Max. Pressure	Maximum pressure, Reset via the option "reset" to the acting pressure value using the parameter "Reset Max Pres Peak Hold"
Min. Temperature	Minimum temperature, Reset via the option "reset" to the acting temperature using the parameter "Reset min Peak Hold"
Max. Temperature	Maximum temperature, Reset via the option "reset" to the acting temperature using the parameter "Reset max Peak Hold"

6.4 Locking/unlocking

After all parameters have been entered, the manufacturer's-specific parameters can be locked.

- via the keys +Z, –Z, +S and –S or
- via the parameter "Security Looking" by entering a three digit code ≠ 130.
  (130 is the code for unlocking the parameters)

This protects the measuring point from accidental and unauthorised entries.



Locking with keys has priority

Keys

#	Key	Entry
1		Lock operation: Press +Z and –S simultaneously once
2		Unlock operation: Press –Z and +S simultaneously once

Parameter

#	Parameter	Entry	Significance
1	Security Looking	e.g. 131	Parameters locked
2	Security Looking	130	Parameters unlocked

The table below summarises the locking function.

Locking via	Display/reading of parameters	Changing/writing via		Unlocking via	
		keys	communication	keys	communication
Keys	yes	no	no	yes	no
Parameters	yes	no	no	yes	yes

6.5 Analog input block parameters

Three sets of parameters can be set in the analog input block for:

- Scaling of the input and output values
- Tuning of the outputs
- Setting of alarms

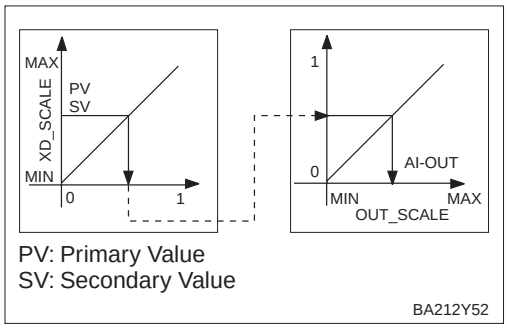
Parameters

For the NI_FBUS tool, these are to be found in the Saling, Tuning and Alarms folders.

Parameter	Significance
XD_SCALE..... XD_SCALE_MIN XD_SCALE_MAX XD_SCALE_UNIT XD_SCALE_DEC	Scales the input from the transducer block (result shown in FIELD_VAL) Comprises the lower and upper range-values, the code for the engineering units and the number of figures to the right of the decimal point. Is effective for L_TYPE = INDIRECT. Only of interest after a linearization when the OUT value is to be different to the display value. Default 0% – 100%
OUT_SCALE..... OUT_SCALE_MIN OUT_SCALE_MAX OUT_SCALE_UNIT OUT_SCALE_DEC	Scales the output of the analog input block Comprises the lower and upper range-values, the code for the engineering units and the number of figures to the right of the decimal point. Only of interest only when the OUT value is to be different to the display value, see example below. Default 0% – 100%.
L_TYPE	Sets the type of linearisation in the analog input block, for level: DIRECT bypasses the XD_SCALE and OUT_SCALE functions INDIRECT switches in the XD_SCALE and OUT_SCALE functions
PV_FTIME	Influences the time it takes for the output to react to a sudden change in level (63% of steady-state value), see also output damping, Chapter 6.2.
ACK_OPTION	Sets the way in which alarms and warnings are to be acknowledged.
ALARM_HYS	Sets the hysteresis (in output engineering units) for all configured alarms. A hystersis of e.g. 2% on a HI_HI_LIMIT of 95% would cause the alarm to activate when the level reaches 95% and to deactivate when the level drops below 93%. A hystersis of e.g. 2% on a LO_LO_LIMIT of 5% would cause the alarm to activate when the level drops below 5% and to deactivate when the level rises to 7%.
HI_HI_PRI	The priority (1 – 15,) of the HI_HI alarm
HI_HI_LIM	Sets the HI_HI alarm limit in output engineering units
HI_PRI	The priority (1 – 15) of the HI alarm
HI_LIM	Sets the HI advisory limit in output engineering units
LO_PRI	The priority (1 – 15) of the LO alarm
LO_LIM	Sets the LO advisory limit in output engineering units
LO_LO_PRI	The priority (1 – 15) of the LO_LO alarm
LO_LO_LIM	Sets the LO_LO alarm limit in output engineering units

Example: OUT value scaling (0 – 2^{15} = 32768)

#	Parameter	Entry	Significance
1	L_TYPE	INDIRECT	Switches in OUT_Scale function
2	Out_SCALE… _MIN _MAX _UNIT _DEC	0 32768 1997 0	Param. expands: lower range-value upper range-value code for units * decimal point positon



* Units selected from pull-down menu.

If the display and the OUT value of the analog input block are to provide the same value, then the lower and upper limits of XD_SCALE value during calibration or linearization must be entered as the lower and upper limits of the OUT_SCALE value (default = 0% and 100%).

6.6 Measuring point information

The following information about the measuring point can be read:

All blocks

Parameter	Significance
MODE_BLK	Indicates current operating mode of block

Resource block

Parameter	Significance
WRITE_LOCK	Indicates position of write protection DIP-switch WP

Transducer block

Parameter	Significance
PRIMARY_VALUE	Primary value output by transducer block, here it is pressure
SECONDARY_VALUE	Secondary value output by transducer block, here it is temperature
Measured Value	Pressure displayed by the device after calibration and any scaling/linearization.
Sensor pressure	Actual sensor pressure (Unit selectable with "Select Pressure Unit")
Lower Sensor Limit	Lower range-limit of sensor (Unit selectable with "Select Pressure Unit")
Upper Sensor Limit	Upper range-limit of sensor (Unit selectable with "Select Pressure Unit")
Lower Range Value	Lower range-value – zero (affects bargraph)
Upper Range Value	Upper range-value – span (affects bargraph)
Int. Counter high	Counter for pressure values above the upper range-limit, max. value = 255, Options: # – no action, clear – counter is reset to "0"
Sensor Temperature	Actual sensor temperature (Unit selectable with "Select Temperature Unit")
Unbiased Pressure	Current pressure value without bias correction
Biased Pressure	Current pressure value with bias correction
Transducer_sw_vers	Sofware version of the device
Diagnostic Code	Code with associated message of current device alarm
Last Diagnostic Code	Code with associated message of previous device alarm

Analog input block

Parameter	Significance
PV	The input value of the analog input block or a value associated with it (%)
FIELD_VAL	Output of transducer block in % of set range.
OUT	The value output by the analog input block
XD_SCALE...	The scaling values and engineering units for FIELD_VAL and PV These are always 0% and 100% for L_TYPE = DIRECT. For L_TYPE = INDIRECT they should be correspond to the range values set for the transducer block output value, e.g. during a linearisation.
OUT_SCALE	The scaling values for the OUT value. These are always 0% and 100% for L_TYPE = DIRECT. For L_TYPE = INDIRECT they can be adjusted the desired OUT range.
L_TYPE	Type of linearisation: must always be set to DIRECT or INDIRECT
HI_HI_ALM	Flags status of upper alarm limit
HI_ALM	Flags status of upper warning limit
LO_ALM	Flags status of lower warning limit
LO_LO_ALM	Flags status of lower alarm limit

7 Level Measurement

This chapter describes the parameters which must be enterd to commision a Deltabar S for level measurement. This chapter contains the following information:

- Calibration via tool
- Empty/ Full calibration
- Dry calibration
- Damping
- Locking/unlocking of the manufacturer's-specific parameters
- Analog input block parameter
- Measuring point information

Note!

Note!
Additional functions that are required for level measurement, e.g. linearization can be accessed only via a configuration tool.

7.1 Calibration via a configuration tool

The calibration is made via a configuration tool (remote operation).

Parameter	Significance
Lower Range Value	Entry of pressure for lower range-value – zero (bargraph and pressure for "empty")
Upper Range Value	Entry of pressure for upper range-value – span, max. turndown 20:1 (bargraph and pressure for "full")
Set Lower Range Value	Acting pressure is taken as lower range-value – zero (bargraph and pressure for "empty")
Set Upper Range Value	Acting pressure is taken as upper range-value – span, max. turndown 20:1 (bargraph and pressure for "full")
Set Bias Pressure	Entry of bias pressure (affects display module and parameter "Biased Pressure" only)
Bias Pres Autom	Acting pressure is taken as bias pressure (affects display module and parameter "Biased Pressure" only)
Set Output Damp.	Entry of damping τ (0...40 s)
Select Press Unit	Options pressure unit: mbar, bar, Pa, hPa, kPa, MPa, mm H_2O, m H_2O, in H_2O, ft H_2O, psi, g / cm^2, kg / cm^2, kgf / cm^2, atm, lb / ft^2, torr, mm Hg or in Hg.
Linearization	Operating mode: "level linear" (level, volume and weight) or "level horizontal cylinder" (volume and weight)
Start Point	Zero for output scaling (corresponds to lower range-value)
Full Scale	Scale value for output scaling (corresponds to upper range-value)
Unit After Linearization	Selecting units for mesuring the level, volume or weight – the options depend on the operating mode selected. The linearised value is shown in these units. The measured value is not converted into the new units.
Density Factor	Density factor – Applications with media with a density not equal to 1 g/cm^3.

Selecting pressure units

The units for pressure are selected with the parameter "Select Pressure Unit". After selecting the new pressure units all information on pressure is converted into the new units. Example: After selecting the units "psi" the measuring range from 0…10 bar is converted in 0…145.5 psi.

Density correction

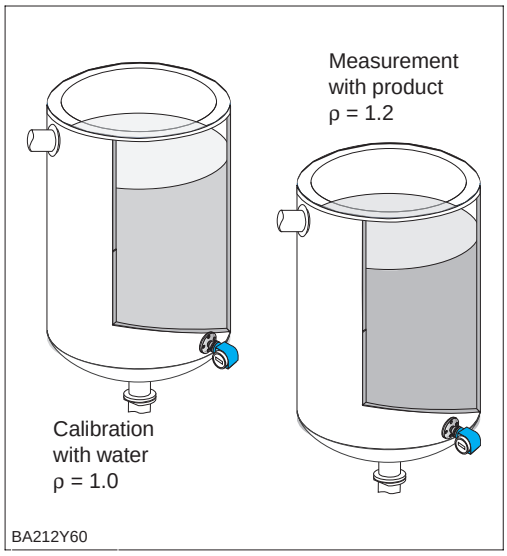
If the calibration has been made with water and the product changes at a later date, the calibration values can be corrected by entering a density factor.

