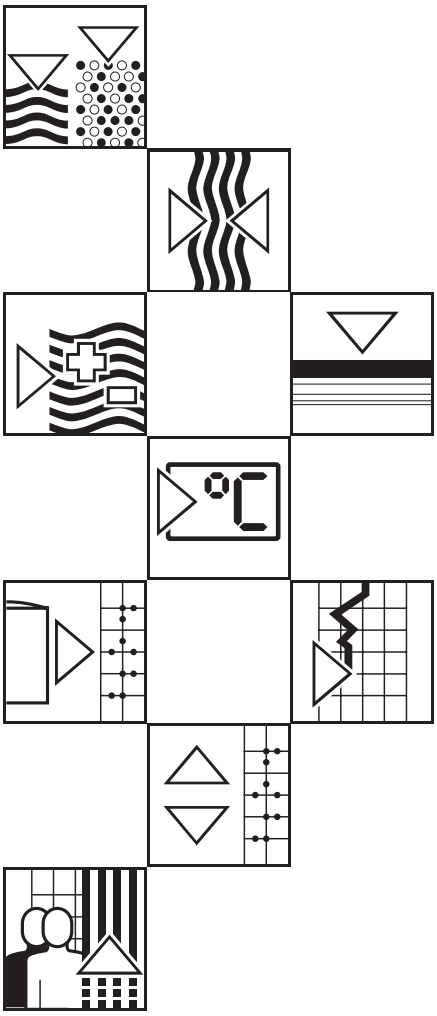
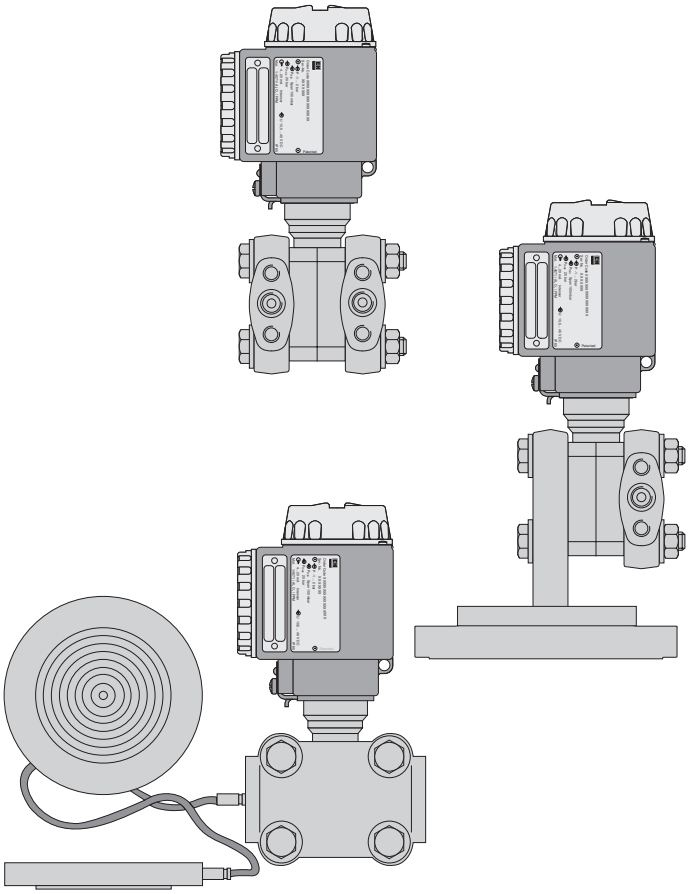
BA 174P/00/en/05.03
Software version 7.1
52016863

deltabar S
Differential pressure transmitter

Operating Instructions

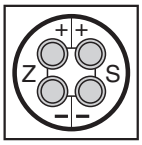




Endress+Hauser

The Power of Know How

Short Instructions



Commissioning on-site
– Flow
– Level
– Differential pressure
Chapter 4

Additional functions through remote operation with
– Commuwin II
– Universal HART Communicator DXR 275
– Commulog VU 260 Z (INTENSOR)

Flow, level, differential pressure?

Differential pressure
Chapter 5

– Damping
– Calibration
– 4 mA threshold
– Output on alarm
– Locking/unlocking the operation
– Information on measuring point

Level
Chapter 6

– Damping
– 4 mA threshold
– Output on alarm
– Density correction

Empty/full calibration

Dry calibration

Linearisation?

no

yes

table

automatic

– Locking/unlocking the operation
– Information on measuring point

Flow
Chapter 7

– Damping
– Calibration
– Creep flow suppression
– 4 mA threshold
– Output on alarm
– Locking/unlocking the operation
– Information on measuring point

Table of Contents

Software History

HART electronics (operation using Universal HART Communicator DXR 275)

SW/BA	Device and Software No.	Device revision	DD revision	Changes
1.x	731x	1	2	———
2.0 from 10.97	7320	2	1	– Operation Mode (V3H0) "Level Manual" extended. New parameters for the "Level Manual" mode: Manual Level, Table Editing (V3H6), Row No. Table (V3H7), Input Level (V3H8), Set Volume (V3H9). – "Pressure Before Bias", "Pressure After Bias" and "Security Locking" parameters moved from the Linearisation menu to the Service menu. – "Set Simulation Current" (V7H1) Simulation limits extended from 3.8 to 22 mA. – "MIN Alarm" option for "Set Output Safety" (V0H8) parameter no longer possible. – Error and warning list extended.
5.0	7350	5	1	– "MIN Alarm" option for "Set Output Safety" (V0H8) parameter available again. – "Set Simulation Current" (V7H1) parameter: Simulations limits again 3.6 to 22 mA.
6.0 from 11.99	7360	6	1	– New totalizer function. New parameters for totalizer functions: Internal Counter (V5H0), Display Mode (V5H1), Counter Display (V5H2), Conversion Factor (V5H3), Counting Units (V5H4). – Units list for "Level Cylindrical" and "Square Root" extended.
7.0 from 10.00	7370	7	1	– Operation Mode (V3H0) "Pressure in %" extended. – New "Alarm Current Max" (V9H4) parameter. – Zero correction function: New parameters for zero correction function, refer to page 38 Zero Correction (V9H5), Zero Correction Value (V9H6). – Editing limits: Refer to chapter 8.4. – Download error E116, resettable using Reset 5140.
7.1 from 03.03	7371	7	2	– Parameter names changed **old** → **new** (matrix position in brackets) Set output safety → Alarm mode (V0H8) • Min. (–10 %) → Min. alarm • Max. (+110 %) → Max. alarm • Continue → Value hold Min. pressure → Peak hold P Min (V2H3) Max. pressure → Peak hold P Max (V2H4) Min. temperature → Peak hold T Min (V2H7) Max. temperature → Peak hold T Max (V2H8) Low Sensor Cal → Low Sensor Trim (V7H4) High Sensor Cal → High Sensor Trim (V7H5) Set max. current → Max. alarm current (V9H4) Serial number → HART Serial number (VAH2)

Note!

Note!

- The entries in brackets indicate the matrix position in Commuwin II. If you use the DXR 275 handheld terminal, you can access the parameters via Menu, see chapter 11.2 HART Matrix.
- An upload/download is only possible within a software revision, e.g. 1.x.

INTENSOR electronics (operation using Commulog VU 260 Z)

SW/BA	Device and Software No.	VU 260Z	Changes
1.x	721x	1.7	———
2.0 from 10.97	7220	1.8	– Operation Mode (V3H0) "Level Manual" extended. New parameters for the "Level Manual" mode: Manual Level, Table Editing (V3H6), Row No. Table (V3H7), Input Level (V3H8), Set Volume (V3H9). – "Pressure Before Bias", "Pressure After Bias" and "Security Locking" parameters moved from the Linearisation menu to the Service menu. – Error and warning list extended. – "Set Simulation Current" (V7H1) parameter, Simulations limits from 3.8 to 22 mA. – "MIN Alarm" option for "Set Output Safety" (V0H8) parameter no longer possible.
5.0	7250	1.8	– "MIN Alarm" option for "Set Output Safety" (V0H8) parameter available again. – "Set Simulation Current" (V7H1) parameter: Simulation limits again from 3.6 to 22 mA

Note!
- The "Totalizer", "Zero Correction", "Editing Limits" and "Alarm Current MAX " functions are not included in the INTENSOR electronics (software version 5.0).
- An upload/download is only possible within the software revision, e.g. 1.x.

Note!

Notes on Safety

Approved usage

The Deltabar S is a differential pressure transmitter for measuring differential pressure, flow and level.

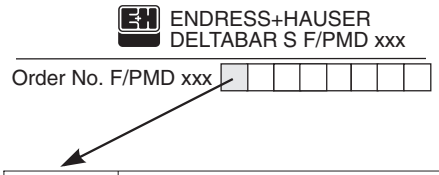
Mounting, commissioning operation

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

Explosion hazardous areas

If the device is to be installed in an explosion hazardous area, then the specifications in the certificate as well as all national and local regulations must be observed. The instrument can be delivered with the certificates listed in the table below. A separate Ex-documentation is enclosed with the device and is an integral part of this documentation. The installation regulations, connection values and Safety Instructions listed in this document must be observed. The certificate can be identified from the first letter of the order code stamped on the nameplate (see table below).

- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local regulations.



Certificates for applications in explosion hazardous areas

Code	Certificate	Explosion protection
A, F, K, S, 5	Standard	none
C, L, 6	ATEX	ATEX II 1/2 G EEx ia IIC T4/T6
M, T	ATEX	ATEX II 2 G EEx d IIC T5/T6
B, N	ATEX	ATEX II 3 G EEx nA II T6
U	FM	Explosion proof Class I, II, III, Div. 1, Group A-G
W	FM	IS Class I, II, III, Div. 1, Group A-G
1	CSA	Explosion proof Class I, II, III, Div. 1, Group B-G
2	CSA	IS Class I-III, Div. 1, Group A-G
P	TIIS	EEx d IIC T6 or EEx ia IIC T6

Safety Conventions and Symbols

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

Safety conventions

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

Explosion protection

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

Electrical symbols

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

1 Introduction

Application

The Deltabar S family of devices is used for the measurement of differential pressure, level and flow in gases, vapours and liquids. They are used in all sectors of industry.

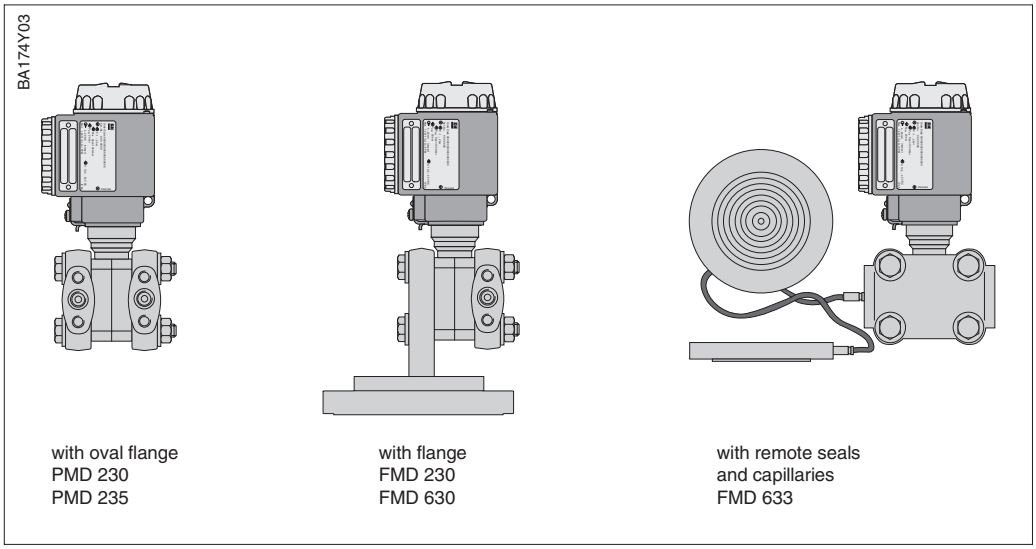


Figure 1.1
Deltabar S versions

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.

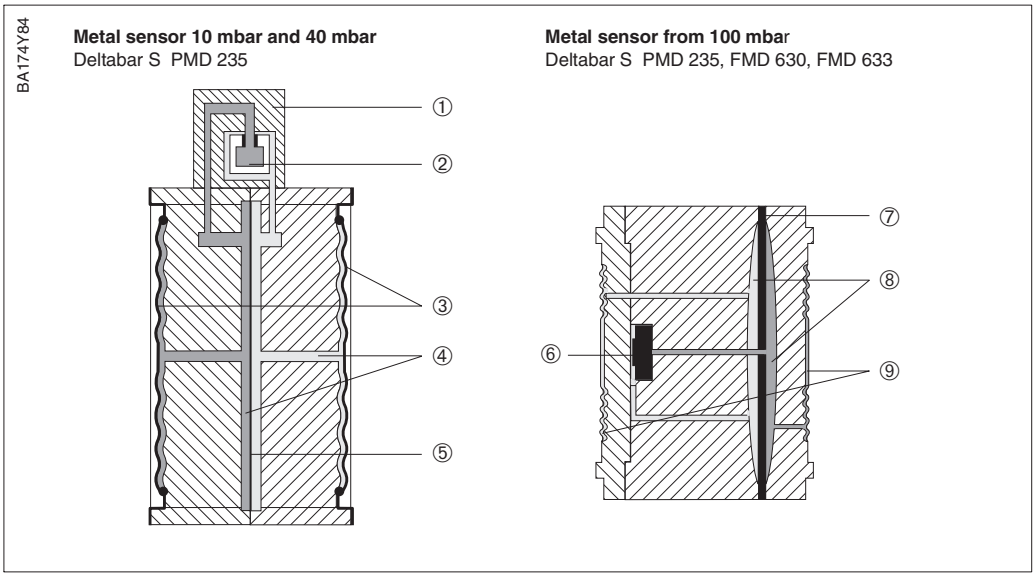
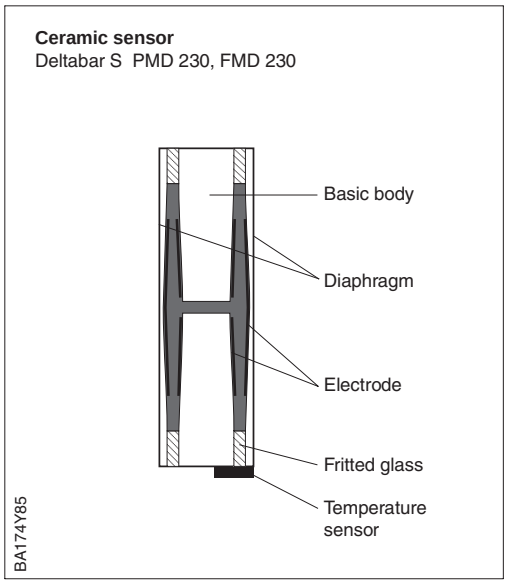


Figure 1.2

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*

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.



1.1 Measuring system

In the simplest case, the complete measuring system comprises
- a Deltabar S with 4…20 mA current output
- an optional four-character display for pressure
- supply voltage for non-hazardous area: 11.5…45 V DC,
  EEx ia: 11.5…30 V DC, EEx d: 13…30 V DC, EEx nA: 11.5…30 V DC

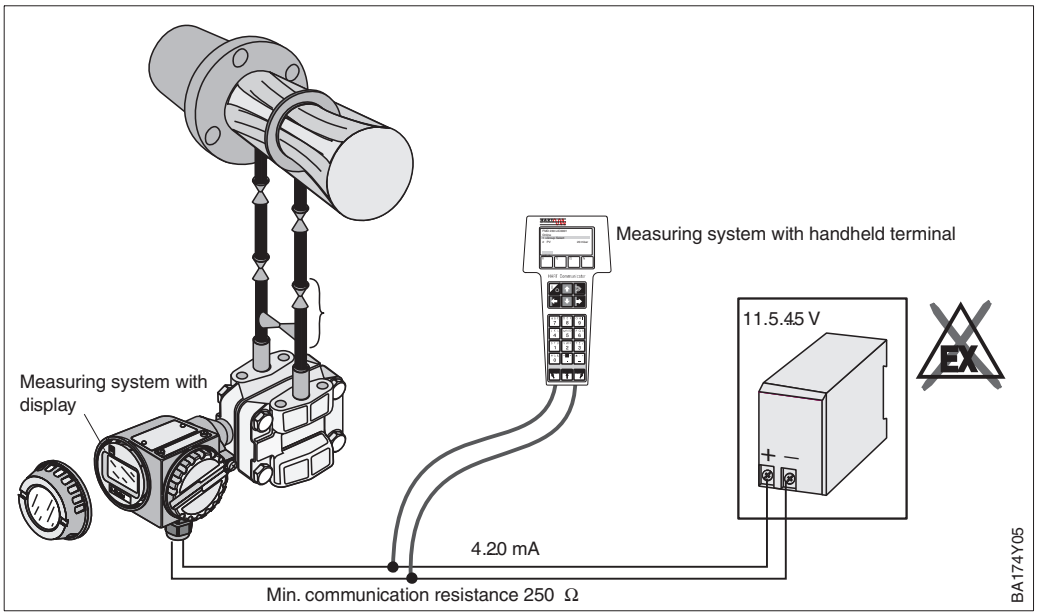


Fig. 1.3
Deltabar S measuring system with display and/or handheld terminal

The HART or INTENSOR versions have a digital communication signal superposed on the current signal which is used for remote calibration.
These transmitters have extended functions so that level or flow can also be measured.
The device is operated:
- via the Commuwin II operating program
- via the Universal HART Communicator DXR 275 universal handheld terminal (HART protocol)
- via the Commulog VU 260 Z handheld terminal (INTENSOR protocol)

2 Installation

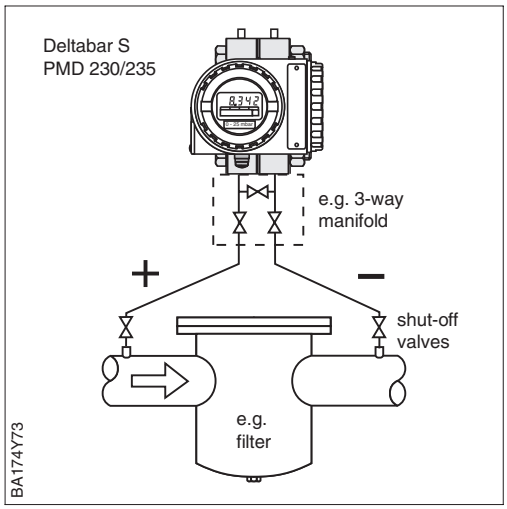
This chapter describes the measuring set-up of the Deltabar S and the electrical connection.

2.1 Measuring system for differential pressure measurement

Note!

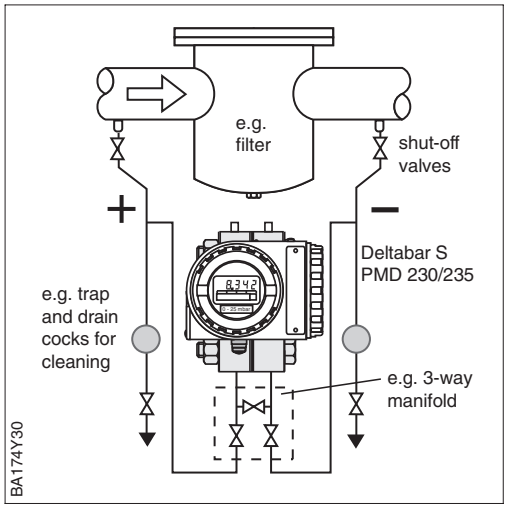
- General recommendations for laying pressure piping may be taken from DIN 19210 "Methods for measurement of fluid flow; differential pressure piping for flow measurement devices" or the appropriate national or international standards.
- Check that pressure piping installed outdoors is adequately insulated and/or heated.


Note!



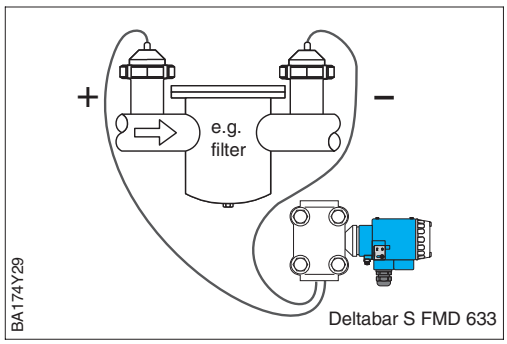
Gases and vapours

- Mount the Deltabar S above the tapping point, so that condensation can run back into the process piping.
- Use a three-way 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 back into the process pipe.
- Use a three-way 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 cocks are used.
- Install the pressure piping with a continuous fall of at least 10%.



Gases, vapours and liquids with diaphragm seals and capillaries

- 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.
- Always use two identical diaphragm seals (e.g. diameter, material etc.) for the plus and minus sides.

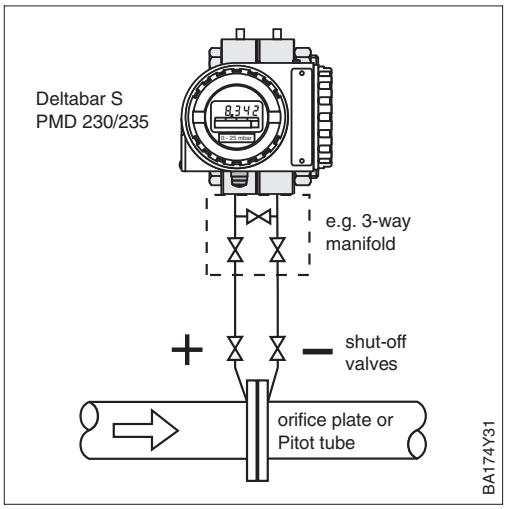
2.2 Measuring system for flow measurement

Note!

Note!
General recommendations for laying pressure piping may be taken from DIN 19210 "Methods for measurement of fluid flow; differential pressure piping for flow measurement devices" or the appropriate national or international standards.

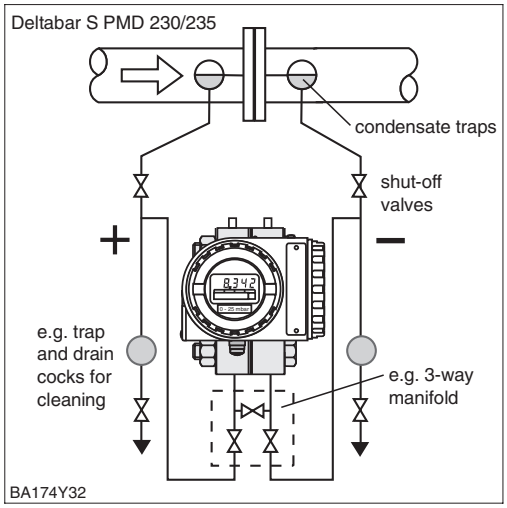
Gases

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



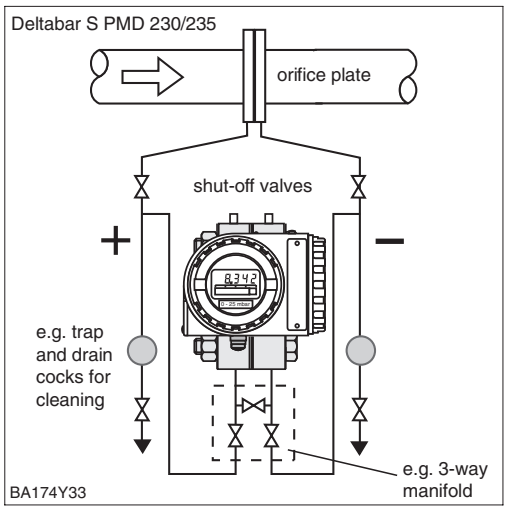
Vapours

- 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-way 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 back into the process pipe.
- Use a three-way 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 cocks are used.
- Install the pressure piping with a continuous fall of at least 10%.

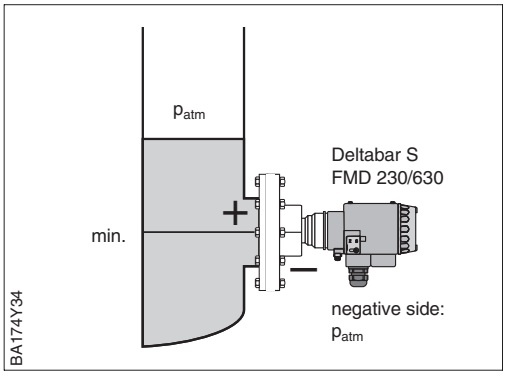


2.3 Measuring system for level measurement

Note!
General recommendations for laying pressure piping may be taken from DIN 19210 "Methods for measurement of fluid flow; differential pressure piping for flow measurement devices" or the appropriate national or international standards.

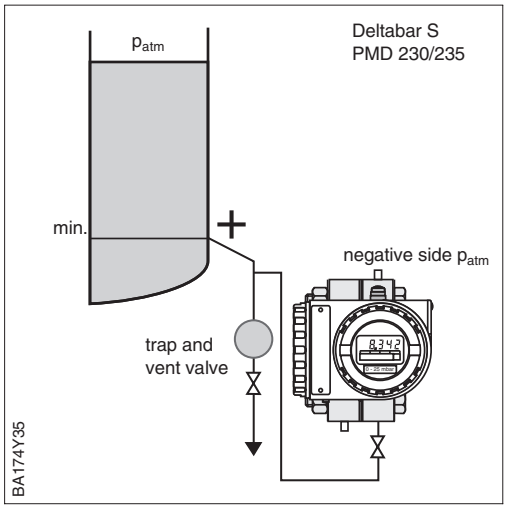
Note!

Open tank



FMD 230, FMD 630

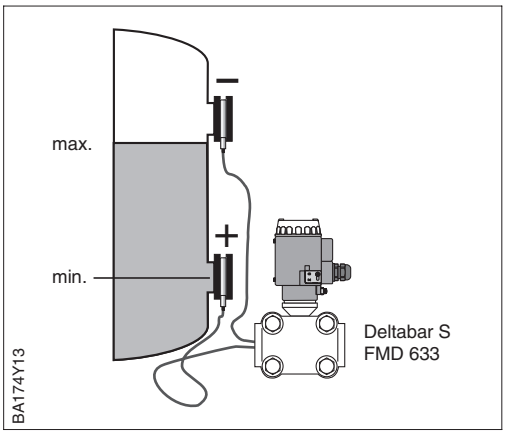
- Mount the Deltabar S direct on the tank.
- The negative side is open to atmosphere pressure.



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.
- Always use two identical diaphragm seals (e.g. diameter, material etc.) for the plus and minus sides.

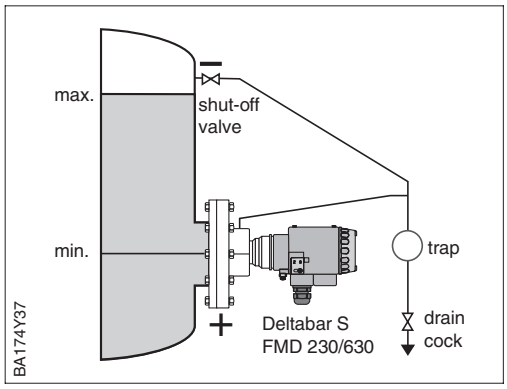
Note!
Level measurement can only be carried out between the upper edge of the lower remote seal and the lower edge of the upper remote seal.

Note!

Closed tank

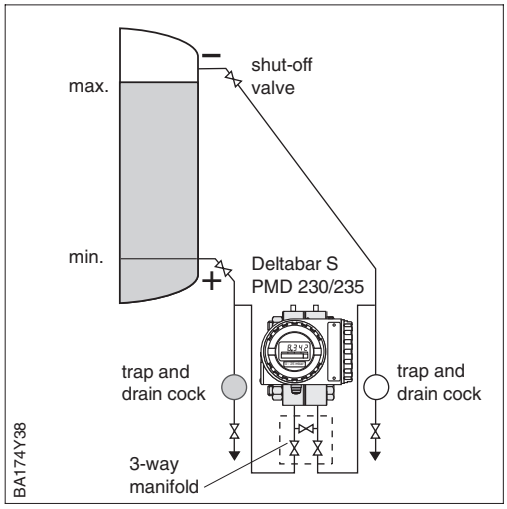
FMD 230, FMD 630

- 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

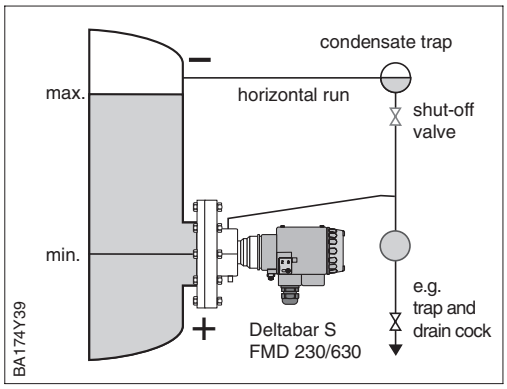
- Mount the Deltabar S below the lower tapping so that the pressure piping is always filled with liquid.
- The negative side must be above the maximum level to be measured.
- Traps prevent the build up of dirt in the pressure piping.
- Use a three-way manifold for simple mounting without interrupting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



Closed tank with steaming liquid

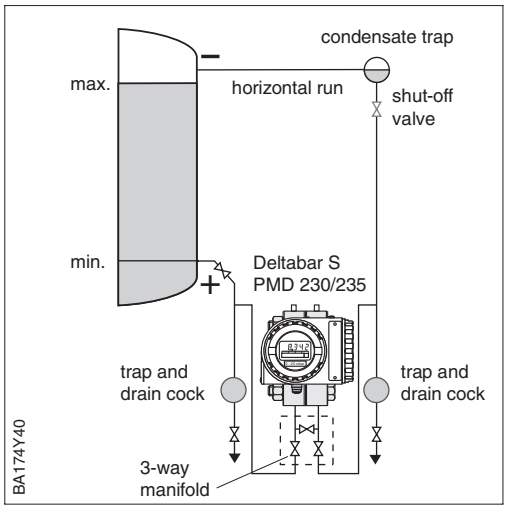
FMD 230, FMD 630

- Mount the Deltabar S direct on the tank.
- The tapping for the negative side must be above the maximum level to be measured.
- A condensate 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 condensate trap ensures a constant pressure.
- Traps prevent the build up of dirt in the pressure piping.
- Use a three-way 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.

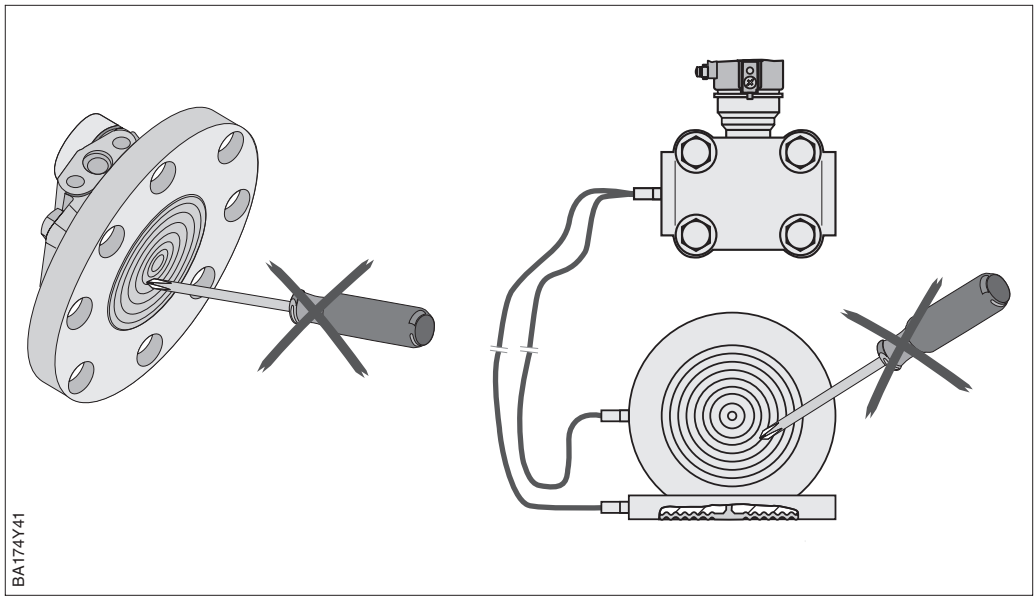


Figure 2.1
Handle diaphragm seals with care!