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

Determining the density factor

Example: A tank is filled with water and calibrated. The density of the water (old density) is 1 g/cm^3. Later the tank will be used as a storage tank and be filled with the actual medium to be measured. The new density is 1.2 g/cm^3. "Density Factory" still contains the factory setting "1", i.e. the current factor is "1".

$$\text{density factor} = 1 \bullet \frac{1.2\ \text{g/cm}^3}{1\ \text{g/cm}^3} = 1.2$$



#	Parameter	Entry	Significance
1	Density Factor	e.g. 1.2	Density correction
2	Measured Value	e.g. 62.5 %	Corrected level

Result
The measured value in parameter "Measured Value" is divided by the density factor and is thus correct for the new product.

Note!
The density factor directly affects the level measurement. If the product density changes, make sure that the density factor is updated before an existing linearization curve is used.


Note!

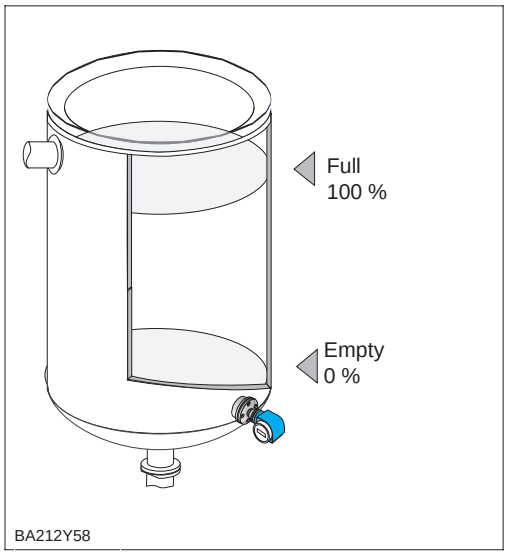
7.2 Empty/full calibration

The empty/full calibration lays down the desired minimum and maximum levels for measurement. The entries can be made in any units. There are two prerequisites:

- The Deltabar S has been mounted.
- The tank can be filled.

"Level linear"

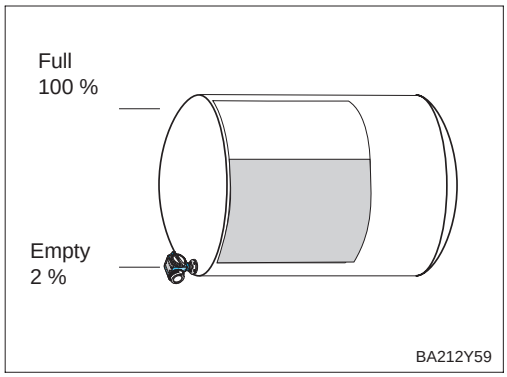
#	Parameter	Entry	Significance
1	Measuring point ready for operation? See Chapter 5.3.		
2	Linerazition	"level linear"	Operating mode
3	The tank is empty (0...40 %)		
4	Set Lower Value	Confirm	Register pressure
5	Start Point	e.g. 0	Current level = level for "empty"
6	The tank is full (60...100 %)		
7	Set Upper Value	Confirm	Register pressure
8	Full Scale	e.g. 100	Current level = level for "full"
9	Unit After Lin	e.g. %	Select level units



Result
- Level is displayed in "Measured Value"

"Level horizontal cylinder"

#	Parameter	Entry	Significance
1	Measuring point ready for operation? See Chapter 5.3.		
2	Linearization	"level horizontal cylinder"	Operating mode
3	The tank is empty (0...40 %)		
4	Set Lower Value	Confirm	Register pressure
5	Start Point	e.g. 2	Current level = level for "empty"
6	The tank is full (60...100 %)		
7	Set Upper Value	Confirm	Register pressure
8	Full Scale	e.g. 100	Current level = level for "full"
9	Unit After Lin	e.g. %	Select level units



Result
- Level is displayed in "Measured Value"

Unit after linearization

The units for level, volumetric or weight are selected with the parameter "Unit After Linearization". Selecting these units is only to help the operator. It has no effect on the main measured value in parameter "Measured Value".

Example: 55 % is shown as 55 hl after selecting the unit "hl".

7.3 Dry calibration

The dry calibration is a calculated calibration, which can be made with an empty tank or on the test bench. It is not recommended for transmitters with capillaries or closed tanks with steam. The "empty" calibration point is normally at the sensor mounting point. If the measurement is to begin at another level, then this must be considered in the calculation. The prerequisites for a dry calibration are:

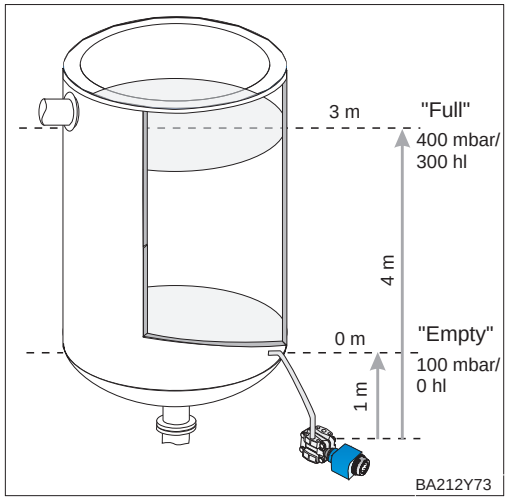
- The empty and full levels are known.
- The density factor is known.
- The pressure for »empty« and »full« has been calculated (p = ρgh).

If the device has a display and the point of mounting is below the empty level, then a bias pressure must be entered in "Set Bias Pressure" (position correction).

"Level linear"

#	Parameter	Entry	Significance
1	Measuring point ready for operation? See Chapter 5.3.		
2	Select Press Unit	e.g. mbar	Select pressure unit
5	Set Bias Pressure	e.g. 100 = Lower Range Value	For display module bias pressure
3	Lower Range Value	e.g. 100	Pressure for "empty"
4	Upper Range Value	e.g. 400	Pressure for "full"
6	Linearization	"level linear"	Operating mode
7	Start Point	e.g. 0	Level for "empty"
8	Full Scale	e.g. 300	Level for "full"
9	Unit After Lin	e.g. hl	Select level units

Example:

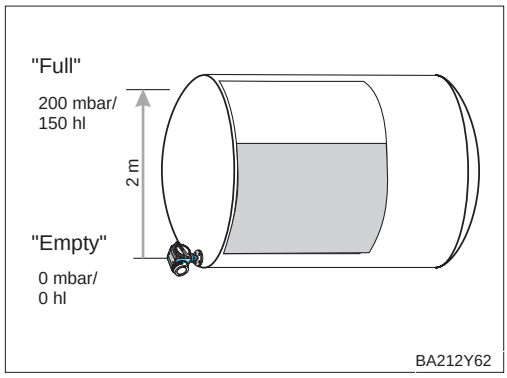


Result:
- Level is displayed in "Measured Value".

"Level horizontal cylinder"

#	Parameter	Entry	Significance
1	Measuring point ready for operation? See Chapter 5.3.		
2	Select Press Unit	e.g. mbar	Select pressure unit
3	Lower Range Value	e.g. 0	Pressure for "empty"
4	Upper Range Value	e.g. 200	Pressure for "full"
5	Linearization	"level horizontal cylinder"	Operating mode
6	Start Point	e.g. 0	Level for "empty"
7	Full Scale	e.g. 150	Level for "full"
8	Unit After Lin	e.g. hl	Select level units

Example:



Result:
- Level is displayed in "Measured Value".

Check after installation

After a calibration, the first filling of the tank should be carefully observed, so that any errors or uncertainties are immediately detected.

7.4 Activate Level Measurement

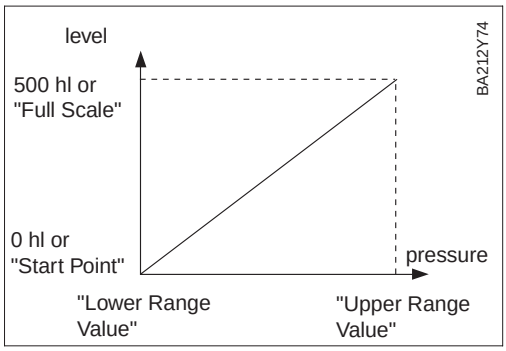
Activate level measurement

If the measuring point was commissioned as described in Chapter 5.3, level can be measured by simply selecting the appropriate operating mode.

The measured value is output as 0 % … 100 % level. It is measured over the nominal pressure range printed on the nameplate.

By entering level values for zero and span, the measured value can be assigned level units.

Example:



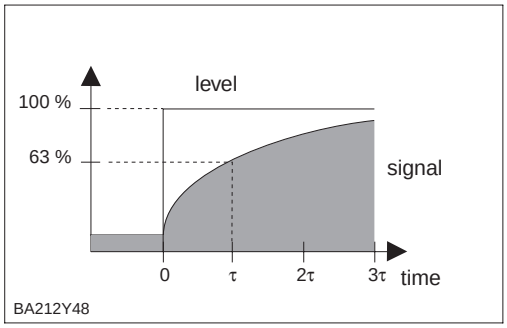
#	Parameter	Entry	Significance
1	Measuring ponit ready for measurement? See Chapter 5.3.		
2	Linearization	"level linear" or "level horizontal cylinder"	Operating mode: level measurement
3	Start Point	e.g. 0	Level value for zero
4	Full Scale	e.g. 500	Level value for span
5	Unit After Lin	e.g. hl	Select flow units

Result:
- Level is displayed in "Measured Value".

7.5 Damping

Output damping

The damping influences the time it takes for the display in "Measured Value" to react to a change in pressure.



#	Parameter	Entry	Significance
1	Set Output Damping	e.g. 30	Damping in transducer block incrreased to 30 s

Note!

Note!
Both the transducer block output and the analog input block can be damped. We recommend that the damping be set in the transducer bloch during commissioning and increased if necessary in the analog input block during normal operation. This prevents the device switching to "Out of Service" when the parameter is editted.