Seal for flange mounting

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

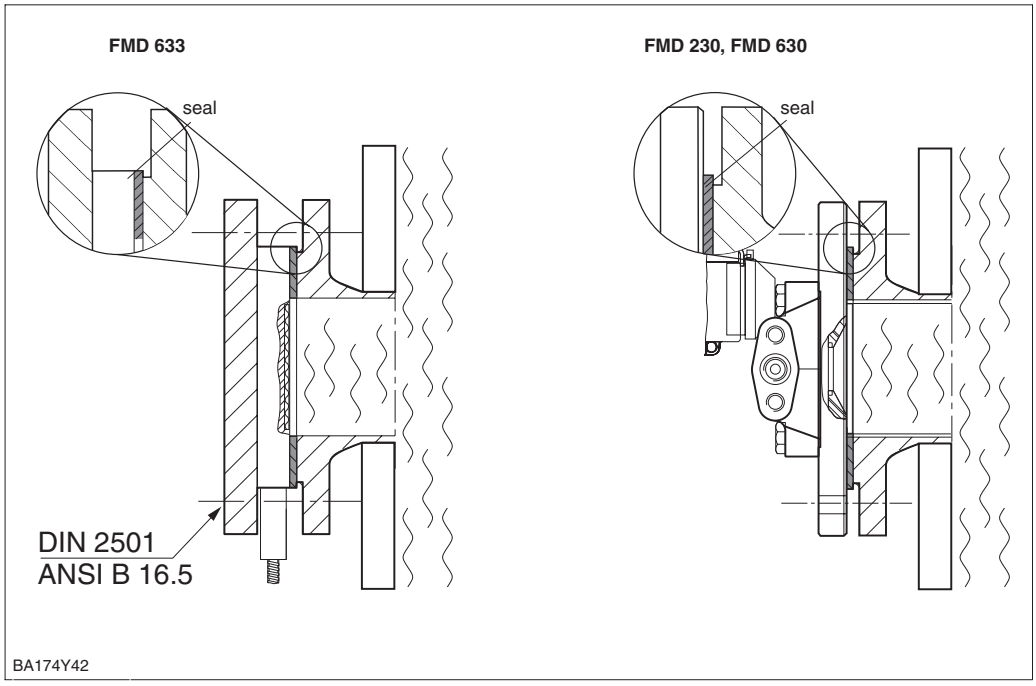
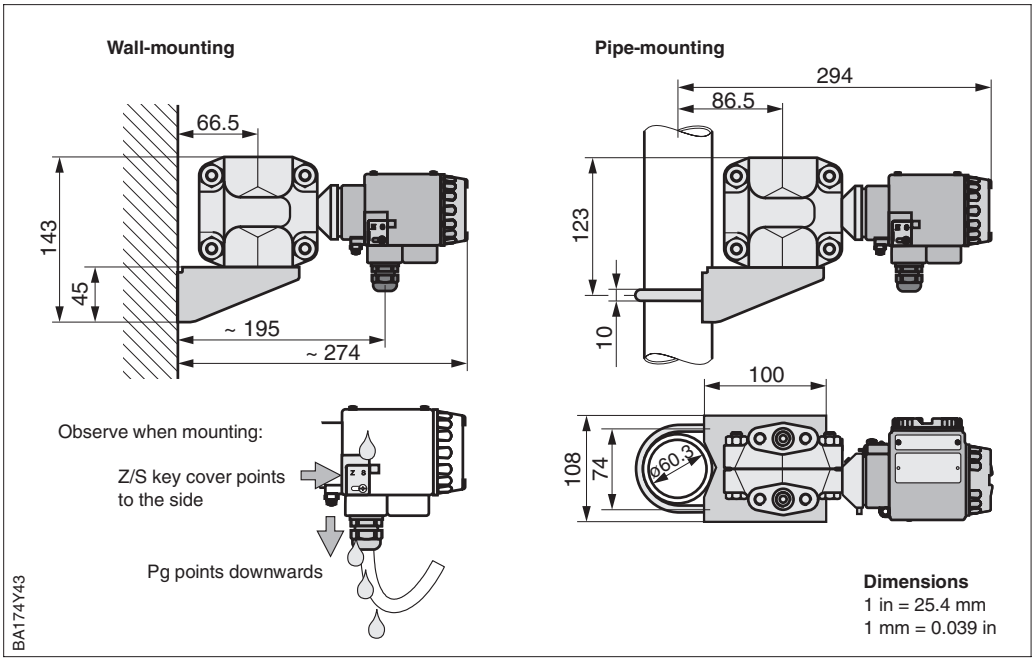


Figure 2.2
Mounting of the version with flange or diaphragm seal

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.

Figure 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.

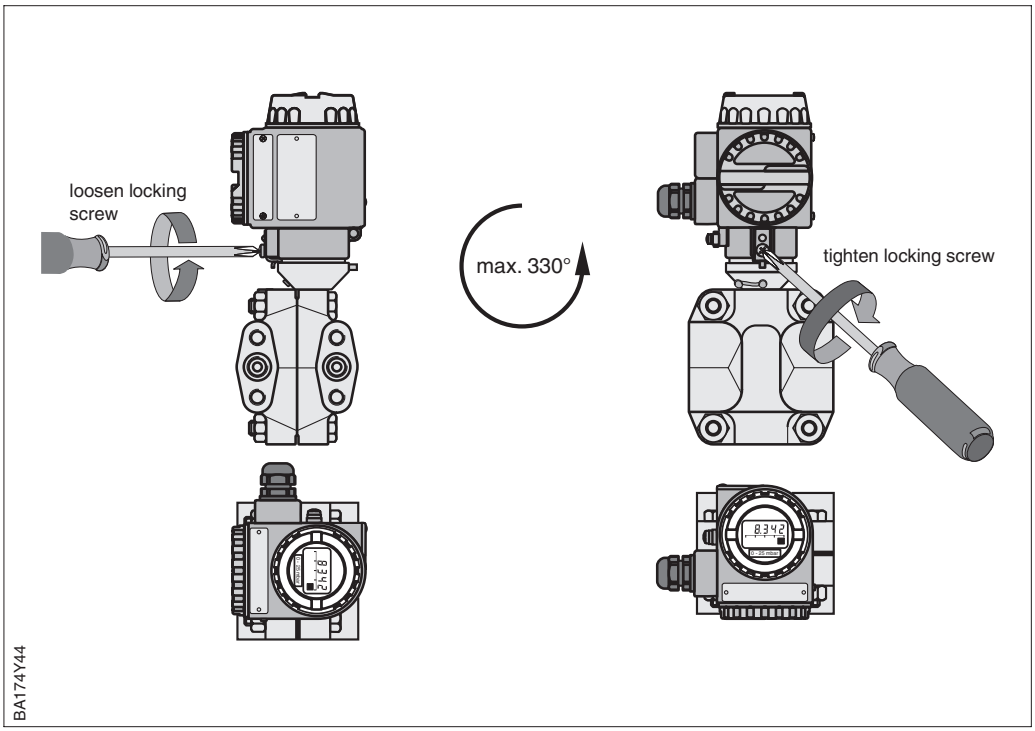


Figure 2.4
Align housing

2.5 Electrical Connection

Screen twisted pairs are recommended for the instrumentation cable.
Supply voltage:
Non-hazardous area: 11.5…45 V DC
EEx ia: 11.5…30 V DC, EEx d: 13…30 V DC, EEx nA: 11.5…30 V DC
Internal protection circuits protect against reverse polartity, HF interference an overvoltage peaks.
A test signal can be measured using terminals 1 and 3 without interrupting the process measurement.

Cable connection

- Unscrew the connection compartment lid
- Thread cable through the cable entry
- Connect cable cores according to the connection diagram
- Screw lid down

Note!
For devices for use in explosion-hazardous areas, see national regulations and Safety Instructions (XA…), Installation or Control Drawing.


Note!

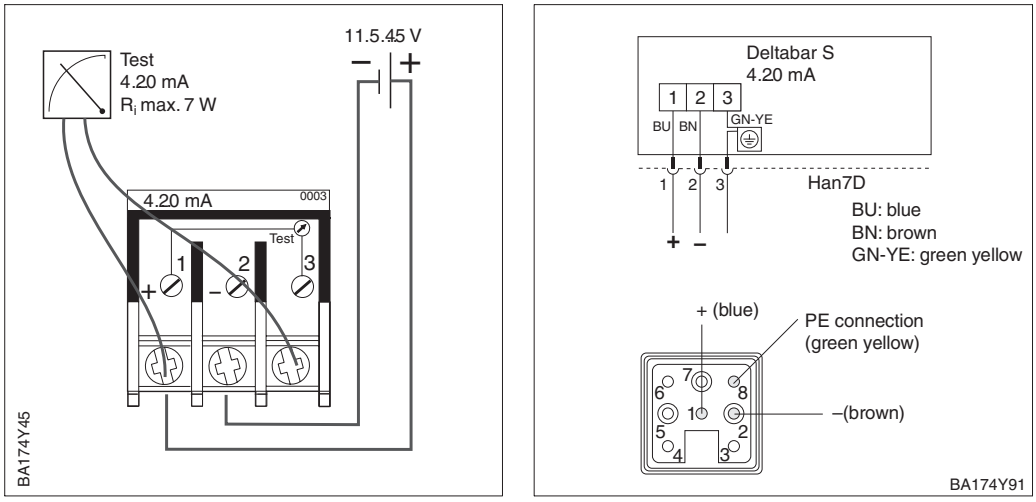


Figure 2.5

Electrical connection Deltabar S

left:
For all versions with 4.20 mA

right:
Harting plug pin assignment
Structure
"Certificate and cable entry"
FMD 230 –F,
FMD 630 –F,
FMD 633 –F

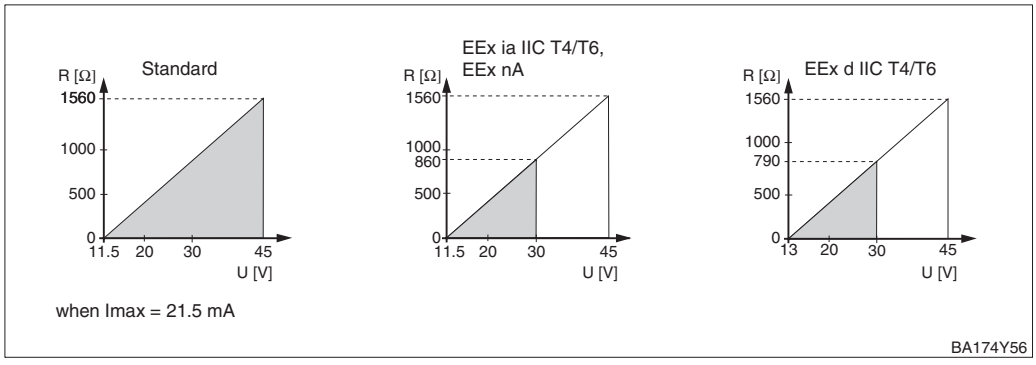


Figure 2.6
Load diagrams

Connecting the Commubox FXA 191 for operating via Commuwin II

The Commubox FXA 191 connects intrinsically safe Smart transmitters with a HART or INTENSOR protocol to the RS 232 C serial interface of a personal computer. This enables the transmitter to be remotely operated with the Endress+Hauser Commuwin II operating program. The Commubox FXA 191 is used for intrinsically safe signal circuits.

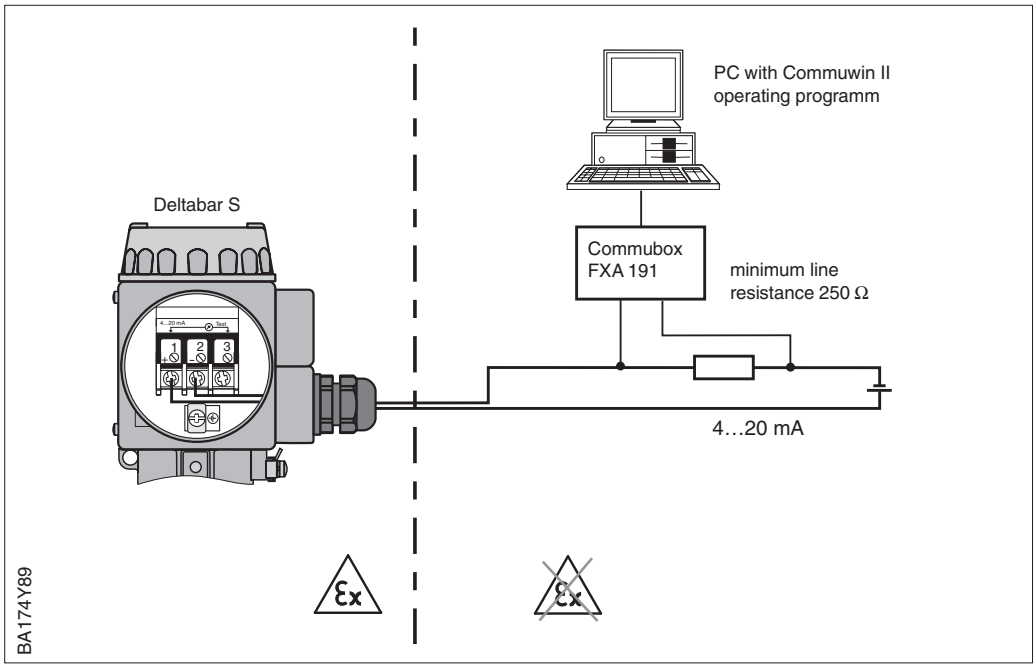


Figure 2.7
The Commubox can be connected anywhere along the 4…20 mA cable.

Connection of handheld terminals

- Do not connect the Ex d handheld terminal in explosion hazardous areas
- Do not change batteries in explosion hazardous areas.
- FM or CSA certificates cover the Deltabar S: Electrical connection is according to "Installation Drawing" or "Control Drawing" (enclosed in the Deltabar S packing).
- For correct transmission o f the communication signal a there must be a total minimum resistance of 250 Ω between the connecting points and the power supply.

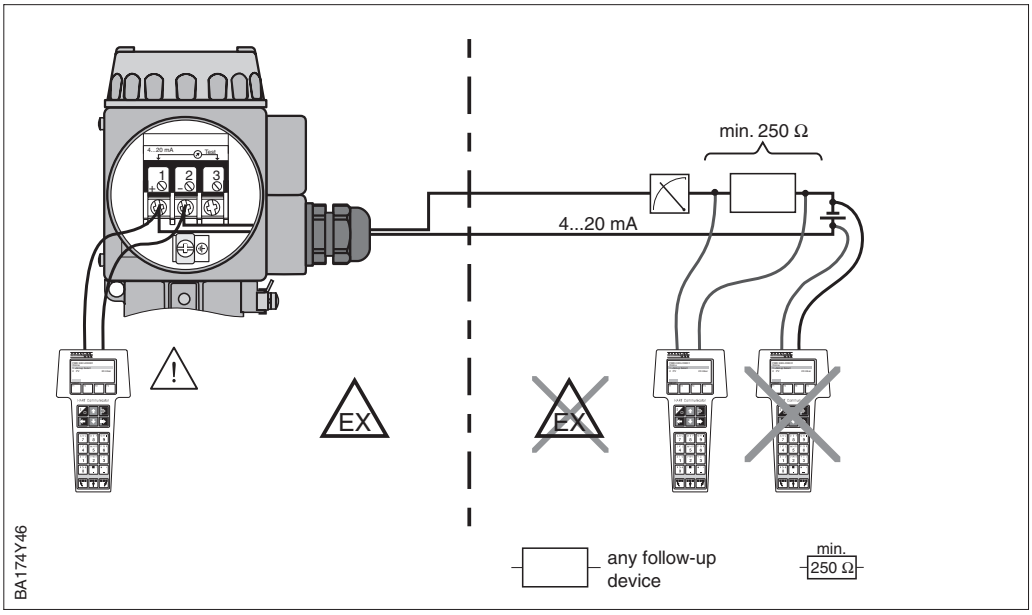


Figure 2.8
Connection of the handheld terminal for remote operation

3 Operation

3.1 On-site operation

Operating elements

Four keys, which allow the lower range-value and upper range-value to be set, are available for on-site operation. The key functions are listed in the table below.

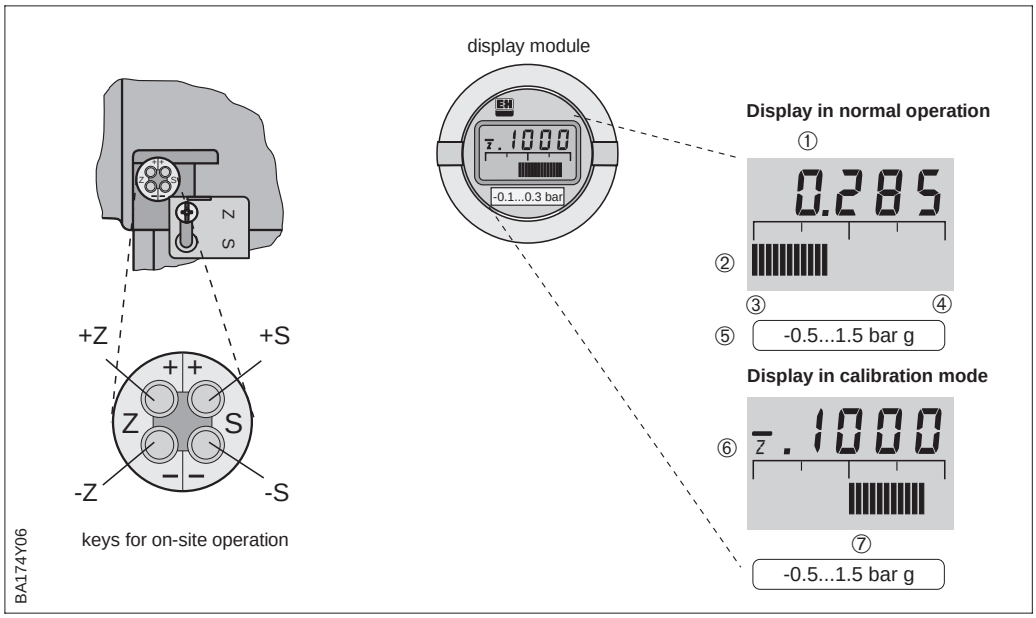


Figure 3.1
User interface of the Deltabar S with optional display

Display in normal operation
① *4-figure display of measured value and entered parameters*
② *Bar graph 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*

Display module

The local display module (optional) 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.

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	
+Z and –Z	the acting pressure is taken as lower range-value (4 mA)
+S and –S	the acting pressure is taken as upper range-value (20 mA)
Bias pressure	
2 times +Z and +S	the acting pressure is taken as bias pressure**
1 time +Z and +S	the current bias pressure** is displayed
2 times –Z and –S	the current bias pressure** is deleted
Secure measuring point	
+Z and –S	lock measuring point
–Z and +S	unlock measuring point

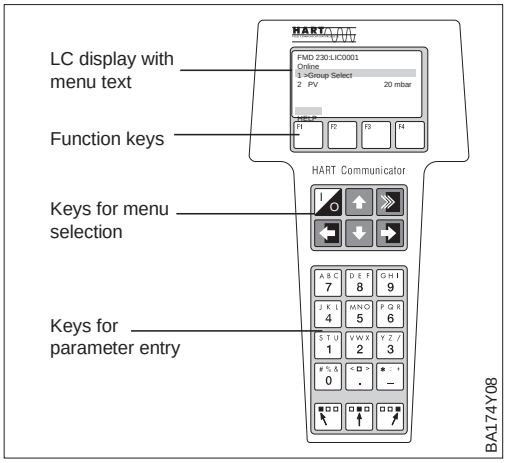
Table 3.1
Key functions

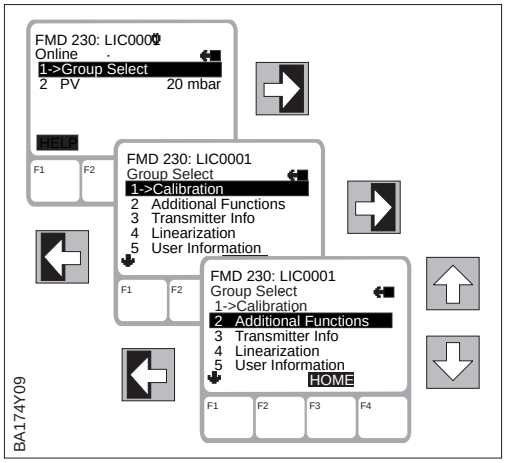
** Note: Pressing once activates the display, only by pressing again does the display begin to count. When first pressing the key the values slowly change and then increase in speed*

*** If the display indicates zero not zero at process pressure after calibrating the lower range-value (depending on position), you can correct the display value to zero by adopting a bias pressure. The posion calibration using a bias pressure does not affect the current output.*

The step-by-step commissioning of the measuring point with local operation is described in chapter 4.

3.2 Operation using the Universal HART Communicator DXR 275



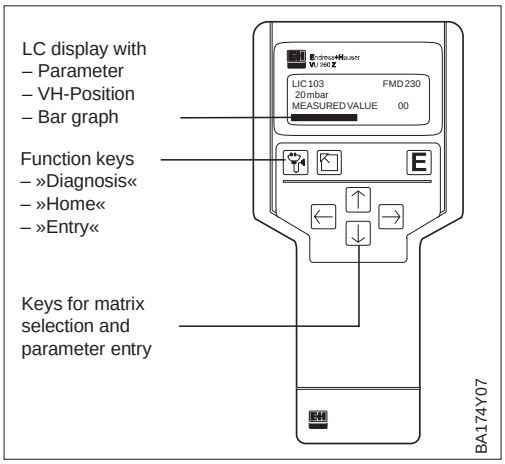


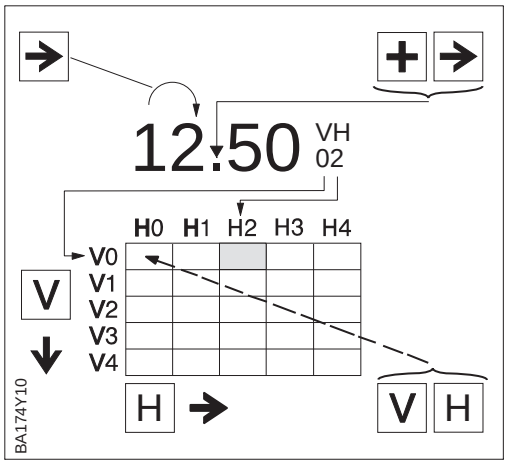
If the HART protocol is used, the device is operated via a menu which is derived from this matrix, see manual for handheld terminal.

- The menu "Group Select" calls up the matriy.
- The rows are represented by the menu headings.
- The parameters are set using submenus.

Connecting the handheld terminal is described in chapter 2.5 Connection on page 18. Commissioning the tapping point with the Universal HART Communicator DXR 275 is described in chapters 5 to 7.

3.3 Operation with Commulog VU 260 Z





Deltabar S with INTENSOR protocol can be operated with the handheld terminal Commulog VU 260 Z (from Version 7.0), see also Operating Instructions BA 028F.

- Select matrix field with ←, →, ↑, ↓.
- Call entry mode with E.
- Enter parameters with ←, →, ↑, ↓, E.
- On alarm, ↻ calls up error messages in plain text.

Connecting the handheld terminal is described in chapter 2.5 Connection on page 18. Commissioning the tapping point with the Commulog VU 260 Z handheld terminal is described in chapters 5 to 7.

3.4 Operation with Commuwin II

When operating the Commuwin II display an operating program, the Deltabar S is set and operated either using

- Matrix mode or
- Graphic mode.

The appropriate server (e.g. HART or ZA 672) must therefore be activated. A description of the operating program Commuwin II is to be found in Operating Instructions BA 124F.

Note!
You can obtain the current device description (DD) either from your local Endress+Hauser Sales Center or via the Internet (http://www.endress.com → Products → Product Portfolio → Process Solutions → Commuwin II → Updates/Downloads).

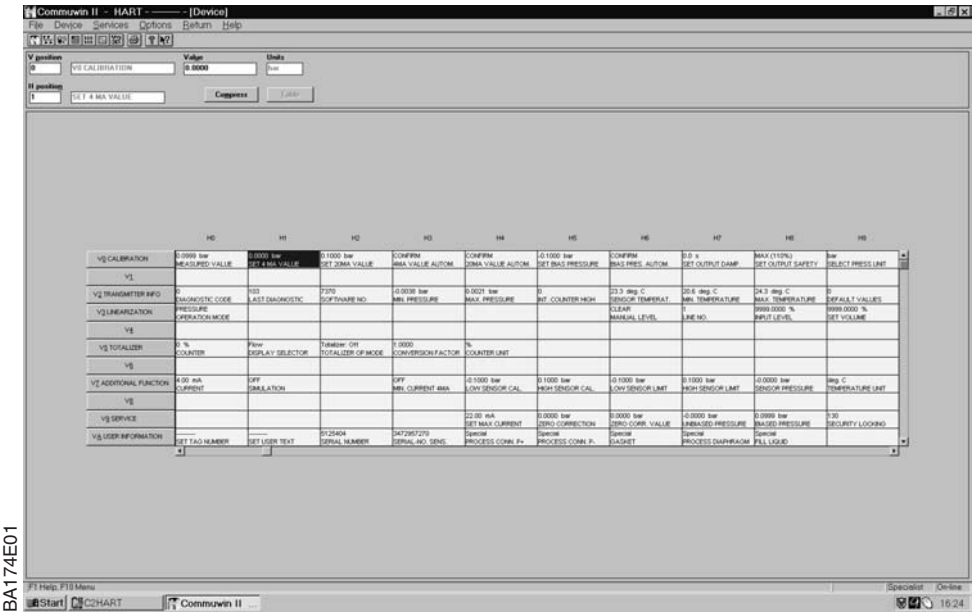
Note!

Matrix mode (Menu Device)

You can access the extended funtions of the Deltabar S, such as level measurement, using the "Device/Parameter Matrix" menu.

- Each row is allocated to a particular function,
- Each field sets or displays one parameter.

Enter the setting parameters in the appropriate fields and confirm by pressing ↵.

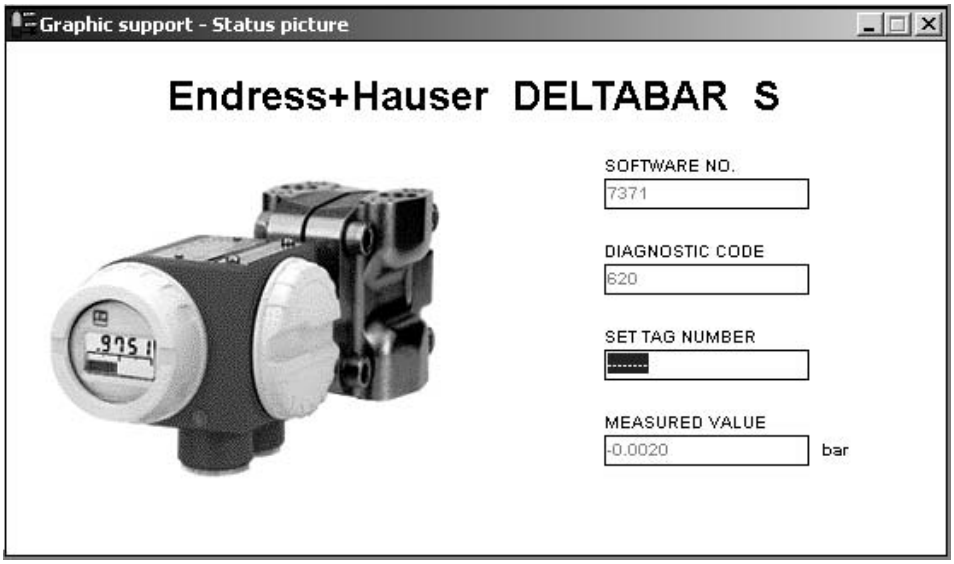


BA174E01

Figure 3.2
Menu "Device/Parameter matrix" in Commuwin II

Graphic mode (Menu Device)

Commuwin II offers graphic examples of certain configuration procedures which you can access from the "Device/Graphics" menu. There you can directly modify parameters and confirm by pressing ↵.



BA174E02

Figure 3.3
Menu "Device/ Graphics" in Commuwin II

4 Commissioning the Measuring Point

Deltabar S PMD 230/235: The chapter describes how measuring points equipped with three-way 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 the handheld terminal.

All operations can be made over the keyboard, the handheld terminals or the Commuwin II operating program. These are described in the following chapters along with extended functions such as creep flow suppression, linearisation and scaling the display depending on the application.

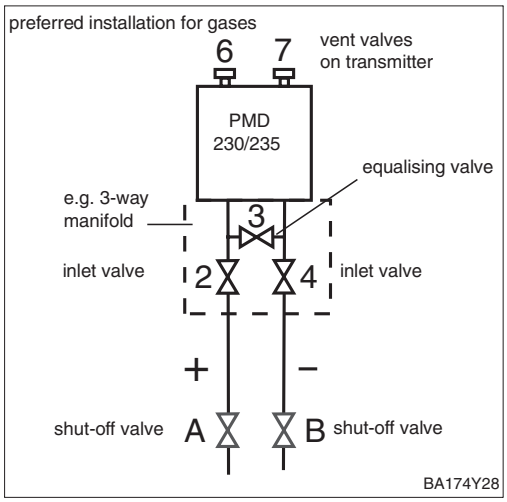
4.1 Function of the manifolds

Three-way manifold

The three-way 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).

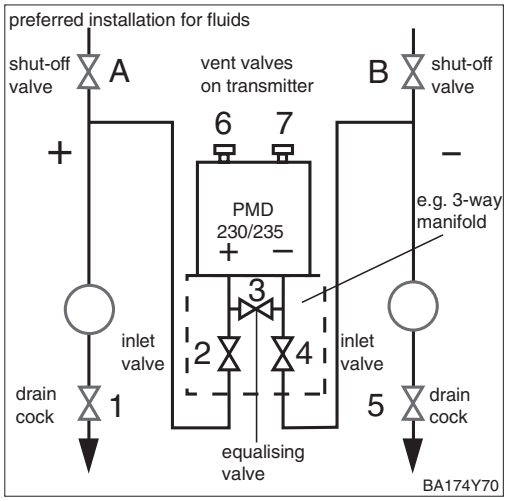


Dirty liquids

Drain cocks or blow-off valves are usually required in dirty liquids which tend to build-up.

- Drain cocks (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.

4.2 Differential pressure measurement

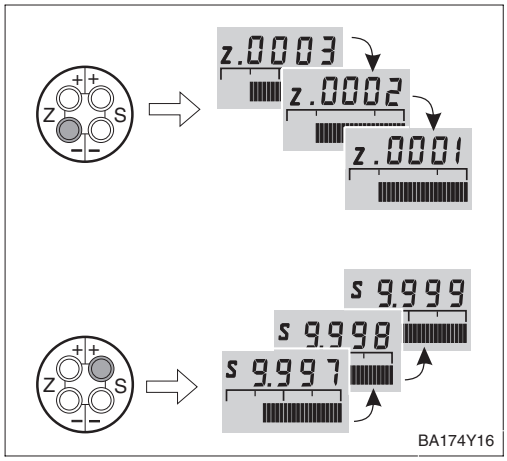
This chapter contains the following information:

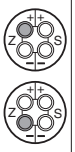
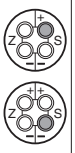
- General description of **operation with keys**
  - Setting lower and upper range-values: calibration without reference pressure
  - Adjusting lower and upper range-values: adjustment with reference pressure
  - Adjusting lower and upper range-values: reference pressure is near lower and upper range-values
  - Position calibration (display only)
- Commissioning the measuring point in steps
- Select "linear" curve with rotary switch
- Set damping (integration time)

Further information is obtained over the **operating matrix**. Operating over the handheld terminals or operating matrix is described in **chapter 5**.

Lower and upper range-values: calibration without reference pressure

The desired lower and upper range-values are set using keys.



#	Key	Entry
1		**Set lower range-value:** Press +Z or –Z several times. (As the span remains constant, the upper range-value is shifted to the same extent as the lower range-value.)
2		**Set upper range-value:** Press +S or –S serveral times (The lower range-value is unaffected.)