7.6 Maximum pointer function

Maximum pointer function

The maximum pointer function displays the maximum and minimum pressure and temperature measured since the last pointer reset.

The units for pressure and temperature are selected with the parameter "Select Pressure Unit" and "Select Temperature Unit" respectively. Please note that any change in the pressure units affects all pressure entries.

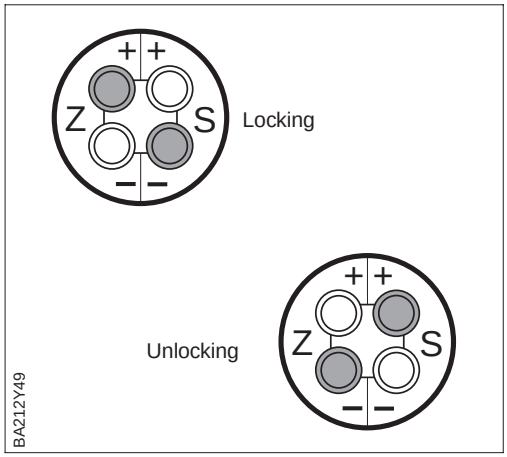
Parameter	Significance
Min. Pressure	Minimum pressure, Reset via the option "reset" to the acting pressure value using the parameter "Reset Min Pres Peak Hold"
Max. Pressure	Maximum pressure, Reset via the option "reset" to the acting pressure value using the parameter "Reset Max Pres Peak Hold"
Min. Temperature	Minimum temperature, Reset via the option "reset" to the acting temperature using the parameter "Reset min Peak Hold"
Max. Temperature	Maximum temperature, Reset via the option "reset" to the acting temperature using the parameter "Reset max Peak Hold"

7.7 Locking/unlocking

After all parameters have been entered, the manufacturer's-specific parameters can be locked.

- via the keys +Z, –Z, +S and –S or
- via the parameter "Security Looking" by entering a three digit code ≠ 130. (130 is the code for unlocking the parameters)

This protects the measuring point from accidental and unauthorised entries.



Locking with keys has priority

Keys

#	Key	Entry
1		Lock operation: Press +Z and -S simultaneously once
2		Unlock operation: Press -Z and +S simultaneously once

Parameter

#	Parameter	Entry	Significance
1	Security Looking	e.g. 131	Parameters locked
2	Security Looking	130	Parameters unlocked

The table below summarises the locking function.

Locking via	Display/reading of parameters	Changing/writing via		Unlocking via	
		keys	communication	keys	communication
Keys	yes	no	no	yes	no
Parameters	yes	no	no	yes	yes

7.8 Analog input block parameters

Three sets of parameters can be set in the analog input block for:

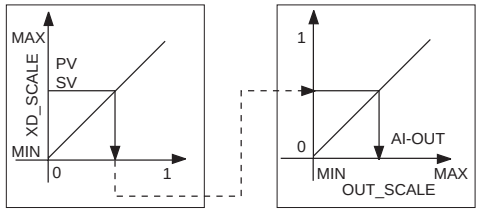
- Scaling of the input and output values
- Tuning of the outputs
- Setting of alarms

Parameters

For the NI_FBUS tool, these are to be found in the Saling, Tuning and Alarms folders.

Parameter	Significance
XD_SCALE..... **XD_SCALE_MIN** **XD_SCALE_MAX** **XD_SCALE_UNIT** **XD_SCALE_DEC**	Scales the input from the transducer block (result shown in FIELD_VAL) Comprises the lower and upper range-values, the code for the engineering units and the number of figures to the right of the decimal point. Is effective for L_TYPE = INDIRECT. Only of interest after a linearisation when the OUT value is to be different to the display value. Default 0% – 100%
OUT_SCALE..... **OUT_SCALE_MIN** **OUT_SCALE_MAX** **OUT_SCALE_UNIT** **OUT_SCALE_DEC**	Scales the output of the analog input block Comprises the lower and upper range-values, the code for the engineering units and the number of figures to the right of the decimal point. Only of interest only when the OUT value is to be different to the display value, see example below. Default 0% – 100%.
L_TYPE	Sets the type of linearisation in the analog input block, for level: DIRECT bypasses the XD_SCALE and OUT_SCALE functions INDIRECT switches in the XD_SCALE and OUT_SCALE functions
PV_FTIME	Influences the time it takes for the output to react to a sudden change in level (63% of steady-state value), see also output damping, Chapter 7.5.
ACK_OPTION	Sets the way in which alarms and warnings are to be acknowledged.
ALARM_HYS	Sets the hysteresis (in output engineering units) for all configured alarms. A hystersis of e.g. 2% on a HI_HI_LIMIT of 95% would cause the alarm to activate when the level reaches 95% and to deactivate when the level drops below 93%. A hystersis of e.g. 2% on a LO_LO_LIMIT of 5% would cause the alarm to activate when the level drops below 5% and to deactivate when the level rises to 7%.
HI_HI_PRI	The priority (1 – 15,) of the HI_HI alarm
HI_HI_LIM	Sets the HI_HI alarm limit in output engineering units
HI_PRI	The priority (1 – 15) of the HI alarm
HI_LIM	Sets the HI advisory limit in output engineering units
LO_PRI	The priority (1 – 15) of the LO alarm
LO_LIM	Sets the LO advisory limit in output engineering units
LO_LO_PRI	The priority (1 – 15) of the LO_LO alarm
LO_LO_LIM	Sets the LO_LO alarm limit in output engineering units

Example: OUT value scaling (0 – 2^{15} = 32768)



PV: Primary Value
SV: Secondary Value

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#	Parameter	Entry	Significance
1	L_TYPE	INDIRECT	Switches in OUT_Scale function
2	Out_SCALE… _MIN _MAX _UNIT _DEC	 0 32768 1997 0	Param. expands: lower range-value upper range-value code for units * decimal point positon

* Units selected from pull-down menu.

If it is desired that the display and AI-Out offer the same value, then the lower and upper limits of the XD_SCALE value during calibration or linearization must be entered as the lower and upper limits of the OUT_SCALE value (default = 0% and 100%).

7.9 Measuring point information

The following information about the measuring point can be read:

All blocks

Parameter	Significance
MODE_BLK	Indicates current operating mode of block

Resource block

Parameter	Significance
WRITE_LOCK	Indicates position of write protection DIP-switch WP

Transducer block

Parameter	Significance
PRIMARY_VALUE	Primary value output by transducer block, here it is linearization value
SECONDARY_VALUE	Secondary value output by transducer block, here it is temperature
Measured Value	Pressure displayed by the device after calibration and any scaling/linearization.
Sensor pressure	Actual sensor pressure (Unit selectable with "Select Pressure Unit")
Lower Sensor Limit	Lower range-limit of sensor (Unit selectable with "Select Pressure Unit")
Upper Sensor Limit	Upper range-limit of sensor (Unit selectable with "Select Pressure Unit")
Lower Range Value	Lower range-value – zero (affects bargraph and linearization)
Upper Range Value	Upper range-value – span (affects bargraph and linearization)
Int. Counter high	Counter for pressure values above the upper range-limit, max. value = 255, Options: # – no action, clear – counter is reset to "0"
Sensor Temperature	Actual sensor temperature (Unit selectable with "Select Temperature Unit")
Start Point	Zero for output scaling (correponds to lower range-value)
Full Scale	Scale value for output scaling (corresponds to upper range-value)
Unbiased Pressure	Current pressure value without bias correction
Biased Pressure	Current pressure value with bias correction
Transducer_sw_vers	Sofware version of the device
Diagnostic Code	Code with associated message of current device alarm
Last Diagnostic Code	Code with associated message of previous device alarm

Analog input block

Parameter	Significance
PV	The input value of the analog input block or a value associated with it (%)
FIELD_VAL	Output of transducer block in % of set range.
OUT	The value output by the analog input block
XD_SCALE...	The scaling values and engineering units for FIELD_VAL and PV These are always 0% and 100% for L_TYPE = DIRECT. For L_TYPE = INDIRECT they should be correspond to the range values set for the transducer block output value, e.g. during a linearisation.
OUT_SCALE	The scaling values for the OUT value. These are always 0% and 100% for L_TYPE = DIRECT. For L_TYPE = INDIRECT they can be adjusted the desired OUT range.
L_TYPE	Type of linearisation: must always be set to DIRECT or INDIRECT
HI_HI_ALM	Flags status of upper alarm limit
HI_ALM	Flags status of upper warning limit
LO_ALM	Flags status of lower warning limit

8 Flow Measurement

This chapter describes the operating mode "flow measurement", which can be activated only via foundation fieldbus. This chapter contains the following information:

- Calibration via tool
- Damping
- Locking/unlocking of the manufacturer's-specific parameters
- Measuring point information

8.1 Calibration via a configuration tool

The calibration is made via a configuration tool (remote operation).

Matrix field	Significance
Lower Range Value	Entry of pressure for lower range-value – zero (bargraph and pressure for "zero flow")
Upper Range Value	Entry of pressure for upper range-value – span, max. turndown 20:1 (bargraph and pressure for "max. flow")
Set Lower Range Value	Acting pressure is taken as lower range-value – zero (bargraph and pressure for "zero flow")
Set Upper Range Value	Acting pressure is taken as upper range-value – span, max. turndown 20:1 (bargraph and pressure for "max. flow")
Set Bias Pressure	Entry of bias pressure (affects display module and parameter "Biased Pressure" only)
Bias Pres Autom	Acting pressure is taken as bias pressure (affects display module and parameter "Biased Pressure" only)
Set Output Damp.	Entry of damping τ (0...40 s)
Select Press Unit	Option pressure unit: mbar, bar, Pa, hPa, kPa, MPa, mm H_2O, m H_2O, in H_2O, ft H_2O, psi, g / cm^2, kg / cm^2, kgf / cm^2, atm, lb / ft^2, torr, mm Hg, in Hg.
Linearization	Operating mode: "flow" (square root function)
Start Point	Zero for output scaling (corresponds to lower range-value = zero flow)
Full Scale	Scale value for output scaling (corresponds to upper range-value = max. flow)
Unit After Linearization	Options flow unit: %, ft^3/min, ft^3/hr, l/s, ft^3/s, m^3/s, norm m^3/hr, std m^3/min, m^3/min USgal/hr, gal/day, gal/min, kg/s, kg/min, kg/hr, tonne/hr, tonne/min, tonne/day, lb/s, lb/min, lb/hr, special; The linearized value is shown in these units. The measured value is not converted into the new units.
Creep Flow Suppr.	Suppresses the display on small flow rates.