Lower an upper range-values: calibration with reference pressure

A reference pressure which corresponds exactly to the desired lower and upper range-values is available.

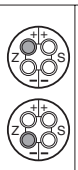
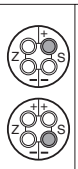
#	Key	Entry
1	Exact pressure for lower range-value is acting	
2		Simultaneously press +Z and –Z once. (As the span remains constant, the upper range-value is shifted to the same extent as the lower range-value.)
3	Exact pressure for upper range-value is acting	
4		Simultaneously press +S or –S once.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

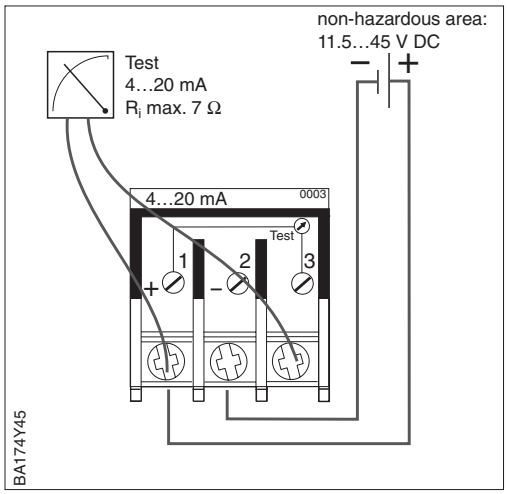
Lower and upper range-values: setting using reference pressure for devices without display

On devices without a display, you can set the lower and upper range-values with the reference pressure and an ammeter. The reference pressure should be near the lower and upper range-values. The associated current value must be calculated using the following equation:

$$I = 4\ mA + \frac{16\ mA \bullet (p - pLRV)}{(pURV - pLRV)}$$

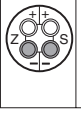
I – Current value
p – Reference pressure is near lower or upper range-values
p_{LRV} – Pressure lower range-value
p_{URV} – Pressure upper range-value

#	Key	Entry
1		Example: Set a pressure transmitter as follows: Lower range-value p_{MA} = 0 bar and Upper range-value p_{ME} = 1.0 bar. There are two reference pressures available: Near to lower range-value p = 0.1 bar Near to upper range-value p = 0.9 bar
2		Enter pressure near the lower range-value e.g. 0.1 bar
3		Calculate the associated current value for the applied reference pressure, e.g. 0.1 bar equals 5.4 mA
4		Set the current value 5.4 mA by pressing the +Z or –Z keys serveral times
5		Enter pressure near the upper range-value e.g. 0.9 bar
6		Calculate the associated current value for the applied reference pressure, e.g. 0.9 bar equals 18.4 mA
7		Set the current value 18.4 mA by pressing the +S or –S keys serveral times



Position calibration – display only (bias pressure)

If the **display** does not show zero after zero point adjustment (due to position), then you can correct the display value to zero by adopting the bias pressure acting (depending on position). The position calibration using a bias pressure does not affect the current output.

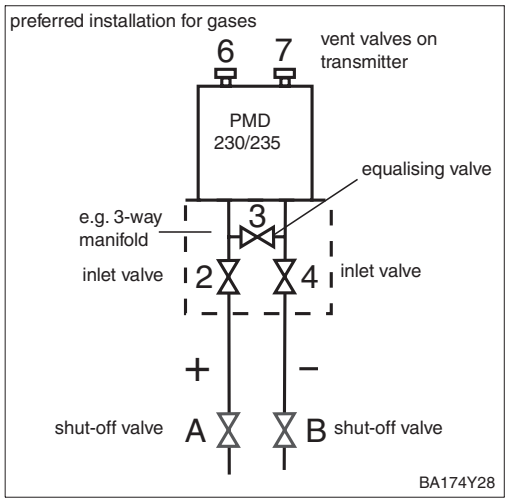
#	Key	Entry
1		**Correct display:** Press +Z and +S twice simoultaneously. The bias pressure acting is adoted.
2		**Display bias pressure:** Press +Z and +S once simoultaneously. The bias pressure entered is shown briefly.
3		**Delete bias pressure:** Press –Z and –S twice simoultaneously. The bias pressure entered is deleted.

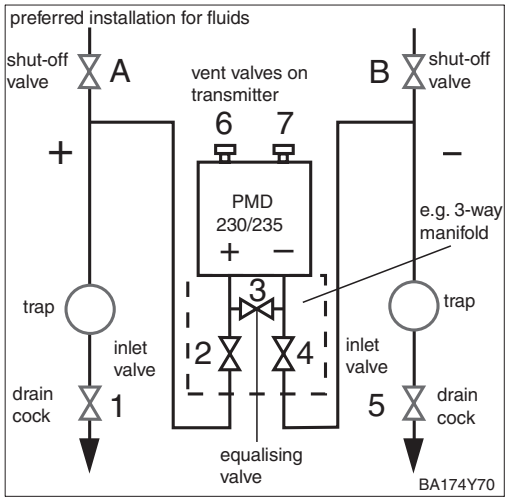
Commissioning the measuring point in steps

Before using the Deltabar S for measuring differential pressure, clean the pressure piping and fill the device with medium. The span (upper range-value – lower range-value) is either preset (see pages 23 and 24), or is calibrated during commissioning.

#	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	
5	**Set the measuring point in operation**	
	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 lower range-value 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	
		Lower range-value: Press +Z and –Z simultaneously once
		If appropriate correct the display.: Press +Z and +S simultaneously twice
7	**Set upper range-value to final pressure** – Filters: Shut off or allow minimum flow for contaminated filters – Tanks or pipe pressure: enter final pressure	
		Upper range-value: Press +S and –S simultaneously once
6	Select curve and damping see page 26	
7	**Measuring point is ready for operation**	

* For arrangements with five valves only

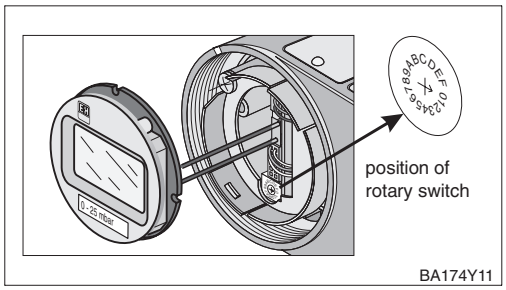




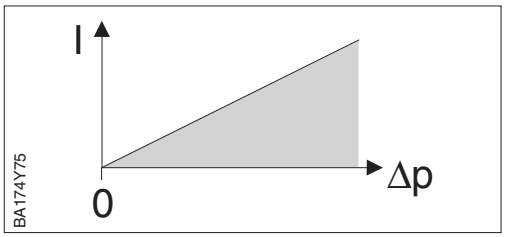
Caution!
When opening and closing valves to the process, care must be taken to avoid overheating or one-sided overloading (beyond specifications) of the measuring cell. If the measuring range is adjusted, the output signal may not lead to impermissible jumps in the control loop.

Select characteristic curve

After calibration, a characteristic curve for the output signal must be selected according to the application. The setting is done with the rotary switch which can also be used for damping.



Linear curve: Switch position 1

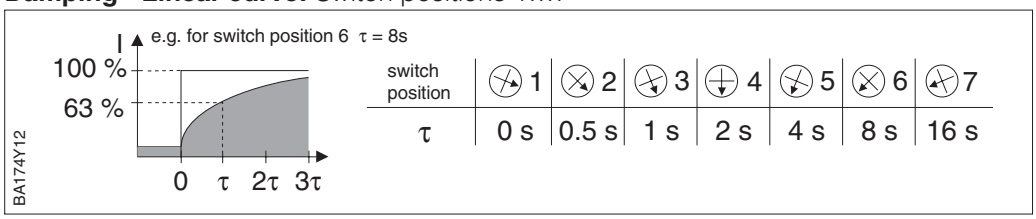


Damping τ

Damping affects the speed at which the output signal reacts to changes in pressure.

The switch positions **1…7** are for permanently setting damping values.
They can be set direct on the device.

Damping - Linear curve: Switch positions 1…7



switch position	1	2	3	4	5	6	7
τ	0 s	0.5 s	1 s	2 s	4 s	8 s	16 s

4.3 Level measurement

This chapter contains the following information:

- General description of **operation with keys**
  - Setting lower and upper range-values: Calibration without reference pressure
  - Adjusting lower and upper range-values: Calibration with reference pressure
  - Adjusting lower and upper range-values: Reference pressure is near lower and and upper range-values
  - Compensation for bias pressure
- Commissioning the measuring point
  - Open tank
  - Closed tank
  - Closed tank with steaming liquid
- Select "linear" curve with the rotary switch
- Set damping (integration time)

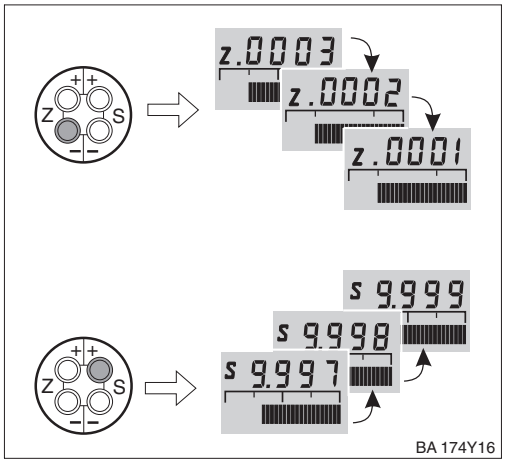
Further information is obtained over the **operating matrix**. Operating over the handheld terminals or operating matrix is described in **chapter 6**.

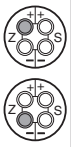
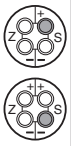
Note: Calibration with keys
If initial start-up is carried out without a handheld terminal or operating program then any display mounted will show pressure values with zero point compensation. After initial settings with the handheld terminal or operating software, level can be shown in other units (level, volume, mass). (See chapter 6.)

Note!

Lower and upper range-values: calibration without reference pressure

The desired lower and upper range-values are set using keys.



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

Lower and upper range-values: calibration with reference pressure

A reference pressure which corresponds exactly to the desired upper and lower range-values is available.

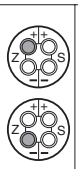
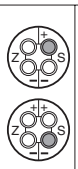
#	Key	Entry
1	Exact pressure for lower range-value is acting	
2		Simultaneously press +Z and –Z once. (As the span remains constant, the upper range-value is shifted to the same extent as the lower range-value.)
3	Exact pressure for upper range-value is acting	
4		Simultaneously press +S and –S once.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

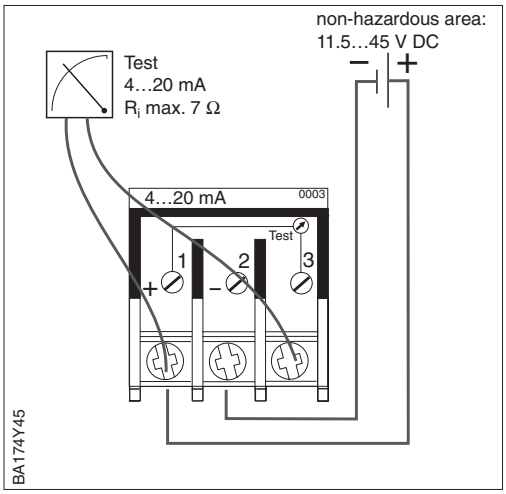
Lower and upper range-values: setting using reference pressure for devices without display

On devices without a display, you can set the lower and upper range-values with the reference pressure and an ammeter. The reference pressure should be near the lower and upper range-values. The associated current value must be calculated using the following equation:

$$I = 4\ mA + \frac{16\ mA \bullet (p - pLRV)}{(pURV - pLRV)}$$

I – Current value
p – Reference pressure is near lower or upper range-values
p_{LRV} – Pressure lower range-value
p_{URV} – Pressure upper range-value

#	Key	Entry
1		Example: Set a pressure transmitter as follows: Lower range-value p_{MA} = 0 bar and Upper range-value p_{ME} = 1.0 bar. There are two reference pressures available: Near to lower range-value p = 0.1 bar Near to upper range-value p = 0.9 bar
2		Enter pressure near the lower range-value e.g. 0.1 bar
3		Calculate the associated current value for the applied reference pressure, e.g. 0.1 bar equals 5.4 mA
4		Set the current value 5.4 mA by pressing the +Z or –Z keys several times
5		Enter pressure near the upper range-value e.g. 0.9 bar
6		Calculate the associated current value for the applied reference pressure, e.g. 0.9 bar equals 18.4 mA
7		Set the current value 18.4 mA by pressing the +S or –S keys several times



Position calibration – display only bias pressure

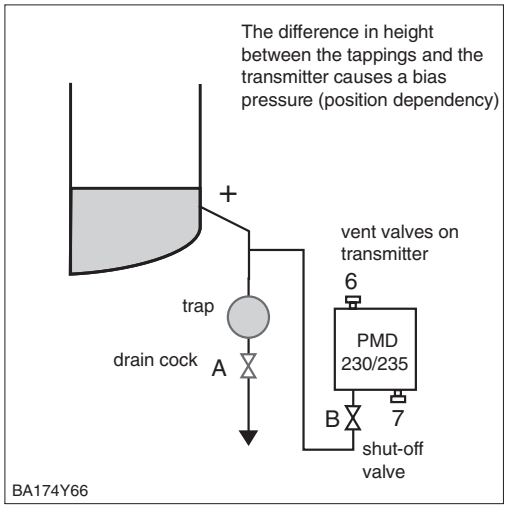
If the **display** does not show zero after zero point adjustment (due to position), then you can correct the display value to zero by adopting the bias pressure acting (depending on position). The position calibration using a bias pressure does not affect the current output.

#	Key	Entry
1		**Correct display:** Press +Z and +S twice simoultaneously. The bias pressure acting is adoted.
2		**Display bias pressure:** Press +Z and +S once simoultaneously. The bias pressure entered is shown briefly.
3		**Delete bias pressure:** Press –Z and –S twice simoultaneously. The bias pressure entered is deleted.

Caution!
When opening and closing values 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!

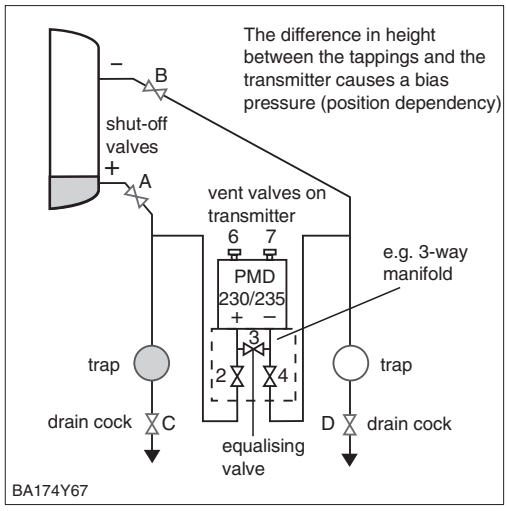
Commissioning the measuring point – open tank



#	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	**Making the measuring point ready for operation**	
	Now: A and 6 are closed B is open	
5	Calibration: Keyboard operation from page 27 onwards or operating via handheld terminals see chapter 6	
6	Select curve and damping see page 31	
7	**Measuring point is ready for measurement**	

Note!
- If present, the trap is washed out with valve A.
- 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 opening the shut-off valve.

Commissioning the measuring point – closed tank



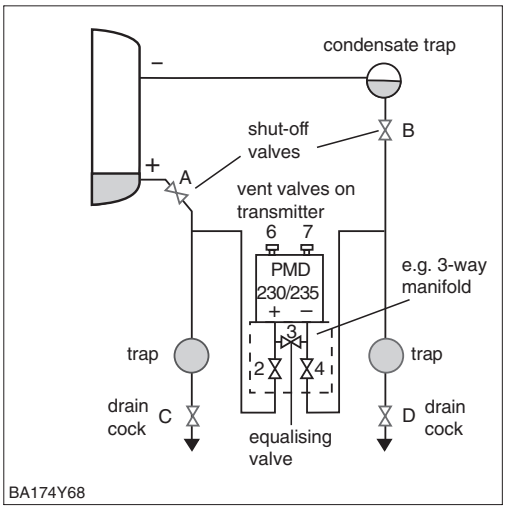
#	Valve	Significance
1	Fill tank to a level above the lower tapping	
2	Fill measuring system with medium	
	Close 3 Open A and B	Shut off positive from negative side Open shut-off valve
3	Let out air on positive side (if necessary drain negative side)	
	Open 2 and 4	Let medium into positive side
	Briefly open 6 and 7 then shut again	Fill positive side with medium and let out air
4	**Making the measuring point ready for operation**	
	Now: 3, 6 and 7 are closed 2, 4, A and B are open	
5	Calibration: keyboard operation from page 27 onwards or operating via handheld terminals see chapter 6	
6	Select curve and damping see page 31	
7	**Measuring point is ready for measurement**	

Note!
- If present, the traps are washed out with valves C and D.
- For empty calibration, the 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!

Closed tank with steaming liquid

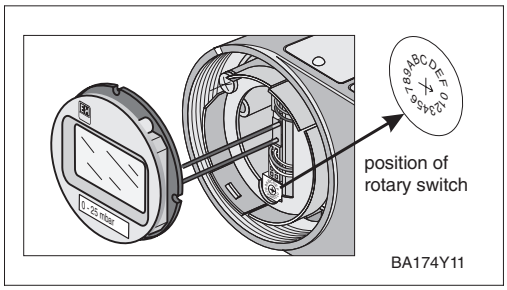
#	Valve	Significance
1	Fill tank to a level above the lower tapping	
2	Fill measuring system with medium	
	Open A and B	Open shut-off valves
	Fill condensate trap or wait until enough condensate has collected. This can take some minutes.	
3	Let air out of transmitter	
	Open 2 and 4	Let in medium
	Close 4	Shut off negative side
	Open 3	Connect possible and negative side
	Briefly open 6 and 7 then shut again	Fill transmitter with medium and let out air
4	**Making the measuring point ready for operation**	
	Close 3	Shut off positive from negative side
	Open 4	Connect negative side
	Now: 3 is closed 6 and 7 are closed 2 and 4 are open A and B are open (if present)	
5	Calibration: keyboard operation from page 27 onwards or operating via handheld terminals see chapter 6	
6	Select curve and damping See page 31	
7	**Measuring point is ready for operation**	



Note!

Note!

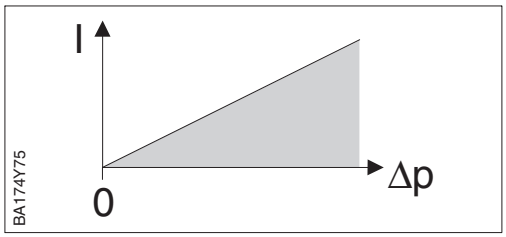
- Any dirt or condensate trap is washed out with valves C or D.
- For calibration, both positive and negative pressure piping must be filled with medium.
- Version FMD 230/630 is ready for measurement after the opening of the shut-off valve if present. The "–" pressure piping must be filled with medium.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



Select characteristic curve

After calibration, a characteristic curve for the output signal must be selected according to the application. The setting is done with the rotary switch which can also be used for damping.

Linear curve: Switch position 1

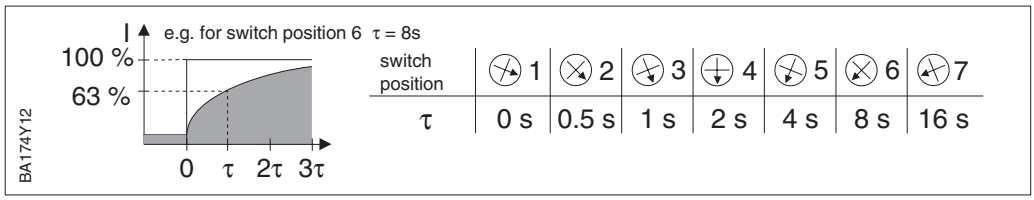


Damping τ

The damping affects the time it takes for the output signal to react to a change in pressure.

Fixed damping values are assigned to the switch positions.
They can be set direct on the rotary switch.

Damping-Linear curve: Switch positions 1…7



switch position	1	2	3	4	5	6	7
τ	0 s	0.5 s	1 s	2 s	4 s	8 s	16 s

4.4 Flow measurement with differential pressure

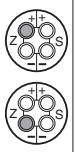
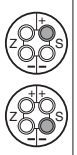
This chapter contains the following information:

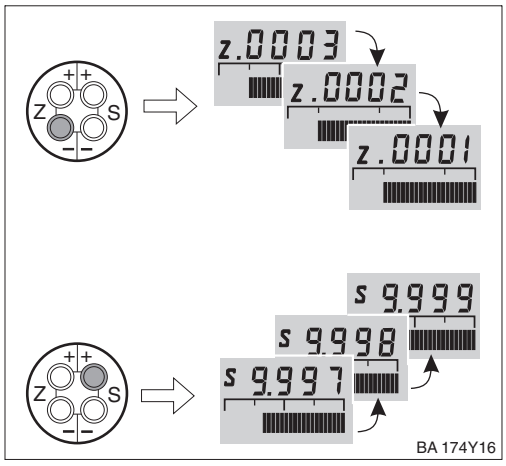
- General description of **calibration with keys**
  - Setting lower and upper range-values: Calibration without reference pressure
  - Adjusting lower and upper range-values: Calibration with reference pressure
  - Adjusting lower and upper range-values: Reference pressure is near lower and and upper range-values
  - Compensation for bias pressure
  - Commissioning the measuring point in steps
  - Commissioning the measuring point
- Select curve with the rotary switch
- Set damping (integration time)

Other functions are accessible over the **operating matrix**. Operating the handheld terminal is described in **chapter 7**.

Lower and upper range-values: calibration without reference pressure

Set the required lower and upper range-values with the keys. The flow is determined using the differential pressure and primary elements, e.g. pitot tube or orifice plate. The lower range-value corresponds to a flow of zero (differential pressure = 0 mbar). The upper range-value corresponds to the differential pressure at maximum flow (see also the Deltatop/Deltaset design sheet).

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



Lower and upper range-values: calibration with reference pressure

A reference pressure is available corresponding exactly to the required lower or upper range-values. The lower range-value corresponds to a flow of zero (differential pressure = 0 mbar). The upper range-value corresponds to the differential pressure at maximum flow (see also the Deltatop/Deltaset design sheet).

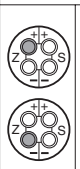
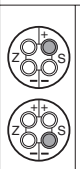
#	Key	Entry
1	Exact pressure for lower range-value is acting	
2		Simultaneously press +Z and –Z once. (As the span remains constant, the upper range-value is shifted to the same extent as the lower range-value.)
3	Exact pressure for upper range-value is acting	
4		Simultaneously press +S and –S once.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

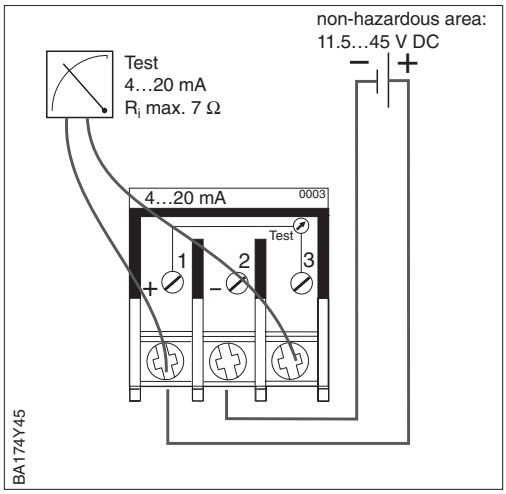
Lower and upper range-values: setting using reference pressure for devices without display

On devices without a display, you can set the lower and upper range-values with the reference pressure and an ammeter. The reference pressure should be near the lower and upper range-values. The associated current value must be calculated using the following equation:

$$I = 4\ mA + \frac{16\ mA \bullet (p - pLRV)}{(pURV - pLRV)}$$

I – Current value
p – Reference pressure is near lower or upper range-values
p_{LRV} – Pressure lower range-value
p_{URV} – Pressure upper range-value

#	Key	Entry
1		Example: Set a pressure transmitter as follows: Lower range-value p_{MA} = 0 bar and Upper range-value p_{ME} = 1.0 bar. There are two reference pressures available: Near to lower range-value p = 0.1 bar Near to upper range-value p = 0.9 bar
2		Enter pressure near the lower range-value e.g. 0.1 bar
3		Calculate the associated current value for the applied reference pressure, e.g. 0.1 bar equals 5.4 mA
4		Set the current value 5.4 mA by pressing the +Z or –Z keys several times
5		Enter pressure near the upper range-value e.g. 0.9 bar
6		Calculate the associated current value for the applied reference pressure, e.g. 0.9 bar equals 18.4 mA
7		Set the current value 18.4 mA by pressing the +S or –S keys several times



Position calibration – display only (bias pressure)

If the **display** does not show zero after zero point adjustment (due to position), then you can correct the display value to zero by adotpting the bias pressure acting (depending on position). The position calibration using a bias pressure does not affect the current output.

#	Key	Entry
1		**Correct display:** Press +Z and +S twice simoultaneously. The bias pressure acting is adoted.
2		**Display bias pressure:** Press +Z and +S once simoultaneously. The bias pressure entered is shown briefly.
3		**Delete bias pressure:** Press –Z and –S twice simoultaneously. The bias pressure entered is deleted.

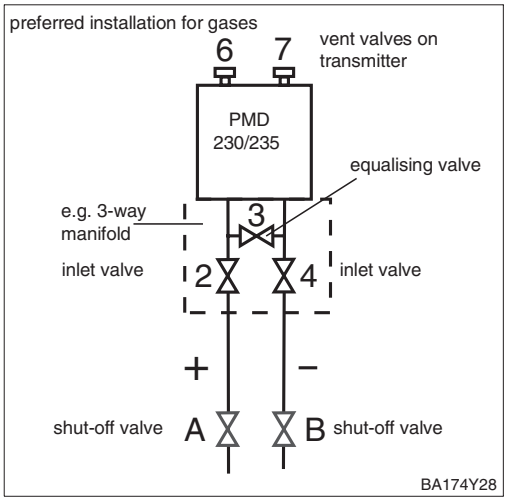
Commissioning the measuring point

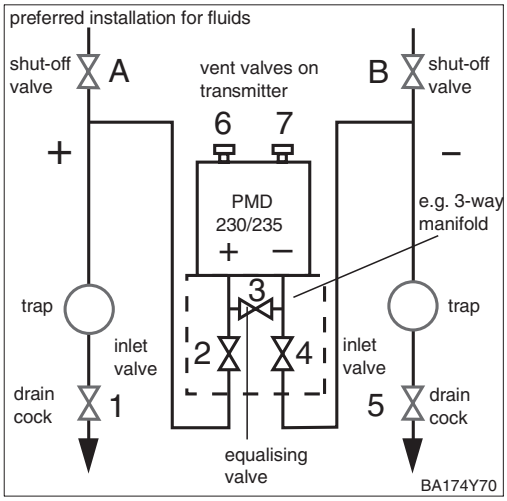
Before using the Deltabar S for measuring differential pressure, clean the pressure piping and fill the device with medium. The span (upper range-value – lower range-value) is either preset (see pages 32 and 33), or only the lower range-value is set during commissioning, as described below.

#	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 lower range-value 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.	
		Lower range-value: Press +Z and –Z simultaneously once
		If appropriate correct the display: Press +Z and +S simultaneously twice
6	**Set the measuring point in operation**	
	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)	
Set lower range-value and display to zero If flow can be shut off, then this calibration of zero and display is to be carried out here. Step 5 is then ignored.		
7	Shut off flow	
		Lower range-value: Press +Z and –Z simultaneaoulsy once
		If appropriate correct display: Press +Z and +S twice simultaneously
	Open flow	

* For arrangements with five valves only.

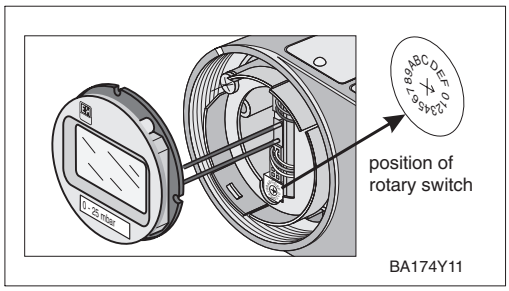
#	Valve	Significance
8	Select curve and damping See next page	
9	**Measuring point is ready for operation**	





Caution!

When opening and closing values 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.

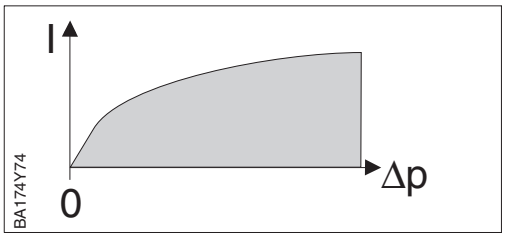


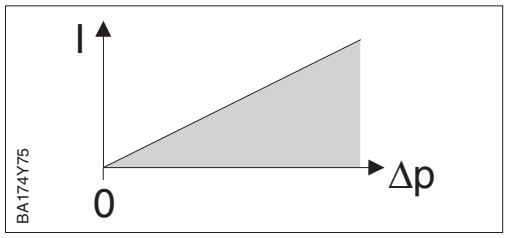
Select characteristic curve

After calibration, a characteristic curve for the output signal must be selected according to the application. The setting is done with the rotary switch which can also be used for damping.

Curve for flow (root function):
Switch position 9
Under normal circumstances – no curve needs to be calibrated.

Linear curve:
Switch position 1
The current output is linear.
The curve for root function is set in the following signal evaluation (e.g. in PLC).



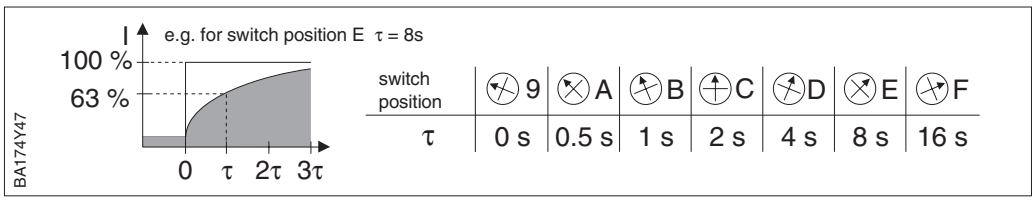


Damping τ

The damping influences the time it takes for the output signal to react to a change in pressure.

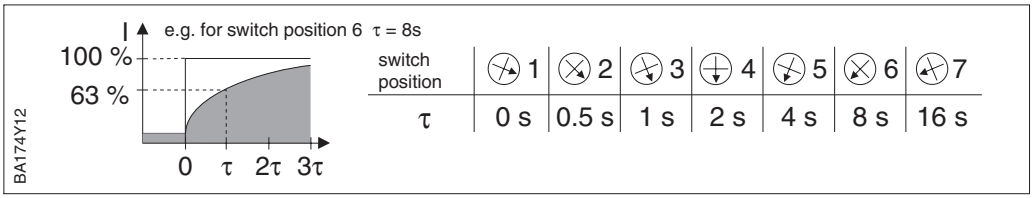
Fixed damping values are assigned to the switch positions.
They can be set direct on the rotary switch.

Damping-Root curve: Switch position 9…F



switch position	9	A	B	C	D	E	F
τ	0 s	0.5 s	1 s	2 s	4 s	8 s	16 s

Damping-Linear curve: Switch position 1…7



switch position	1	2	3	4	5	6	7
τ	0 s	0.5 s	1 s	2 s	4 s	8 s	16 s

5 Differential Pressure Measurement

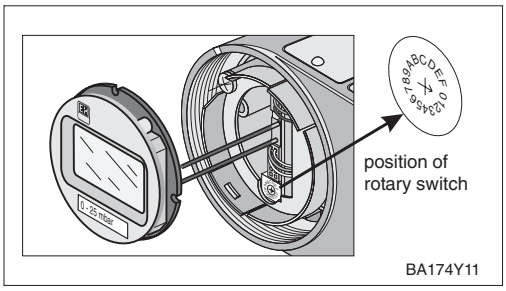
5.1 Commisioning with the Universal HART Communicator DXR 275, Commulog VU 260 Z or Commuwin II

If the Deltabar S is started up as described in chapter 4.2, it can start measurement immediately. The measuring range corresponds to the specification on the nameplate. Normally, the measured variable is transmitted in the unit given on the nameplate. After a reset "code 5140", the measured variable is transmitted in "bar".