Selecting pressure units

The units for pressure are selected with the parameter "Select Pressure Unit". After selecting the new pressure units all information on pressure is converted into the new units. Example: After selecting the units "psi" the measuring range from 0…10 bar is converted in 0…145.5 psi.

Calibration without reference pressure

A pressure for the bargraph zero and span is entered into the device. Zero corresponds to zero flow. Span is zero plus the final differential pressure given in the design documentation of the transmitter. No particular pressure must be acting.

#	Parameter	Entry	Significance
1	Default Values	5140	Reset to factory setting
2	Lower Range Value	e.g. 0	Zero
3	Upper Range Value	e.g. 100	Span
4	Measured Value	e.g. 15.5	Measured value in e.g. kPa

Calibration with reference pressure

An acting reference pressure or process pressure corresponds exactly to the desired bargraph zero and span. The reference pressure for zero corresponds to zero flow. The reference pressure for span corresponds to zero plus the final differential pressure value given in the design documentation of the transmitter.

#	Parameter	Entry	Significance
1	Default Values	5140	Reset
2	The exact pressure for zero is acting		
3	Set Lower Value	Confirm	Register zero
4	The exact pressure for span is acting		
5	Set Upper Value	Confirm	Register span
6	Measured Value	e.g. 15.5	Measured value in e.g. kPa

Bias pressure (display only)

If the display does not show zero flow then this pressure can be corrected by entering a bias pressure.

Entry of a bias pressure

#	Parameter	Entry	Significance
1	Set Bias Pressure	e.g. 0.1	Enter bias pressure

Registration of an acting bias pressure

#	Parameter	Entry	Significance
1	Bias Press Autom	Confirm	Register bias pressure

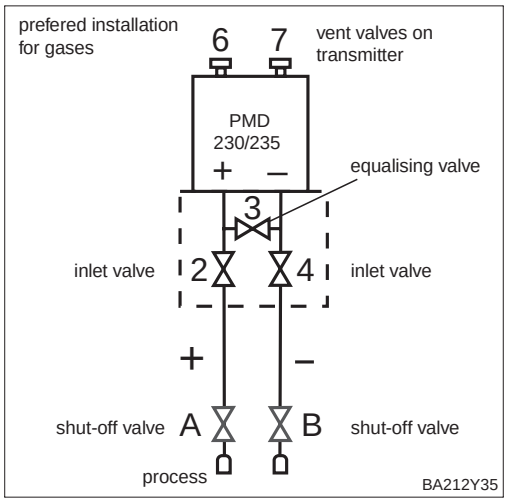
Note!
In liquids and steam a bias pressure can only be adopted if:
- the flow is shutt off or
- the tapping points are at the same height.

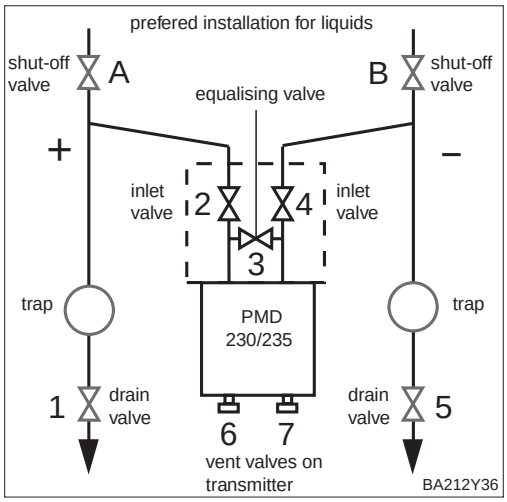
The pressure piping must always be filled.

Note!

Comissioning the measuring point

The span (span-zero) is either preset (without reference pressure), or is callibrated during operation (with or without reference pressure).





Caution!

When opening and closing valves to the process, care must be taken to avoid overheating or one-sided overloading (beyond specifications) of the measuring cell. If the measuring range is adjusted, the output signal may not lead to impermissible jumps in the control loop.

Caution!

#	Valves	Significance
1	Close 3	
2	Fill measuring system with medium	
	Open A, B, 2, 4	Lets medium in
3	If appropriate clean pressure piping* – for gases with compressed air – for liquids by washing out	
	Close 2 and 4	Shut off transmitter
	Open 1 and 5*	Blow out/wash out pressure piping
	Close 1 and 5*	Close valves after cleaning
4	Let air out of transmitter	
	Open 2 and 4	Let in medium
	Close 4	Close negative side
	Open 3	Connect positive and negative side
	Briefly open 6 and 7 then close again	Fill transmitter with medium and let out air
5	Set zero and display to zero **Note:** The following entries are only appropriate here if: – the process cannot be shut off **and** – the tapping points (A and B) are at the same height. If the flow can be shut off then this calibration of zero and display is to be carried out **after** step 6.	
	➤ Parameter Set Lower Value	Acting pressure is taken as zero
	➤ Parameter Bias Pres Autom	Set display to "0" (affects display)
6	Set the measuring point for measurement	
	Close 3	Shut off positive from negative side
	Open 4	Close negative side
	Now: 1*, 3, 5*, 6 and 7 are closed 2 and 4 are open A and B are open (if present)	
7	Set zero and display to zero If the flow can be shut off then the calibration of zero and display is to be carried out here. Step 5 is therefore ignored.	
	Shut off flow	
	➤ Parameter Set Lower Value	Active pressure is taken as zero
	➤ Parameter Bias Pres Autom	Set display to "0" (affects display)
	Open flow	
8	Select operating mode "square root function (flow)" (parameter "Linearization") Set parameters "Start Point", "Full Scale", "Unit After Lin", "Output Damping" etc. See page this chapter page 61 onwards.	
9	Measuring point is ready for measurement	

* For arrangemants with five valves

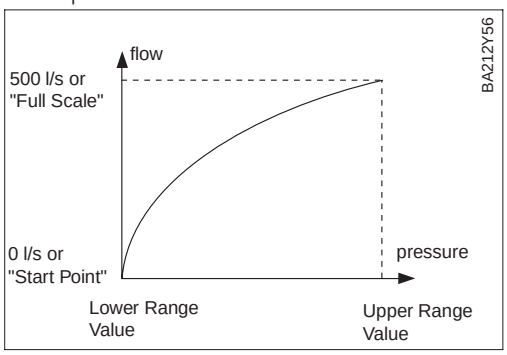
Activate flow measurement

If the measuring point was commissioned as described in Chapter 5.4 or this Chapter page 60, flow can be measured by simply selecting the appropriate operate operating mode.

The measured value is output as 0 % … 100 % flow. It is measured over the nominal pressure range printed on the nameplate.

By entering flow values for zero and span, the measured value can be assigned fow units.

Example:

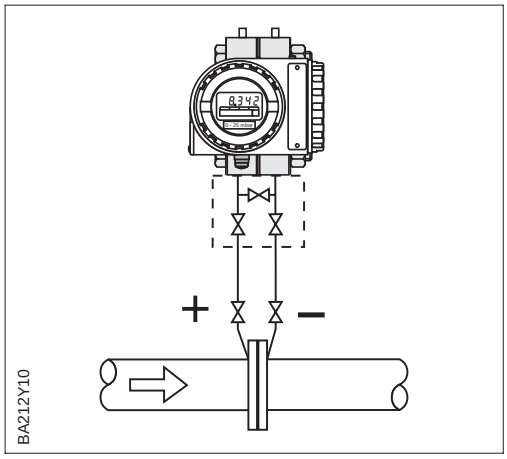


#	Parameter	Entry	Significance
1	Measuring point ready for measurement? See Chapter 5.4 page 42 or this Chapter page 60.		
2	Linearization	"square root function"	Operating mode: flow measurement
3	Start Point	e.g. 0	Flow value for zero
4	Full Scale	e.g. 500	Flow value for span
5	Unit After Lin	e.g. l/s	Select flow units

Result:
- Flow value is displayed in parameter "Measured Value".

Remote calibration for flow measurement

If the calibration is to be made by Foundation Fieldbus or only part of the nominal pressure range is to be used, then the transmitter is assigned pressure values with corresponding flow rates for zero and span.



#	Parameter	Entry	Significance
1	Measuring point ready for measurement? See Chapter 5.4 page 42 or this Chapter page 60.		
2	Select Press Unit	e.g. kPa	Select pressure unit
3	Lower Range Value	e.g. 0	Pressure for "zero flow"
4	Upper Range Value	e.g. 10	Pressure for "max. flow"
5	Linearization	"square root function"	Operating mode: flow measurement
6	Start Point	0	Flow value for "zero flow"
6	Full Scale	e.g. 500	Flow value for "max. flow"
7	Unit After Lin	e.g. l/s	Select flow units

Result:
- Flow value is displayed in parameter "Measured Value"

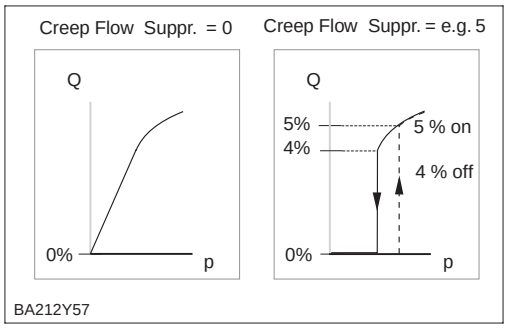
Unit after linearization

The units for flow is selected with the parameter "Unit After Liniarization". Selecting flow units is only to help the operator. It has no effect on the main measured value in parameter "Measured Value."

Example: 500 l/s is shown as 500 kg/s after selecting the unit "kg/s".

Creep flow suppression

In the lower flow range small flows – creep leeds to large flow variations. By entering a value for parameter "creep flow suppression, these flows will no longer be registered. Entries are always in % of flow. It is practical to suppress 3…6 % of the measuring range.

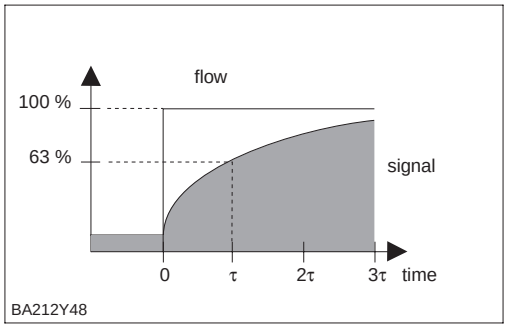


#	Parameter	Entry	Significance
1	Creep Flow Suppr.	e.g. 5 %	Suppresses the display on small flow rates.

8.2 Damping

Output damping

The damping influences the time it takes for the display in "Measured Value" and the output signal to react to a change in flow.



#	Parameter	Entry	Significance
1	Set Output Damping	e.g. 30	Damping in transducer block incrreased to 30 s

Note!

Note!
Both the transducer block output and the analog input block can be damped. We recommend that the damping be set in the transducer bloch during commissioning and increased if necessary in the analog input block during normal operation. This prevents the device switching to "Out of Service" when the parameter is edited.

8.3 Maximum pointer function

Maximum pointer function

The maximum pointer function displays the maximum and minimum pressure and temperature measured since the last pointer reset.

The units for pressure and temperature are selected with the parameter "Select Pressure Unit" and "Select Temperature Unit" respectively. Please note that any change in the pressure units affects all pressure entries.

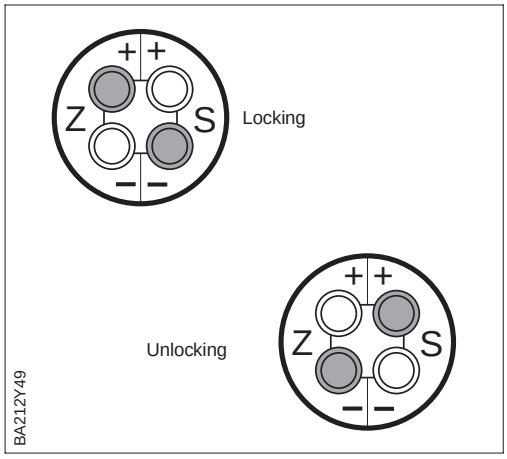
Parameter	Signifiance
Min. Pressure	Minimum pressure, Reset via the option "reset" to the acting pressure value using the parameter "Reset Min Pres Peak Hold"
Max. Pressure	Maximum pressure, Reset via the option "reset" to the acting pressure value using the parameter "Reset Max Pres Peak Hold"
Min. Temperature	Minimum temperature, Reset via the option "reset" to the acting temperature using the parameter "Reset min Peak Hold"
Max. Temperature	Maximum temperature, Reset via the option "reset" to the acting temperature using the parameter "Reset max Peak Hold"

8.4 Locking/unlocking

After all parameters have been entered, the manufacturer's-specific parameters can be locked.

- via the keys +Z, –Z, +S and –S or
- via the parameter "Security Looking" by entering a three digit code ≠ 130.
  (130 is the code for unlocking the parameters)

This protects the measuring point from accidental and unauthorised entries.



Keys

#	Key	Entry
1		Lock operation: Press +Z and –S simultaneously once
2		Unlock operation: Press +S and –Z simultaneously once

Parameter

#	Parameter	Entry	Significance
1	Security Looking	e.g. 131	Parameters locked
2	Security Looking	130	Parameters unlocked

Locking with keys has priority

The table below summarises the locking function.

Locking via	Display/reading of parameters	Changing/writing of parameters		Unlocking via	
		keys	communication	keys	communcation
Keys	yes	no	no	yes	no
Parameters	yes	no	no	yes	yes

8.5 Analog input block parameters

Three sets of parameters can be set in the analog input block for:

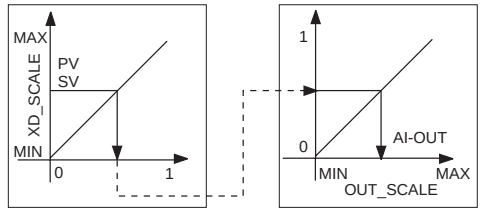
- Scaling of the input and output values
- Tuning of the outputs
- Setting of alarms

Parameters

For the NI_FBUS tool, these are to be found in the Saling, Tuning and Alarms folders.

Parameter	Significance
XD_SCALE..... XD_SCALE_MIN XD_SCALE_MAX XD_SCALE_UNIT XD_SCALE_DEC	Scales the input from the transducer block (result shown in FIELD_VAL) Comprises the lower and upper range-values, the code for the engineering units and the number of figures to the right of the decimal point. Is effective for L_TYPE = INDIRECT. Only of interest after a linearisation when the OUT value is to be different to the display value. Default 0% – 100%
OUT_SCALE..... OUT_SCALE_MIN OUT_SCALE_MAX OUT_SCALE_UNIT OUT_SCALE_DEC	Scales the output of the analog input block Comprises the lower and upper range-values, the code for the engineering units and the number of figures to the right of the decimal point. Only of interest when the OUT value is to be different to the display value, see example below. Default 0% – 100%.
L_TYPE	Sets the type of linearisation in the analog input block, for level: DIRECT bypasses the XD_SCALE and OUT_SCALE functions INDIRECT switches in the XD_SCALE and OUT_SCALE functions
PV_FTIME	Influences the time it takes for the output to react to a sudden change in level (63% of steady-state value), see also output damping, Chapter 8.2.
ACK_OPTION	Sets the way in which alarms and warnings are to be acknowledged.
ALARM_HYS	Sets the hysteresis (in output engineering units) for all configured alarms. A hystersis of e.g. 2% on a HI_HI_LIMIT of 95% would cause the alarm to activate when the level reaches 95% and to deactivate when the level drops below 93%. A hystersis of e.g. 2% on a LO_LO_LIMIT of 5% would cause the alarm to activate when the level drops below 5% and to deactivate when the level rises to 7%.
HI_HI_PRI	The priority (1 – 15,) of the HI_HI alarm
HI_HI_LIM	Sets the HI_HI alarm limit in output engineering units
HI_PRI	The priority (1 – 15) of the HI alarm
HI_LIM	Sets the HI advisory limit in output engineering units
LO_PRI	The priority (1 – 15) of the LO alarm
LO_LIM	Sets the LO advisory limit in output engineering units
LO_LO_PRI	The priority (1 – 15) of the LO_LO alarm
LO_LO_LIM	Sets the LO_LO alarm limit in output engineering units

Example: OUT value scaling (0 – 2 ^{15} = 32768)



PV: Primary Value
SV: Secondary Value

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#	Parameter	Entry	Significance
1	L_TYPE	INDIRECT	Switches in OUT_Scale function
2	Out_SCALE… _MIN _MAX _UNIT _DEC	0 32768 1997 0	Param. expands: lower range-value upper range-value code for units * decimal point positon

* Units selected from pull-down menu.

If the display and the OUT value of the analog input block are to provide the same value, then the lower and upper limits of XD_SCALE value during calibration or linearization must be entered as the lower and upper limits of the OUT_SCALE value (default = 0% and 100%).

8.6 Measuring point information

The following information about the measuring point can be read:

All blocks

Parameter	Significance
MODE_BLK	Indicates current operating mode of block

Resource block

Parameter	Significance
WRITE_LOCK	Indicates position of write protection DIP-switch WP

Transducer block

Parameter	Significance
PRIMARY_VALUE	Primary value output by transducer block, here it is linearization value
SECONDARY_VALUE	Secondary value output by transducer block, here it is temperature
Measured Value	Pressure displayed by the device after calibration and any scaling/linearization.
Sensor pressure	Actual sensor pressure (Unit selectable with "Select Pressure Unit")
Lower Sensor Limit	Lower range-limit of sensor (Unit selectable with "Select Pressure Unit")
Upper Sensor Limit	Upper range-limit of sensor (Unit selectable with "Select Pressure Unit")
Lower Range Value	Lower range-value – zero (affects bargraph and linearization)
Upper Range Value	Upper range-value – span (affects bargraph and linearization)
Int. Counter high	Counter for pressure values above the upper range-limit, max. value = 255, Options: # – no action, clear – counter is reset to "0"
Sensor Temperature	Actual sensor temperature (Unit selectable with "Select Temperature Unit")
Start Point	Zero for output scaling (corresponds to lower range-value = zero flow)
Full Scale	Scale value for output scaling (corresponds to upper range-value)
Unbiased Pressure	Current pressure value without bias correction
Biased Pressure	Current pressure value with bias correction
Transducer_sw_vers	Sofware version of the device
Diagnostic Code	Code with associated message of current device alarm
Last Diagnostic Code	Code with associated message of previous device alarm

Analog input block

Parameter	Significance
PV	The input value of the analog input block or a value associated with it (%)
FIELD_VAL	Output of transducer block in % of set range.
OUT	The value output by the analog input block
XD_SCALE...	The scaling values and engineering units for FIELD_VAL and PV These are always 0% and 100% for L_TYPE = DIRECT. For L_TYPE = INDIRECT they should be correspond to the range values set for the transducer block output value, e.g. during a linearization.
OUT_SCALE	The scaling values for the OUT value. These are always 0% and 100% for L_TYPE = DIRECT. For L_TYPE = INDIRECT they can be adjusted the desired OUT range.
L_TYPE	Type of linearisation: must always be set to DIRECT or INDIRECT
HI_HI_ALM	Flags status of upper alarm limit
HI_ALM	Flags status of upper warning limit
LO_ALM	Flags status of lower warning limit
LO_LO_ALM	Flags status of lower alarm limit

9 Diagnosis and Trouble-Shooting

9.1 Diagnosis of errors and warnings

Errors

When the Deltabar S detects an error:

- An error code is transmitted along with the measured value.
- If the display is present, the error code is displayed and flashes
- The current error code is displayed in parameter "Diagnostic Code", the last one in parameter "Last Diagnostic Code".

Warning

When the Deltabar S detects a warning:

- An error code is transmitted along with the measured value: the Deltabar S continues measuring.
- The current error code is displayed in parameter "Diagnostic Code" the last error code in parameter "Last Diagnostic Code".

Error codes in "Diagnostic Code" and "Last Diagnostic Code"

If several errors occur simultaneously, then they are displayed in sequence corresponding to the priority of the error.