This chapter contains the following information:
- Preparation for commissioning
  - Setting the damping rotary switch for operation over communication
  - Resetting to factory set values
  - Setting the damping
  - Selecting pressure units
- General description of setting the span and bias pressure
  - Upper and lower range-values: calibration without reference pressure
  - Upper and lower range-values: calibration with reference pressure
  - Compensation for bias pressure
- Commissioning the measuring point in steps

Setting the damping rotary switch

Set the blue damping switch to "0".
The transmitter can only be operated by the handheld terminals or the Commuwin II operating program when in this position.

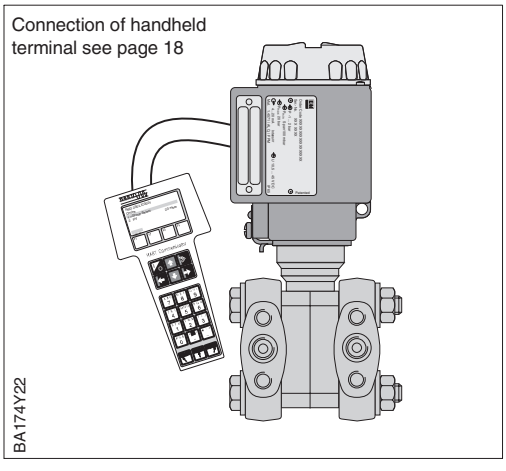


Note on operating with the Commulog VU 260 Z
- Press E once to call up the entry mode – the line blinks.
- On completion, press E once again to confirm entry.

Reset to factory settings

By entering a specific code number settings entered in the matrix can all or partially reset to factory values. Further information on the various types of "reset" and their effects can be found in chapter 8.3 "Reset".

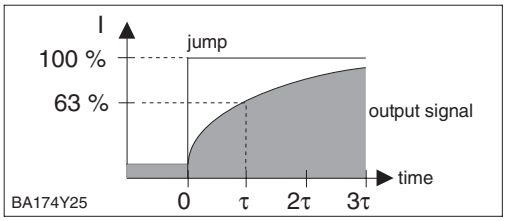
#	Matrix	Path through the menus	Entry
Main group: Transmitter info			
1	Reset to factory settings		
	V2H9	➤ Reset	2380 Confirm E



Damping τ

The damping influences the time with which the display in V0H0 and the output signal react to a change in pressure.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Suppressing measured value variations		
	V0H7	➤ Damping τ = 0…40 s	e.g. 20 s Confirm E



Selecting pressure units

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 into 0…145.5 psi.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Select pressure units		
	V0H9	➤ Selects pressure units	e.g. bar Confirm E

The pressure units in the table below are available:

mbar	bar	Pa	hPa	kPa	MPa	mmH_2O
mH_2O	inH_2O	ftH_2O	psi	g/cm^2	kg/cm^2	kgf/cm^2
atm	lb/ft^2	Torr	mmHg	inHg		

If you want the pressure value to be displayed in "%", follow the instructions in the section "Output Pressure in %" below.

Output Pressure in %

If you want the pressure value to be displayed in "%", set the operating mode to "Pressure %". The "Display at 4 mA" (V3H1) and "Display at 20 mA" (V3H2) parameters set the lower and upper range-values. Select "%" in the "Unit after Linearisation" (V3H3) parameter.

#	Matrix	Path through the menus	Entry
Main group: Linearisation			
1	Select operation mode "Pressure %"		
	V3H0	➤ Operation mode pressure %	Confirm E
2	Enter lower range-value		
	V3H1	➤ Display at 4 mA	e.g. 0% Confirm E
3	Enter upper range-value		
	V3H2	➤ Display at 20 mA	e.g. 100% Confirm E
4	Select "%" unit		
	V3H3	➤ Unit after linearisation	% Confirm E

Lower and upper range-values: calibration without reference pressure

The desired lower and upper range-values are set by communication.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Enter known pressure for lower range-value		
	V0H1	➤ Sets 4 mA	e.g. 1 bar Confirm E
2	Enter known pressure for upper range-value		
	V0H2	➤ Sets 20 mA	e.g. 2 bar Confirm E

Lower and upper range-values: calibration with reference pressure

A reference pressure which corresponds exactly to the desired lower and upper range-values is available.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Acting pressure is taken for lower range-value		
	V0H3	➤ Sets 4 mA automatically	Confirm E
2	Acting pressure is taken as upper range-value		
	V0H4	➤ Sets 20 mA automatically	Confirm E

Position calibration – display only (bias pressure)

If the **display** does not show zero after zero point adjustment (due to position), then you can correct the display value to zero by entering a bias pressure or by adopting the bias pressure acting (depending on position). The position calibration using a bias pressure does not affect the current output.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Set display to "0" A bias pressure acting (position-dependent pressure) is adopted as zero pressure.		
	V0H6	➤ Sets bias pressure automatically	Confirm E
alternatively			
2	Set display to "0" by entering a known bias pressure (position-dependent pressure).		
	V0H5	➤ Sets bias pressure	e.g. 20 mbar Confirm E

Note!

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

Zero correction

The "Zero Correction" (V9H5) parameter offers a further possibility of carrying out position calibration. Besides the display value, and in contrast to position calibration using bias pressure (V0H5/V0H6), the current value is balanced with the on-site display (measured value (V0H0)).

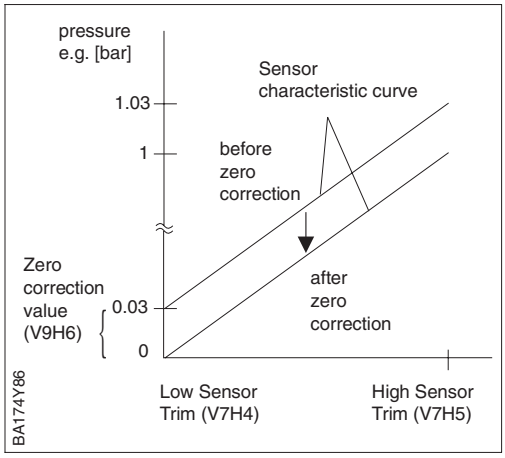
When carrying out a zero correction, an applied pressure is assigned a correction value using "Zero Correction" (V9H5). This shifts the sensor characteristic curve according to the diagram and the "Low Sensor Trim" (V7H4) and "High Sensor Trim" (V7H5) values are recalculated. The "Zero Correction Value" (V9H6) matrix field indicates the value by which the sensor characteristic curve was shifted.

The "Zero Correction Value" (V9H6) is calculated as follows:

- "Zero Correction Value" (V9H6) =
  "Sensor Pressure" (V7H8) – "Zero Correction" (V9H5)

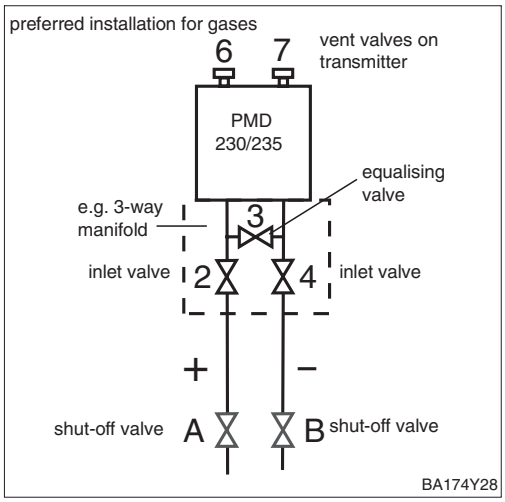
  The "Sensor Pressure" (V7H8) indicates the current applied pressure.

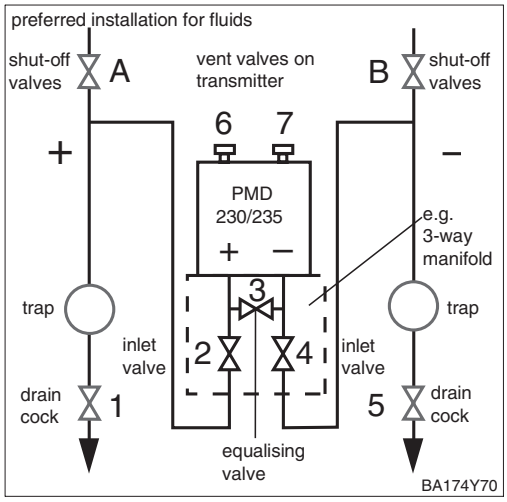
#	Matrix	Path through the menus	Entry
1	Display "Measured Value" (V0H0) = 0.03 bar (position-dependent pressure) Display "Current" (V7H0) = 4.03 mA		
2	The pressure for zero correction is: "Sensor Pressure" (V7H8) = 0.03 bar (corresponds to the position-dependent pressure)		
Main group: Service			
3	The value 0.0 is assigned to the applied pressure.		
	V9H5	➤ Zero correction	0.0 bar confirm E
4	After making inputs into the "Zero Correction" (V9H5) parameter, the parameters adopt the following values: – Zero Correction Value (V9H6): V9H6 = V7H8 – V9H5 V9H6 = 0.03 bar – 0.0 bar V9H6 = 0.03 bar – "Measured Value" (V0H0) = 0.0 bar – "Current" (V7H0) = 4.00 mA		



Commissioning the measuring point

Before using the Deltabar for measuring differential pressure, clean the pressure piping and fill the device with medium. The span (upper range-value – lower range-value) is either preset (see pages 37 and 38), or is calibrated during operation.





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 output signal may not lead to impermissible jumps in the control loop.

#	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	**Make measuring point ready for operation**	
	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 lower range-value and display to zero** – Filters: Shut off or allow minimum flow for clean filters – Tanks or pipe pressure: Enter zero pressure	
	V0H3 ➤ Sets 4 mA automatically	Acting pressure is taken for lower range-value
	V0H6 ➤ Sets bias pressure automatically	Set display to "0" (of display)
7	**Set upper range-value to final pressure** – Filters: Minimum flow is acting for contaminated filters – Tanks or pipe pressure: Final pressure is acting	
	V0H4 ➤ Sets 20 mA automatically	Acting pressure is taken for upper range-value
6	V3H0 ➤ Measurement mode pressure linear	Select measurement mode "pressure linear"
7	**Measuring point is ready for operation**	

* For arrangement with five valves only

4 mA level

The signal current is set to a standard 3.8…20.5 mA when measuring correctly. Selecting the 4 mA level ensures that a minimum signal current does not fall below of 4 mA.

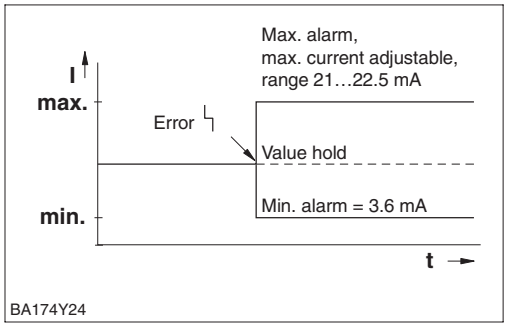
The following applies:
- OFF: lower current limit 3.8 mA
- ON: lower current limit 4 mA

#	Matrix	Path through the menus	Entry
Main group: Additional functions			
	V7H3	➤ Current output min. 4 mA	e.g. ON Confirm E

Alarm mode

To indicate an error, an error code is transmitted with the measured value.
The bar graph in the display adopts the value selected by the operator.
For the "Alarm mode" (V0H8)[1)] = "Max. alarm" setting, the current is adjustable from 21…22.5 mA using the "Max. alarm current" (V9H4) parameter (Factory setting: 22 mA).

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Select response on error		
	V0H8	➤ Alarm mode [1)]	e.g. Max. alarm Confirm E
Main group: Service			
2	Enter current "Max. alarm" value		
	V9H4	➤ Max. alarm current	e.g. 22 mA Confirm E



1) INTENSOR: "Set output damping"

5.2 Locking/unlocking the matrix

After all parameters have been entered, the matrix can be locked:
- via the keys +Z and –S or
- via the matrix by entering a code ≠ 130 in V9H9 (130 is the code for unlocking the matrix).

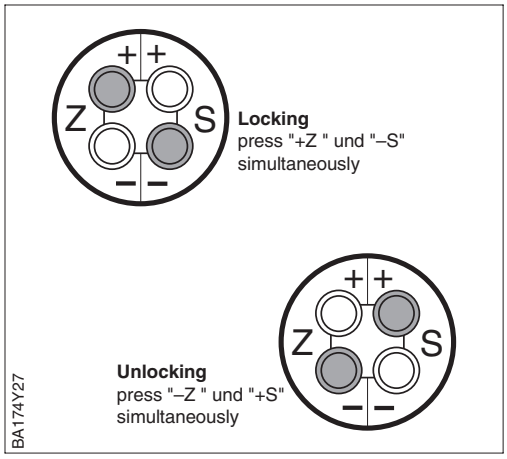
This protects the measuring point from accidental and unauthorised entries.

Keys

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

Matrix

#	Matrix	Path through the menus	Entry
Main group: Service			
1	Block operation (locking)		
	V9H9	➤ Locking	e.g. 131 Confirm E
2	Release operation (unlocking)		
	V9H9	➤ Unlock	130 Confirm E



Locking with keys has priority

The table below summarises the locking function.

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

5.3 Measuring point information

The following information about the measuring point can be read:

Matrix field	Display or entry
Measured value	
V0H0	Main measured value: differential pressure
V2H6	Current sensor temperature (units selectable in V7H9)
V7H0	Output current in mA
V7H8	Sensor pressure (units selectable in V0H9)
Sensor data	
V0H1	Lower range-value (zero)
V0H2	Upper range-value (span)
V2H5	Overload counter pressure (0…255)
V7H4	Low Sensor Trim (units selectable in V0H9)
V7H5	High Sensor Trim (units selectable in V0H9)
V7H6	Lower range-limit of sensor (units selectable in V0H9)
V7H7	Upper range-limit of sensor (units selectable in V0H9)
V9H7	Pressure before bias correction (units selectable in V0H9)
V9H8	Pressure after bias correction (units selectable in V0H9)
Measuring point information	
V2H2	Device and software number
Behaviour on fault	
V2H0	Current diagnostic code
V2H1	Last diagnostic code

Display messages for diagnosis

The level indicator enables the smallest and largest measured values for pressure and temperature to be called up. The value is not lost on switching off the device.

Matrix field	Display
V2H3	Peak hold P Min (Maximum pointer for minimum pressure)
V2H4	Peak hold P Max (Maximum pointer for maximum pressure)
V2H7	Peak hold T Min (Maximum pointer for minimum temperature)
V2H8	Peak hold T Max (Maximum pointer for maximum temperature)
V2H5	Overload counter (0…255)
V2H6	Current sensor temperature (unit in V7H9 selectable)

Communication level

The matrix line "VA Communication" can only be called up and calibrated with the Commuwin II operating program or the Universal HART Communicator DXR 275 or Commulog VU 260 Z handheld terminals.

VAH0	Measuring point tag The measuring point can be identified with a max. of 8 characters
VAH1	User text
VAH2 – VAH8	Information about the device

6 Level Measurement

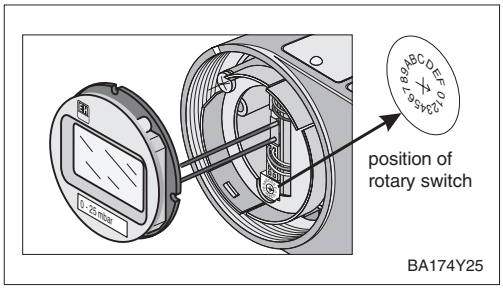
6.1 Commissioning with the Universal HART Communicator DXR 275, Commulog VU 260 Z or Commuwin II

This chapter describes the "Level" operating mode which can only be activated via communication. The pressure measuring range corresponds to the specifications on the nameplate. When measuring a level, the measured variable in displayed in "%" as default.

This chapter contains the following information:
- Preparation for commissioning
  – Setting the damping rotary switch for operation via communication
  – Resetting to factory set values
  – Setting the damping
  – Selecting pressure and level units
  – Density correction
- General description of setting the span
  – Calibration with reference pressure
  – Dry calibration
- Level adjustments
  – Linearisation manual or semi-automatic
- See chapter 4.2 for operating the 3-way manifold and shut-off valves.

Setting the damping rotary switch

Set the blue damping switch to "0".
The transmitter can only be operated by the handheld terminals or the Commuwin II operating program when in this position.

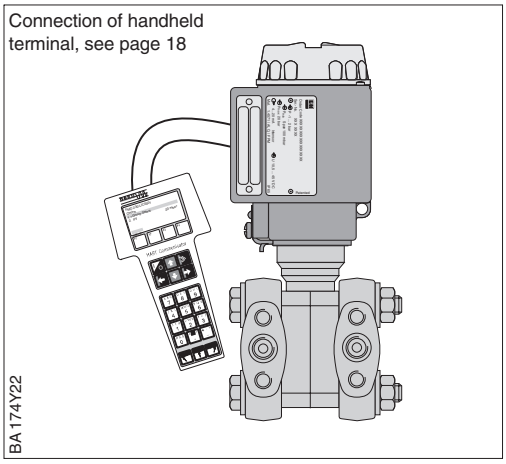


Note on operating with the Commulog VU 260 Z
- Press E once to call up the entry mode – the line blinks.
- On completion, press E once again to confirm entry.

Reset to factory settings

By entering a specific code number settings entered in the matrix can all or partially reset to factory values. Further information on the various types of "reset" and their effects can be found in chapter 8.3 "Reset".

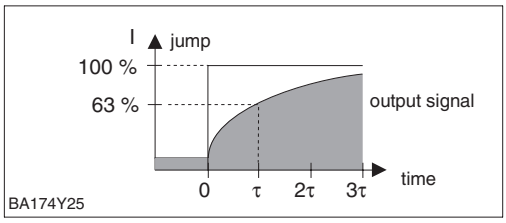
#	Matrix	Path through the Menüs	Entry
Main group: Transmitter info			
1	Reset to factory settings		
	V2H9	➤ Reset	2380 Confirm E



Damping τ

The damping influences the time with which the display in V0H0 and the output signal react to a change in pressure.

#	Matrix	Path through the Menüs	Entry
Main group: Basic settings			
1	Suppress variations in measured values		
	V0H7	➤ Damping τ = 0…40 s	e.g. 20 s Confirm E



Selecting pressure units

After selecting new pressure units all information on the pressure are converted into the new units.
Example: After selecting the unit "psi" the measuring range from 0…10 bar is converted into 0…145.5 psi.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Select pressure units		
	V0H9	➤ Selects pressure units	e.g. mbar Confirm E

Units for operation mode "Pressure":

mbar	bar	Pa	hPa	kPa	MPa	mmH_2O
mH_2O	inH_2O	ftH_2O	psi	g/cm^2	kg/cm^2	kgf/cm^2
atm	lb/ft^2	Torr	mmHg	inHg		

Selecting level, volume or weight units (Units after Linearisation)

The units for level, volume or weight are selectable using the "Unit After Linearisation" (V3H3) parameter. Selecting a unit only helps to improve the display and does not affect the main measured value in the matrix field V0H0.
Example: After selecting the unit "t", "55 kg" is displayed as "55 t".

#	Matrix	Path through the menus	Entry
Main group: Linearisation			
1	Select unit for level, volume or weight		
	V0H9	➤ Unit after linearisation	e.g. kg Confirm E

Units for operation mode "Level linear" and "Manual level":

%	cm	dm	m	inch	ft
l	hl	cm^3	dm^3	m^3	ft3
US gal	Imp gal	ton	kg	t	lb

Units for operation mode "Level cylindrical horizontal":

%	l	hl	cm^3	dm^3	m^3
m^3 • 10	m^3 • 100	ft^3	ft3 • 10	ft^3 • 100	US gal
Imp gal	ton	kg	t	lb	

When you want to display the measured variable (V0H0) converted into the selected level unit, enter converted values for the minimum and maximum level values. The "Display at 4 mA" (V3H1) parameter corresponds to the minimum level value and the "Display at 20 mA" (V3H2) parameter to the maximum level value.

#	Matrix	Path through the menus	Entry
1	Example: – Lower and upper range-values are set: "Set 4 mA Value" (V0H1) = 0 mbar "Set 20 mA Value" (V0H2) = 1500 mbar		
2	The current measured value (V0H0) displays in the pressure mode (V0H0) = 750 mbar.		
Main group: Linearisation			
3	Select operation mode e.g. "Level linear"		
	V3H0	➤ Level linear	Confirm E
4	The minimum level, maximum level and current measured variable are displayed as follows: – "Display at 4 mA" (V3H1) = 0 % – "Dispaly at 20 mA" (V3H2) = 100 % – "Measured Value" (V0H0) = 50 %		
5	Select unit for level, volume or weight		
	V3H3	➤ Unit after Linearisation	e.g. m Confirm E
6	Enter the converted minimum level value		
	V3H1	➤ Display at 4 mA	e.g. 0 (m) Confirm E
7	Enter the converted maximum level value		
	V3H2	➤ Display at 20 mA	e.g. 15 (m) Confirm E

Results
- The parameters for the minimum and maximum level value indicate:
  – "Display at 4 mA" (V3H1) = 0 m
  – "Display at 20 mA" (V3H2) = 15 m
- The current measured value (V0H0) indicates:
  – "Measured value" (V0H0) = 7.5 m

Density correction

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

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

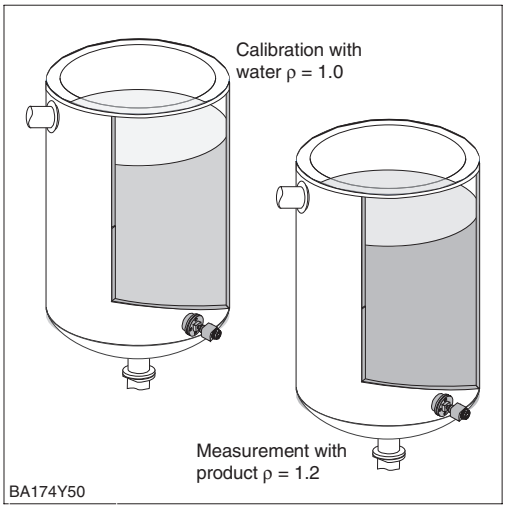
Determining the density factor

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. V3H4 still contains the factory setting 1, i.e. the current factor is 1.

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

#	Matrix	Path through the menus	Text
Main group: Linearisation			
1	Entry of a density factor, e.g. after the product changes		
	V3H4	➤ Density factor	e.g. 1.2 Confirm E

Result
- The measured value in V0H0 is divided by the density factor and is thus correct for the new product.



Note!

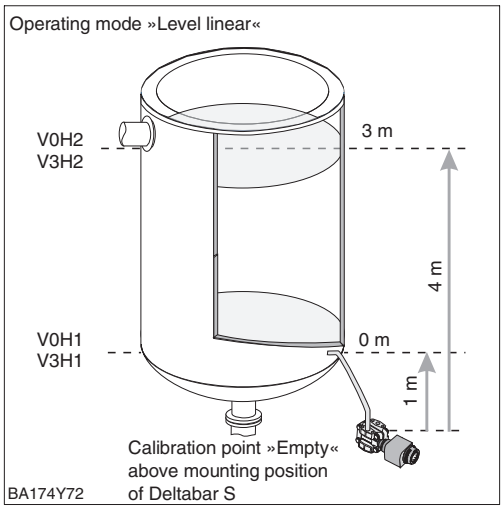
Note!
The density factor affects the level measurement. If the product density changes, first enter the new density factor before using any existing linearisation curve.

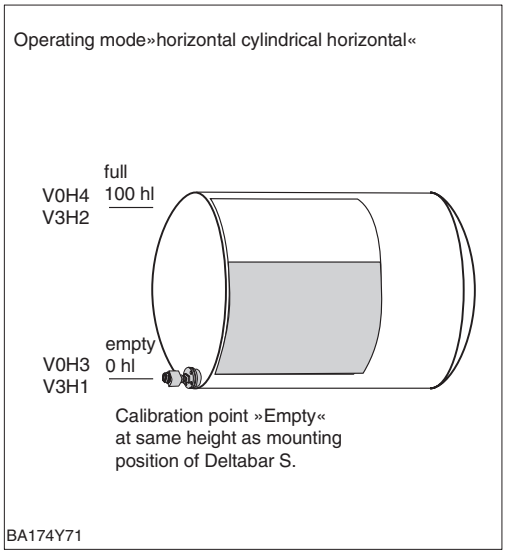
6.2 Calibration with reference pressure

The tank is filled for either the lower range-value or the upper range-value for calibration.
Selecting the operating mode enables two tank shapes to be chosen
- vertical – "level linear" and
- horizontal – "level cylindrical horizontal".

Calibration

#	Matrix	Path through the menus	Entry
1	Measuring point ready for operation? See chapter 4, page 27 onwards and this chapter, page 42 onwards		
2	Set the display to "0" with acting pressure taken as bias pressure (affects display)		
	V0H6	➤ Sets bias pressure automatically	Confirm E
3	Fill tank to the lower range-value		
	V0H3	➤ Sets 4 mA automatically	Confirm E
4	Fill tank to the upper range-value		
	V0H4	➤ Sets 20 mA automatically	Confirm E
#	Product change? See "Density correction", page 44		
Main group: Linearisation			
5	Select type of operation		
	V3H0	Type of operation ➤ Level linear **or** ➤ Level cylindrical horizontal	Confirm E Confirm E
6	Enter height or volume at minimum level		
	V3H1	➤ Display at 4 mA	e.g. 0 Confirm E
7	Enter height or volume at maximum level		
	V3H2	➤ Display at 20 mA	e.g. 100 Confirm E
8	Select level or volume units (Select units from the table on page 43)		
	V3H3	➤ Units after linearisation	e.g. hl Confirm E





Measuring system see chapters 2 and 4

Note!
For step 2, you can also carry out a zero correction according to the procedure described in chapter 5.1, page 38.

Note!

6.3 Dry calibration

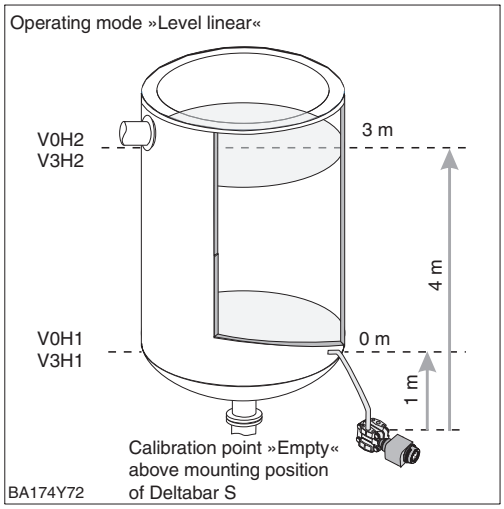
Dry calibration based on calculation and which can be carried out when the Deltabar S is not mounted or with an empty tank. *It is not recommended for transmitters with capillaries or closed tanks with steam.* The calibration point "empty" can be at the same height (flanged version) or above the tapping point of the Deltabar S. The requirements for dry calibration are:

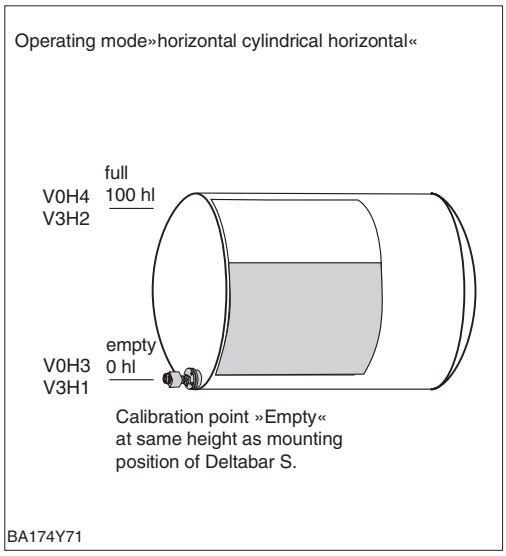
- The levels for the calibration points "empty" and "full" are known.
- The density factor is known.
- The pressure for "empty" and "full" is calculated ($p = \rho gh$)

Selecting the type of operation enables either the tank geometry to be used
- vertical – "level linear" and
- horizontal – "level cylindrical and horizontal".

Calibration

#	Matrix	Path through the menus	Entry
1	Measuring point ready for operation? See chapter 4, page 27 onwards and this chapter, page 42 onwards		
2	Set the display to "0" with acting pressure taken as bias pressure (affects display)		
	V0H5	➤ Sets bias pressure	e.g. 0.1 mbar Confirm E
3	Enter calculated pressure for lower range-value		
	V0H1	➤ Sets 4 mA	e.g. 0 mbar Confirm E
4	Enter calculated pressure for upper range-value		
	V0H2	➤ Sets 20 mA	e.g. 300 mbar Confirm E
#	Product change? See "Density correction", page 44		
Main group: Linearisation			
5	Select type of operation		
	V3H0	Type of operation ➤ Level linear **or** ➤ Level cylindrical horizontal	Confirm E / Confirm E
6	Enter height or volume at minimum level		
	V3H1	➤ Display at 4 mA	e.g. 0 Confirm E
7	Enter height or volume at minimum level		
	V3H2	➤ Display at 20 mA	e.g. 10 Confirm E
8	Select level or volume units (Select units from the table on page 43)		
	V3H3	➤ Units after linearisation	e.g. hl Confirm E





Measuring system see chapters 2 and 4

Note!

Note!
For step 2, you can also carry out a zero correction according to the procedure described in chapter 5.1, page 38.

Check after installation

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

6.4 Linearisation

Linearisation mode

Linearisation enables volumetric measurement to be carried out in vessels, e.g. with conical outlets in which the volume is not directly proportional to the level. The table below gives a summary of the linearisation function (V3H6) that is available with the operating mode "level curve" (V3H0). Linearisation follows a calibration in the volumetric units required. The units for level, volume or weight are selectable using the "Unit after Linearisation" (V3H3) parameter (see also tables, page 43).

Entry V3H6	Linearisation mode	Significance
1	Manual entry	For a linearisation curve max. 21 pairs of values for a % level and the appropriate % volume are entered.
2	Semi-automatic entry of a linearisation curve "gauging"	With semi-automatic entry of the linearisation curve the tank is filled or emptied. The height is automatically determined by the Deltabar S by the hydrostatic pressure, the appropriate volume is entered.
In addition V3H6 offers the functions:		
0	Activating table	The entered linearisation table only comes into effect after it has been activated.
3	Deleting table	Before a new linearisation table is entered, any previously active table must be deleted. On deletion the linearisation mode is automatically set to linear.

Warnings

When activated, the linearisation curve is checked for plausibility.
The following warnings may occur:

Code	Type	Significance
E602	Warning	The linearisation curve does not rise continuously. The number of the last valid pair automatically appears in V3H7. All value pairs from this number onwards must be re-entered.
E604	Warning	The linearisation curve comprises less than two value pairs. Enter more value pairs.

After selection the operating mode "level curve", the following error message may be displayed:

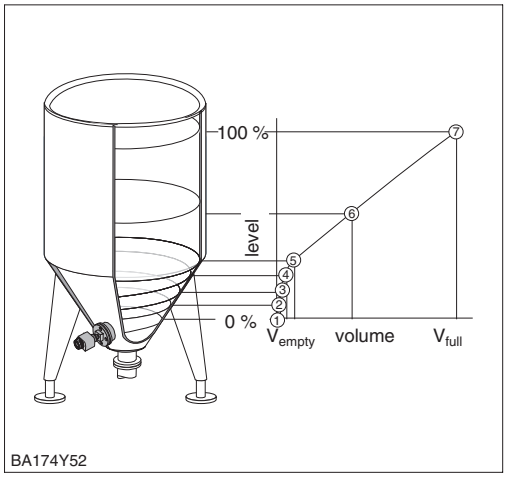
Code	Type	Significance
E605	Alarm	The manual linearisation curve is not complete or there is no linearisation curve present. Enter the linearisation curve in the operating mode "linear" and then select the operation mode table.