Code	Type	Source and remedy
E 101	Error	Electronic instrument error – Remedy by Endress+Hauser Service
E 102	Warning	Electronic instrument error with the maximum counter function – Carry out reset (Code 5140), recalibrate the instrument
E 103	Error	Initialising in progress – Wait until the procedure is completed
E 104	Warning	Sensor calibration – Recalibrate sensor
E 110	Error	Check sum error – Carry out reset (Code 5140), the error remains – Remedy by Endress+Hauser Service
E 111, E 112, E 113, E 114	Error	Electronic instrument error – Remedy by Endress+Hauser Service
E 115	Error	Sensor overpressure – Remains until overpressure is no longer present
E 120	Error	Sensor underpressure – Remains until underpressure is no longer present
E 610	Error	Calibration error, same pressure value for "Lower Range Value" and "Upper Range Value" – Check the calibration
E 620	Warning	Measured value outside range

9.2 Simulation

Simulation of the OUT value

The OUT value can also be simulated in the analog input block:

1. Check that the simulation is enabled at the DIP-switch WP, see Chapter 3.2.

2. Click on the SIMULATE parameter:
   – Set to enable
   – Enter a simulation value
   – Click on WRITE CHANGES button
   – Check the effect on the OUT value and any following links.

3. Disable the SIMULATE parameter.

During simulation, the BLOCK_ERROR shows the status "simulation active".

9.3 Reset

By entering a code, the entries in the manufactuer's-specific parameters are reset completely to factory settings.

#	Parameter	Entry	Significance
1	Default Values	5140	Reset to factory setting

The following table provides a summary of factory settings. (***** = display value)

Parameter	Default Value
Measured Value *	
Lower Range Value	0.0
Upper Range Value	= High Sensor Limit
Set Lower Range Value	
Set Upper Range Value	
Set Bias Pressure	0.0
Bias Pressure Automat-ically	
Set Output Damping	0.0
Select Pressure Unit	bar
Diagnostic Code *	0
Last Diagnostic *	0
Clear Last Diagnostic Code	
Transducer_sw_vers *	
Min. Pressure *	Act. pressure
Reset Min. Pres Peak Hold	
Max. Pressure *	Act. pressure
Reset Max. Pres Peak Hold	
Integer Counter high *	0
Sensor Temperature *	Act. temperature
Min. Temperature *	Act. temperature
Reset min Temp. Peak Hold	
Max. Temperature *	Act. temperature
Reset max Temp. Peak Hold	"Pressure linear"

Parameter	Default Value
Default Values	
Linearization (operating mode)	
Start Point	0.0
Full Scale	100.0
Unit After Liniarization	bar
Density Factor	1.0
Creep Flow Suppression	0.0
Low Sensor Calibration	= Low Sensor Limit
High Sensor Calibration	= High Sensor Limit
Low Sensor Limit *	
High Sensor Limit *	
Sensor Pressure *	Act. sensor press.
Temperature Unit	°C
Unbiased Pressure *	Act. sensor press.
Biased Pressure *	Act. sensor press.
Security Locking	130
Serial-No. SENS. *	
Process Conn. P+	special
Process Conn. P–	special
Gasket	special
Process Diaphram.	special
Fill Liquid	special

10 Maintenance and Repair

10.1 Repair

If the Deltabar S must be sent to Endress+Hauser for repair, then a note should be enclosed containing the following information.

- An exact description of the application
- The chemical and physical characteristics of the product.
- A brief description of the error.

Before sending in the Deltabar S to Endress+Hauser for repair, please take the following protective measures:

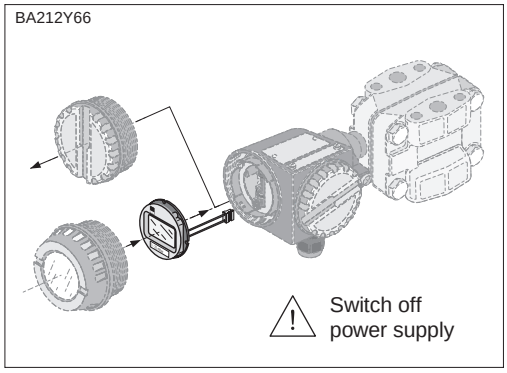
- Remove all traces of the product.
  This is particularly important if the product is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- We do request that no instrument should be returned to us without all dangerous material being completely removed first as it can, e.g. penetrate into fissures or diffuse through plastic.


Caution!

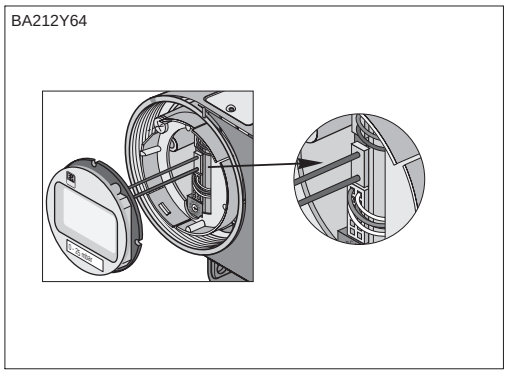
Caution!
Instruments with certificates of conformity or design approval must be sent in for repair as complete units only.

10.2 Mounting the display

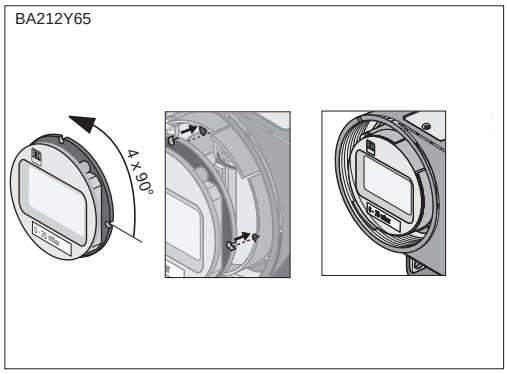
Mounting the display



- Switch off power supply.
- Open the cover to the display compartment (use a cover with a sight glass after mounting the display).

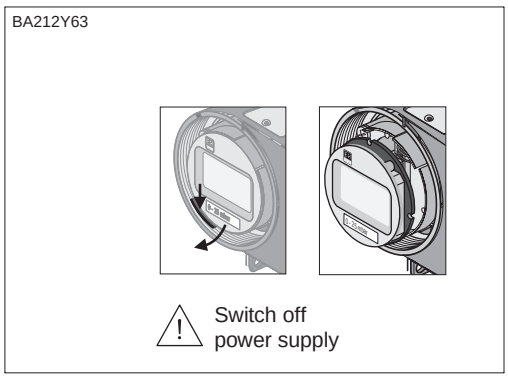


- Insert the plug of the display in the centre jack. Note the coding of the plug and jack.



- Attach display.
  The display can be rotated through 90°.
- Screw down the cover.

Removing the display



- Switch off power supply.
- Open the cover to the display compartment.
- Press the down the latch at the front.
- Tilt the display forward and remove.
- Remove plug.
- Screw down the cover.

10.3 Changing the sensor module and electronics

Warning!

Warning!
The sensor module and electronics should only be replaced by E+H Service when using the instrument in EEx d and EEx ia areas.
The Deltabar S must be sent back to E+H Service as a complete unit.

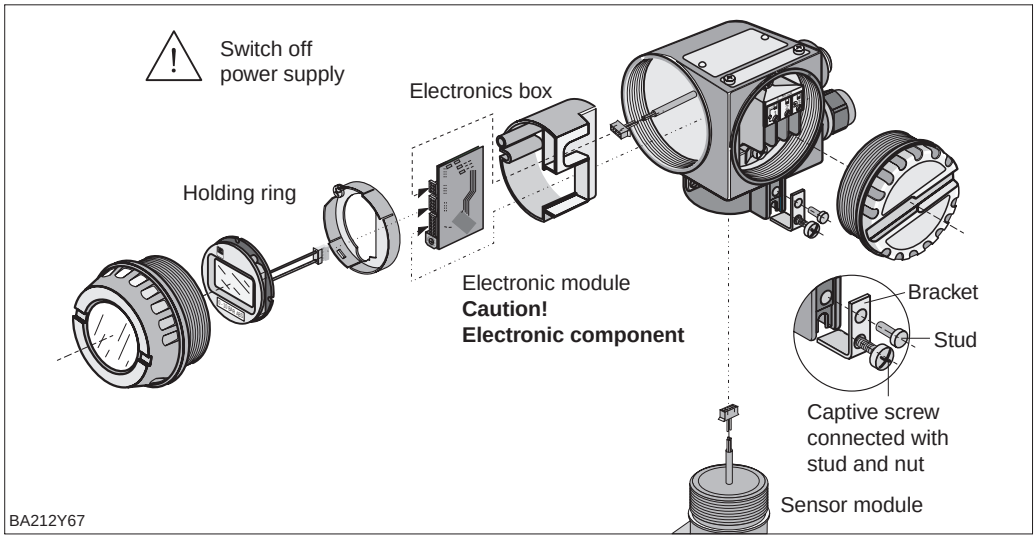
Caution!

Caution!
The electronic module is an electronic component. Electrostatic discharge can affect the operation of the instrument or cause damage to its electronic components. Contact should be made with a grounded object before handling the electronic module. Switch off power supply.

Changing the electronics

Removal
- Open the cover to the display compartment
- Remove the display
- Undo the two screws on the holding ring and remove
- Remove the plug from the electronic module
- Remove the electronic module

Mounting
- Insert the electronic module
- Mount the holding ring
- Insert the plug, noting size and coding
- Attach display of cover and screw down the cover to the display compartment

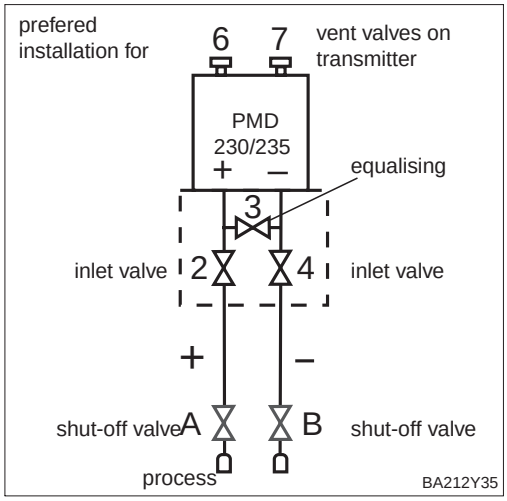


Changing the sensor module

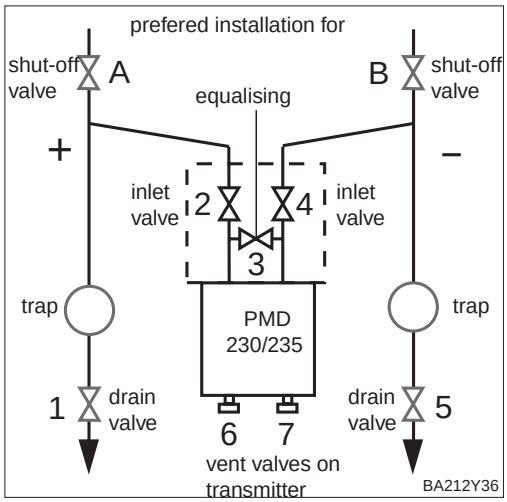
Removal
- Remove the complete electronics and electronic box from the housing (see above).
- Position the bracket and smooth face on the sensor module parallel to each other. Remove the stud, undo the screw and lift out the bracket. When unscrewing the sensor module, carefully rotate the cable with it.