Manual entry

The **requirements** for a manual linearisation are as follows:

- The max. 21 value pairs for the linearisation curve are known.
- The curve is entered as % level (% pressure span) versus % volume. The linearisation curve must rise or fall continuously.
- The measured value is output as a volume.

$$\text{volume at x \% level} = \frac{\text{total volume} \bullet \text{volume (\%)}}{100}$$



Specimen table

Point	Measured value (mbar)	Level (%)	Volume (%)
1	0	0	0
2	100	20	8
3	200	40	20
…			
7	500	100	100

The **entries in the table** are made after an empty/full pr dry calibration in %. The procedure which follows includes a dry calibration.

#	Matrix	Path through the Menus	Entry
1	Measuring point ready for operation? See chapter 4, page 27 onwards and this chapter, page 42 onwards		
2	Set the display to "0"		
	V0H5	➤ Sets bias pressure	e.g. 0.1 mbar Confirm E
3	Enter calculated pressure for lower range-value		
	V0H1	➤ Sets 4 mA	0 mbar Confirm E
4	Enter calculated pressure for upper range-value		
	V0H2	➤ Sets 20 mA	300 mbar Confirm E
#	Product change? See "Density correction", page 44		
Main group: Linearisation			
5	Select linearisation mode "manual entry"		
	V3H6	Type of operation ➤ manual	Confirm E
6	Enter table		
	V3H7	➤ Line number	1 Confirm E
	V3H8	➤ Entry Level	e.g. 0% Confirm E
	V3H9	➤ Entry Volume	e.g. 0% Confirm E
	Repeat step 6 until all points have been entered.		
7	Activate curve		
	V3H6	➤ Activate table	Confirm E
8	Select operating mode level table		
	V3H0	➤ Level table	Confirm E
9	Enter level or volume at minimum level		
	V3H1	➤ Display at 4 mA	e.g. 0 Confirm E
10	Enter level or volume at maximum level		
	V3H2	➤ Display at 20 mA	e.g. 10 hl Confirm E
11	Select level or volume units (Select units from the table on page 43)		
	V3H3	➤ Units after linearisation	e.g. hl Confirm E

Note!

Note!

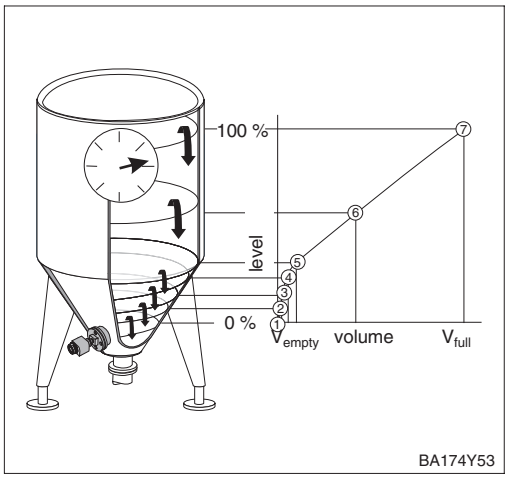
- For step 1, you can also carry out a zero correction according to the procedure described in chapter 5.1, page 38.
- An empty/full calibration can be made at steps 2-4, see page 45 "calibration with reference pressure".
- In edit mode V3H6 = Manual, you can delete individual points in a linearisation table by entering "9999" for level or volume. But first activate the linearisation table.

Semi-automatic entry

The **requirements** for a semi-automatic entry of the table is as follows:

- The max. 21 value pairs for the linearisation curve are known.
- The tank can be filled, for example, for the empty/full calibration and gradually emtpied for the linearisation. The level is automatically detected from the hydrostatic pressure. The associated volume must be entered in %.
- The measured value is supplied as a volume.

$$\text{volume at x \% level} = \frac{\text{total volume} \bullet \text{volume (\%)}}{100}$$



Specimen table

Point	Measured value (mbar)	Level (%)	Volume (%)
1	0	0	0
2	100	20	8
3	200	40	20
…			
7	500	100	100

Note!
- For step 1, you can also carry out a zero correction according to the procedure described in chapter 5.1, page 38.
- An dry calibration can be made at steps 2-4, see page 46.
- In edit mode V3H6 = Manual, you can delete individual points in a linearisation table by entering "9999" for level or volume. But first activate the linearisation table.

The **entries in the table** are made after an empty/full or dry calibration in %. The procedure which follows includes an empty/full calibration.

#	Matrix	Path through the Menus	Entry
1	Measuring point ready for operation? See chapter 4, page 27 and this chapter, page 42 onwards		
2	Set the display to "0"		
	V0H6	➤ Sets bias pressure automatically	Confirm E
3	Fill tank to lower range-value		
	V0H3	➤ Sets 4 mA automatically	Confirm E
4	Fill tank to upper range-value		
	V0H4	➤ Sets 20 mA automatically	Confirm E
#	Product change? See "Density correction", page 44		
Main group: Linearisation			
5	Select linearisation mode "semi-automatic entry"		
	V3H6	Type of operation ➤ semi-automatic	Confirm E
6	Enter table		
	V3H7	➤ Line number	7 Confirm E
	V3H8	➤ Entry Level	Confirm E
	The actual level is automatically detected		
	V3H9	➤ Entry Volume	e.g. 100% Confirm E
	Repeat step 6 until all points have been entered		
7	Activate table		
	V3H6	➤ Activate table	Confirm E
8	Select operating mode level curve		
	V3H0	➤ Level Curve	Confirm E
9	Enter height or volume at minimum level		
	V3H1	➤ Display at 4 mA	e.g. 0 Confirm E
10	Enter height or volume at maximum level		
	V3H2	➤ Display at 20 mA	e.g. 10 Confirm E
11	Select level or volume units (Select units from the table on page 43)		
	V3H3	➤ Units after linearisation	e.g. hl Confirm E

Note!

4 mA level

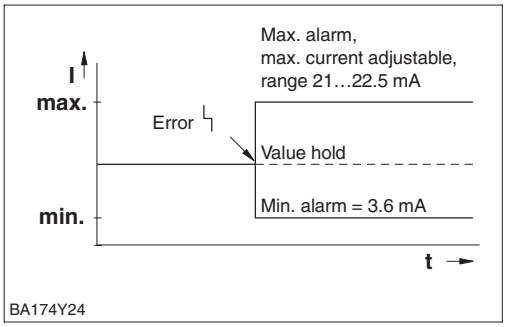
The signal current is set to a standard 3.8…20.5 mA when measuring correctly. Selecting the 4 mA level ensures that a minimum signal current does not fall below of 4 mA. Therefore:
- OFF: lower current limit 3.8 mA
- ON: lower current limit 4 mA

#	Matrix	Path through the menus	Entry
Main group: Additional functions			
1	V7H3 (V1H3)	➤ Current output min. 4 mA	e.g. ON Confirm E

Alarm mode

To indicate an error, an error code is transmitted with the measured value.
The bar graph in the display adopts the value selected by the operator.
For the "Alarm mode" (V0H8)[1] = "Max. alarm" setting, the current is adjustable from 21…22.5 mA using the "Max. alarm current" (V9H4) parameter (Factory setting: 22 mA).

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Select response on error		
	V0H8	➤ Alarm mode [1]	e.g. Max. alarm Confirm E
Main group: Service			
2	Enter current "Max. alarm" value		
	V9H4	➤ Max. alarm current	e.g. 22 mA Confirm E



1) INTENSOR: "Set output damping"

6.5 Locking/unlocking the matrix

After all parameters have been entered, the matrix can be locked:
- via the keys +Z and –S or
- via the matrix by entering a code ≠ 130 in V9H9 (130 is the code for unlocking the matrix).

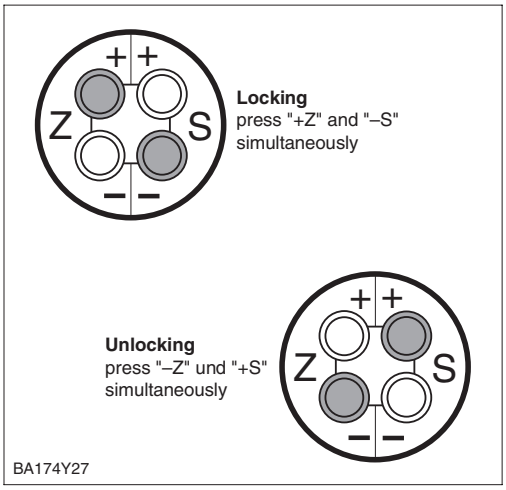
This protects the measuring point from accidental and unauthorised entries:

Keys

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

Matrix

#	Matrix	Path through the menus	Entry
Main group: Service			
1	Lock operation (locking)		
	V9H9	➤ Locking	e.g. 131 (≠ 130) Confirm E
2	Release operation (unlocking)		
	V9H9	➤ Unlock	e.g. 130 Confirm E



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	communication
Keys	yes	no	no	yes	no
Matrix	yes	no	no	yes	yes

6.6 Measuring point information

The following information about the measuring point can be read:

Matrix field	Display or entry
Measured value	
V0H0	Main measured value: level, volume or weight
V2H6	Current sensor temperature (units selectable in V7H9)
V7H0	Output current in mA
V7H8	Sensor pressure (units selectable in V0H9)
Sensor data	
V0H1	Lower range-value (zero) (pressure for level "empty")
V0H2	Upper range-value (span) (pressure for level "full")
V2H5	Overload counter pressure (0…255)
V3H1	Lower range-value (zero) for level, volume or weight ("empty")
V3H2	Upper range-value (span) for level, volume or weight ("full")
V7H4	Low Sensor Trim (units selectable in V0H9)
V7H5	High Sensor Trim (units selectable in V0H9)
V7H6	Lower range-limit of sensor (units selectable in V0H9)
V7H7	Upper range-limit of sensor (units selectable in V0H9)
Measuring point information	
V2H2	Device and software number
Behaviour on fault	
V2H0	Current diagnostic code
V2H1	Last diagnostic code

Display messages for diagnosis

The level indicator enables the smallest and largest measured values for pressure and temperature to be called up. The value is not lost on switching off the device.

Matrix field	Display
V2H3	Peak hold P Min (Maximum pointer for minimum pressure)
V2H4	Peak hold P Max (Maximum pointer for maximum pressure)
V2H7	Peak hold T Min (Maximum pointer for minimum temperature)
V2H8	Peak hold T Max (Maximum pointer for maximum temperature)
V2H5	Overload counter (0…255)
V2H6	Current sensor temperature (units selectable in V7H9)

Communication level

The matrix line "VA Communication" can only be called up and calibrated via the Commuwin II operating program or the Universal HART Communicator DXR 275 or Commulog VU 260 Z handheld terminals.

VAH0	Measuring point tag The measuring point can be identified with a max. of 8 characters
VAH1	User text
VAH2 – VAH8	Information about the device

7 Flow Measurement

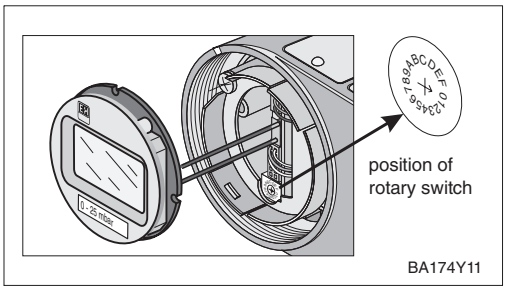
7.1 Commissioning with the Universal HART Communicator DXR 275, Commulog VU 260 Z or Commuwin II

This chapter describes the "Flow" operating mode which can only be activated via communication. The flow is determined using the differential pressure and primary elements, e.g. pitot tube or orifice plate. The pressure measuring range corresponds to the specifications on the nameplate. When measuring a flow, the measured variable in displayed in "%" as default.

This chapter contains the following information:
- Preparation for commissioning
  - Setting the damping rotary switch for operation via communication
  - Resetting to factory set values
  - Setting the damping
  - Selecting pressure units
- General description of setting the span and bias pressure
  - Upper and lower range-values: calibration without reference pressure
  - Upper and lower range-values: calibration with reference pressure
  - Compensation for bias pressure
- Commissioning the measuring point in steps
- Flow adjustments
  - flow characteristic curve, flow display, flow units
  - Creep suppression

Setting the damping rotary switch

Set the blue damping switch to "0".
The transmitter can only be operated by the handheld terminals or the Commuwin II operating program when in this position.

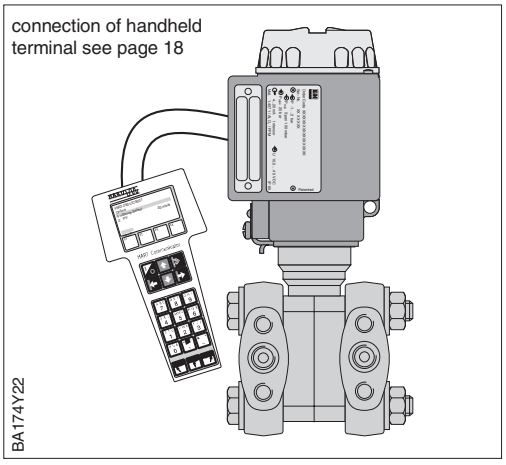


Note on operating with the Commulog VU 260 Z
- Press E once to call up the entry mode – the line blinks
- On completion, press E once again to confirm entry

Reset to factory settings

By entering a specific code number settings entered in the matrix can all or partially reset to factory values. Further information on the various types of "reset" and their effects can be found in chapter 8.3 "Reset".

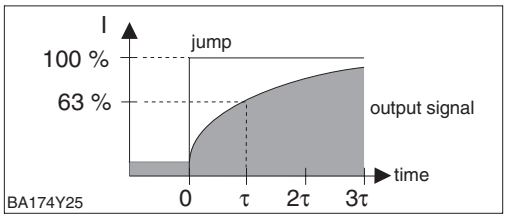
#	Matrix	Path through the menus	Entry
Main group: Transmitter Info			
1	Reset to factory settings		
	V2H9	➤ Reset	2380 Confirm E



Damping τ

The damping influences the time with which the display in V0H0 and the output signal react to a change in pressure.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Suppressing variations in measured values		
	V0H7	➤ Damping τ = 0…40 s	e.g. 20 s Confirm E



Selecting pressure units

After selecting new pressure units all information on the pressure are converted into the new units.
Example: After selecting the unit "psi" the measuring range from 0…10 bar is converted into 0…145.5 psi.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Select pressure units		
	V0H9	➤ Selects pressure units	e.g. mbar Confirm E

Units for operation mode "Pressure":

mbar	bar	Pa	hPa	kPa	MPa	mmH_2O
mH_2O	inH_2O	ftH_2O	psi	g/cm^2	kg/cm^2	kgf/cm^2
atm	lb/ft^2	Torr	mmHg	inHg		

Selecting the flow rate units (Unit after Linearisation)

The unit for flow is selectable using "Unit after Linearisation" (V3H3) parameter. Selecting a unit only helps to improve the display and does not affect the main measured value in the matrix field V0H0.
Example: After selecting the unit "t/min", "112 kg/s" is displayed as "112 t/min".

#	Matrix	Path through menus	Entry
Main group: Basic settings			
1	Select unit for flow rate units		
	V3H3	➤ Unit after linearisation	e.g. kg/s Confirm E

Units for operation mode "Square Root" (flow):

%	ft^3/min	m^3/h	l/s	ft^3/s	m^3/s	norm m^3/h	std ft^3/min
m^3/min	USG/h	USG/d	MGal/d	g/min	kg/s	kg/min	kg/h
t/min	t/h	t/d	lb/s	lb/min	lb/h		

When you want to display the measured value (V0H0) converted into the selected flow rate unit, enter the calculated values for the minimum and maximum flow rate values. See also the specifications in the Deltatop/Deltaset design sheet. The "Display at 4 mA" (V3H1) parameter corresponds to the minimum flow rate value and the "Display at 20 mA" (V3H2) parameter to the maximum flow rate value.

#	Matrix	Path through the menus	Entry
1	Example: – Lower and upper range-values are set: "Set 4 mA Value" (V0H1) = 0 mbar "Set 20 mA Value" (V0H2) = 200 mbar		
2	The current measured value displays in the pressure mode (V0H0) = 128 mbar.		
Main group: Linearisation			
3	Select operation mode "square root" (flow)		
	V3H0	➤ Operation mode square root	Confirm E
4	The minimum flow rate, maximum flow rate and current measured variable are displayed as follows: – "Display at 4 mA" (V3H1) = 0% – "Display at 20 mA" (V3H2) = 100% – "Measured value" (V0H0) = 80%		
5	Select unit for flow rate		
	V3H3	➤ Unit after Linearisation	e.g. m^3/h Confirm E
6	Enter the converted minimum flow rate value		
	V3H1	➤ Display at 4 mA	e.g. 0 (m^3/h) Confirm E
7	Enter the converted maximum flow rate value (see also Deltatop/Deltaset design sheet)		
	V3H2	➤ Display at 20 mA	e.g. 3400 (m^3/h) Confirm E

Results

- The parameters for the minimum and maximum flow rate value indicate:
  – "Display at 4 mA" (V3H1) = 0 m^3/h
  – "Display at 20 mA" (V3H2) = 3400 m^3/h
- The current measured value (V0H0) indicates:
  – "Measured value" (V0H0) = 2720 m^3/h

Lower and upper range-values: calibration without reference pressure

Set the required lower and upper range-values via communication. The flow is determined using the differential pressure and primary elements, e.g. pitot tube or orifice plate. The lower range-value corresponds to a flow of zero (differential pressure = 0 mbar). The upper range-value corresponds to the differential pressure at maximum flow (see also the Deltatop/Deltaset design sheet).

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Enter known pressure for lower range-value		
	V0H3	➤ Sets 4 mA	e.g. 0 mbar Confirm E
2	Enter known pressure for upper range-value		
	V0H4	➤ Sets 20 mA	e.g. 1000 mbar Confirm E

Lower and upper range-values: calibration with reference pressure

A reference pressure is available corresponding exactly to the required lower and upper range-values. A reference pressure is available corresponding exactly to the required lower or upper range-values. The lower range-value corresponds to a flow of zero (differential pressure = 0 mbar). The upper range-value corresponds to the differential pressure at maximum flow (see also the Deltatop/Deltaset design sheet).

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Acting pressure is taken for lower range-value		
	V0H3	➤ Sets 4 mA automatically	Confirm E
2	Acting pressure is taken for upper range-value		
	V0H4	➤ Sets 20 mA automatically	Confirm E

Position calibration – display only (bias pressure)

If the **display** does not show zero flow after zero point adjustment (due to position), then you can correct the display value to zero by entering a bias pressure or by adopting the bias pressure acting (depending on position). The position calibration using a bias pressure does not affect the current output.

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Set display to "0" A bias pressure acting (position-dependent pressure) is adopted as zero pressure.		
	V0H6	➤ Sets bias pressure automatically	Confirm E

alternatively

1	Set display to "0" by entering a known bias pressure (position-dependent pressure).		
	V0H5	➤ Sets bias pressure	e.g. 20 mbar Confirm E

Note!

Note!

In liquids and steams a bias pressure (position-dependent pressure) can only be adopted if:
- the flow is shut off or
- the tapping points are at the same height.

The pressure piping must always be filled.

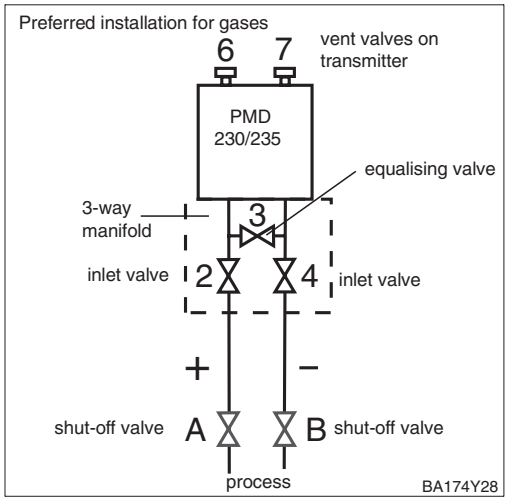
Commisioning the measuring point

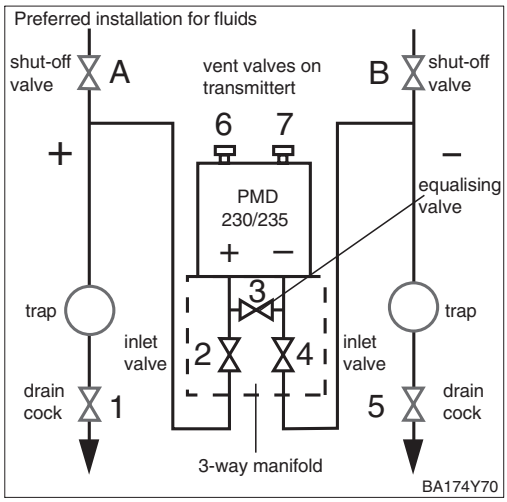
Before using the Deltabar S for measuring differential pressure, clean the pressure piping and fill the device with medium. The measuring span (upper range-value – lower range-value) is either preset (see pages 54 and 55), or only the lower range-value is set during commissioning, as described below.

#	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.	
	V0H3: ➤ Set 4 mA automatically	Acting pressure is taken as lower range-value
	V0H6: ➤ Sets bias pressure automatically	Set display to "0" (position calibration)
6	**Make measuring point ready for operation**	
	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)	
Set lower range-value and display to zero If the flow can be shut off then this calibration of lower range-value and display is to be carried out here. Step 5 is therefore ignored.		
7	Shut off flow	
	V0H3: ➤ Sets 4mA automatically	Active pressure is taken as zero
	V0H6: ➤ Sets bias pressure automatically	Set display to "0" (position calibration)
	Open flow	

* For arrangements with five valves only

#	Valves	Significance
8	Select curve see next page	
9	**Measuring point is ready for operation**	





Caution!

When opening and closing values 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.

Characteristic curve
Flow display
Flow rate units

After starting up the measuring point in accordance with chapter 4.4 or chapter 7.1, select the operating mode and the values for "Zero" flow rate and "Max." flow rate. The required root characteristic curve is already set in the transmitter if the downstream evaluating devices (e.g. PLC) do not extract roots.

* is effective when the damping rotary switch is at "0"

#	Matrix	Path through the menus	Entry
1	Measuring point ready for operation? See steps 1-7, page 56 or chapter 4.4, page 34.		
Main group: Linearisation			
2	Select linearisation mode "square root" (flow)		
	V3H0	➤ Operation mode square root*	Confirm E
Enter flow range for display and communication			
3	Enter value for minimum flow		
	V3H1	➤ Display at 4 mA	0 Confirm E
4	Enter value for maximum flow		
	V3H2	➤ Display 20 mA	e.g. 50 Confirm E
5	Select flow rate unit for display and communication (Select units from the table on page 53)		
	V3H3	➤ Units after linearisation	e.g. m^3/h Confirm E

Remote calibration for flow measurement

If configuration is carried out via communication or if only part of the measuring range is used, enter the pressure and the associated flow values for the lower and upper range-values.

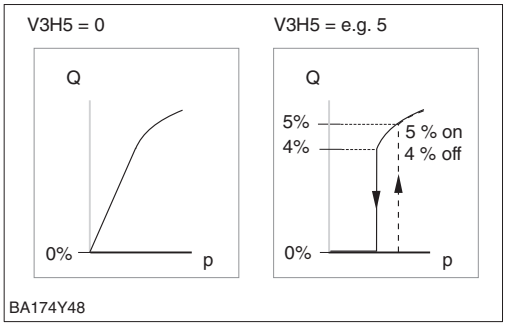
#	Matrix	Path through the menus	Entry
1	Measuring point ready for operation? See steps 1-6, page 56.		
Main group: Basic setting			
2	If necessary, set display to "0" by entering a known bias pressure (position-dependent pressure)		
	V0H5	➤ Sets bias pressure	e.g. 0 mbar Confirm E
3	Enter known pressure for lower range-value		
	V0H1	➤ Sets 4 mA	e.g. 0 mbar Confirm E
4	Enter known pressure for upper range-value		
	V0H2	➤ Sets 20 mA	e.g. 100 mbar Confirm E

#	Matrix	Path through the menus	Entry
Main group: Linearisation			
5	Select operation mode "square root" (flow)		
	V3H0	➤ Operation mode square root	Confirm E
6	Enter value for minimum flow		
	V3H1	➤ Display at 4 mA	0 Confirm E
7	Enter value for maximum flow		
	V3H2	➤ Display at 20 mA	e.g. 500 Confirm E
5	Select flow rate unit for display and communication (Select units from the table on page 53)		
	V3H3	➤ Units after linearisation	e.g. m^3/h Confirm E

Creep flow suppression

In the lower flow range small flows – creep leads to large flow variations. By entering a value for creep 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.

#	Matrix	Path through the menus	Entry
Main group: Linearisation			
1	Enter value for creep flow suppression		
	V3H5	➤ Creep flow suppression	e.g. 5 % Confirm E



4 mA level

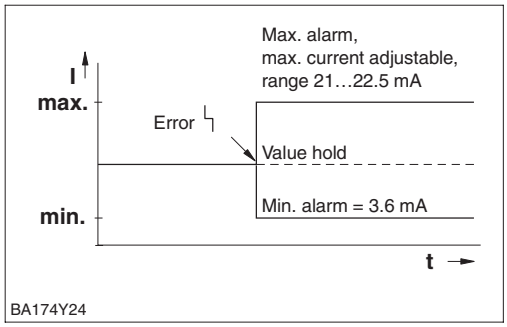
The current signal is set to 3.8…20.5 mA a standard when operating correctly. When selecting the 4 mA level, it is ensured that a minimum current signal does not fall below 4 mA.
The following applies:
• OFF: lower current level 3.8 mA
• ON: lower current level 4 mA

#	Matrix	Path through the menus	Entry
Main group: Additional functions			
1	V7H3 (V1H3)	➤ Current output min. 4 mA	e.g. ON Confirm E

Alarm mode

To indicate an error, an error code is transmitted with the measured value.
The bar graph in the display adopts the value selected by the operator.
For the "Alarm mode" (V0H8)[1)] = "Max. alarm" setting, the current is adjustable from 21…22.5 mA using the "Max. alarm current" (V9H4) parameter (Factory setting: 22 mA).

#	Matrix	Path through the menus	Entry
Main group: Basic settings			
1	Select response on error		
	V0H8	➤ Alarm mode [1)]	e.g. Max. alarm Confirm E
Main group: Service			
2	Enter current "Max. alarm" value		
	V9H4	➤ Max. alarm current	e.g. 22 mA Confirm E



1) INTENSOR: "Set output damping"

7.2 Locking/unlocking the matrix

After all parameters have been entered, the matrix can be locked.

- via the keys +Z and –S or
- via the matrix by entering a code number ≠ 130 in V9H9 (130 is the code to unlock the matrix).

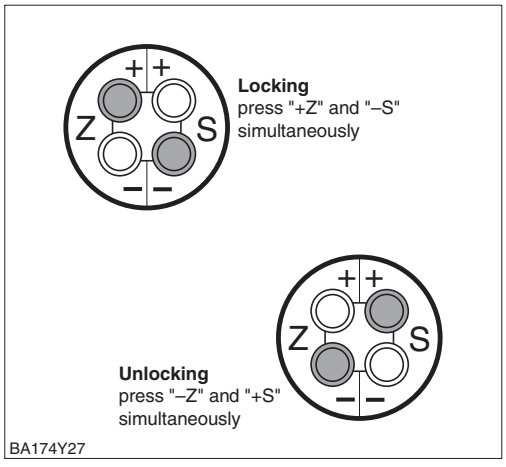
This protects the measuring point from accidental and unauthorised entries:

Keys

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

Matrix

#	Matrix	Path through the menus	Entry
Main group: Service			
1	Lock operation (locking)		
	V9H9	➤ Locking	e.g. 131 Confirm E
2	Release operation (unlocking)		
	V9H9	➤ Unlock	e.g. 130 Confirm E



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	communication
Keys	yes	no	no	yes	no
Matrix	yes	no	no	yes	yes

7.3 Measuring point information

The following information about the measuring point can be read:

Matrix field	Display or entry
Measured value	
V0H0	Main measured value: flow
V2H6	Current sensor temperature (unit selectable in V7H9)
V7H0	Output current in mA
V7H8	Sensor pressure (unit selectable in V0H9)
Sensor data	
V0H1	Lower range-value (pressure for flow "zero")
V0H2	Upper range-value (pressure for flow "max.")
V2H5	Overload counter pressure (0…255)
V3H1	Lower range-value for flow "min.", enter "0"
V3H2	Upper range-value for flow "max."
V7H4	Low Sensor Trim (unit selectable in V0H9)
V7H5	High Sensor Trim (unit selectable in V0H9)
V7H6	Lower range-limit of sensor (unit selectable in V0H9)
V7H7	Upper range-limit of sensor (unit selectable in V0H9)
V9H7	Pressure before bias correction (unit selectable in V0H9)
V9H8	Pressure after bias correction (unit selectable in V0H9)
Measuring point information	
V2H2	Device and software number
Behaviour on fault	
V2H0	Current diagnostic code
V2H1	Last diagnostic code

Display messages for diagnosis

The level indicator enables the smallest and largest measured values for pressure and temperature to be called up. The value is not lost on switching off the device.

Matrix field	Display
V2H3	Peak hold P Min (Maximum pointer for minimum pressure)
V2H4	Peak hold P Max (Maximum pointer for maximum pressure)
V2H7	Peak hold T Min (Maximum pointer for minimum temperature)
V2H8	Peak hold T Max (Maximum pointer for maximum temperature)
V2H5	Overload counter (0…255)
V2H6	Current sensor temperature

Communication level

The matrix line "VA Communication" can only be called up and calibrated with the Commuwin II operating program or the Universal HART Communicator DXR 275 or Commulog VU 260 Z handheld terminals.

VAH0	Measuring point tag The measuring point can be identified with a max. of 8 characters
VAH1	User text
VAH2 – VAH8	Information about the device

7.4 Totalizer

For devices with Order No. PMD 230 - ❑ 1 ❑ ❑❑ ❑ ❑❑ ❑ ❑ and
PMD 235 - ❑ 1 ❑ ❑❑ ❑ ❑❑ ❑ ❑ only (see nameplate).

Software version

The function "Totalizer" is found in Deltabar S from software version 6.0 and can be set using the Endress+Hauser Commuwin II operating program or via the handheld terminal Universal HART Communicator DXR 275.

Software version/ operating instructions	Universal Hart Communicator DXR 275/ Commuwin II	Universal Hart Communicator DXR 275	
	Device and software No.	Device revision	DD revision
6.0/11.99	7360	6	1

Function

The function "Totalizer" enables the flow rate to be determined and totalled in units of volume or mass by entering a conversion factor as flow quantity.

Before selecting the function "Totalizer", the Deltabar S must be mounted and calibrated according to the procedure on page 12 and following pages.
Note the following instructions:
- The flow rate entered for "Display 4 mA after linearisation" (V3H1) should always be 0.
- The function "Totalizer" can only be selected in the mode "Square root (flow)" (V3H0).

Display selector

The display can be selected for current flow rate or total flow rate.
- **Flow:** Display showing current flow rate.
  The bar graph shows the current flow rate.
- **Totalizer:** Display showing total flow rate.
  The bar graph shows the current flow rate.

#	Matrix	Path through the menus	Entry
Main group: Totalizer			
1	Select display		
	V5H1	➤ Display selector	e.g. Totalizer Confirm E

The "Counter" (V5H0) parameter always outputs the total flow rate irrespective of the choice of operating mode display.

Note!

Note!
The totalizer can count with up to 7 digits before the decimal point. The display module of the Deltabar S can show only 4 digits. Thus, for values with more than four digits the digits 1…4 and 5…7 are shown alternately every 4 seconds.

When incrementing, the counter jumps from 9 999 999 to 0 and when decrementing from 0 to 9 999 999.

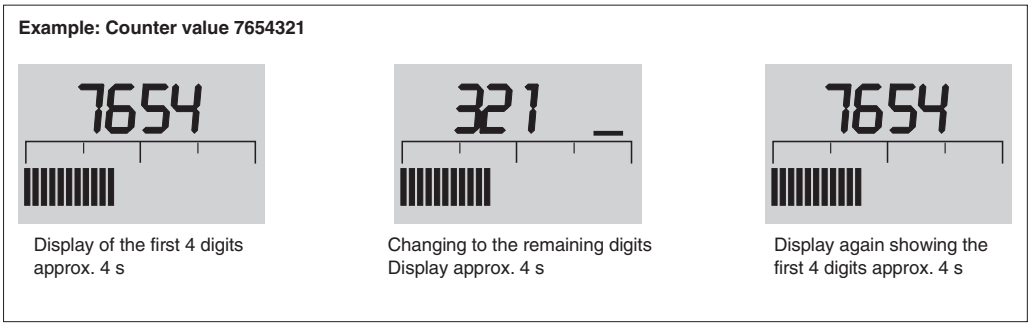
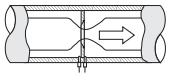
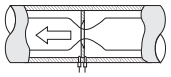


Figure 7.1
Display
- *The digits show alternately the total flow rate.*
- *The bar graph always shows the current flow rate.*

Totalizer Operation Mode (Counter mode)

The Totalizer Operation Mode field is used to activate the totalizer and determine how negative flow values are totalled.

#	Matrix	Path through the menus	Entry
Main group: Totalizer			
1	Select Totalizer Operation Mode		
	V5H2	➤ Totalizer operation mode	e.g. neg. flow Decr. Confirm E

	Case 1: positive flow	Case 2: negative flow
		
Totamizer: Off	Totalizer does not count	Totalizer does not count
neg. flow: Stop	Total increases	Total remains constant
neg. flow: Decr.	Total increases	Total decreases
neg. flow: Incr.	Total increases	Total increases

Counter Unit

Selecting a volume or mass unit only helps to improve the display. It has no impact on the display in V5H0. By default, the flow rate is indicated in "%".

#	Matrix	Path through the menus	Entry
Main group: Totalizer			
1	Select counter unit		
	V5H4	➤ Counter unit	e.g. l Confirm E

%	l	hl	cm^3
dm^3	m^3	m^3 • 10	m^3 • 100
ft^3	ft^3 • 10	ft^3 • 100	US Gal
Imp Gal	ton	kg	t
lb			

Conversion Factor

Entering the Conversion Factor enables the flow rate to be converted into a total flow rate.

#	Matrix	Path through the menus	Entry
Main group: Totalizer			
1	Enter conversion factor		
	V5H3	➤ Conversion factor	e.g. 13.62605 Confirm E

The conversion factor is derived from the "Units of Flow" (V3H3) and the "Counter Units" (V5H4) selected. The conversion factors for most units are shown in the tables on the following pages. The conversion factors are calculated as shown in the following example:

Example:
Flow rate from 0…100% should be shown as a measured value (V0H0) in 0…50 m^3/h. The "Counter" (V5H0) should be counting in US Gal.

- Converting the flow rate units into flow units per second
  50 m^3/h = 50 m^3 / [60 (min) x 60 (s)] = 0.013888 m^3/s
- Converting the flow rate units per second into counter units per second
  0.013888 m^3/s x 264.2 US Gal/m^3 = 3.6694 US Gal/s
  (1 m^3 corresponds to 254.2 US Gal)
- Calculating the conversion factor by dividing the flow rate by the previously calculated counter value
  50 / 3.6694 = 13.62604

Conversion factor for volumetric flow units

	Counter units											
	l	hl	cm^3	dm^3	m^3	m^3 x 10	m^3 x 100	ft^3	ft^3 x 10	ft^3 x 100	US Gal	Imp. Gal
ft^3/min	2.1186	211.86	0.002118	2.1186	2118.6	21186	211860	60	600	6000	8.018925	9.63
m^3/h	3.6	360	0.0036	3.6	3600	36000	360000	101.954	1019.54	10195.41	13.62604	16.3636
l/s	1	100	0.001	1	1000	10000	100000	25.3206	283.206	2832.058	3.785011	4.54545
ft^3/s	0.03531	3.531	0.000035	0.03531	35.31	353.1	3531	1	10	100	0.133649	0.1605
m^3/s	0.001	0.1	0.000001	0.001	1	10	100	0.02832	0.238321	2.832058	0.003785	0.00455
m^3/min	0.06	6	0.00006	0.06	60	600	6000	1.69924	16.9924	169.9235	0.227101	0.27273
Gal/h	951.12	95112	0.95112	951.12	951120	9511200	—	26936.3	269363	2693627	3600	4323.27
Gal/day	22826.88	2282688	22.82688	22826.9	—	—	—	646471	6464707	—	86400	103759
Mgal/day	0.022826	2.28269	0.000023	0.02283	22.82688	228.2688	2282.688	0.64647	6.46471	64.64706	0.0864	0.10376

Example: conversion factor for flow rate units in m^3/h in counter units US gal = 13.62604

Conversion factor for mass flow units

	Counter units				
	ton (UK) (long ton)	ton (US) (short ton)	kg	t	lb
g/min	—	—	60000	—	27210.88
kg/s	1016.053	907.4410	1	1000	0.453514
kg/min	60963.21	54446.46	60	60000	27.21088
kg/h	3657793	3266787	3600	3600000	1632.653
metric t/min	60.96321	54.44646	0.06	60	0.027210
metric t/h	3657.793	3266.787	3.6	3600	1.632653
metric t/day	87787.03	78402.90	86.4	86400	39.18367
lb/s	2240.398	2000.907	2.205	2205	1
lb/min	134423.8	120054.4	132.3	132300	60
lb/h	8065433	7203266	7938	7938000	3600

Calculating volumetric units

	l	hl	cm^3	dm^3	m^3	m^3 x 10	m^3 x 100	ft^3	ft^3 x 10	ft^3 x 100	US Gal	Imp.Gal
1 l	1	0.01	1000	1	0.001	0.0001	0.00001	0.03531	0.003531	0.000353	0.2642	0.22
1 hl	100	1	100000	100	0.1	0.01	0.001	3.531	0.3531	0.03531	26.42	22
1 cm^3	0.001	0.00001	1	0.001	—	—	—	—	—	—	0.000264	0.00022
1 dm^3	1	0.01	1000	1	0.001	0.01	0.1	0.03531	0.003531	0.000353	0.2642	0.22
1 m^3	1000	10	—	1000	1	0.1	0.01	35.31	3.531	0.3531	264.2	220
1 m^3 x 10	10000	100	—	10000	10	1	0.1	353.1	35.31	3.531	2642	2200
1 m^3 x 100	100000	1000	—	100000	100	10	1	3531	353.1	35.31	26420	22000
1 ft^3	28.32	0.2832	28320	28.32	0.02832	0.002832	0.000283	1	0.1	0.01	7.492	6.23
1 ft^3 x 10	283.2	2.832	283200	283.2	0.2832	0.02832	0.002832	10	1	0.1	74.92	62.3
1 ft^3 x 100	2832.05	28.32	2832000	2832	2.832	0.2832	0.02832	100	10	1	749.2	623
1 US Gal	3.785	0.03785	3785	3.785	0.003785	0.000378	0.000037	0.1336	0.01336	0.001336	1	0.8326
1 Imp. Gal	4.545	0.04545	4545	4.545	0.004545	0.000454	0.000045	0.1605	0.01605	0.001605	1.201	1

Example: 1m^3 = 264.2 US Gal

Calculating mass units

	ton (UK) (long ton)	ton (US) (short ton)	kg	t	lb
1 ton (UK) (long ton)	1	1.12	1016.05	1.0165	2240
1 ton (US) (short ton)	0.8928	1	907.2	0.9072	2000
1 kg	0.000993	0.001102	1	0.001	2.205
1 t	0.9934	1.102	1000	1	2205
1 lb	0.000446	0.0005	0.4535	0.000453	1

8 Trouble-Shooting

8.1 Diagnosis of errors and warnings

Errors

When the Deltabar S detects an error:

- an error code is transmitted along with the measured value
- with a plugged in display, the bar graph assumes the value selected on error (Min. alarm, Max. alarm or Value hold – the last measured value is kept) and flashes.
- The actual error code can be read in V2H0, the last error code in V2H1.

Warnings

When the Deltabar S detects a warning:

- An error code is transmitted along with the measured value: the Deltabar S continues measuring.
- The actual error code can be read in V2H0, the last error code in V2H1.

Error codes in V2H0 and V2H1

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

Code	Type	Cause and Remedy	Priority
E 101	Error	Sensor Checksum Error Error reading checksums from the EEPROM of the sensor. – Checksum incorrect, transmission errror during read process due to effects of EMC (larger than specified in chapter 10, Technical Data). *Block EMC effects.* – EEPROM of the sensor defective. *Replace sensor.*	3
E 103	Error	Initialisation active – The electronics are initialised after the device is connected. *Wait for end of initialisation process.*	2
E 104	Warning	Sensor calibration – Values in V7H4 and V7H5 (Low Sensor Trim and High Sensor Trim) are too close together, e.g. after sensor recalibration. *Reset system (Code 2509), recalibrate sensor.*	23
E 106	Error	Download active (Commuwin II) – *Wait for end of download.*	10
E 110	Error	Checksum error – During a write process (e.g. when display indicates "E 103") the power supply is interrupted. *Restore the power supply. Reset (Code 5140) if necessary.* – EMC effects (larger than specified in chapter 10, Technical Data). *Block EMC effects.* – Main electronics defective. *Replace electronics.*	1
E 111	Error	No connection to EEPROM of the sensor – Cable connections from sensor electronics via main electronics to display (internal bus) interrupted or sensor electronics defective. *Check plug to sensor. Check cable connection. Replace sensor.*	4
E 112 PMD 230, FMD 230	Error	No connection to sensor analogue/digital converter – Cable connection from sensor to main electronics interrupted. *Check cable connection.* – Main electronics defective. *Replace electronics.* – Sensor electronics defective. *Replace sensor.*	5
E 113 PMD 230, FMD 230	Error	Measuring error during pressure and temperature measurement The sensor electronics are no longer correctly converting the measured pressure and temperature values. – "Pressure signal" (PIN 6) connection disconnected at the plug. *Reconnect.* Sensor or sensor electronics defective. *Replace sensor.*	6

Error codes in V2H0 and V2H1 (continuation)

Code	Type	Cause and Remedy	Priority
E 113 PMD 235, FMD 630, FMD 633	Error	Measuring errors during pressure and temperature measurement Incorrect transfer of analogue signals from sensor to main electronics. – Cable connection between sensor and main electronics interrupted. *Check cable connection.* – Main electronics defective. *Replace electronics.* – Sensor electronics defective. *Replace sensor.*	6
E 114	Error	Measuring error during temperature measurement. Difference between temperature calculated in sensor and measured temperature is greater than 50 K. – Cable connection between sensor and main electronics interrupted. *Check cable connection.* – Sensor electronics defective. *Replace sensor.*	7
E 115	Error	Sensor overpressure plus side – Overpressure present. *Reduce pressure until message disappears.* – Cable conntection between sensor and main electronics interrupted. *Check cable connection.* – Sensor defective. *Replace sensor.*	8
E 116	Error	Download error (PC → Transmitter) – During the download, the data is not being correctly transferred to the processor, e.g. due to an open cable connection, voltage peaks (ripple) on supply voltage, EMC effects. *Check the cable connection between PC and transmitter.* *Reset system (Code 5140), restart download.*	11
E 118	Error	Calibration error Editing limits[1] or maximum turn down exceeded, e.g. due to inappropriate download. *– System reset (Code 5140). Repeat download.*	15
E 120	Error	Sensor overpressure minus side – Pressure too low. *Increase pressure until message disappears.* – Cable connection between sensor and main electronics interrupted. *Check cable connection.* – Sensor defective. *Replace sensor.*	9
E 602	Warning	Linearisation curve does not increase or decrease monotonically. – Value pairs for the linearisation curve entered incorrectly. *Check Level Manual for plausibility. (E.g. does the volume increase with the level?) If necessary, carry out linearisation again or re-enter the value pairs, see chapter 6.4 Linearisation.*	14
E 604	Warning	Linearisation curve contains less than 2 value pairs. – *Check manual level. If necessary, carry out linearisation again or add more value pairs, see chapter 6.4 Linearisation.*	13
E 605	Error	No linearisation curve saved – Linearisation curve not activated, although the "Manual Level" operating mode was selected. *After entering the value pairs for the linearisation curve, activate the Level Manual using the V3H6 (manual level) matrix field.* Note: The message also appears, if, during entry, the value pairs of the "Level manual" are selected.	12
E 613	Warning	Current simulation active – Simulation is switched on using V7H1, i.e. the transmitter is not currently measuring. *Switch off simulation.*	22
E 620	Warning	Signal current is outside range – The current is outside the permitted range 3.8...20.5 mA or 4.0...20.5 mA, i.e. the output current does not fit the measured value. – The applied pressure is too great or too small. – The calibration values for "Set 4 mA Value" (V0H1) and "Set 20 mA Value" (V0H2) are incorrect. *Correct calibration values for V0H1 and V0H2.*	23

1) The editing limits are described in Chapter 8.4.

Error codes on-site-display

Code	Type	Cause and Remedy	Priority
E 670[2)]	Warning	4 mA value was not transferred – The 20 mA value is outside the editing limits[1)]. As the span remains constant during a change to the 4 mA value, the 20 mA value shifts with the 4 mA value. This warning only appears when calibrating with reference pressure using the Z– and Z+ keys. *Carry out the calibration again. The 20 mA value must be within these editing limits. If necessary, set the 20 mA value to a smaller value. After this, first calibrate the 4 mA value and then the 20 mA.*	16
E 672[2)]	Warning	Editing limit[1)] for 4 mA value reached. – Lower or upper editing level reached for 4 mA value. This warning appears when calibrating the 4 mA value without a reference pressure using the Z+ or Z– keys. The value is not accepted. *Carry out the calibration again and make sure that the lower/upper editing limits for the 4 mA value are not undershot or exceeded.*	17
E 673[2)]	Warning	Editing limit[1)] for 20 mA value reached. – Lower or upper editing level reached for 20 mA value. This warning appears when calibrating the 20 mA value without a reference pressure using the S+ or S– keys. The value is not accepted. *Carry out the calibration again and make sure that the lower/upper editing limits for the 20 mA value are not undershot or exceeded.*	18
E 674[2)]	Warning	Calibration error: turn down too big. – The maximum possible turn down was exceeded. This warning appears during a calibration using the keys of the on-site operating terminal. The value is not accepted. *Carry out calibration again. The pressure value for the calibration of the 20 mA value may not be too close to 4 mA value.*	19
E 675[2)]	Warning	Current pressure value outside the sensor limits. – The currently applied pressure for calibrating the 4 mA or 20 mA values is outside the editing limits[1)] (calibration with reference pressure and using the Z+ and Z– or S+ and S– keys). The value is not accepted. *Carry out calibration again. The currently applied pressure for calibrating the 4 mA and the 20 mA values must be within the editing limits.*	20

1) The editing limits are described in chapter 8.4.
2) These error codes only appear on the on-site display.

8.2 Current simulation

If functions or specific responses of devices are checked, then a signal current can be simulated independent of the acting system pressure.
The current value is settable within the limits of 3.6 mA and 22 mA using the "Simulate Current" parameter (V7H2).

#	Matrix	Path through the menus	Entry
Main group: additional functions			
1	V7H1	➤ Simulation	ON
2	V7H2	➤ Sets simulation current	e.g. 22 mA

8.3 Reset

By entering a code, the entries in the matrix are reset partially or completely to factory settings.

#	Matrix	Path through the menus	Entry
Main group: transmitter info			
1	V2H9	➤ Factory setting	e.g. 2380

The Deltabar S differentiates between different reset codes with different effects. To find out which parameters are reset with the 5140, 2380 and 731 reset codes, refer to the table on page 68.

Other reset codes have the following effects:
- Device warm start = 62
- 2509: This reset sets the lower and upper sensor calibration limits and the zero correction value to the factory setting. I. e.:
  Low Sensor Trim = Low Sensor Limit (V7H4 = V7H6),
  High Sensor Trim = High Sensor Limit (V7H5 = V7H7).
  Zero Correction Value (V9H6) = 0.0

Reset Codes		H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
	V0	**Measured value**	**Set 4 mA value**	**Set 20 mA value**	**4 mA value autom.**	**20 mA value autom.**	**Set bias pressure**	**Bias pressure autom.**	**Set output damp. [s]**	**Alarm mode**	**Select pressure unit**
5140			0.0	= V7H7			0.0		0.0	Max. alarm	bar
2380			0.0	= V7H7			0.0		0.0	Max. alarm	
731			0.0	= V7H7			0.0		0.0	Max. alarm	
	V1										
	V2	**Diagnostic code**	**Last Diagnostic code**	**Software no.**	**Peak hold P Min**	**Peak hold P Max**	**Int. counter high**	**Sensor temperat.**	**Peak hold T Min**	**Peak hold T Max**	**Default value**
5140			0		=V7H8[1)]	=V7H8[1)]	0		=V2H6[2)]	=V2H6[2)]	
2380			0		=V7H8[1)]	=V7H8[1)]	0		=V2H6[2)]	=V2H6[2)]	
731			0								
	V3	**Operation mode**	**Display at 4 mA[3)]**	**Display at 20 mA[3)]**	**Unit after Lin.[3)]**	**Density factor[4)]**	**Creep flow suppr. %[5)]**	**Manual level**	**Line no.**	**Input Level**	**Input volume**
5140		1(pressure)	0.0%	100.0%	%	1.0	0.0%	delete	1	9999.0%	9999.0%
2380			0.0%	100.0%		1.0	0.0%				
731			0.0%	100.0%		1.0	0.0%				
	V4										
	V5	**Counter**	**Display selector**	**Totaliser op. mode**	**Convers. factor**	**Counter unit**					
5140		0%	Flow	Off	1.0	%					
2380											
731											
	V6										
	V7	**Current [mA]**	**Simulation**	**Set simulation current**	**Min. current 4 mA**	**Low sensor trim**.	**High sensor trim**	**Low sensor limit**	**High sensor limit**	**Sensor pressure**	**Temperat. unit**
5140			Off		Off	= V7H6	= V7H7				°C
2380					Off	= V7H6	= V7H7				
731					Off						
	V8										
	V9					**Max. alarm current**	**Zero correction**	**Zero correction value**	**Unbiased pressure**	**Biased pressure**	**Security locking**
5140						22.0	0.0	0.0	= V7H8[1)]	= V7H8[1)]	130
2380									= V7H8[1)]	= V7H8[1)]	
731											
	VA	**Set tag number**	**Set user text**	**HART serial number**	**Serial number sensor**	**Process conn. P+**	**Process-conn. P–**	**Gasket**	**Process diaphragm**	**Fill liquid**	
5140		delete	delete			special	special	special	special	special	
2380		delete	delete								
731											

1) After a reset, fields V2H3, V2H4, V9H7 and V9H8 show the currently applied pressure.
2) After a reset, fields V2H7 and V2H8 show the currently measured temperature.
3) Fields V3H1, V3H2 and V3H3 are not displayed in "Pressure" mode.
4) Field V3H4 (Density Factor) is displayed in the "Level lin", "Level cyl. linear" and "Level Manual" modes.
5) Field V3H5 (Creepage %) is only shown in the "Square Root" (flow rate) mode.

8.4 Editing limits

To avoid incorrect device functioning because of excessively large or excessively small values, for some parameters there is a minimum and maximum permissible input value (editing limits). The set measuring range must be within these editing limits. An attempt to exceed or undershoot these editing limits generates an error message (refer to chapter 8.1 Diagnosis of errors and warnings).

The following parameters are checked to make sure they are within the editing limits:

- Set 4 mA Value (V0H1)
- Set 20 mA Value (V0H2)
- Set 4 mA Value Automatically (V0H3)
- Set 20 mA Value Automatically (V0H4)
- Set Bias Pressure (V0H5)
- Bias Pressure Automatically (V0H6)

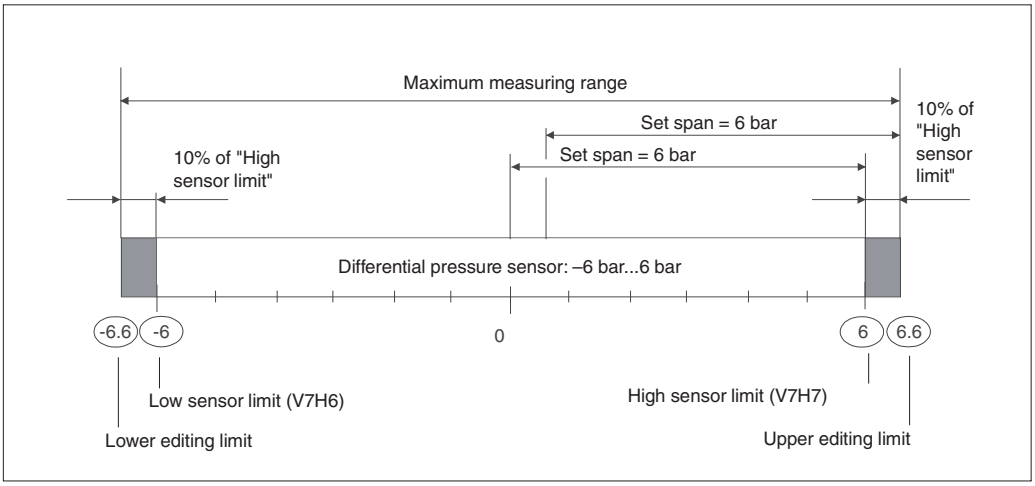
The table below lists the editing limits and the smallest span which you can set:

Sensor range	Low sensor limit (V7H6)	High sensor limit (V7H7)	Lower editing limit	Upper editing limit	Smallest span
Ceramic sensor PMD 230 / FMD 230					
–25...25 mbar	–25 mbar	25 mbar	–27.5 mbar	27.5 mbar	0.5 mbar
–100...100 mbar	–100 mbar	100 mbar	–110 mbar	110 mbar	2 mbar
–500...500 mbar	–500 mbar	500 mbar	–550 mbar	550 mbar	10 mbar
–3...3 bar	–3 bar	3 bar	–3.3 bar	3.3 bar	0.06 bar
Silicon sensor PMD 235 / FMD 630 / FMD 633					
–10...10 mbar	–10 mbar	10 mbar	–11 mbar	11 mbar	0.2 mbar
–40...40 mbar	–40 mbar	40 mbar	–44 mbar	44 mbar	0.8 mbar
–100...100 mbar	–100 mbar	100 mbar	–110 mbar	110 mbar	2 mbar
–500...500 mbar	–500 mbar	500 mbar	–550 mbar	550 mbar	10 mbar
–3...3 bar	–3 bar	3 bar	–3.3 bar	3.3 bar	0.06 bar
–16...16 bar	–16 bar	16 bar	–17.6 bar	17.6 bar	0.32 bar
–40...40 bar	–40 bar	40 bar	–44 bar	44 bar	0.8 bar

Editing limits are calculated as follows

- Lower editing limit =
  "Low Sensor Limit" (V7H6) – 10% of "High Sensor Limit" (V7H7)
- Upper editing limit =
  "High Sensor Limit" (V7H7) + 10% of "High Sensor Limit" (V7H7)

Example of editing limits for a differential pressure sensor –6…+6 bar



Note!

Note!
If a reversal of action from the current output to the measured pressure is required (inverted output), i.e. the 4 mA calibration value corresponds to the upper range-value and the 20 mA calibration value corresponds to the lower range-value, then the calibration should be carried out as follows:

#	Matrix	Path through the menus	Entry
Main group: Basic setting			
1	Enter value for upper range-value		
	V0H2	➤ Sets 20 mA	e.g. –1bar Confirm E
2	Enter known pressure for lower range-value		
	V0H1	➤ Sets 4 mA	e.g. 1 bar Confirm E
3	Enter known pressure for upper range-value		
	V0H2	➤ Sets 20 mA	e.g. 0 bar Confirm E

Editing limits for zero correction and recalibration

There are also editing limits for the "Low Sensor Trim" (V7H4), "High Sensor Trim" (V7H5) and "Zero Correction" (V9H5) parameters. For the parameters, the editing limits are defined by the sensor limits and the applied pressure.

To carry out a recalibration or a zero correction, the device must have a reference pressure (Refer to chapter 6.1, Section on "Zero Correction" and chapter 9.5 "Recalibration"). Enter a value assigned to the applied pressure using the relevant "Low Sensor Trim" (V7H4), "High Sensor Trim" (V7H5) or "Zero Correction Value" (V9H5) parameters.

- Calculation of the value for the lower editing limit of V7H4, V7H5 und V9H5: "Sensor Pressure" (V7H8) – 10% of the sensor end value
- Calculation of the value for the upper editing limit of V7H4, V7H5 und V9H5: "Sensor Pressure" (V7H8) + 10% of the sensor end value

The "Sensor Pressure" parameter (V7H8) shows the applied pressure on the device.

#	Example:
1	Sensor: –3...3 bar (Sensor end value = 3 bar) applied pressure = "Sensor Pressure" (V7H8) = 0.1 bar (e.g. depending on position)
2	The applied pressure (V7H8) can be assigned to a value between the upper and lower editing limits using the "Zero Correction" (V9H5) parameter. In this example values from –0.2 bar to 0.4 bar. Value for lower editing limit, V9H5 = "Sensor Pressure" – 10% of sensor end value 0.1 bar – 0.1 • 3 bar = 0.1 bar – 0.3 bar = –0.2 bar Value for upper editing limit, V9H5 = "Sensor Pressure" + 10% of sensor end value 0.1 bar + 0.1 • 3 bar = 0.1 bar + 0.3 bar = 0.4 bar

9 Maintenance and Repair

9.1 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 product.
  This is particularly important if the product is dangerous to health, i.e. corrosive, poisonous, carcinogenic, radioactive, etc.
- We do request that no device 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.

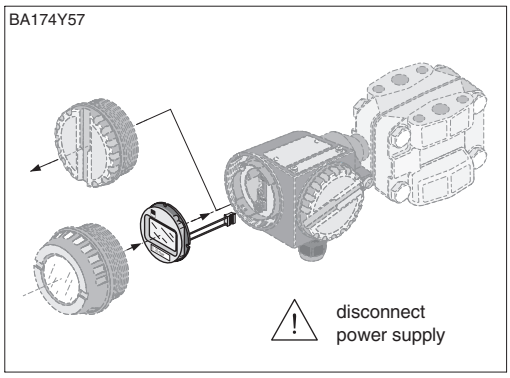
Caution!
Devices with certificates of conformity or design approval must be sent in for repair as complete units only.


Caution!

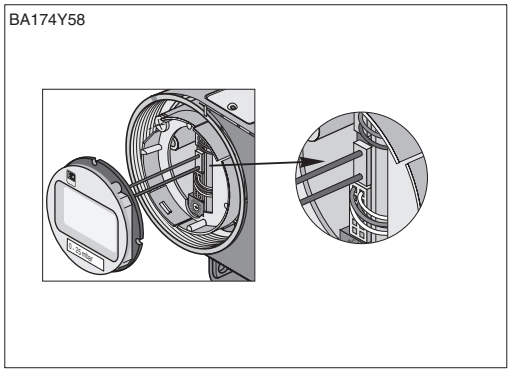
9.2 Mounting the display

Mounting the display

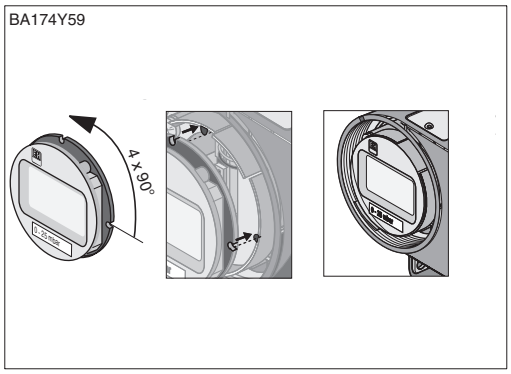
- Switch off power supply.
- Open the cover to the display compartment (use a cover with sight glass after mounting the display).



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

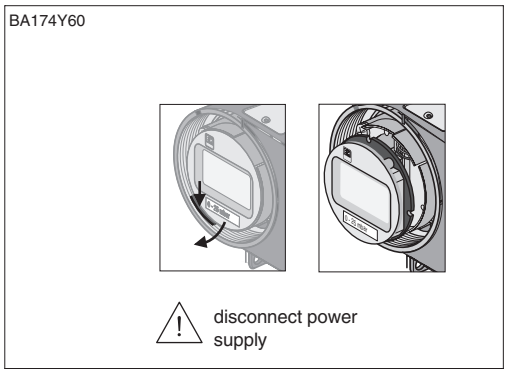


- Attach display.
  The display can be rotated through 90°.
- Screw down the cover.



Removing the display

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



9.3 Exchanging the sensor module and electronics

Warning!
If the device is operated in an explosion hazardous zone of type EEx ia, please note the following:

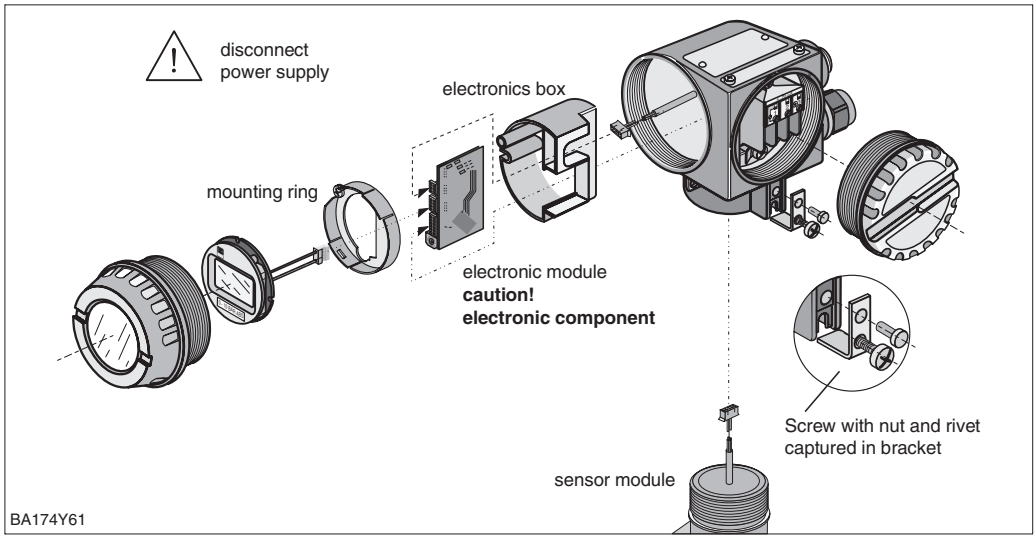
- Only specially trained personnel or E+H Service is allowed to replace the sensor module and electronics.
- Comply with prevailing standards, national explosion protection regulations and safety instructions (XA…).
- After replacing the sensor module and electronics, make sure that the electrical strength between the intrinsically safe circuit and the housing is 500 VAC.

Caution!
The electronic module is an electronic component. Electrostatic discharge can affect the operation of the device 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.
- Remove the plug from the electronic module.
- Unscrew the mounting ring and remove.
- Remove the electronics module.

Mounting
- Insert the electronic module.
- Fix the mounting ring.
- Plug in the connectors, noting size and coding.
- Attach display of cover and screw down the cover to the display compartment.



Changing the sensor module

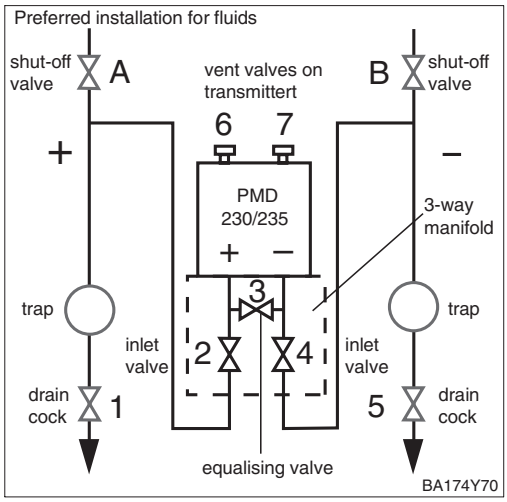
Removal

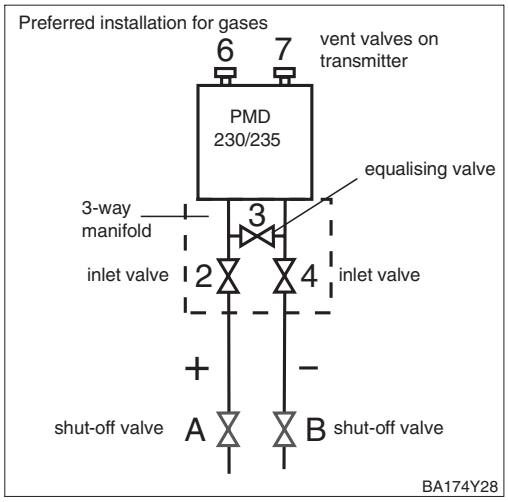
- Remove the complete electronics from the housing.
- Position the bracket and smooth face on the sensor module parallel to each other. Remove the stud and lift out the bracket. When unsrewing the sensor module, carefully rotate the cable with it.
- For version with oval flanges, unscrew retaining bolts and remove complete sensor module.