Mounting
- Insert the cable with plug into the display compartment.
- Screw in the sensor module right to the stop, taking care to turn the cable with it.
- To ensure that the Deltabar S can be fully turned when mounted, turn the unit in the other direction by one complete turn.
- Position the bracket and smooth face parallel to the sensor module.
- Secure the bracket with the stud and screw.
- Mount the electronics and electronic box and insert the plug, noting size and coding.

10.4 Exchanging the transmitter



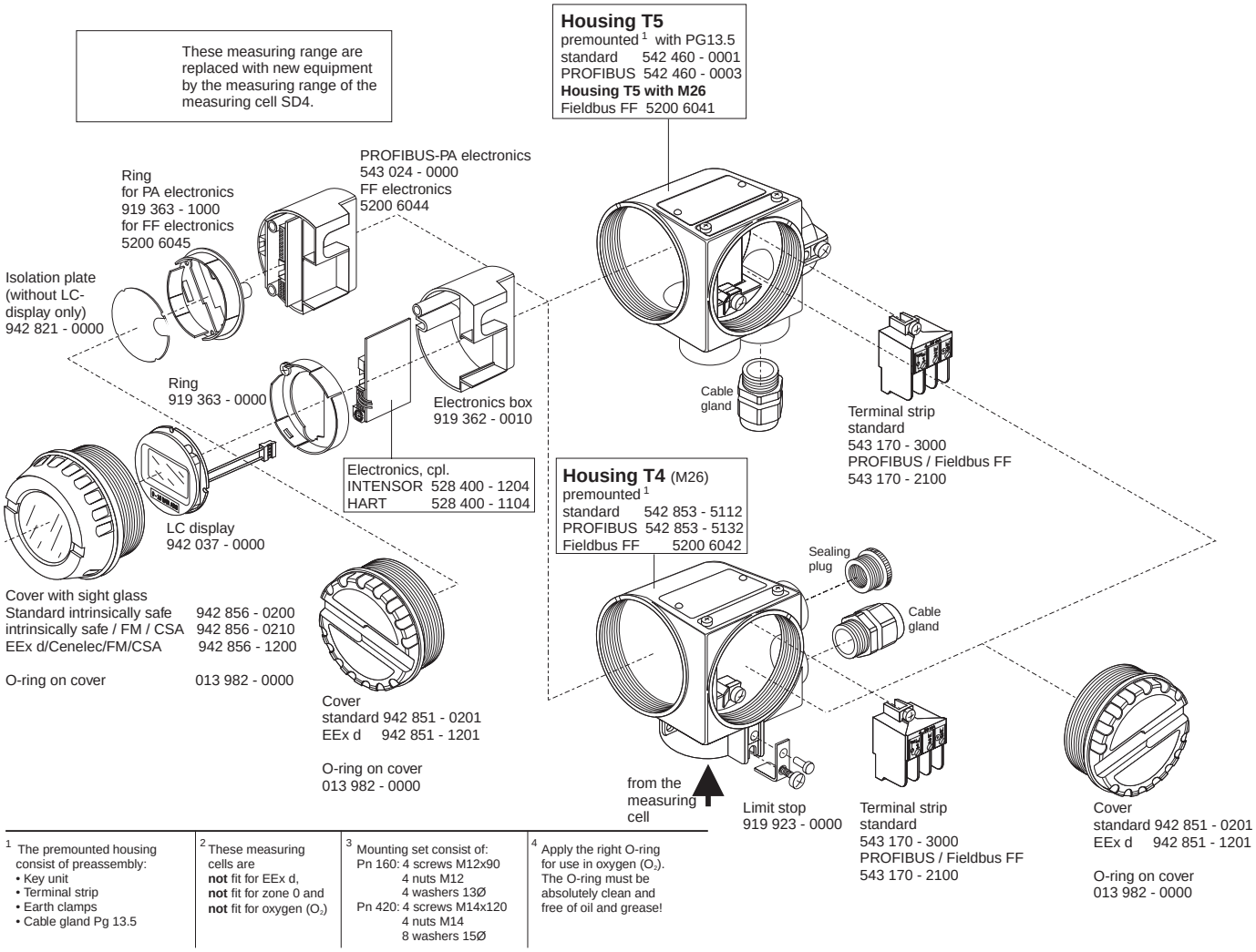
#	Valve	Significance
1	Close A and B	Close shut-off valves
2	Close 4	Close negative side
3	Open 3	Connect positive and negative side
4	Close 2	Shutt off transmitter to positive side
5	Exchange transmitter	
6	Commission new transmitter, see Chapter 5	



10.5 Replacement parts

The diagram below shows all electronics replacement parts, together with their order numbers, which can be ordered from Endress+Hauser.

When ordering replacement parts, please note the following:
- If parts given in the order code are to be replaced, then it must be ensured that the order code (instrument designation) on the nameplate is still valid.
- If the instrument designation on the nameplate has changed then a modified nameplate must also be ordered. The information about the new instrument must then be entered on the modified nameplate. This must then be attached to the housing of the Deltabar S.
- It is not possible to convert a standard instrument into an Ex instrument by replacing its parts.



[1] The premounted housing consist of preassembly:
- Key unit
- Terminal strip
- Earth clamps
- Cable gland Pg 13.5

[2] These measuring cells are **not** fit for EEx d, **not** fit for zone 0 and **not** fit for oxygen (O_2)

[3] Mounting set consist of:
Pn 160: 4 screws M12x90, 4 nuts M12, 4 washers 13Ø
Pn 420: 4 screws M14x120, 4 nuts M14, 8 washers 15Ø

[4] Apply the right O-ring for use in oxygen (O_2). The O-ring must be absolutely clean and free of oil and grease!

11 Technical Data

General information

Manufacturer	Endress+Hauser
Instrument	Pressure transmitter
Designation	Deltabar S PMD 230, PMD 235, FMD 230, FMD 630, FMD 633
Technical documentation Version Technical data	BA 212P/00/en 05.00 DIN 19259

Input

Measured variables	Differential pressure for deriving flowrate (volumetric or mass flow), level, mass or volume

Measuring range

Nom. value ceramic sensor	Measurement limits		Recommended span		Overload [3]		Sensor
PMD 230 FMD 230 [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	Minimum [mbar]	Maximum [mbar]	One-sided [mbar]	Two-sided (System pres. PN) [bar]	Filling fluid [2]
25	–25	25	2	25	10	10	silicone oil
100	–100	100	5	100	16 [1]	16 [1]	silicone oil
500	–500	500	25	500	100 [1]	100 [1]	silicone oil
3000	–3000	3000	150	3000	100 [1]	140 [1]	silicone oil

1) 10 bar with PVDF process connection for PMD 230, 40 bar with process connection for FMD 230
2) Voltalef 1A for applications in very pure gases
3) The overload limit applies to the cell only. The limit for diaphragm seal is given by their maximum permissible pressure.

Nom. value Silicon sensor (URL)	Measurement limits		Recommended span		System pressure [3]	Overload [6]		Sensor
PMD 235 FMD 630 FMD 633 [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	Minimum [mbar]	Maximum [mbar]	PN [bar]	One-sided	Two-sided [4]	Filling fluid [2]
10 [1]	–10	10	0.5	10	160 [5]	PN	1.5 x PN	silicone oil
40 [1]	–40	40	2	40	160 [5]	PN	1.5 x PN	silicone oil
100	–100	100	5	100	160 [5]	PN	1.5 x PN	silicone oil
500	–500	500	25	500	160 420	PN	1.5 x PN	silicone oil
3000	–3000	3000	150	3000	160 420	PN	1.5 x PN	silicone oil
16000	–16000	16000	800	16000	160 420	PN	1.5 x PN	silicone oil
160	–160	160	8	160	160 [5]	PN	1.5 x PN	silicone oil
1000	–1000	1000	800	1000	160 420	PN	1.5 x PN	silicone oil
6000	–6000	6000	300	6000	160 420	PN	1.5 x PN	silicone oil
40000 [1]	–40000	40000	2000	40000	160 420	100 bar	1.5 x PN	silicone oil

1) PMD 235 only
2) Voltalef 1A for applications in very pure gases, other filling fluids on request
3) 160 bar version with stainless steel bolts, 420 bar version with chromized steel bolts
4) Type tested for burst pressure (FM) up to 1120 bar on both sides with PN 420 bar version
5) High pressure 420 bar version on request
6) The overload limit applies to the cell only. The limit for diaphragm seal is given by their maximum permissible pressure.

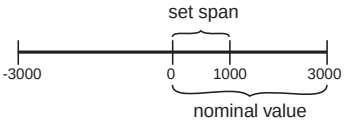
Output

Output signal	Digital communication signal, Foundation Fieldbus protocol
FF function	Publisher-Subscriber
Transmission rate	31.25 kBit/s
Signal on alarm	Signal: Status bit set, last vald measured value will be held Display module: error code
Damping	0…40 s via configuration tool
Communication resistance	Foundation Fieldbus termination resistor

Accuracy

Explanation of terms:

Turn down (TD)
= Nominal value / set span



Example: Nominal value = 3000 mbar
Set span = 1000 mbar TD 3:1

"**Platinum**"
* Values for instruments with higher accuracy ("Platinum") are shown with an asterisk *
(PMD 235 – ****A****
PMD 235 – ****B****
PMD 235 – ****C****)

Root values
For root characteristic curves:
The accuracy specifications of the Deltabar S are reduced by a factor of ½ when calculating flowrates.