Mounting
- If appropriate, reassemble the oval flanges around the new sensor cell.
- 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 insert the plug, noting size and coding.

9.4 Exchanging the transmitter

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





9.5 Recalibration

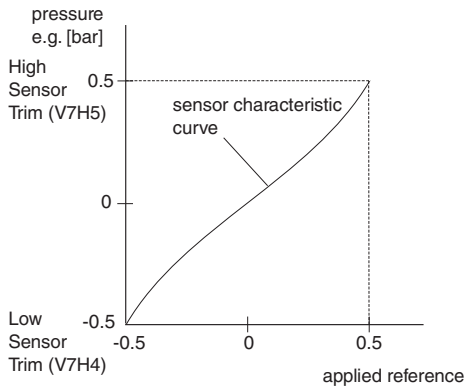
If you want to fit the pressure transmitter with a diaphragm seal you can recalibrate the sensor using the "Low Sensor Trim" (V7H4) and "High Sensor Trim" (V7H5) parameters.

The highest measurement accuracy is obtained when the value for the "Low Sensor Trim" (V7H4) parameter corresponds to the 4 mA calibration value (V0H1/V0H3) and the value for the "High Sensor Trim" (V7H5) parameter to the 20 mA calibration value (V0H2/V0H4).

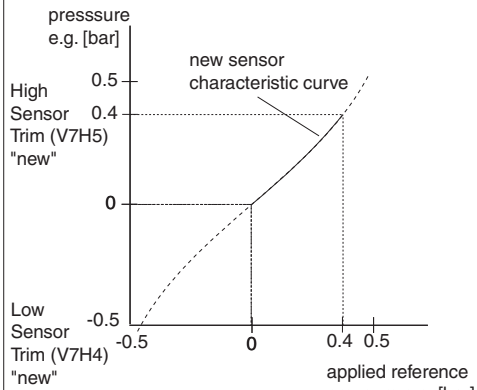
There must be a known reference pressure when setting a new lower or upper sensor characteristic curve value. The more accurate the reference pressure is during recalibration, the higher the accuracy of the pressure transmitter will be later. A new value is assigned to the applied pressure using the "Low Sensor Trim" (V7H4) and "High Sensor Trim" (V7H5) parameters.

#	Matrix	Path through the menus	Entry
1	A device with a sensor: –0.5…0.5 bar must be recalibrated for the 0.0…0.4 bar range.		
Main group: Additional functions			
2	Reference pressure of 0.0 bar for "Low Sensor Trim" (V7H4) value.		
3	The value 0.0 is assigned to the applied pressure.		
	V7H4	➤ Low Sensor Trim	0.0 bar Confirm E
4	Reference pressure for "High Sensor Trim" (V7H5) value = 0.4 bar.		
5	The value 0.4 is assigned to the applied pressure.		
	V7H5	➤ High Sensor Trim	0.4 bar Confirm E
6	The sensor is now calibrated for 0.0…0.4 bar. The "Low Sensor Trim" and "High Sensor Trim" parameters indicate: Low Sensor Trim = 0.0 bar High Sensor Trim = 0.4 bar		

Sensor characteristic curve for the default factory calibration – here for a differential pressure sensor: –0.5…0.5 bar



Sensor characteristic curve – recalibrated for the measuring range: 0.0…0.4 bar



Note!

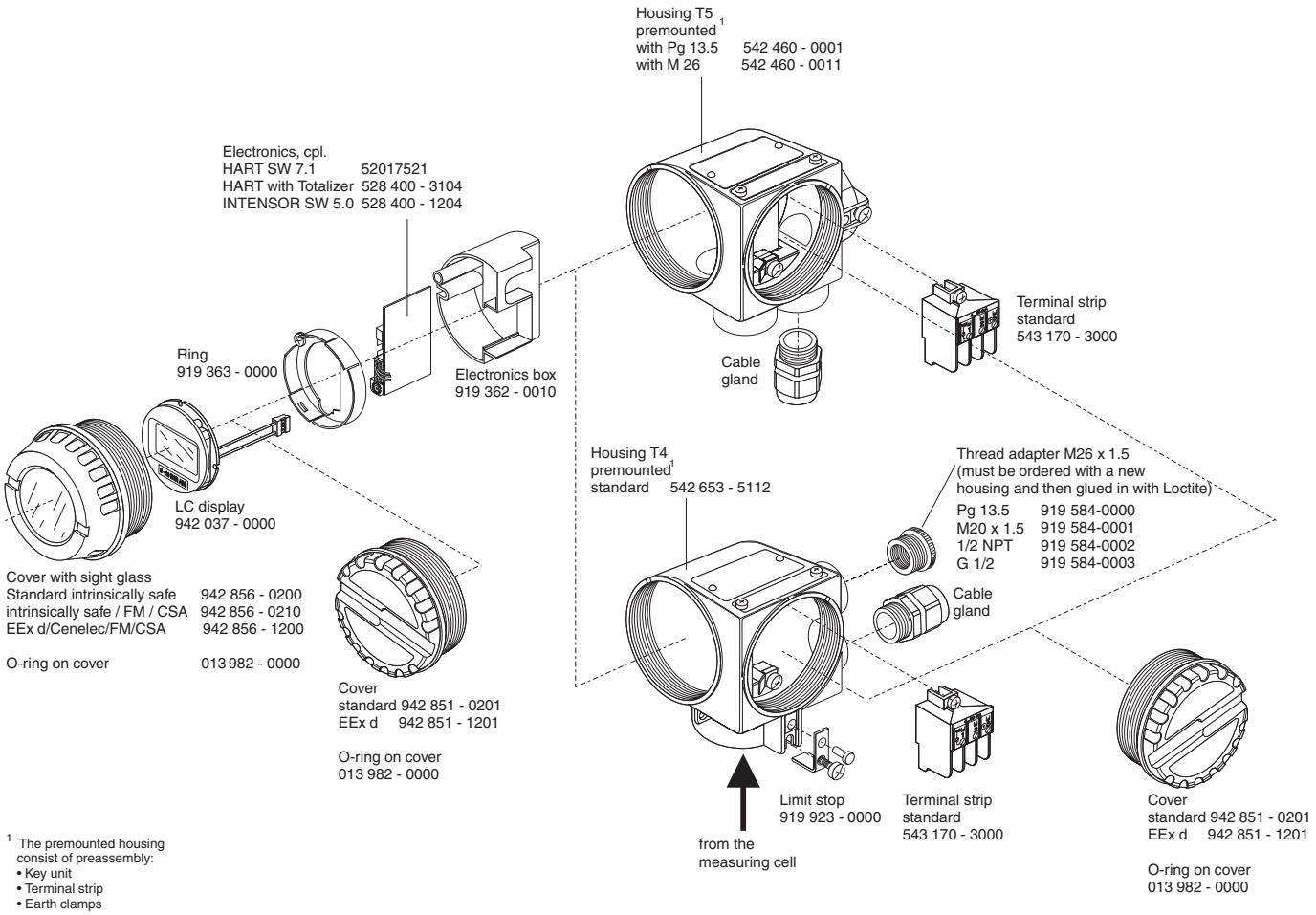
- By entering the reset code "2509" in the V2H9 matrix field, you return the following parameters to the factory setting:
  – Low Sensor Trim = Low Sensor Limit (V7H4 = V7H6),
  – High Sensor Trim = High Sensor Limit (V7H5 = V7H7),
  – Zero Correction Value (V9H6) = 0.0
- When the "Low Sensor Trim" (V7H4) and "High Sensor Trim" (V7H5) values are too close together, the device outputs the error message "E 104".

Note!

9.6 Replacement parts

The diagram on the next page shows all 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 (device designation) on the nameplate is still valid.
- If the device designation on the nameplate has changed then a modified nameplate must also be ordered. The information about the new device must then be entered on the modified nameplate. This must then be attached to the housing of the Deltabar S.
- Some spare parts are available both in the standard version and in the version for explosion-hazardous areas (e.g. cover). In this case, only hazardous area versions of the spare parts may only be used on devices for explosion-hazardous areas.
- It is not possible to convert a standard device into an Ex device by replacing its parts.



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

Note!

Note!
Each spare part comes with exchange instructions. For more information on service and spare parts contact the Service Department at Endress+Hauser.

10 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 174P/00/en 05.03 DIN 19259

Input

Measured variables	Differential pressure for deriving flowrate (volumetric or mass flow), level, mass or volume
Adjusting the span (Turn down)	100:1

Measuring range

Nom. value ceramic sensor	Measurement limits		Span		PN	Overload		Sensor
PMD 230 FMD 230 [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	recom-mended (TD 20:1) [mbar]	smallest [mbar]	[bar]	One sided [bar]	Two sided (PN) [bar]	Fill fluid3)
25	–25	25	2,5	0.5	10	10	10	mineral oil
100	–100	100	10	2	16[1)]	16[1)]	16[1)]	mineral oil
500	–500	500	50	10	100[1), 2)]	100[1), 2)]	100[1), 2)]	silicone oil
3000	–3000	3000	300	60	100[1), 2)]	100[1), 2)]	140[1), 2), 4)]	silicone oil

1) p_{max} = 10 bar for PMD 230 with PVDF process connection.
2) FMD 230: The specified PN (pressure rating) or specified overload applies to the sensor. Observe the maximum pressure of the flange.
3) Voltalef 1A for applications in very pure gases, observe operating limits for oxygen service for non-metallic materials.
4) 100 bar for FM and CSA

Nom. value Silicon sensor (URL)	Measurement limits		Span		PN[3), 4)]	Overload[3)]		Sensor
PMD 235 FMD 630 FMD 633 [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	recom-mended (TD 20:1) [mbar]	smallest [mbar]	[bar]	One sided	Two sided[5)]	Fill fluid[2)]
10[1)]	–10	10	1	0.2	160[6)]	PN	1.5 x PN	silicone oil
40[1)]	–40	40	4	0.8	160[6)]	PN	1.5 x PN	silicone oil
100	–100	100	10	2	160[6)]	PN	1.5 x PN	silicone oil
500	–500	500	50	10	160 420	PN	1.5 x PN	silicone oil
3000	–3000	3000	300	60	160 420	PN	1.5 x PN	silicone oil
16000	–16000	16000	1600	320	160 420	PN	1.5 x PN	silicone oil
40000[1)]	–40000	40000	4000	800	160 420	100 bar	1.5 x PN	silicone oil

1) PMD 235 only
2) Voltalef 1S for applications in very pure gases, other filling fluids on request. Observe operating limits for oxygen service for non-metallic materials.
3) The specified PN (pressure rating) or specified overload applies to the sensor. Observe the maximum pressure of the flange.
4) 160 bar version with stainless steel bolts, 420 bar version with chromized steel bolts
5) Type tested for burst pressure (FM) up to 1120 bar on both sides with PN 420 bar version
6) High pressure 420 bar version on request

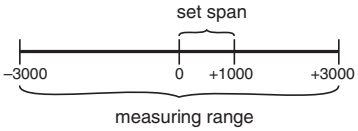
Output

Output signal	4…20 mA, with optional communications signal for INTENSOR or HART protocol and can be switched to linear (proportional to differential pressure) or square root extraction (flow proportional) Underrun 3.8 mA (4 mA adjustable), overrun 20.5 mA
Load	see Chapter 2
Signal on alarm	Options: – Max. alarm: setting in the range 21…22.5 mA – Value hold: last value is on hold – Min. alarm: 3.6 mA
Resolution	Better than 5 µA
Damping (Integration time)	– 0 to 40 s infinitely adjustable with handheld terminal or personal computer with operating program – 0 to 16 s in steps via rotary switch on the instrument
Communication resistance	min. 250 Ω
Adjusting range	Freely adjustable within the limits of the lower range-value and upper range-values

Accuracy

Terminology:

Turn down (TD) =
Measuring range / set span



Example: measuring range = 6 bar
set span = 1 bar
TD = 6:1

"Platinum"
* Values for transmitters with improved accuracy ("Platinum") are indicated 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.

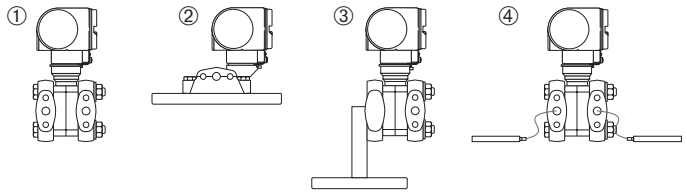
Reference conditions	According to IEC 60770 T_U=+25°C (+77°F) Accuracy data apply for the case when the values for "Low Sensor Trim" and "High Sensor Trim" are used for the lower range-value and upper range-value respectively.
Non-linearity including hysteresis and non-reproducibility (limit point method according to IEC 60770)	to TD 10:1: ±0.1 % (* ±0.05%) of set span for TD 10:1 to 20:1: ±0.1 % (* ±0.05 %) of set span x TD/10
Long-term drift	±0,1% of nominal range/year, ±0.25% of nominal range/5 years
Effect of process pressure on zero (on span) Values in percent of nominal value	**Metal sensor** / **Ceramic sensor**

Metal sensor		Ceramic sensor	
Nom. range	Deviation	Nom. range	Deviation
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
500 mbar, 3 bar, 16 bar, 40 bar	0.2 (0.2)%/100 bar	3000 mbar	0.2% (0.2)/100 bar

Temperature coefficient	–10…+60°C (+14…+140°F): 0.04% (* 0.03%) of nominal value/30 K and –40…–10°C (–40…+14°F) or +60…+85°C (+140…+185°F): 0.1% (* 0.08%) of nominal value/30 K
Temperature coefficient of diaphragm seal	See Technical Information TI 256P, Dimensions Deltabar S FMD 630 and FMD 633, column "diaphragm seal", T_K
Thermal effects (max. TD 20:1)	(0.2% x TD + 0.2%) of set span
Settling time	PMD 230, FMD 230: 300 ms PMD 235: 250 ms FMD 630, FMD 633: dependent on diaphragm seal
Scanning time	min. 20 times per second
Rise time	1/3 of settling time
Warm-up period	2 s
Vacuum resistance	PMD 230, 235, FMD 230: up to 1 $mbar_{abs}$ FMD 630, 633: dependent on fill fluid, see Technical Information TI 256P, "Instructions for Diaphragm Seals with FMD 630, FMD 633"

Operating conditions

Installation conditions

Calibration position ①, ② PMD 230, PMD 235, FMD 230 ③ FMD 630 ④ FMD 633	
Orientation	As required, orientation-dependent zero shift can be fully corrected, with no effect on span

Process conditions

Medium temperature range	PMD 230, FMD 230: –40…+85°C (–40…+185°F) PMD 235: –40…+120°C (–40…+248°F) FMD 630, FMD 633: to +350°C (+662°F) Observe the temperature application limits of the seal, see this page "Temperature application limits seals" For FMD 630 and FMD 633: Observe the temperature application limits of the corresponding fill fluid, see Technical Information TI 256P. Do not use the diaphragm seal with 0.9 mm PTFE film as per AISI 316L (1.4435/1.4404) in vacuum applications. Upper temperature limit is +205°C (+401°F).
Temperature application limits seals	

*	Seals for PMD 230 and FMD 230	Temperature application limits
1	FPM, Viton	–20°C (–4°F)**
4	EPDM	–40°C (–40°F)**
C	Chemraz	–10 °C (+14°F)**
7	Kalrez	+5°C (+41°F)**
8	FPM, Viton oil and grease free	–10°C (+14°F)
6	FPM, Viton cleaned for oxygen service, Compound V70G3	–10…+60°C (+14…+140°F)

*	Seals for PMD 235 and FMD 630	Temperature application limits
1	FPM, Viton	–20 °C (–4°F)**
2	NBR	–20…+80 °C (–4…+176°F)
3	PTFE	–40 °C (–40°F)**
8	FPM, Viton oil and grease free, Compound V70G3	–10 °C (+14°F)**
6	FPM, Viton cleaned for oxygen service, Compound V70G3	–10…+60°C (+14…+140°F)
H	Copper	–40 °C (–40°F)**

* Version in order code, e.g. PMD 230 – ❑ ❑ ❑❑ ❑ ❑❑ _ ❑
** For the upper temperature limit, see this page, "Medium temperature limit".

Pressure specification	See nameplate, observe pressure-temperature derating.

Operating conditions (continuation)

Ambient conditions

Ambient temperature	–40…+85°C (–40…+185°F) [1]
Storage temperatue	–40…+100°C (–40…+212°F) [1, 3]
Climatic class	4K4H to DIN EN 60721-3
Vibrational resistance	Ceramic sensor: ± 0.1% of span (as per DIN IEC 68 part 2-6) Metal sensor: ± 0.1% of span (as per DIN IEC 68 part 2-6)
Ingress protection	IP 65/NEMA 4X (IP 68 on request)
Electromagnetic compatibility	Interference emission to EN 61326, electrical equipment class B; Interference immunity to EN 6 326; Annex A (industrial) and NAMUR recommendation EMV (NE 21); Interference immunity to EN 61000-4-3: 30 V/m.

Mechanical construction

Design

Dimensions	See Technical Information TI 256P
Housing	Housing T4 (display on side) or T5 (display on top), Housing can be rotated up to 330°, Separate electronic and connection compartments, Optional electrical connection via – cable gland M 20x1.5 – cable entry G ½, ½ NPT – Harting plug Han 7D Terminals for cable cross-section 0.5…2.5 mm^2 (AWG 20 …13)
Process connection	Optional flange or diaphragm seal with capillary extension available, see also Technical Information TI 256P

Materials

Housing	– Cast aluminium housing with protective polyester-based powder coating RAL 5012 (blue), cover RAL 7035 (grey), salt water spray test DIN 50021 (504 h) passed – AISI 316L (1.4435)
Nameplates	AISI 304 (1.4301)
Process connection	Optional: AISI 316L (1.4435), Alloy C276 (2.4819), Steel C 22.8, PMD 230: PVDF coated, FMD 230: ECTFE coated
Process diaphragm	– PMD 230, FMD 230: Al_2O_3 Aluminium oxide ceramic – PMD 235: AISI 316L (1.4404) Alloy C276, Tantalum, Monel – FMD 630: AISI 316L, Alloy C276, Tantalum – FMD 633: AISI 316L (1.4435), Alloy C276, Tantalum, AISI 316L with PTFE film 0.09 mm
Filling fluid in diaphragm seals	Silicone oil AK 100, High-temperature oil (Paraffin), Fluorolube, vegetable oil (Neobee)
Gaskets ceramic sensor	FPM Viton, EPDM, Chemraz, Kalrez, FPM Viton cleaned for oxygen service[2], Temperature application limits see table "Seals for PMD 230 and FMD 230", page 79
metal sensor	FPM Viton, NBR, PTFE, FPM Viton oil and grease-free, FPM Viton cleaned for oxygen service[2], Temperature application limits see table "Seals for PMD 235, FMD 630 and FMD 633", page 79
O-ring for sealing cover	NBR
Mounting accessories	Mounting set with screws AISI 304 (1.4301)

1) For devices approved for use in hazardous areas, see Safety Instructions (XA…), Installation Drawing or Control Drawing (ZD…).
2) Observe operating limits for oxygen service for non-metallic materials.
3) With Display max. +85°C (+185°F)

Display and operating interface

Display (optional)	Pluggable digital display and extra bar graph (28 segments) (Pressure display as four-digit number and also in relating to set measuring range as bar graph).
Display resolution	Digital display: 0.1% Bar graph: 1 segment equals 3.57% of the set span
On-site operation	Four keys on the device
Remote operation	HART protocol: Universal HART Communicator DXR 275 INTENSOR protocol: via Commulog VU 260 Z

Communication interfaces

Handheld terminal	HART protocol: Universal HART Communicator DXR 275 for connecting anywhere along the 4…20 mA line, minimum line resistance: 250 Ω
PC	Commubox FXA 191 for connecting to a serial interface of a PC and operating with the Commuwin II operating program for connecting anywhere along the 4…20 mA line minimum line resistance: 250 Ω

Power supply

Power voltage	11.5…45 V DC EEx ia: 11.5…30 V DC, EEx nA: 11.5…30 V DC, EEx d: 13…30 V DC[1)]
Residual ripple	No effect for 4…20 mA signal up to ±5 % residual ripple within permissible range with communication: HART protocol: U_{PP} smaller than 0.2 V (0.47 Hz to 125 Hz) and U_{eff} smaller than 2.2 mV (500 Hz to 10 kHz)

Certificates and Approvals

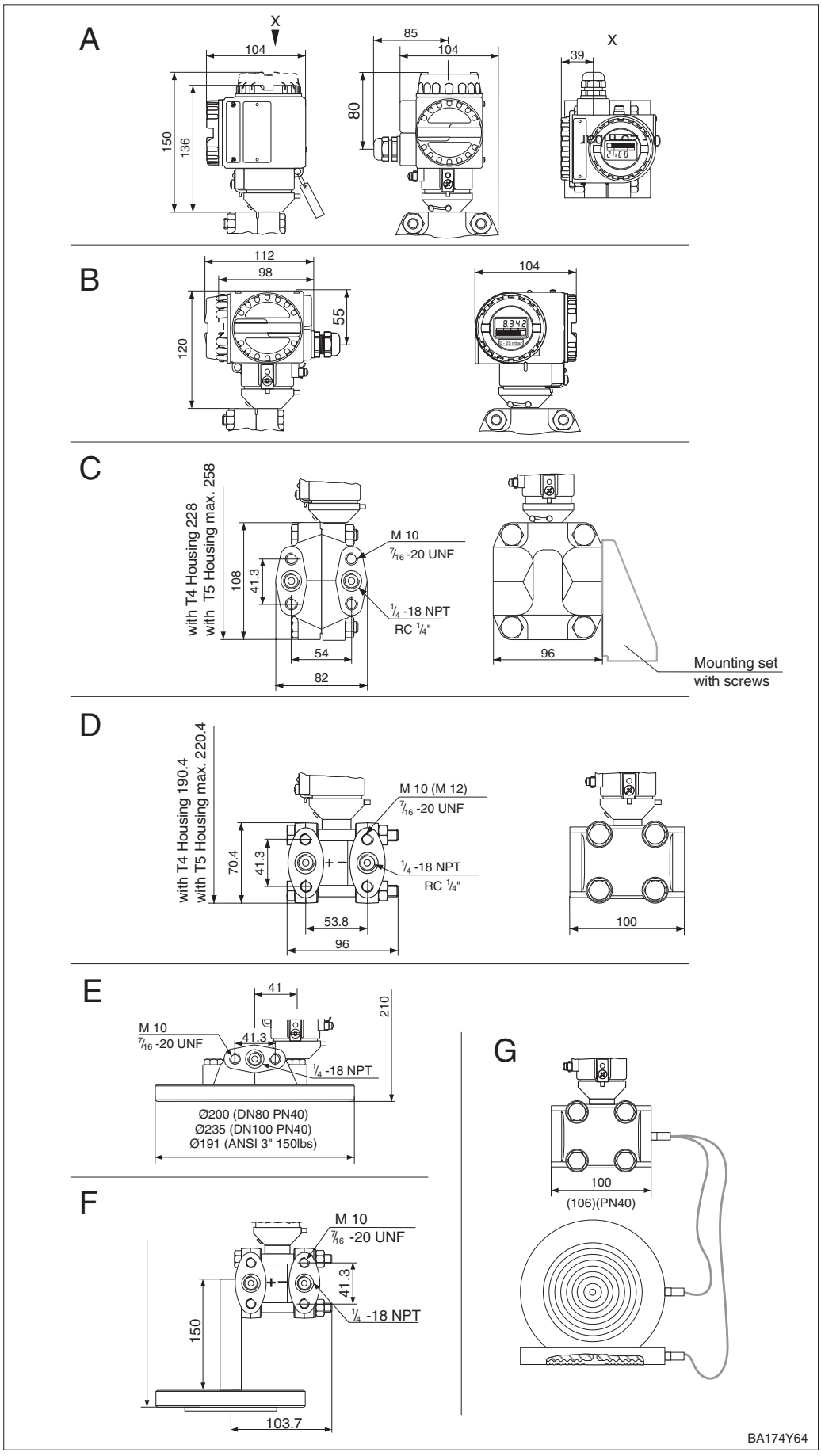
Pressure Equipment Directive	This device conforms to Article 3(3) of EC Directive 97/23/EG (Pressure Equipment Directive) and is developed and produced in sound engineering practice. – PMD 235, PN >200 bar: suitable for stable gases in fluid group 1. – FMD 633 with pipe diaphragm seals ≥ DN 40/1½": suitable for stable gases in fluid group 1.
CE mark	By attaching the CE Mark, Endress+Hauser confirms that the instrument fulfils all the requirements of the relevant EC directives.

1) For devices approved for use in hazardous areas, see Safety Instructions (XA…), Installation Drawing or Control Drawing (ZD…).

Dimensions Deltabar S

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

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm



Deltabar S
- *A T5 housing (display on top)*
- *B T4 housing (display on side)*
- *C PMD 230 (ceramic sensor) with oval flange*
- *D PMD 235 (metal sensor) with oval flange*
- *E FMD 230 with flush-mounted ceramic diaphragm*
- *F FMD 630 (metal) with diaphragm seal*
- *G FMD 633 (metal) with capillary and remote seals*

Dimensions are in mm

11 Operating Matrix

11.1 Matrix HART Commuwin II (Software version 7.1)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 Basic calibration	Measured value	Set 4 mA value	Set 20 mA value	4 mA value automatic	20 mA value automatic	Set bias pressure	Bias pressure autom.	Set output damping	Alarm mode	Select pressure unit
V1										
V2 Transmitter information	Diagnostic code	Last Diagnostic code	Software No.	Peak hold P Min	Peak hold P Max	Int. counter high	Sensor temperat.	Peak hold T Min	Peak hold T Max	Default value
V3 Linearisation	Op. mode pressure: 1 Sq. root: 2 Level: 3 Cyl. hor.: 4 Manual: 5 Press.% : 6	Display at 4 mA[1]	Display at 20 mA[1]	Unit after linearisation[1]	Density factor[2]	Creep flow suppr.[3]	Clear manuel level	Line No. (1…21)	Input level	Set volume
V4										
V5 Totalizer	Counter	Display selector	Totalizer op. mode	Convers. factor	Counter unit					
V6										
V7 Additional functions	Current	Simulation	Set simulation current	Min. current min. 4 mA	Low sensor trim	High sensor trim	Low sensor limit	High sensor limit	Sensor pressure (P)	Temperat. unit
V8										
V9 Service					Max. alarm current	Zero correction	Zero correction value	Unbiased pressure	Biased pressure	Security locking[4]
VA User information	Set tag number	Set user text	HART serial number	Serial number sensor	Process connection P+	Process connection P–	Gasket	Process diaphragm	Fill liquid	

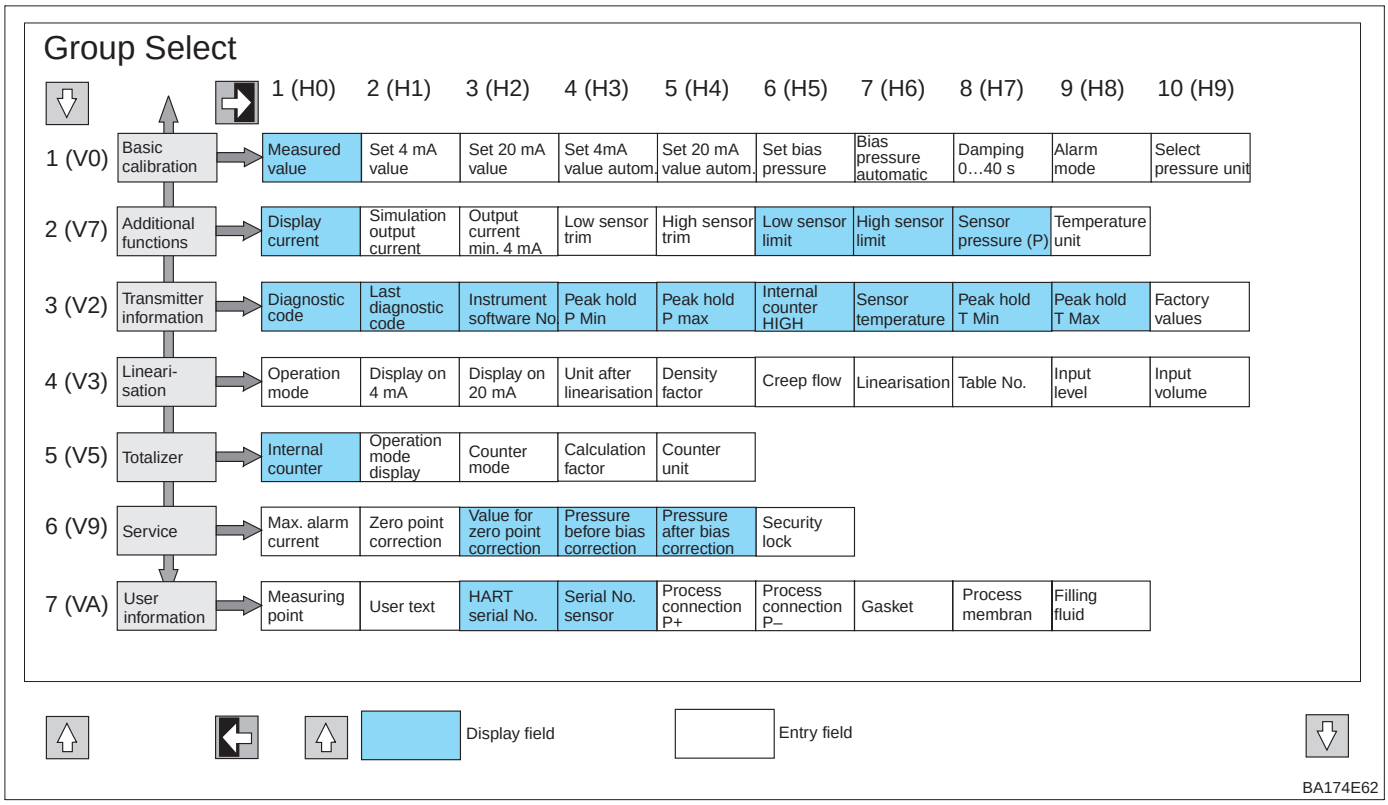
Display field

1) Not in "Pressure" mode.
2) Only in the "Level linear", "Level cyl. linear" and "Level manual" operating modes.
3) Only in the "Square root" mode (flow rate).
4) Locking ≠ 130, Unlocking = 130.
When the operating console is interlocked using the +Z and -S keys, the matrix field indicates 9999.

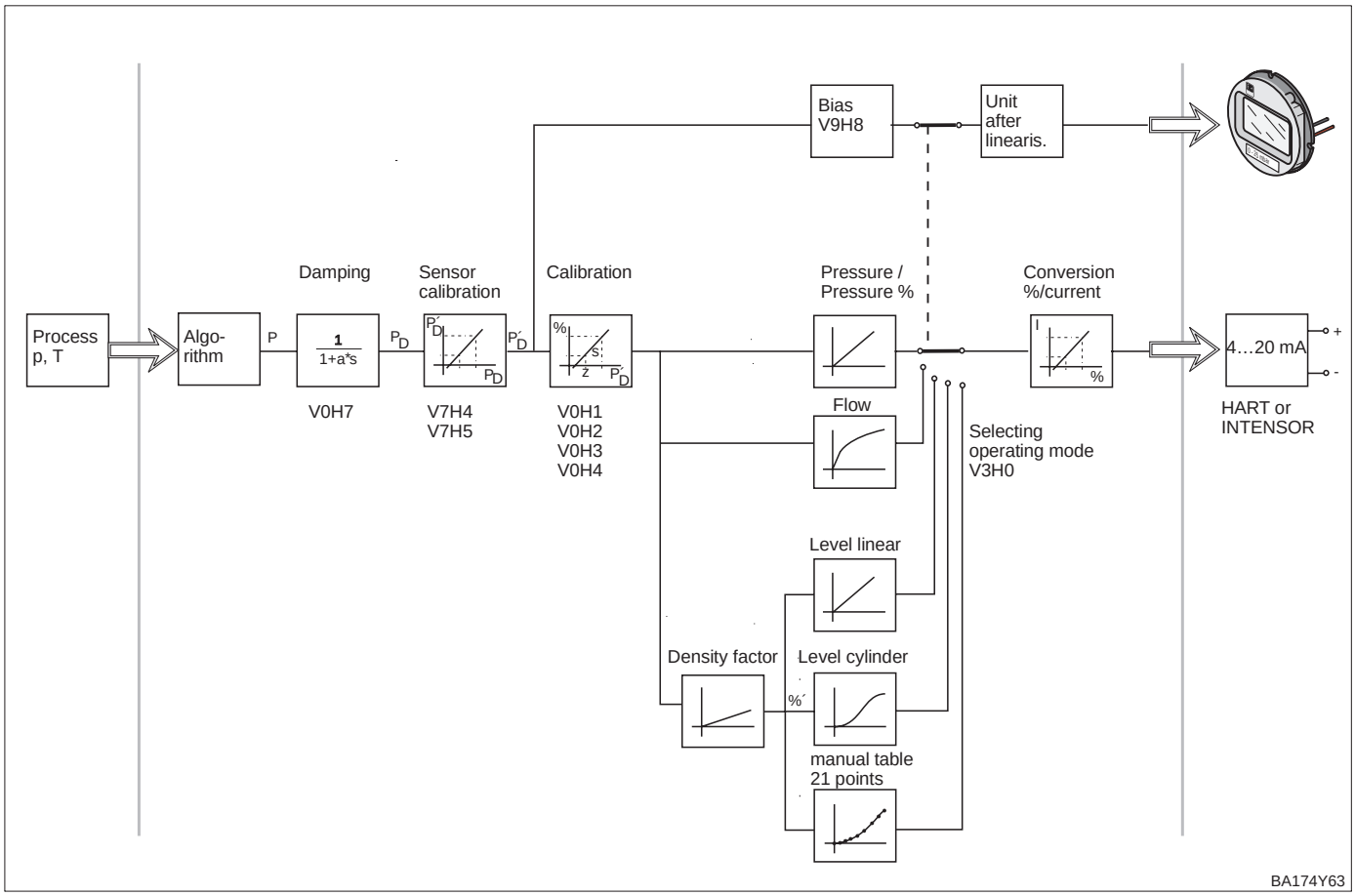
This matrix provides a summary of all factory settings. You can also enter your own values here.

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0		0	V7H7	—	—	0	—	0	max.	1 (bar)
V1										
V2	0	0	xxxx	current pressure	current pressure	0	current temperature	current temperature	current temperature	
V3	1 pressure									
V4										
V5										
V6										
V7		Off		Off	V7H6	V7H7			current pressure	°C
V8										
V9					22.0	0.0	0.0	—	—	130
VA	_____	_____	xxxx	xxxx						

11.2 Matrix Universal HART Communicator DXR 275 (Software version 7.1)



11.3 Block diagram



11.4 Matrix INTENSOR Commuwin II (Software version 5.0)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0	Measured value	Set 4 mA value	Set 20 mA value	Confirm 4 mA value autom.	Confirm 20 mA autom.	Set bias pressure	Confirm bias pressure autom.	Set output damping	Set output safety min. max. continue	Select pressure unit
V1										
V2	Diagnostic code	Last diagnostic	Software No.	Minimum pressure	Maximum pressure	Internal counter high	Sensor temperature	Min. temperature	Max. temperature	Default values
V3	Operation mode – pressure – square root – level – cyl. horizont.	Display on 4 mA after linearisation [1]	Display on 20 mA after linearisation [1]	Unit after linearisation [1]	Density factor [2]	Creep flow suppr. [3]	Clear manual level - activate - manual - semi-autom. - clear	Line No.	Input level	Set volume
V4... V6										
V7	Current	Simulation	Simulation output current	Min. current 4 mA	Low sensor calibration	High sensor calibration	Low sensor limit	High sensor limit	Sensor pressure	Temperature unit
V9								Unbiased pressure	Biased pressure	Security locking [4]
VA	Set tag number	Set user text	Serial number	Serial number sensor	Process connection P+	Process connection P–	Gasket	Process diaphragm	Fill liquid	

Display field

1) Not in "Pressure" mode.
2) Only in the "Level linear", "Level cyl. linear" and "Level manual" operating modes.
3) Only in the "Square root" mode (flow).
4) Locking ≠ 130, Unlocking = 130.
When the operating console is interlocked using the +Z and -S keys, the matrix field indicates 9999.

11.5 Description of parameters

Parameter	Description
Measured Value (V0H0)	This parameter indicates the current value measured. The matrix field V0H0 corresponds to the on-site display. For the "Pressure" operating mode, select a pressure unit using the parameter "Select Pressure Unit" (V0H9). The measured value is converted and displayed in the pressure unit you selected. In the "Level" and "Square Root" (flow) modes, the measured variable is displayed in "%" as standard. Use the parameter "Unit after Linearisation" (V3H3) to select a level, volume, weight or flow rate unit. This unit is only for display. The measured variable is not converted to the unit you selected.
Set 4 mA Value [1] **(V0H1)**	Enter a pressure value for the 4 mA calibration value (calibration without reference pressure). In on-site operation, this is equivalent to incrementing the value by pressing the +Z key or decrementing the value by pressing the –Z key. Factory Setting: 0.0
Set 20 mA Value [1] **(V0H2)**	Enter a pressure value for the 20 mA calibration value (calibration without reference pressure). In on-site operation, this is equivalent to incrementing the value by pressing the +S key or decrementing the value by pressing the –S key. Factory Setting: "High Sensor Limit" (V7H7)
4 mA Value automatic [1] **(V0H3)**	If you confirm this parameter, the current pressure value is set as the 4 mA calibration value (Lower range-value) (calibration with reference pressure). The value is displayed in parameter "Set 4 mA Value" (V0H1). This is equivalent in on-site operation to pressing +Z and –Z once simultaneously.
20 mA Value automatic [1] **(V0H4)**	If you confirm this parameter, the current pressure value is set as the 20 mA calibration value (Upper range-value) (calibration with reference pressure). The value is displayed in parameter "Set 20 mA Value" (V0H2). This is equivalent in on-site operation to pressing +S and –S once simultaneously.
Set Bias Pressure [1] **(V0H5)**	If the on-site display indicates zero not zero at process pressure after calibrating the Lower range-value (depending on position), you can correct the display value of the on-site display to zero (bias pressure) by entering a pressure value. The parameters "Measured Value" (V0H0), "Set 4 mA Value" (V0H1) and "Set 20 mA Value" (V0H2) are corrected by the bias pressure. Factory Setting: 0.0
Bias Pressure automatic [1] **(V0H6)**	If you confirm this parameter, the current pressure value is adopted as bias pressure. The value is displayed in the parameter "Set Bias Pressure" (V0H5). This is equivalent in on-site operation to pressing the +Z and +S keys twice simultaneously. Refer to the parameter description "Set Bias Pressure" (V0H5).
Set Output Damping (V0H7)	Damping (integration time) affects the speed at which the output signal and the value indicated respond to a change in pressure. Damping is adjustable from 0 to 40 s. Factory Setting: 0.0
Alarm mode (V0H8) **(INTENSOR: Set Output Safety)**	In the event of an error, the current value is set to the value selected here. The bar graph on the on-site display indicates the current. Options: – Min. alarm: 3.6 mA – Value hold: last value is on hold. – Max. alarm: 21…22.5 mA. The current value for "Max. alarm" is adjustable via the parameter "Max. alarm current" (V9H4). Refer to chapter 5.1, 6.4 or 7.1, Section "Alarm mode". Factory Setting: Max. alarm (22.0 mA)
Select Pressure Unit (V0H9)	Selects a pressure unit. When you select a new pressure unit, all pressure-related parameters are converted and indicated together with the new pressure unit. Factory Setting: bar
Diagnostic Code (V2H0)	If the pressure transmitter detects an error or a warning, it generates an error code. This parameter displays the current error code. See chapter 8.1 for a description of error codes.
Last Diagnostic (V2H1)	Indicates the last error code. See chapter 8.1 for a description of error codes. Factory Setting: 0

1) The electronics check the input value of this parameter for compliance with editing limits, refer to chapter 8.4.

Description of parameters (continuation)

Parameter	Description
Software No. (V2H2)	Indicates the device and software number. The first two digits represent the device number and digits 3 and 4 the software version. Deltabar S HART with SW 7.1 = 7371
Peak Hold P Min (V2H3)	Indicates the smallest measured pressure value (maximum pointer). This parameter is reset to the current pressure value when you confirm by pressing the ENTER key.
Peak Hold P Max (V2H4)	Indicates the largest pressure value measured (maximum pointer). This parameter is reset to the current pressure value when you confirm by pressing the ENTER key.
Internal Counter High (V2H5)	This counter indicates how often a measured pressure was above the upper sensor limit (V7H7). Maximum value = 255 This parameter is reset to zero when you confirm by pressing the ENTER key.
Sensor Temperature (V2H6)	Indicates the current temperature measured. The unit for displaying the temperature is selectable using the parameter "Temperature Unit" (V7H9).
Peak Hold T Min (V2H7)	Indicates the lowest temperature measured (maximum pointer). This parameter is reset to the current temperature value when you confirm by pressing the ENTER key.
Peak Hold T Max (V2H8)	Indicates the largest temperature measured (maximum pointer). This parameter is reset to the current temperature value when you confirm by pressing the ENTER key.
Default Values (Reset) (V2H9)	Enters a reset code. Possible reset codes include: 5140, 2380, 731, 62 and 2509. chapter 8.3 lists the parameters which the reset codes reset to the factory settings.
Operation Mode (V3H0)	Select the operation mode: – Pressure: for linear pressure measurements. The measured value (V0H0) indicates the pressure in the selected pressure unit (V0H9). Refer to chapter 5. – Pressure %: for linear pressure measurement. The measured value (V0H0) is calculated and displayed in %. Refer to chapter 5. – Square Root *: for flow measurements, e.g. with an orifice plate or a pitot tube. A square root function converts the measured differential pressure to a flow-proportional output signal. Refer to chapter 7. – Level linear *: for level, volume or weight measurements for standing tanks. The level is linear to the measured pressure. Refer to chapter 6. – Level cylindrical horizontal *: for level, volume or weight measurements with cylindrical horizontal tanks. The volume or the weight is not proportional to the level. A linearisation table is integrated. Refer to chapter 6.4. – Level manual *: for precise volume or weight measurement where the volume or weight is not proportional to the level or to the measured pressure, e.g. tanks with conical outlet. Use the parameters "Line No." (V3H7), "Input Level" (V3H8) and "Set Volume" (V3H9) to enter a linearisation table. This linearisation table is used to calculate the output signal. Refer to chapter 6.4. Factory Setting: pressure * In these modes, the measured value (V0H0) factory setting is displayed in %. To obtain a better presentation, use the parameters "Unit after Linearisation" (V3H3) to select a level, volume, weight or flow rate unit. Refer to the parameter description of "Unit after Linearisation" (V3H3).
Display at 4 mA (V3H1)	Only for operation modes "Pressure%", "Square Root" (flow), "Level linear" and "Level cylindrical horizontal". Enter a value for the measuring point "Min. flow rate" or "Level empty". The value is assigned to the 4 mA calibration point "Set 4 mA" (V0H1). The parameter is displayed as standard in %. To obtain a better presentation, select a different unit using the parameter "Unit after Linearisation" (V3H3). Factory Setting: 0%
Display at 20 mA (V3H2)	For operation modes "Pressure%", "Square Root" (flow), "Level linear" and "Level cylindrical horizontal". Enter a value for the measuring point "Max. flow rate" or "Level full". The value is assigned to the 20 mA calibration point "Set 20 mA" (V0H2). The parameter is displayed as standard in %. To obtain a better presentation, select a different unit using the parameter "Unit after Linearisation" (V3H3). Factory Setting: 100%

Description of parameters (continuation)

Parameter	Description
Unit after Linearisation (V3H3)	Only for operation modes "Pressure%", "Square root" (flow), "Level linear", "Level cylindrical horizontal" and "Level manual". Selects a level, volume, weight or flow rate unit. The options depend on the selected operation mode. The unit is only for display. The "Measured Value" (V0H0) is not converted to the selected unit. Example: V0H0 = 55%. After selected the unit "hl", V0H0 indicates 55 hl. (When you want to display the measured value (V0H0) converted into the selected unit, enter the calculated value for the parameters "Display at 4 mA" (V3H1) and "Display at 20 mA" (V3H2).) Factory Setting: %
Density Factor (V3H4)	Only for operation modes "Level linear", "Level cylindrical horizontal" and "Level manual". The Density Factor matches the output value and the "Measured Value" (V0H0) to changes in the density of a liquid measuring medium. The density factor results from the ratio between "new density" and "old density". Factory Setting: 1.0
Creep Flow Suppression (V3H5)	Only for operation mode "Square Root" (flow). In the lower measuring range, small flow rates (creepage) can lead to large fluctuations in measured value. By entering a low flow cut off, these flow rates are no longer detected. Input is always in % flow rate. Refer to chapter 7, Section "Low flow cut off". Factory Setting: 0.0 %
Manual Level (Linearisation) (V3H6)	Only in operation mode "Level manual". Selects the edit mode for the linearisation table. Options: Activate Table, Manual, Semi-automatic and Clear Table. Refer to chapter 6.4 Linearisation. Factory Setting: Clear table
Line No. (V3H7)	Only in operation mode "Level manual". Enter line numbers for the linearisation table. Use the parameters "Line No." (V3H7), "Input Level" (V3H8) and "Set Volume" (V3H9) to enter a linearisation table. Number of lines in linearisation table: Min. = 2 and Max. = 21 Refer to chapter 6.4 Linearisation. Factory Setting: 1
Input Level (V3H8)	Only in operation mode "Level manual". Enter a fill value in the linearisation table. The input is in %. If you enter "9999.0" for this parameter, you may delete individual points from the linearisation table. First activate the linearisation table using the parameter "Manual Level" (V3H6). Refer to this table, parameter "Line No." (V3H7) and chapter 6.4 Linearisation. Factory Setting: 9999.0 %
Set Volume (V3H9)	Only in operation mode "Level manual". Enter a volume value in the linearisation table. The input is in %. If you enter "9999.0" for this parameter, you may delete individual points from the linearisation table. First activate the linearisation table using the parameter "Manual Level" (V3H6). Refer to this table, parameter "Line No." (V3H7) and chapter 6.4 Linearisation. Factory Setting: 9999.0 %
Counter (V5H0)	Only in operation mode "Square Root" (flow). Indicates the total flow rate measured. After a reset "5140" the counter is reset to zero. Refer to chapter 7.4 "Totalizer". Factory Setting: 0
Display Selector (V5H1)	Only in operation mode "Square Root" (flow). Selects the operation mode for the on-site display. Options: – Flow: Indicates the current volume or mass flow, equivalent to the display of the parameter "Measured Value" (V0H0). Select the unit using the parameter "Unit after Linearisation" (V3H3). – Totalizer: Indicates the total flow rate, equivalent to the display of the parameter "Counter" (V5H0). Select the unit using the parameter "Counter Unit" (V5H4). The bar graph always indicates the current flow rate measured. Refer to chapter 7.4 "Totalizer". Factory Setting: Flow

Description of parameters (continuation)

Parameter	Description
Totalizer Operation Mode (V5H2)	Only in operation mode "Square Root" (flow). This parameter activates the totalizer function and defines how to count negative flows. Refer to chapter 7.4 "Totalizer". Factory Setting: OFF
Conversion Factor (V5H3)	Only in operation mode "Square Root" (flow). The Conversion Factor converts the current flow rate into a total flow rate. Refer to chapter 7.4 "Totalizer". Factory Setting 1.0
Counter Unit (V5H4)	Only in operation mode "Square Root" (flow). Selects a volume or a mass unit for the parameter "Counter" (V5H0). Only select for display. The "Counter" (V5H0) is not converted to the selected unit. Example: V5H0 = 55%. After selected the unit "l", V5H0 indicates 55 hl. Refer to chapter 7.4 "Totalizer". Factory Setting: %
Current (V7H0)	Displays current signal current in mA.
Simulation (V7H1)	Simulation of a signal current, e.g. to test the function of looped evaluation devices. Set the simulation current using parameter "Set Simulation Current". Refer to chapter 8.2. OFF: Current simulation off ON: Current simulation on Factory Setting: OFF
Set Simulation Current (V7H2)	Defines a simulation current. The current can be simulated within limits of 3.6 mA to 22 mA.
Min. Current 4 mA (V7H3)	Use this parameter to set the lower current limit. (Evaluation devices partly accept no value less than 4.0 mA.) OFF: Lower current limit = 3.8 mA EIN: Lower current limit = 4.0 mA Refer to chapter 5.1, 6.4 or 7.1, Section "4 mA level". Factory Setting: OFF
Low Sensor Trim [1] (V7H4)	Enter the lower point of the sensor characteristic curve during recalibration. Use this parameter to assign a new value to a reference pressure applied to the device. The pressure applied and the value entered for "Low Sensor Trim" correspond to the lower point of the sensor characteristic curve. Refer to chapter 9.5 "Recalibration". Factory Setting: "Low Sensor Limit" (V7H6)
High Sensor Trim [1] (V7H5)	Enter the upper point of the sensor characteristic curve for recalibration. Use this parameter to assign a new value to a reference pressure applied to the device. The applied pressure and the value entered for "High Sensor Trim" are equivalent to the upper point of the sensor characteristic curve. Refer to chapter 9.5 "Recalibration". Factory Setting: "High Sensor Limit" (V7H7)
Low Sensor Limit (V7H6)	Indicates the lower sensor limit.
High Sensor Limit (V7H7)	Indicates the upper sensor limit.
Sensor Pressure (V7H8)	Indicates the current pressure applied.
Temperature Unit (V7H9)	Selects a temperature unit. Options: °C, K,°F. When you select a new temperature unit, all temperature-specific parameters (V2H6, V2H7, V2H8) are converted and the new temperature unit is displayed. Factory Setting: °C
Max. Alarm Current (V9H4)	Default for current value for parameter "Alarm mode" (V0H8) = Max. alarm The current value is adjustable from 21 mA to 22.5 mA. Refer to chapter 5.1, 6.4 or 7.1, Section "Alarm mode". Factory Setting: 22 mA

1) The electronics check the input values for these parameters for compliance with editing limits, refer to chapter 8.4.

Description of parameters (continuation)

Parameter	Description
Zero Correction [1] (V9H5)	Use this parameter to carry out a calibration (zero correction) for the values indicated on the on-site display ("Measured Value" (V0H0)) and for the signal current at the same time. For zero correction, a pressure applied to the device is assigned a new value using this parameter. The sensor characteristic curve is shifted by this value and the parameters "Low Sensor Trim" (V7H4) and "High Sensor Trim" (V7H5) are recalculated. Refer to chapter 5.1, Section "Zero Correction". Factory Setting: 0.0
Zero Correction Value (V9H6)	Indicates the value by which the sensor characteristic curve was shifted for a zero correction. Refer to parameter description "Zero Correction" (V9H5) and chapter 5.1, Section "Zero Correction". Factory Setting: 0.0
Unbiased Pressure (V9H7)	This parameter indicates the current damped pressure without any bias correction. Refer to the parameter description "Set Bias Pressure" (V0H5).
Biased Pressure (V9H8)	This parameter indicates the current damped pressure with bias correction. Refer to the parameter description "Set Bias Pressure" (V0H5). Calculation: "Biased Pressure" (V9H8) = "Unbiased Pressure" (V9H7) – "Set Bias Pressure" (V0H5) In "Pressure" operation mode, this parameter and the parameter "Measured Value" (V0H0) indicate the same value.
Security Locking (V9H9)	Enter a code to lock or unlock the operation matrix and on-site operating unit. Lock operation: – Using the parameter "Security Locking": enter a number ≠ 130, – using on-site operation: press the +Z und –S keys once simultaneously. Unlock operation: – Using the parameter "Security Locking": enter the number 130, – using on-site operation: press the –Z and +S keys once simultaneously. Refer to chapters 5.2, 6.5 and 7.2.
Set Tag Number (VAH0)	Enter a text describing the measuring point. (up to 8 characters, uppercase letters and numerals)
Set User Text (VAH1)	Enter a text as additional information. (up to 8 characters, uppercase letters and numerals)
HART Serial Number (VAH2)	Indicates the serial number of the device.
Serial No. Sensor (VAH3)	Indicates the serial number of the sensor.
Process Connection P+ (VAH4)	Select and display the process connection material on the plus side. Options: steel, 304 stainless, 316 stainless, Hastelloy C, Monel, tantalum, titanium, PTFE (Teflon), 316L stainless, PVC, Inconel, ECTFE and special (for others)
Process Connection P– (VAH5)	Select and display the process connection material on the minus side. For options, see parameter "Process Connection" (VAH4).
Gasket (VAH6)	Select and display the gasket material. Options: FPM Viton, NBR, EPDM, urethane, IIR, KALREZ, FPM Viton for oxygen applications, CR, MVQ and special (for others).
Process Diaphragm (VAH7)	Select and display the diaphragm material. Options: 304 stainless, 316 stainless, Hastelloy C, Monel, tantalum, titanium, PTFE (Teflon), ceramic, 316L stainless, Inconel, special (for others).
Fill Liquid (VAH8)	Select and display the oil filling. Options: silicon oil, vegetable oil, glycerine, inert oil, HT oil (high-temperature oil), special (for others).

1) The electronics check the input values for these parameters for compliance with editing limits, refer to chapter 8.4.

Index

Europe

Austria
❑ Endress+Hauser Ges.m.b.H.
Wien
Tel. (01) 880 56-0, Fax (01) 880 56-335

Belarus
Belorgsintez
Minsk
Tel. (017) 2 508473, Fax (017) 2 508583

Belgium / Luxembourg
❑ Endress+Hauser N.V.
Brussels
Tel. (02) 248 06 00, Fax (02) 248 05 53

Bulgaria
Intertech-Automation
Sofia
Tel. (02) 9627152, Fax (02) 9621471

Croatia
❑ Endress+Hauser GmbH+Co.
Zagreb
Tel. (01) 6637785, Fax (01) 6637823

Cyprus
I+G Electrical Services Co. Ltd.
Nicosia
Tel. (02) 484788, Fax (02) 484690

Czech Republic
❑ Endress+Hauser Czech s.r.o.
Praha
Tel. (02) 66784200, Fax (026) 6678 4179

Denmark
❑ Endress+Hauser A/S
Søborg
Tel. (70) 13 11 32, Fax (70) 13 21 33

Estonia
Elvi-Aqua
Tartu
Tel. (7) 44 16 38, Fax (7) 44 15 82

Finland
❑ Metso Endress+Hauser Oy
Helsinki
Tel. (204) 831 60, Fax (204) 831 61

France
❑ Endress+Hauser S.A.
Huningue
Tel. (389) 69 67 68, Fax (389) 69 48 02

Germany
❑ Endress+Hauser
Messtechnik GmbH+Co. KG
Weil am Rhein
Tel. (07621) 975-01, Fax (07621) 975-555

Great Britain
❑ Endress+Hauser Ltd.
Manchester
Tel. (0161) 2865000, Fax (0161) 9981841

Greece
I & G Building Services Automation S.A.
Athens
Tel. (01) 924 15 00, Fax (01) 922 17 14

Hungary
❑ Endress+Hauser Magyarország
Budapest
Tel. (01) 4120421, Fax (01) 412 04 24

Iceland
Sindra-Stál hf
Reykjavik
Tel. 5750000, Fax 5750010

Ireland
❑ Flomeaco Endress+Hauser Ltd.
Clane
Tel. (045) 86 86 15, Fax (045) 86 81 82

Italy
❑ Endress+Hauser S.p.A.
Cernusco s/N Milano
Tel. (02) 921 92-1, Fax (02) 921 92-362

Latvia
Elekoms Ltd.
Riga
Tel. (07) 336444, Fax (07) 312894

Lithuania
UAB "Agava"
Kaunas
Tel. (03) 7202410, Fax (03) 7207414

Netherlands
❑ Endress+Hauser B.V.
Naarden
Tel. (035) 695 86 11, Fax (035) 695 88 25

Norway
❑ Endress+Hauser A/S
Lierskogen
Tel. (032) 85 98 50, Fax (032) 85 98 51

Poland
❑ Endress+Hauser Polska Sp. z o.o.
Wroclaw
Tel. (071) 7803700, Fax (071) 7803700

Portugal
❑ Endress+Hauser Lda.
Cacem
Tel. (219) 4267290 Fax (219) 4267299

Romania
Romconseng S.R.L.
Bucharest
Tel. (01) 410 16 34, Fax (01) 411 25 01

Russia
❑ Endress+Hauser GmbH+Co
Moscow
Tel. (095) 158 75 64, Fax (095) 7846391

Slovak Republic
Transcom Technik s.r.o.
Bratislava
Tel. (2) 44 88 86 90, Fax (2) 44 88 71 12

Slovenia
❑ Endress+Hauser D.O.O.
Ljubljana
Tel. (01) 5192217, Fax (01) 5192298

Spain
❑ Endress+Hauser S.A.
Sant Just Desvern
Tel. (93) 480 33 66, Fax (93) 473 38 39

Sweden
❑ Endress+Hauser AB
Sollentuna
Tel. (08) 55 51 16 00, Fax (08) 55 51 16 55

Switzerland
❑ Endress+Hauser Metso AG
Reinach/BL 1
Tel. (061) 715 75 75, Fax (061) 711 16 50

Turkey
Intek Endüstriyel Ölcü ve
Levent/Istanbul
Tel. (0212) 275 13 55, Fax (0212) 266 27 75

Ukraine
Photonika GmbH
Kiev
Tel. (44) 268 8102, Fax (44) 269 0805

Yugoslavia Rep.
Meris d.o.o.
Beograd
Tel. (11) 444 12966, Fax (11) 3085778

Africa

Algeria
Symes Systemes et mesures
Annaba
Tel. (38) 883003, Fax (38) 883002

Egypt
Anasia Egypt For Trading S.A.E.
Heliopolis/Cairo
Tel. (02) 2684159, Fax (02) 2684169

Morocco
Oussama S.A.
Casablanca
Tel. (02) 22241338, Fax (02) 2402657

South Africa
❑ Endress+Hauser Pty. Ltd.
Sandton
Tel. (011) 262 80 00, Fax (011) 262 80 62

Tunisia
Controle, Maintenance et Regulation
Tunis
Tel. (01) 793077, Fax (01) 788595

America

Argentina
❑ Endress+Hauser Argentina S.A.
Buenos Aires
Tel. (11) 45227970, Fax (11) 45227909

Bolivia
Tritec S.R.L.
Cochabamba
Tel. (04) 425693, Fax (04) 425081

Brazil
❑ Samson Endress+Hauser Ltda.
Sao Paulo
Tel. (011) 5031 3455, Fax (011) 5031 3067

Canada
❑ Endress+Hauser Ltd.
Burlington, Ontario
Tel. (905) 681 92 92, Fax (905) 681 94 44

Chile
❑ Endress+Hauser Chile Ltd.
Santiago
Tel. (02) 321-3009, Fax (02) 321-3025

Colombia
Colsein Ltda.
Bogota D.C.
Tel. (01) 236 76 59, Fax (01) 610 41 86

Costa Rica
EURO-TEC S.A.
San Jose
Tel. 2202808, Fax 2961542

Ecuador
Insetec Cia. Ltda.
Quito
Tel. (02) 226 91 48, Fax (02) 246 18 33

Guatemala
Automatizacion Y Control Industrial S.A.
Ciudad de Guatemala, C.A.
Tel. (03) 34 59 85, Fax (03) 32 74 31

Mexico
❑ Endress+Hauser S.A. de C.V.
Mexico, D.F
Tel. (5) 55568-2407, Fax (5) 55568-7459

Paraguay
Incoel S.R.L.
Asuncion
Tel. (021) 21 39 89, Fax (021) 226 583

Peru
Process Control S.A.
Lima
Tel. (2) 610515, Fax (2) 612978

USA
❑ Endress+Hauser Inc.
Greenwood, Indiana
Tel. (317) 535-7138, Fax (317) 535-8498

Venezuela
Controval C.A.
Caracas
Tel. (02) 944 09 66, Fax (02) 944 45 54

Asia

Azerbaijan
Modcon Systems
Baku
Tel. (12) 929859, Fax (12) 929859

China
❑ Endress+Hauser Shanghai
Instrumentation Co. Ltd.
Shanghai
Tel. (021) 54 90 23 00, Fax (021) 54 90 23 03

❑ Endress+Hauser Beijin
Instrumentation Co. Ltd.
Beijing
Tel. (010) 65882468, Fax: (010) 65881725

Hong Kong
❑ Endress+Hauser H.K. Ltd.
Hong Kong
Tel. 85225283120, Fax 85228654171

India
❑ Endress+Hauser (India) Pvt. Ltd.
Mumbai
Tel. (022) 852 14 58, Fax (022) 852 19 27

Indonesia
PT Grama Bazita
Jakarta
Tel. (21) 795 50 83, Fax (21) 797 50 89

Japan
❑ Sakura Endress Co. Ltd.
Tokyo
Tel. (0422) 54 06 11, Fax (0422) 55 02 75

Malaysia
❑ Endress+Hauser (M) Sdn. Bhd.
Shah Alam, Selangor Darul Ehsan
Tel. (03) 78464848, Fax (03) 78468800

Pakistan
Speedy Automation
Karachi
Tel. (021) 772 29 53, Fax (021) 773 68 84

Philippines
❑ Endress+Hauser Inc.
Pasig City, Metro Manila
Tel. (2) 6381871, Fax (2) 6388042

Singapore
❑ Endress+Hauser (S.E.A.) Pte., Ltd.
Singapore
Tel. (65) 66 82 22, Fax (65) 66 68 48

South Korea
❑ Endress+Hauser (Korea) Co., Ltd.
Seoul
Tel. (02) 658 72 00, Fax (02) 659 28 38

Taiwan
Kingjarl Corporation
Taipei
Tel. (02) 27 18 39 38, Fax (02) 27 13 41 90

Thailand
❑ Endress+Hauser Ltd.
Bangkok
Tel. (2) 996 78 11-20, Fax (2) 996 78 10

Uzbekistan
Im Mexatronoka EST
Tashkent
Tel. (71) 1167316, Fax (71) 1167316

Vietnam
Tan Viet Bao Co. Ltd.
Ho Chi Minh City
Tel. (08) 833 52 25, Fax (08) 833 52 27

Iran
PATSA Industy
Tehran
Tel. (021) 8726869, Fax(021) 8747761

Israel
Instrumetrics Industrial Control Ltd.
Netanya
Tel. (09) 835 70 90, Fax (09) 835 06 19

Jordan
A.P. Parpas Engineering S.A.
Amman
Tel. (06) 5539283, Fax (06) 5539205

Kingdom of Saudi Arabia
Anasia Ind. Agencies
Jeddah
Tel. (02) 671 00 14, Fax (02) 672 59 29

Lebanon
Network Engineering
Jbeil
Tel. (3) 944 080, Fax (9) 548 038

Sultanate of Oman
Mustafa Sultan Science & Industry Co. L.L.C.
Ruwi
Tel. 602009, Fax 607066

United Arab Emirates
Descon Trading EST.
Dubai
Tel. (04) 265 36 51, Fax (04) 265 32 64

Australia + New Zealand

Australia
❑ Endress+Hauser PTY. Ltd.
Sydney
Tel. (02) 88777000, Fax (02) 88777099

New Zealand
EMC Industrial Group Limited
Auckland
Tel. (09) 415 51 10, Fax (09) 415 51 15

All other countries

❑ Endress+Hauser GmbH+Co.KG
Instruments International
Weil am Rhein
Germany
Tel. (07621) 975-02, Fax (07621) 975-345

http://www.endress.com

Endress+Hauser
The Power of Know How

❑ Members of the Endress+Hauser group 06.02/PT

BA 174P/00/en/05.03
52016863
CCS/CV5

52016863