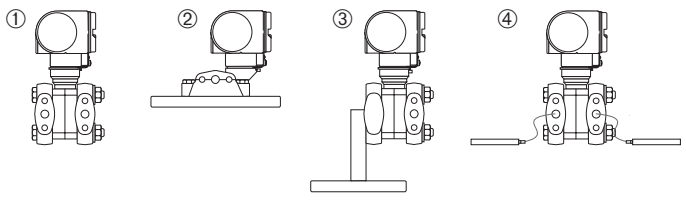
Reference conditions	DIN IEC 770 T_U=25°C (77°F) Accuracy data adopted after entering "Low sensor calibration" and "High sensor calibration"for lower range-value and upper range-value.
Linearity including hysteresis and repeatability based on the limit point method to IEC 770	to TD 10:1: ±0.1% (* ±0.05%) of set span for TD 10:1 to 20:1: ±0.1% (* 0.05%) x [nominal value / (set span x 10)] of set span
Long-term drift as a function of nominal value	0.1% of nominal value / year, 0.25% of nominal value / 5 years
Effects of system pressure on the zero point (on the span) Values in percent of nominal value	**Metallic sensor** / **Ceramic sensor**

Metallic sensor		Ceramic sensor	
Nom. value	Diviation	Nom. value	Diviation
10 mbar	1.5 (0.5)%/100 bar	25 mbar	0.5 (0.2)%/10 bar
40 mbar	0.5 (0.2)%/100 bar	100 mbar	0.2 (0.2)%/16 bar
100 mbar	0.3 (0.2)%/100 bar	500 mbar	0.2 (0.2)%/100 bar

Temperature coefficient	0.04% (* 0.03%) of nominal value / 30 K (–10 to 60°C/14 to 140°F) and 0.1% (* 0.08%) of nominal value / 30 K (–40 to –10°C or 60 to 85°C/ –40 to 14°F or 140 to 185°F)
Temperature coefficient of diaphragm seal	See Technical Information TI 256P tables on pages 29 and 31, column "diaphragm seal", T_K
Settling time	PMD 230/FMD 230: 300 ms FMD 235: 150 ms FMD 630/633: dependent upon diaphragm seal
Scanning time	min. 20 times per second
Rise time	1/3 of the settling time
Warm-up period	2 s
Thermal effects	(0.2 % x TD + 0.2 %) of set span
Vacuum resistance	PMD 2130, 235, FMD 230: up to 1 mbar abs FMD 630, 633: up to 10 mbar abs

Application conditions

Installation conditions

Calibration position ①, ② FMD 230 ③ FMD 630 ④ FMD 633	
Orientation	As required, orintation-dependent zero shift can be fully correted, with no efffect of span

Process conditions

Process temperature range in process	PMD 230/FMD 230: –40…+85°C (–40…+185°F) PMD 235: –40…+120°C (–40…+248°F) FMD 630/633: to +350°C (+662°F)
Process Pressure	Corresponds to permissible overload, see page 74

Ambient conditions

Ambient temperature	–40…+85°C (–40…+185°F)
Storage temperature	–40…+100°C (–40…+212°F)
Climatic class	G P C to DIN 40 040
Vibration resistance	Ceramic sensor: ± 0.1% of span (DIN IEC 68 Part 2-6) Metal sensor: ± 0.1% of span (DIN IEC 68 Part 2-6)
Protection	IP 65
Electromagnetic compatibility	Interference emission to EN 61 326 electrical equipment B, Interference immunity to EN 61 326 Annex A (industrial) and NAMUR derictive NE 21, Interference immunity to EN 61 000-4-3: 30 V/m Use twisted creened two-wire cabling.

Mechanical construction

Design

Dimensions	See Technical Information TI 256, page 77
Housing	Housing T4 (display on side) or T5 (display on top), Housing can be rotated up to 330°, Separated electronics and connection compartments, Optional electrical connection via Pg 13.5 with cable gland or M 20x1.5, G ½, ½ NPT thread as well as via PROFIBUS-PA M 12, FF 7/8" or Harting HAN7D connector
Process connections	Optional flange or diaphragm seal with capillary extension available, see also Technical Information TI 256P

Materials

Nameplate	1.4301 (AISI 304)
Process connections	Optional: 1.4435 (AISI 316L), Steel C 22.8, Hastelloy 2.4819 (C279)
Process diaphragm	Ceramic sensor: Al_2O_3 Aluminium oxide ceramic Metal sensor: Optional 1.4401 (AISI 316), Hastelloy C, Monel, tantalum optional 1.4435 (AISI 316L)
Filling fluid in diaphragm seals	Silicone oil AK 100, High-temperature oil, Fluorolube, glycerine, vegetable oil
Seals Ceramic sensor	FPM Viton, FPM Viton oil and grease-free, Kalrez, FPM Viton oil and grease-free for oxygen, EPDM, PTFE-bound Hastelloy C-4 seal for p_{abs}>900 mbar
Metal sensor	FPM Viton, NBR, FPM Viton oil and grease-free for oxygen, FPM Viton oil and grease-free, PTFE
O-ring for cover seal	NBR
Mounting accessories	Mounting set with screws 1.4301 (AISI 304)

Diasplay and ooerating interface

Display (optional)	Plu-in display module with four-character pressure display and analogue display (bargraph) of current with 28 segments
On-site operation	Via four keys Z–, Z+, S–, S+
Remote operation	Via interface card H1 direct connection to PC with operating program or via Link and interface card H1 connection to PC with operating program

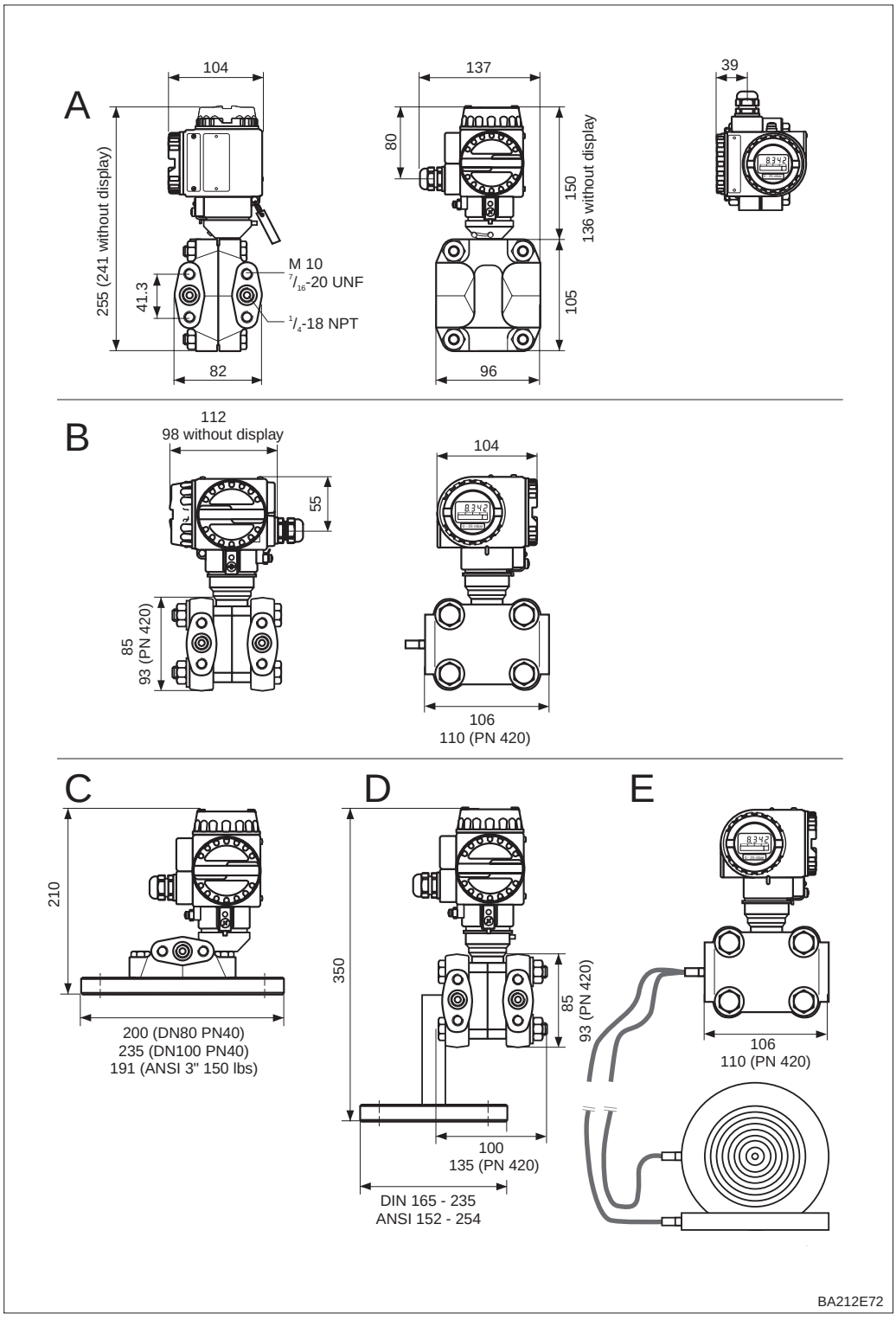
Power supply

Power supply voltage	Standard: 9…32 V DC; for EEx see Certificate of Conformity
Current consumption	10.5 mA ± 1 mA
Power up current	Corresponds to Table 4, IEC 1158-2

Dimensions Deltabar S

Further details on the dimensions and clearances of the transmitter versions can be taken from Technical Information TI 256P.

Dimensions
1 in = 25.4 mm
1 mm = 0.039 in



Deltabar S
- *A PMD 230 (ceramic sensor) with T5 housing and oval flange according to DIN 19 213*
- *B PMD 235 (ceramic sensor) with T4 housing and oval flange according to DIN 19 213*
- *C FMD 230 with flush ceramic diaphragm*
- *D FMD 630 (metal sensor) with diaphragm seal*
- *E FMD 633 (metal sensor) with capillary and remote seals*

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